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Minerals Yearbook 1969

Volume III

AREA REPORTS: DOMESTIC

Prepared by staff of the
BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR • Rogers C. B. Morton, Secretary

BUREAU OF MINES • Elburt F. Osborn, Director

Created in 1849, the Department of the Interior—America's Department of Natural Resources—is concerned with the management, conservation, and development of the Nation's water, 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 parks 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 edition of the Minerals Yearbook provides a record of performance of the world's minerals industry during 1969. It continues the Federal Government's historical record of mineral industry developments, begun on an annual basis in 1882. The intervening 88 years have seen this report grow from a one-volume publication devoted principally to domestic activities to three books encompassing global mineral industry developments. The general content of the individual volumes is as follows:

Volume I–II, Metals, Minerals, and Fuels, contains chapters on virtually all metal, nonmetal, and mineral fuel commodities important to the domestic economy. In addition, it includes a general review chapter on these industries, a statistical summary, and chapters on employment and injuries and on technologic trends.

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

Volume IV, Area Reports: International, presents the latest available mineral statistics for more than 130 foreign countries and areas and discusses the importance of minerals to the economies of these nations. A separate chapter reviews minerals and their relationship to the world economy.

The Bureau of Mines will continue its efforts in the years ahead to increase the Yearbook's value to its many users. Toward that end, the constructive comments and suggestions of readers will be most welcome.

ELBURT F. OSBORN, *Director*

Acknowledgments

In preparing this Minerals Yearbook volume, the Bureau of Mines was assisted in the collection of statistical data and mineral-industry information by various 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 coauthors. For this assistance acknowledgment is made to the following cooperating organizations:

Alabama: Geological Survey of Alabama.
Alaska: Division of Mines and Geology and the Division of Oil and Gas, Alaska Department of Natural Resources.
Arizona: Arizona Bureau of Mines.
Arkansas: Arkansas Geological Commission; Arkansas Oil and Gas Commission.
California: California Department of Conservation, Division of Mines and Geology.
Colorado: The Oil and Gas Conservation Commission; Coal Mines Inspections Department; and the Colorado Bureau of Mines.
Connecticut: Connecticut Geological and Natural History Survey.
Delaware: Delaware Geological Survey.
Florida: Florida Bureau of Geology, Department of Natural Resources.
Georgia: Department of Mines, Mining, and Geology, State Division of Conservation.
Hawaii: Hawaii Department of Land and Natural Resources.
Idaho: Idaho Bureau of Mines and Geology.
Illinois: Illinois Geological Survey.
Indiana: Geological Survey, Indiana Department of Natural Resources.
Iowa: Iowa Geological Survey.
Kansas: State Geological Survey of Kansas.
Kentucky: Kentucky Geological Survey.
Louisiana: Louisiana Geological Survey.
Maine: Maine Geological Survey.
Maryland: Maryland Geological Survey.
Michigan: Geological Survey Division of the Michigan Department of Natural Resources.
Minnesota: Minnesota Geological Survey.
Mississippi: Mississippi Geological, Economic, and Topographical Survey: Mississippi State Oil Gas Board.
Missouri: Missouri Geological Survey and Water Resources.
Montana: Montana Bureau of Mines and Geology. The Oil and Gas Conservation Commission.
Nebraska: Nebrask Geological Survey; and Nebraska Oil and Gas Conservation Commission.
Nevada: Nevada Bureau of Mines.
New Hampshire: New Hampshire Department of Resources and Economic Development.
New Jersey: New Jersey Division of Resource Development, Bureau of Geology and Topography.
New Mexico: Oil and Gas Accounting Commission.
New York: New York State Museum and Science Service.
North Carolina: Department of Conservation and Development, Division of Mineral Resources.

North Dakota: State Geological Survey of North Dakota.
Oklahoma: Oklahoma Geological Survey; Oil and Gas Conservation Department, Oklahoma Corporation Commission.
Oregon: Oregon Department of Geology and Mineral Industries.
Pennsylvania: Pennsylvania Bureau of Topographic and Geologic Survey.
Puerto Rico: Mineralogy and Geology Section, Industrial Research, Economic Development Administration, Commonwealth of Puerto Rico.
South Carolina: South Carolina Division of Geology, State Development Board.
South Dakota: South Dakota State Geological Survey, and the State Inspector of Mines.
Tennessee: Tennessee Division of Geology, Department of Conservation.
Texas: Bureau of Economic Geology, The University of Texas, Oil and Gas Division, Railroad Commission of Texas.
Utah: Utah Geological and Mineralogical Survey; and Oil and Gas Conservation Commission.
Virginia: Virginia Division of Mineral Resources.
Washington: Washington Division of Mines and Geology.
West Virginia: West Virginia Geological and Economic Survey.
Wisconsin: Wisconsin Geological Survey.
Wyoming: Geological Survey of Wyoming; and Oil and Gas Conservation Commission.

Except for the statistical summary and injury experience and worktime chapters, this volume was prepared by the staffs of the following Bureau of Mines mineral supply field operations centers under the direction of William E. Eckerd, Alaska Field Operation Center, Juneau, Alaska; Robert D. Thomson, Eastern Field Operation Center, Pittsburgh, Pa.; Ottey M. Bishop, Intermountain Field Operation Center, Denver, Colo.; and Richard Appling, Western Field Operation Center, Spokane, Wash.

The manuscripts upon which this volume was based were reviewed by the Minerals Yearbook staff, Office of Technical Data Services, to insure statistical consistency among the tables, figures, and text between this volume and volume I–II, and between this volume and those of former years.

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

ALBERT E. SCHRECK
Editor-In-Chief, Minerals Yearbook

Contents

Statistical Summary

By Julia Muscal [1]

This summary appears in Minerals Yearbook volumes I-II, 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 exported from and imported into the United States. The sections of this chapter and the area chapters in volume III 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.

[1] Statistical assistant, Minerals Yearbook.

Table 1.—Value of mineral production [1] in the United States, by mineral groups

(Millions)

Year	Mineral fuels	Nonmetals (except fuels)	Metals	Total [2]
1965	$14,047	$4,933	$2,544	$21,524
1966	15,088	5,176	2,703	22,968
1967	16,195	r 5,200	2,333	r 23,729
1968	16,820	r 5,448	2,703	r 24,971
1969	17,965	5,625	3,338	26,928

r Revised.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Data may not add to totals shown because of independent rounding.

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

Mineral	1966		1967		1968		1969	
	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	2,041,271	$8,438	1,866,666	$8,136	r 1,797,219	r $8,179	1,918,748	$8,561
Carbon dioxide, natural (estimate) thousand cubic feet	1,140,907	153	1,142,374	165	1,118,027	176	1,194,836	144
Coal:								
Bituminous and lignite [2] thousand short tons	533,881	2,421,293	552,626	2,555,377	545,245	2,546,340	560,505	2,795,509
Pennsylvania anthracite—do	12,941	100,663	12,256	96,160	11,461	97,245	10,473	100,769
Helium:								
Crude—thousand cubic feet	3,654,700	41,556	3,697,300	42,800	3,788,400	44,700	3,992,600	46,843
Grade A—do	951,400	32,541	1,015,000	29,657	1,066,400	28,355	759,800	21,599
Natural gas—million cubic feet	17,206,628	2,702,759	18,171,325	2,898,741	19,322,400	3,168,688	20,698,240	3,455,615
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	179,248	520,635	187,840	546,927	199,049	571,679	201,784	603,084
LP gases—do	288,912	527,223	326,616	632,994	351,262	552,335	378,457	498,927
Peat—short tons	605,858	6,501	619,687	6,768	619,161	7,230	565,760	7,055
Petroleum (crude)—thousand 42-gallon barrels	3,027,763	8,726,423	3,216,715	9,377,516	3,329,042	9,794,826	3,371,751	10,426,680
Total mineral fuels	XX	15,088,000	XX	16,195,000	XX	16,820,000	XX	17,965,000
Nonmetals (except fuels):								
Abrasive stones [3]—short tons	3,806	$515	2,701	$574	3,141	$629	3,311	$600
Asbestos—do	125,928	11,056	123,189	11,102	120,690	10,406	125,936	10,648
Barite—thousand short tons	947	11,259	962	11,604	927	13,706	1,077	15,753
Boron minerals—do	866	68,209	r 892	r 69,819	r 963	r 76,535	1,020	81,261
Bromine—thousand pounds	326,498	78,883	349,757	85,391	362,452	86,787	391,883	87,990
Calcium-magnesium chloride—short tons	(4)	(4)	608,965	11,983	(4)	(4)	(4)	(4)
Cement:								
Portland—thousand 376-pound barrels	373,091	1,162,984	365,570	1,148,208	388,525	1,227,942	400,883	1,284,600
Masonry—thousand 280-pound barrels	22,367	63,407	21,700	62,168	23,167	66,259	23,253	69,106
Natural and slag thousand 376-pound barrels	109	415	94	360	86	332	(4)	(4)
Clays—thousand short tons	56,713	221,714	54,664	223,987	r 57,348	r 246,938	58,694	264,415
Diatomite—short tons	(4)	(4)	(4)	(4)	(4)	(4)	598,482	36,484
Emery—do	11,102	210	(4)	(4)	(4)	(4)	(4)	(4)
Feldspar—long tons	655,452	7,020	615,397	7,086	667,679	8,265	673,985	8,869
Fluorspar—short tons	253,068	10,841	295,643	13,164	252,411	11,656	182,567	8,411
Garnet (abrasive)—do	21,952	2,092	20,494	1,849	22,136	1,922	20,458	1,874
Gem stones (estimate)	NA	2,437	NA	2,430	NA	2,497	NA	2,390
Gypsum—thousand short tons	9,647	35,681	9,393	34,383	10,018	36,775	r 9,905	r 38,354
Lime—do	18,057	239,588	17,985	240,216	18,637	249,639	20,209	280,736
Magnesium compounds from sea water and brine (except for metals) short tons, MgO equivalent	651,187	46,690	544,428	41,883	525,210	43,449	625,618	53,308

Mica:								
Scrap, short tons	113,133	3,733	118,503	2,876	125,323	3,014	133,058	2,893
Sheet, pounds	4,500	1	20,500	(4)	15,000	(4)	(4)	3
Perlite, short tons	404,160	3,907	413,001	3,973	427,574	4,221	471,454	5,100
Phosphate rock, thousand short tons	39,044	261,092	39,770	265,947	41,251	250,692	37,725	208,689
Potassium salts, thousand short tons, K_2O equivalent	3,320	122,210	3,299	105,313	2,722	75,664	2,804	73,572
Pumice, thousand short tons	3,218	6,765	3,446	5,131	3,530	5,570	3,609	5,050
Pyrites, thousand long tons	873	5,088	861	7,943	872	(4)	(4)	(4)
Salt, thousand short tons	36,463	229,985	38,946	251,210	41,274	272,275	44,245	287,680
Sand and gravel, do	934,481	984,982	r 905,899	r 980,619	r 917,468	r 1,020,107	936,906	1,070,302
Sodium carbonate (natural), short tons	1,737,511	40,674	1,726,071	40,539	2,043,405	42,104	2,513,435	50,922
Sodium sulfate (natural), do	640,329	11,271	636,843	10,710	699,706	12,729	672,118	12,427
Stone [6], thousand short tons	813,374	1,260,715	785,592	1,240,244	r 819,597	r 1,317,911	862,895	1,424,694
Sulfur:								
Frasch process mines, thousand long tons	7,721	201,292	7,682	251,670	6,645	268,146	6,551	176,659
Other mines, long tons	557	5	568	3	3,125	46	---	---
Talc, soapstone, and pyrophyllite, short tons	895,045	6,479	902,512	6,871	958,262	6,656	1,029,238	7,508
Tripoli, do	66,163	328	70,984	377	85,534	796	84,673	734
Vermiculite, thousand short tons	262	4,954	255	4,974	290	5,684	310	6,805
Value of items that cannot be disclosed: Aplite, brucite, calcite (1966), graphite, iodine, kyanite, lithium minerals, magnesite, greensand marl, olivine, staurolite, wollastonite, and values indicated by footnote 4	XX	69,911	XX	55,734	XX	79,309	XX	46,940
Total nonmetals	XX	5,176,000	XX	r 5,200,000	XX	r 5,448,000	XX	5,625,000
Metals:								
Antimony ore and concentrate, short tons, antimony content	927	(7)	892	(7)	856	(7)	938	(7)
Bauxite, thousand long tons, dried equivalent	1,796	$20,095	1,654	$19,079	1,665	$23,752	1,843	$25,725
Beryllium concentrate, short tons, gross weight	(7)	(7)	(7)	(7)	168	81	(7)	(7)
Copper (recoverable content of ores, etc.), short tons	1,429,152	1,033,850	954,064	729,401	1,204,621	1,008,195	1,544,579	1,468,400
Gold (recoverable content of ores, etc.), troy ounces	1,803,420	63,119	1,584,187	55,447	1,478,292	[8] 58,038	1,733,176	[8] 71,944
Iron ore, usable (excluding byproduct iron sinter), thousand long tons, gross weight	90,040	854,134	82,415	817,511	81,934	836,433	89,854	929,293
Lead (recoverable content of ores, etc.), short tons	327,368	98,964	316,931	88,741	359,156	94,903	509,013	151,635
Manganese ore (35 percent or more Mn), short tons, gross weight	14,406	(7)	12,585	(7)	11,378	(7)	5,630	157
Manganiferous ore (5 to 35 percent Mn), do	324,926	(7)	289,160	(7)	244,590	(7)	430,637	(7)
Mercury, 76-pound flasks	22,008	9,722	23,784	11,639	28,874	15,464	29,360	14,828
Molybdenum (content of concentrate), thousand pounds	91,670	144,327	81,596	133,604	93,245	151,000	103,009	173,819
Nickel (content of ore and concentrate), short tons	15,036	(7)	15,287	(7)	17,294	(7)	17,056	(7)
Silver (recoverable content of ores, etc.), thousand troy ounces	43,669	56,463	32,345	50,135	32,729	70,191	41,906	75,040
Tin (content of concentrate), long tons	97	265	(7)	(7)	(7)	(7)	(7)	(7)
Titanium concentrate, ilmenite, short tons, gross weight	868,436	17,608	882,414	18,519	960,118	19,484	893,034	18,636

See footnote at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued								
Tungsten ore and concentrate short tons, 60 percent WO_3 basis	8,912	$17,620	9,088	$20,895	10,704	$25,197	9,883	$24,624
Uranium (recoverable content U_3O_8) thousand pounds	19,037	152,281	20,655	165,239	24,139	182,698	23,748	142,161
Vanadium (recoverable in ore and concentrate) short tons	5,166	22,210	4,963	21,331	6,483	23,143	5,577	26,334
Zinc (recoverable content of ores, etc.)---do	572,558	166,044	549,413	151,562	529,446	142,950	553,124	161,512
Value of items that cannot be disclosed: Cobalt, columbium-tantalum concentrate (1967, 1969), magnesium chloride for magnesium metal, manganiferous residuum, platinum-group metals (crude), rare-earth metal concentrates, titanium concentrate (rutile 1966–68), zirconium concentrate, and values indicated by footnote 7	XX	46,615	XX	50,190	XX	51,030	XX	54,148
Total metals	XX	2,703,000	XX	2,333,000	XX	2,703,000	XX	3,338,000
Grand total mineral production	XX	22,968,000	XX	r 23,729,000	XX	r 24,971,000	XX	26,928,000

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

[4] Figure withheld to avoid disclosing individual company confidential data; value included with "Nonmetal items that cannot be disclosed."

[5] Final figure; supersedes figure given in commodity section.

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

[7] Figure withheld to avoid disclosing individual company confidential data; value included with "Metal items that cannot be disclosed."

[8] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968; and Engelhard selling quotations Mar. 20, 1968 through 1969.

Table 3.—Minerals produced in the United States and principal producing States in 1969

Mineral	Principal producing States in order of quantity	Other producing States
Antimony	Idaho, Alaska, Nev.	
Aplite	Va.	
Asbestos	Calif., Vt., Ariz., N.C.	
Asphalt	Tex., Utah, Ala., Mo.	
Barite	Nev., Mo., Ark., Ga	Alaska, Calif., Tenn.
Bauxite	Ark., Ala., Ga.	
Beryllium	Colo., S. Dak., Maine, N. Mex.	
Boron	Calif.	
Bromine	Mich., Ark., Tex., Calif.	
Brucite	Nev.	
Calcium-magnesium chloride	Mich., Calif.	
Carbon dioxide	N. Mex., Colo., Utah, Calif.	
Cement	Calif., Pa., Tex., Mich	Ala., Ariz., Ark., Colo., Fla., Ga., Hawaii., Idaho, Ill., Ind., Iowa, Kans., Ky., La., Maine, Md., Minn., Miss., Mo., Mont., Nebr., Nev., N. Mex., N.Y., N.C., Ohio, Okla., Oreg., S.C., S. Dak., Tenn,. Utah, Va., Wash., W. Va., Wis., Wyo.
Clays	Ga., Ohio, Tex., N.C	All other States except Alaska, R.I.
Coal	W. Va., Ky., Pa., Ill	Ala., Alaska, Ark., Colo., Ind., Iowa, Kans., Md., Mo., Mont., N. Mex., N. Dak., Ohio., Okla., Tenn., Utah, Va., Wash., Wyo.
Cobalt	Pa.	
Columbium-tantalum	S. Dak.	
Copper	Ariz., Utah, N. Mex., Nev	Calif., Colo., Idaho, Maine, Mich., Mo., Mont., Okla., Oreg., Pa., Tenn., Wash., Wyo.
Diatomite	Calif., Nev., Wash., Ariz	Md., Oreg.
Emery	N.Y.	
Feldspar	N.C., Calif., Conn., S.C	Ariz., Colo., Ga., Maine, N.H., N. Mex., S. Dak., Va.
Fluorspar	Ill., Colo., Nev., Mont	Ky., N. Mex., Utah.
Garnet, abrasive	N.Y., Idaho.	
Gold	S. Dak., Nev., Utah, Ariz	Alaska, Calif., Colo., Idaho, Mont., N. Mex., Oreg., Pa., Tenn., Wash., Wyo.
Graphite	Tex.	
Gypsum	Mich., Tex., Calif., Iowa	Ariz., Ark., Colo., Ind., Kans., La., Mont., Nev., N. Mex., N.Y., Ohio, Okla., S. Dak., Utah, Va., Wash., Wyo.
Helium	Kans., Tex., Okla., Ariz	N. Mex.
Iodine	Mich.	
Iron Ore	Minn., Mich., Calif., Mo	Ala., Ariz., Colo., Ga., Idaho, Mont., Nev., N. Mex., N.Y., N.C., Pa., Tex., Utah, Va., Wis., Wyo.
Kyanite	Va., Ga., S.C., Fla.	
Lead	Mo., Idaho, Utah, Colo	Alaska, Ariz., Calif., Ill., Kans., Mont., Nev., N. Mex., N.Y., Okla., Oreg., S. Dak., Va., Wash., Wis.
Lime	Ohio, Pa., Mo., Tex	Ala., Ariz., Ark., Calif., Colo., Conn., Fla., Hawaii, Idaho, Ill., Ind., Iowa, Kans., 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., P.R.
Lithium	N.C., Nev., Calif., S. Dak.	
Magnesite	Nev.	
Magnesium Chloride	Tex.	
Magnesium Compounds	Mich., Tex., Calif., N.J	Fla., Miss., Utah.
Manganese ore	N. Mex., Mont.	
Manganiferous ore	Minn., N. Mex.	
Manganiferous residuum	N.J.	
Marl, greensand	N.J., Md.	
Mercury	Calif., Nev., Tex., Idaho	Alaska, Ariz., Oreg.
Mica:		
Scrap	N.C., Ala., Ga., Ariz	Conn., N.H., N. Mex., Pa., S.C., S. Dak.
Sheet	N.C.	
Molybdenum	Colo., Utah, Ariz., N. Mex	Calif., Nev.
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 1969—Continued

Mineral	Principal producing States in order of quantity	Other producing States
Natural gas liquids	Tex., La., Okla., N. Mex	Ala., Alaska, 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., Ill., Fla., N.J	Calif., Colo., Ga., Idaho, Ind., Iowa, Maine, Md., Mass., Minn., Mont., N. Mex., N.Y., Ohio, Pa., S.C., Vt., Wash., Wis.
Perlite	N. Mex., Ariz., Calif., Nev	Colo., Idaho, 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., N.C	Ala., Calif., Mont., Utah, Wyo.
Platinum-group metals	Alaska.	
Potassium salts	N. Mex., Utah, Calif., Mich.	Md.
Pumice	Ariz., Oreg., Calif., Hawaii	Colo., Idaho, Kans., Mont., Nebr., Nev., N. Mex., Okla., Tex., Utah, Wash., Wyo.
Pyrites	Tenn., Pa., Colo., Nev	Ariz., S.C.
Rare-earth metals	Calif., Ga., Colo.	
Salt	La., Tex., Ohio, N.Y	Ala., Calif., Colo., Hawaii, Kans., Mich., Nev., N. Mex., N. Dak., Okla., Utah, Va., W. Va.
Sand and gravel	Calif., Mich., Ohio, Minn	All other States.
Silver	Idaho, Ariz., Utah, Mont	Alaska, Calif., Colo., Maine, Mich., Mo., Nev., N. Mex., N.Y., Okla., Oreg., Pa., S. Dak., Tenn., Wash., Wyo.
Sodium carbonate	Wyo., Calif.	
Sodium sulfate	Calif., Wyo.	
Staurolite	Fla.	
Stone	Pa., Ill., Ohio, Tex	All other States except Del.
Sulfur (Frasch)	La., Tex.	
Talc, soapstone, and pyrophyllite	N.Y., Tex., Vt., Calif	Ala., Ark., Ga., Md., Mont., Nev., N.C., Oreg., Pa., Va., Wash.
Tin	Colo., S. Dak., Alaska, N. Mex.	
Titanium	N.Y., Fla., N.J., Ga	Va.
Tripoli	Ill., Okla., Ark., Pa.	
Tungsten	Calif., Colo., Mont., Nev	Ariz., Idaho, Utah.
Uranium	N. Mex., Wyo., Colo., Tex	Ariz., S. Dak., Utah.
Vanadium	Colo., Idaho, Ark., Utah	Ariz., N. Mex.
Vermiculite	Mont., S.C., Tex., Ariz.	
Wollastonite	N.Y., Calif.	
Zinc	Tenn., N.Y., Idaho, Colo	Ariz., Calif., Ill., Kans., Ky., Maine., 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 1969

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals in order of value
Alabama	$284,736	22	1.06	Coal, cement, stone, petroleum.
Alaska	257,776	24	.96	Petroleum, sand and gravel, natural gas, coal.
Arizona	859,303	8	3.19	Copper, molybdenum, sand and gravel, cement.
Arkansas	208,126	27	.77	Petroleum, bromine and bromine compounds, natural gas, bauxite.
California	1,850,517	3	6.87	Petroleum, natural gas, cement, sand and gravel.
Colorado	368,494	17	1.37	Molybdenum, petroleum, coal, sand and gravel.
Connecticut	27,767	45	.10	Stone, sand and gravel, feldspar, lime.
Delaware	2,086	50	.01	Sand and gravel, clays, gem stones.
Florida	295,376	21	1.10	Phosphate rock, stone, cement, sand and gravel.
Georgia	190,902	29	.71	Clays, stone, cement, sand and gravel.
Hawaii	29,539	44	.11	Stone, cement, sand and gravel, pumice.
Idaho	118,309	32	.44	Silver, phosphate rock, lead, zinc.
Illinois	659,815	10	2.45	Coal, petroleum, stone, sand and gravel.
Indiana	241,871	26	.90	Coal, cement, stone, sand and gravel.
Iowa	119,930	31	.45	Cement, stone, sand and gravel, gypsum.
Kansas	577,816	15	2.15	Petroleum, natural gas, helium, natural gas liquids.
Kentucky	591,048	13	2.19	Coal, stone, petroleum, natural gas.
Louisiana	4,685,326	2	17.40	Petroleum, natural gas, natural gas liquids, sulfur.
Maine	20,188	47	.07	Cement, sand and gravel, stone, zinc.
Maryland	83,483	36	.31	Stone, cement, sand and gravel, coal.
Massachusetts	49,843	43	.18	Sand and gravel, stone, lime, clays.
Michigan	668,247	9	2.48	Iron ore, cement, copper, sand and gravel.
Minnesota	635,636	12	2.36	Iron ore, sand and gravel, stone, cement.
Mississippi	243,184	25	.90	Petroleum, natural gas, sand and gravel, clays.
Missouri	367,232	18	1.36	Lead, cement, stone, iron ore.
Montana	282,631	23	1.05	Petroleum, copper, sand and gravel, cement.
Nebraska	78,030	39	.29	Petroleum, cement, sand and gravel, stone.
Nevada	168,295	30	.62	Copper, gold, sand and gravel, diatomite.
New Hampshire	8,120	48	.03	Sand and gravel, stone, clays, feldspar.
New Jersey	83,107	37	.31	Stone, sand and gravel, zinc, magnesium compounds.
New Mexico	935,746	7	3.48	Petroleum, natural gas, copper, uranium.
New York	302,339	20	1.12	Cement, stone, salt, sand and gravel.
North Carolina	90,455	34	.34	Stone, sand and gravel, phosphate rock, cement.
North Dakota	91,048	33	.34	Petroleum, coal, sand and gravel, natural gas.
Ohio	580,667	14	2.16	Coal, stone, sand and gravel, lime.
Oklahoma	1,090,809	4	4.05	Petroleum, natural gas, natural gas liquids, stone.
Oregon	60,164	40	.22	Sand and gravel, stone, cement, nickel.
Pennsylvania	976,367	5	3.63	Coal, cement, stone, sand and gravel.
Rhode Island	4,433	49	.02	Sand and gravel, stone, gem stones.
South Carolina	55,864	41	.21	Cement, stone, clays, sand and gravel.
South Dakota	54,921	42	.20	Gold, stone, sand and gravel, cement.
Tennessee	205,451	28	.76	Stone, zinc, cement, coal.
Texas	5,769,970	1	21.43	Petroleum, natural gas, natural gas liquids, cement.
Utah	543,282	16	2.02	Copper, petroleum, coal, molybdenum.
Vermont	27,759	46	.10	Stone, asbestos, sand and gravel, talc.
Virginia	317,527	19	1.18	Coal, stone, cement, sand and gravel.
Washington	88,626	35	.33	Sand and gravel, cement, stone, zinc.
West Virginia	948,430	6	3.52	Coal, natural gas, stone, cement.
Wisconsin	79,792	38	.30	Sand and gravel, stone, zinc, cement.
Wyoming	647,442	11	2.40	Petroleum, natural gas, sodium salts, uranium.
Total	26,927,827	----	100.00	Petroleum, natural gas, coal, copper.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA								
Cement: [2]								
Portland—thousand 376-pound barrels	16,394	$49,537	15,364	$46,510	15,514	$48,147	16,527	$51,251
Masonry—thousand 280-pound barrels	2,570	7,613	2,377	6,938	2,523	7,309	2,600	8,520
Clays—thousand short tons	2,448	5,142	2,724	7,422	2,793	6,995	3,097	7,083
Coal (bituminous)—do	14,219	100,112	15,486	110,696	16,440	115,815	17,456	130,405
Iron ore (usable)—thousand long tons, gross weight	1,508	8,702	1,472	8,286	1,151	6,730	1,125	6,435
Lime—thousand short tons	699	8,442	624	7,719	773	8,933	747	9,870
Natural gas—million cubic feet	252	32	248	31	230	30	180	24
Petroleum (crude)—thousand 42-gallon barrels	8,030	20,878	7,348	19,500	7,635	20,385	7,701	20,793
Sand and gravel—thousand short tons	7,082	7,953	7,229	7,969	8,140	9,130	8,323	9,427
Stone—do	[4] 20,744	[4] 36,839	18,371	33,346	20,643	33,847	19,854	37,512
Value of items that cannot be disclosed: Native asphalt, bauxite, slag cement, scrap mica, natural gasoline 1969, liquefied petroleum gases 1969, phosphate rock 1969, salt, stone (dimension limestone 1966, dimension marble 1966, crushed sandstone 1966, and talc	XX	4,528	XX	2,974	XX	2,300	XX	3,416
Total	XX	249,778	XX	251,391	XX	259,621	XX	284,736
ALASKA								
Antimony ore and concentrate—short tons, antimony content	8	W	10	W	3	W	12	$13
Barite—thousand short tons	W	W	W	W	91	W	W	W
Coal (bituminous)—do	927	$6,953	925	$7,296	750	$4,502	667	4,366
Gold (recoverable content of ores, etc.)—troy ounces	27,325	956	22,948	803	21,262	[5] 835	21,227	[5] 881
Lead (recoverable content of ores, etc.)—short tons	14	4	----	----	W	W	2	1
Natural gas—million cubic feet	11,267	2,794	14,438	3,610	17,343	4,388	50,864	12,665
Peat—short tons	W	W	1,528	12	----	----	----	----
Petroleum (crude)—thousand 42-gallon barrels	14,358	44,007	29,126	91,164	66,204	186,695	73,953	214,464
Sand and gravel—thousand short tons	17,457	21,793	22,370	26,248	18,013	20,366	16,205	18,615
Silver (recoverable content of ores, etc.)—thousand troy ounces	7	9	6	9	4	8	2	4
Stone—thousand short tons	W	W	W	W	W	W	1,954	3,902
Value of items that cannot be disclosed: Copper (1966–68), gem stones, LP gases (1969), mercury, platinum-group metals, tin, and values indicated by symbol W	XX	6,167	XX	4,924	XX	4,923	XX	2,865
Total	XX	82,683	XX	134,066	XX	221,717	XX	257,776
ARIZONA								
Clays—thousand short tons	[3] 89	[3] $121	[3] 67	[3] $37	77	$347	120	$394
Coal (bituminous)—do	----	----	1	5	----	----	----	----
Copper (recoverable content of ores, etc.)—short tons	739,569	535,004	501,741	383,591	627,961	525,566	801,363	761,840
Diatomite—do	1,353	36	W	W	W	W	725	W
Fluorspar—do	----	----	10,000	280	----	----	----	----

Gem stones	NA	120	NA	150	NA	149	NA	153
Gold (recoverable content of ores, etc.)—troy ounces	142,528	4,988	80,844	2,830	95,999	[5] 3,769	110,878	[5] 4,603
Gypsum—thousand short tons	75	394	W	W	W	W	83	424
Helium, grade A—thousand cubic feet	63,500	2,222	73,800	2,066	64,800	1,600	56,300	1,126
Iron ore (usable)—thousand long tons, gross weight	W	W	W	W	16	124	18	136
Lead (recoverable content of ores, etc.)—short tons	5,211	1,575	4,771	1,336	1,704	450	217	65
Lime—thousand short tons	218	3,721	186	3,142	260	4,561	283	5,074
Mercury—76-pound flasks	363	160	W	W	192	103	W	W
Molybdenum (content of concentrate)—thousand pounds	10,161	17,812	9,261	15,385	12,127	19,207	12,699	20,947
Natural gas—million cubic feet	3,161	436	1,255	193	881	142	1,136	199
Petroleum (crude)—thousand 42-gallon barrels	132	370	2,924	8,188	3,370	9,606	2,433	7,056
Pumice—thousand short tons	1,103	1,674	1,064	904	1,033	974	910	814
Sand and gravel—do	18,730	20,448	[r] 17,317	[r] 17,280	13,981	14,423	16,481	18,066
Silver (recoverable content of ores, etc.)—thousand troy ounces	6,339	8,196	4,588	7,112	4,958	10,633	6,141	10,997
Stone—thousand short tons	2,271	4,091	1,910	3,491	3,293	6,239	2,827	5,812
Tungsten ore and concentrate—short tons, 60-percent WO_3 basis	2	5	W	W	1	3	1	2
Uranium (recoverable content U_3O_8)—thousand pounds	437	3,492	83	666	295	1,923	W	W
Vanadium (recoverable in ore and concentrate)—short tons	W	453	W	W	W	W	W	W
Zinc (recoverable content of ores, etc.)—do	15,985	4,636	14,330	3,967	5,441	1,469	9,039	2,639
Value of items that cannot be disclosed: Asbestos, cement, clays (bentonite 1966–67), feldspar, scrap mica, perlite, pyrites, vermiculite (1967–69), and values indicated by symbol W	XX	12,125	XX	13,503	XX	16,253	XX	18,956
Total	XX	622,079	XX	[r] 464,126	XX	617,541	XX	859,303
ARKANSAS								
Barite—thousand short tons	233	$2,266	229	$2,266	166	$3,839	210	$4,616
Bauxite—thousand long tons, dried equivalent	1,718	19,439	1,571	18,269	1,582	23,058	1,755	24,706
Bromine and bromine in compounds—thousand pounds	42,307	10,467	64,450	14,885	95,499	20,790	145,100	28,287
Clays—thousand short tons	[3] 775	[3] 776	941	1,740	919	2,134	992	2,426
Coal (bituminous)—do	236	1,640	189	1,427	211	1,576	228	1,802
Gem stones	NA	35	NA	35	NA	30	NA	24
Lime—thousand short tons	207	3,004	187	2,723	206	3,058	184	2,748
Natural gas—million cubic feet	105,174	16,407	116,522	17,828	156,627	24,456	169,257	26,743
Natural gas liquids:								
Natural gasoline and cycle products—thousand 42-gallon barrels	763	1,923	656	1,780	753	2,192	692	2,049
LP gases—do	1,540	3,233	1,279	3,009	1,435	2,899	1,279	2,098
Petroleum (crude)—do	23,824	63,372	21,075	56,902	19,464	53,137	18,049	51,079
Sand and gravel—thousand short tons	16,056	21,038	14,239	15,531	12,997	14,643	12,674	14,949
Stone—do	19,109	24,588	17,454	23,236	16,322	22,256	16,463	23,134
Value of items that cannot be disclosed: Abrasive stones, cement, clays (kaolin and fire clay 1966), gypsum, mercury (1966–67), phosphate rock (1966), soapstone, tripoli, vanadium (1968–69), and values indicated by symbol W	XX	21,939	XX	19,822	XX	24,655	XX	23,465
Total	XX	190,127	XX	179,453	XX	198,723	XX	208,126

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
CALIFORNIA								
Antimony ore and concentrate—short tons, antimony content	1	(6)						
Asbestos—short tons	81,671	$6,945	77,091	$6,726	75,592	$6,139	75,828	$5,956
Barite—thousand short tons	15	104	10	71	W	W	W	W
Boron minerals—do	866	68,209	r 892	r 69,819	r 963	r 76,535	1,020	81,261
Cement—thousand 376-pound barrels	45,387	146,302	42,034	137,961	47,595	151,961	50,610	170,612
Clays—thousand short tons	2,984	6,708	2,609	6,037	2,755	6,630	2,993	7,443
Copper (recoverable content of ores, etc.)—short tons	1,078	780	788	602	1,182	989	1,129	1,073
Feldspar—long tons	100,915	W	94,769	W	W	W	W	W
Gem stones	NA	200	NA	200	NA	200	NA	200
Gold (recoverable content of ores, etc.)—troy ounces	64,764	2,267	40,570	1,420	15,682	5 616	7,904	5 328
Gypsum—thousand short tons	1,207	3,064	1,241	3,150	1,360	3,603	1,210	3,339
Lead (recoverable content of ores, etc.)—short tons	1,976	597	1,735	486	4,001	1,057	2,518	750
Lime—thousand short tons	552	8,764	539	8,696	568	9,301	585	9,666
Magnesium compounds from sea water and bitterns (partly estimated) short tons, MgO equivalent	87,816	7,413	76,592	6,882	81,622	7,229	76,220	7,143
Mercury—76-pound flasks	16,070	7,100	16,385	8,018	21,417	11,470	18,480	9,333
Natural gas—million cubic feet	689,607	204,059	681,080	202,290	714,893	221,077	677,689	207,440
Natural gas liquids:								
Natural gasoline and cycle products—thousand 42-gallon barrels	15,110	48,867	14,605	46,620	13,403	42,963	12,954	39,944
LP gases—do	8,409	17,304	8,730	19,065	8,589	18,749	8,238	17,646
Peat—short tons	29,235	384	30,014	396	W	W	11,395	106
Perlite—do	W	W	W	W	8,806	80	11,419	105
Petroleum (crude)—thousand 42-gallon barrels	345,295	812,834	359,219	829,133	375,496	883,644	375,291	920,060
Pumice—thousand short tons	580	1,763	866	1,357	776	1,312	866	1,229
Salt—do	1,693	W	1,732	W	1,901	W	1,895	W
Sand and gravel—do	120,692	139,157	116,125	139,212	124,655	153,360	124,718	155,883
Silver (recoverable content of ores, etc.)—thousand troy ounces	190	246	145	224	598	1,282	492	881
Stone—thousand short tons	43,051	61,336	37,186	55,263	36,125	52,671	38,033	57,757
Sulfur ore—long tons	557	5	568	3	3,125	46		
Talc, soapstone, and pyrophyllite—short tons	138,340	1,847	143,466	1,945	165,396	2,075	145,158	2,329
Tin (content of concentrate)—long tons	13	21	W	W				
Zinc (recoverable content of ores, etc.)—short tons	335	97	441	122	3,525	952	3,327	971
Value of items that cannot be disclosed: Bromine, calcite (optical grade, 1966), calcium-magnesium chloride, carbon dioxide, coal (lignite), diatomite, iodine (1966), iron ore, lithium minerals, scrap mica (1966–68), molybdenum, phosphate rock (1968–69), platinum group metals (crude) (1966–68), potassium salts, rare-earth metal concentrates, sodium carbonates and sulfates, tungsten concentrate, uranium (1966), wollastonite, and values indicated by symbol W	XX	141,449	XX	143,722	XX	150,914	XX	149,062
Total	XX	1,687,822	XX	r 1,689,420	XX	r 1,804,855	XX	1,850,517

COLORADO								
Beryllium concentrates—short tons	W	W	W	W	W	W	46	W
Carbon dioxide, natural—thousand cubic feet	147,292	$25	182,701	$31	200,657	$34	175,787	$30
Clays—thousand short tons	599	1,315	596	1,274	616	1,222	732	1,619
Coal (bituminous)—do	5,222	26,075	5,439	25,920	5,558	26,785	5,530	29,121
Copper (recoverable content of ores, etc.)—short tons	4,237	3,065	3,993	3,053	3,451	2,888	3,598	3,421
Feldspar—long tons	891	6	300	2	W	W	358	3
Gem stones	NA	80	NA	118	NA	121	NA	122
Gold (recoverable content of ores, etc.)—troy ounces	31,915	1,117	21,181	741	22,638	[5] 889	25,777	[5] 1,070
Gypsum—thousand short tons	75	269	77	265	98	354	94	339
Iron ore (usable)—thousand long tons, gross weight	164	1,133	W	W	W	W	W	W
Lead (recoverable content of ores, etc.)—short tons	23,082	6,978	21,923	6,138	19,778	5,226	21,767	6,484
Lime—thousand short tons	126	2,327	118	2,028	125	2,375	127	2,449
Manganiferous ore (5 to 35 percent Mn)—short tons, gross weight	---	---	321	3	---	---	---	---
Molybdenum (content of concentrate)—thousand pounds	57,289	88,851	52,040	84,728	61,684	100,296	62,411	105,346
Natural gas—million cubic feet	136,667	17,767	116,857	15,542	121,424	16,392	118,754	17,219
Natural gas liquids:								
Natural gasoline—thousand 42-gallon barrels	1,415	3,565	1,234	3,215	1,289	3,248	1,076	2,798
LP gases—do	1,747	3,596	1,703	3,649	1,987	3,338	1,782	2,762
Peat—short tons	37,111	278	21,988	204	28,457	250	26,103	160
Petroleum (crude)—thousand 42-gallon barrels	33,492	97,462	33,905	99,003	31,937	94,215	28,294	88,277
Pumice—thousand short tons	46	104	18	105	28	234	42	232
Pyrites—thousand long tons	W	W	W	W	23	97	24	120
Sand and gravel—thousand short tons	22,245	23,485	21,810	22,904	23,121	26,608	19,877	27,266
Silver (recoverable content of ores, etc.)—thousand troy ounces	2,085	2,697	1,818	2,817	1,646	3,531	2,599	4,653
Stone—thousand short tons	7,031	11,331	2,992	5,485	2,471	5,201	2,245	5,079
Tin (content of concentrate)—long tons	44	99	31	59	33	64	44	119
Tungsten concentrate—short tons, 60 percent WO_3 basis	1,494	3,626	1,276	3,039	1,893	4,413	1,941	4,440
Uranium (recoverable content U_3O_8)—thousand pounds	2,651	21,205	2,537	20,299	2,706	20,009	2,736	16,935
Vanadium (recoverable in ore and concentrate)—short tons	3,697	15,888	3,317	14,260	3,492	12,468	W	W
Zinc (recoverable content of ores, etc.)—do	54,822	15,898	52,442	14,519	50,258	13,570	53,715	15,685
Value of items that cannot be disclosed: Cement, fluorspar, scrap mica (1967), perlite, rare-earth metal concentrates, salt, and values indicated by symbol W	XX	14,699	XX	16,834	XX	15,630	XX	32,745
Total	XX	362,941	XX	346,235	XX	359,458	XX	368,494
CONNECTICUT								
Clays—thousand short tons	192	$296	191	$334	195	$325	197	$341
Gem stones	NA	8	NA	8	NA	8	NA	8
Sand and gravel—thousand short tons	9,561	8,963	8,320	8,710	8,752	9,321	8,857	10,359
Stone—do	5,618	10,482	5,097	10,141	6,383	12,729	7,562	15,325
Value of items that cannot be disclosed: Feldspar, lime, scrap mica, and peat (1966)	XX	1,597	XX	1,426	XX	1,493	XX	1,734
Total	XX	21,346	XX	20,619	XX	23,876	XX	27,767

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
DELAWARE								
Clays—thousand short tons	11	$11	11	$11	12	$12	11	$11
Gem stones	NA	1	NA	1	NA	1	NA	1
Sand and gravel—thousand short tons	1,610	1,443	1,966	1,846	1,596	1,483	2,257	2,074
Stone—do	210	525	210	525	200	500	---	---
Total	XX	1,980	XX	2,383	XX	1,996	XX	2,086
FLORIDA								
Clays—thousand short tons	762	$11,408	756	$11,574	808	$11,699	907	$13,627
Lime—do	135	1,966	155	2,425	125	2,059	182	2,712
Natural gas—million cubic feet	212	30	123	18	108	16	50	8
Peat—short tons	11,500	91	22,180	155	41,213	277	55,265	359
Petroleum (crude)—thousand 42-gallon barrels	1,799	W	1,568	W	1,474	W	1,731	W
Sand and gravel—thousand short tons	7,403	6,417	6,912	6,479	7,765	7,967	14,409	13,988
Stone—do	35,023	38,167	[4] 33,971	[4] 38,723	[4] 36,692	[4] 46,563	[4] 42,332	[4] 56,611
Value of items that cannot be disclosed: Cement, kyanite (1968–69), magnesium compounds, natural gas liquids, phosphate rock, rare-earth metal concentrates, staurolite, stone (dimension limestone 1967–69) titanium concentrate, zirconium concentrate, and values indicated by symbol W	XX	237,368	XX	250,423	XX	236,042	XX	208,071
Total	XX	295,447	XX	309,797	XX	304,623	XX	295,376
GEORGIA								
Barite—thousand short tons	W	W	W	W	140	$2,874	124	$3,116
Clays—do	5,128	$73,685	4,953	$77,314	5,111	88,632	5,670	98,462
Iron ore (usable)—thousand long tons, gross weight	447	2,200	267	1,450	192	1,119	241	1,338
Mica:								
Scrap—short tons	16,608	380	17,158	291	W	W	W	W
Sand and gravel—thousand short tons	3,915	4,185	3,787	4,206	3,803	4,314	3,824	4,709
Stone—do	24,690	48,193	23,418	49,953	26,903	56,177	27,755	59,451
Talc—short tons	41,000	255	46,150	292	45,600	288	47,790	301
Value of items that cannot be disclosed: Bauxite, cement, feldspar, kyanite, peat,[1] rare-earth metal concentrates, titanium concentrate, zirconium concentrate, and values indicated by symbol W	XX	19,699	XX	19,952	XX	19,686	XX	23,525
Total	XX	148,597	XX	153,458	XX	173,090	XX	190,902
HAWAII								
Cement—thousand 376-pound barrels	1,749	$9,046	1,395	$7,360	1,841	$9,254	2,075	$10,544
Clays—thousand short tons	W	W	W	W	3	4	2	9
Lime—do	10	320	8	265	8	268	9	287
Pumice—do	374	716	290	562	408	724	403	783

Sand and gravel—do	511	1,591	469	1,467	546	1,653	552	1,816
Stone—do	5,079	9,482	4,100	7,207	5,211	11,273	6,534	16,059
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	98	XX	75	XX	49	XX	41
Total	XX	21,253	XX	16,936	XX	23,225	XX	29,539
IDAHO								
Antimony ore and concentrate—short tons, antimony content	834	W	823	W	853	W	922	W
Clays [3]—thousand short tons	23	$22	19	$16	12	$14	23	$51
Cobalt—thousand pounds	1	6						
Copper (recoverable content of ores, etc.)—short tons	4,961	3,589	4,210	3,219	3,525	2,950	3,332	3,168
Gem stones	NA	180	NA	180	NA	200	NA	90
Gold (recoverable content of ores, etc.)—troy ounces	5,056	177	4,838	169	3,227	[5] 127	3,403	[5] 141
Gypsum—thousand short tons					3	13		
Iron ore (usable)—thousand long tons, gross weight	11	97	W	W	W	W	W	W
Lead (recoverable content of ores, etc.)—short tons	72,334	21,867	61,387	17,188	54,790	14,478	65,597	19,541
Mercury—76-pound flasks	1,134	501	898	439	W	W	1,012	511
Peat—short tons	W	W	2,040	16	W	W	1,000	W
Phosphate rock—thousand short tons	W	W	W	W	3,879	22,721	W	W
Pumice—do	55	107	W	W	135	259	21	62
Sand and gravel—do	7,544	6,672	11,246	11,490	8,224	9,133	8,555	7,583
Silver (recoverable content of ores, etc.)—thousand troy ounces	19,777	25,571	17,033	26,402	15,959	34,225	18,930	33,897
Stone—thousand short tons	2,694	5,415	1,986	4,833	2,195	5,209	3,750	6,426
Tungsten concentrate—short tons, 60-percent WO_3 basis	2	1	68	175	W	W	27	63
Zinc (recoverable content of ores, etc.)—short tons	60,997	17,689	56,528	15,650	57,248	15,457	55,900	16,323
Value of items that cannot be disclosed: Cement, clays, (fire clay, bentonite 1966, kaolin), abrasive garnet, lime, perlite, titanium concentrate 1966, vanadium, and values indicated by symbol W	XX	32,991	XX	29,631	XX	9,467	XX	30,453
Total	XX	114,885	XX	109,408	XX	114,253	XX	118,309
ILLINOIS								
Cement:								
Portland—thousand 376-pound barrels	9,203	$28,617	9,069	$30,186	9,372	$32,475	8,720	$29,996
Masonry—thousand 280-pound barrels	614	1,868	591	1,851	602	2,097	603	2,137
Clays [3]—thousand short tons	1,894	3,996	1,881	3,799	2,327	4,813	1,863	4,321
Coal (bituminous)—do	63,571	244,837	65,133	252,975	62,441	250,685	64,722	279,712
Fluorspar—short tons	176,175	8,002	210,207	9,859	188,325	9,134	88,480	4,676
Lead (recoverable content of ores, etc.)—do	2,285	691	2,384	668	1,467	388	791	236
Natural gas—million cubic feet	7,230	860	5,144	602	4,380	552	3,800	536
Peat—short tons	44,374	565	49,716	697	61,520	867	67,330	958
Petroleum (crude)—thousand 42-gallon barrels	61,661	184,983	60,115	181,581	56,391	173,120	50,724	161,302
Sand and gravel—thousand short tons	38,237	43,201	38,801	44,175	45,609	52,943	44,138	56,688
Stone—do	46,157	60,961	48,458	66,757	55,858	80,188	54,857	81,318
Zinc (recoverable content of ores, etc.)—short tons	15,192	4,406	20,416	5,652	18,182	4,909	13,765	4,019
Value of items that cannot be disclosed: Clay (fuller's earth), gem stones, lime, natural gas liquids, and tripoli	XX	34,362	XX	37,999	XX	35,372	XX	33,916
Total	XX	617,349	XX	636,801	XX	647,543	XX	659,815

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
INDIANA								
Abrasive stones—short tons	5	$15	5	$16	5	$16	5	$17
Cement [2]—thousand 376-pound barrels	15,305	49,826	15,924	53,123	14,774	48,096	14,497	45,264
Clays—thousand short tons	1,491	2,196	1,489	2,126	1,550	2,355	1,483	2,264
Coal (bituminous)—do	17,326	67,857	18,772	73,419	18,486	71,680	20,086	82,902
Natural gas—million cubic feet	215	51	198	46	234	55	171	40
Peat—short tons	38,111	456	42,962	441	38,763	557	38,214	515
Petroleum (crude)—thousand 42-gallon barrels	10,617	31,850	10,081	30,041	8,692	26,511	7,841	25,013
Sand and gravel—thousand short tons	24,992	23,542	26,265	25,588	25,774	26,160	26,218	27,438
Stone—do	24,323	42,474	26,977	46,725	26,307	46,790	25,559	45,400
Value of items that cannot be disclosed: Cement (masonry), gypsum, and lime	XX	11,743	XX	13,396	XX	13,166	XX	13,018
Total	XX	230,010	XX	244,921	XX	235,386	XX	241,871
IOWA								
Cement:								
Portland—thousand 376-pound barrels	14,058	$46,736	13,712	$45,394	13,900	$47,275	14,084	$47,265
Masonry—thousand 280-pound barrels	633	1,890	612	1,853	624	1,986	606	1,912
Clays—thousand short tons	1,130	1,438	1,208	1,643	1,264	1,747	1,199	1,660
Coal (bituminous)—do	1,025	3,783	883	3,227	876	3,289	903	3,392
Gypsum—do	1,285	5,577	1,219	5,186	1,351	5,838	1,169	5,274
Sand and gravel—do	19,644	18,213	17,734	16,564	16,332	15,192	18,391	17,867
Stone—do	27,729	40,081	26,133	37,912	26,150	40,397	26,233	40,895
Value of items that cannot be disclosed: Gem stones, lime, and peat	XX	1,595	XX	1,443	XX	1,573	XX	1,665
Total	XX	119,313	XX	113,222	XX	117,297	XX	119,930
KANSAS								
Cement: [2]								
Portland—thousand 376-pound barrels	8,979	$27,246	8,833	$25,545	9,680	$29,898	9,764	$29,365
Masonry—thousand 280-pound barrels	395	1,151	350	1,000	383	1,177	348	1,023
Clays—thousand short tons	847	1,006	935	1,339	932	1,433	[3] 797	[3] 1,070
Coal (bituminous)—do	1,122	5,355	1,136	5,294	1,268	6,526	1,313	7,108
Helium: Crude—thousand cubic feet	2,624,200	30,951	2,719,700	32,554	2,749,700	33,600	2,669,400	32,667
Grade A—do	75,500	1,885	225,000	5,364	291,700	7,300	329,500	7,578
Lead (recoverable content of ores, etc.)—short tons	1,109	335	1,031	289	1,227	324	395	118
Natural gas—million cubic feet	847,495	114,412	871,971	116,844	835,555	115,307	883,156	122,759
Natural gas liquids:								
Natural gasoline—thousand 42-gallon barrels	4,168	9,399	4,623	10,703	4,824	10,977	4,855	11,848
LP gases—do	15,813	25,902	15,835	31,923	15,748	25,827	19,574	26,229
Petroleum (crude)—do	103,738	306,027	99,200	297,600	94,505	285,405	88,716	283,891
Pumice—thousand short tons	W	W	W	W	11	10	W	W
Salt [8]—do	969	13,388	1,069	14,686	1,128	15,520	1,270	17,090

Sand and gravel	do	11,627	8,374	12,066	8,650	12,427	10,559	12,029	10,061
Stone	do	14,027	18,789	13,551	17,806	r 14,372	r 20,650	15,828	22,645
Zinc (recoverable content of ores, etc.)	short tons	4,769	1,383	4,765	1,319	3,012	813	1,900	555
Value of items that cannot be disclosed: Natural cement, clays (fire 1969), gypsum, lime (1968–69), salt (brine), and values indicated by symbol W		XX	2,789	XX	3,152	XX	3,311	XX	3,808
Total		XX	568,392	XX	574,068	XX	r 568,637	XX	577,816
KENTUCKY									
Clays [3]	thousand short tons	1,152	$2,277	1,195	$2,066	1,219	$1,952	1,232	$2,076
Coal (bituminous)	do	93,156	363,440	100,294	396,883	101,156	395,039	109,049	450,950
Fluorspar	short tons	28,725	1,361	32,952	1,686	17,050	878	W	W
Lead (recoverable content of ores, etc.)	do	484	146	845	237	W	W		
Natural gas	million cubic feet	76,536	18,139	89,168	21,400	89,024	22,256	81,304	20,407
Petroleum (crude)	thousand 42-gallon barrels	18,066	51,488	15,535	45,052	14,036	41,125	12,924	40,194
Sand and gravel	thousand short tons	8,064	7,524	7,981	7,859	7,478	8,081	8,364	9,628
Silver (recoverable content of ores, etc.)	thousand troy ounces	1	1	1	1				
Stone	thousand short tons	22,667	31,179	24,812	35,481	30,105	43,266	[4] 30,158	[4] 44,644
Zinc (recoverable content of ores, etc.)	short tons	6,586	1,910	6,317	1,749	W	W	W	W
Value of items that cannot be disclosed: Native asphalt (1966–68), cement, ball clay, natural gas liquids, stone (quartzite, 1969), and values indicated by symbol W		XX	20,899	XX	23,291	XX	22,266	XX	23,149
Total		XX	498,364	XX	535,705	XX	534,863	XX	591,048
LOUISIANA									
Clays	thousand short tons	1,005	$983	995	$1,260	863	$1,163	1,078	$2,943
Lime	do	835	9,274	758	9,891	781	10,159	822	10,750
Natural gas	million cubic feet	5,081,435	929,902	5,716,857	1,057,619	6,416,015	1,212,627	7,227,826	1,387,743
Natural gas liquids:									
Natural gasoline and cycle products	thousand 42-gallon barrels	37,192	113,802	41,777	130,212	49,928	156,903	53,565	171,434
LP gases	do	34,993	72,016	43,921	92,234	57,165	91,464	71,867	96,302
Petroleum (crude)	do	674,318	2,097,129	774,527	2,419,823	817,426	2,570,641	844,603	2,791,269
Salt	thousand short tons	8,736	44,189	9,585	48,483	10,908	53,854	12,435	61,102
Sand and gravel	do	18,216	22,504	20,312	27,442	20,411	26,504	18,131	21,895
Stone [4]	do	8,091	11,253	7,599	11,174	9,387	11,785	9,237	11,892
Sulfur (Frasch process)	thousand long tons	4,018	104,472	4,233	139,739	4,074	162,664	3,999	108,299
Value of items that cannot be disclosed: Cement, gypsum, and stone (crushed miscellaneous)		XX	24,616	XX	23,873	XX	23,246	XX	21,697
Total		XX	3,430,140	XX	3,961,750	XX	4,321,010	XX	4,685,326
MAINE									
Clays	thousand short tons	45	$58	42	$54	[3] 42	[3] $65	[3] 42	[3] $56
Gem stones		NA	35	NA	35	NA	35	NA	35
Peat	short tons	1,600	60	W	W	W	W	W	W
Sand and gravel	thousand short tons	15,036	7,027	11,627	5,368	11,866	5,978	11,275	6,026
Stone	do	1,092	3,622	1,159	2,999	1,187	3,205	1,101	3,798

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MAINE—Continued								
Value of items that cannot be disclosed: Beryllium 1969, cement, fire clay (1968–69), copper (1968–69), feldspar, silver (1968–69), zinc (1968–69), and values indicated by symbol W	XX	$5,932	XX	$6,426	XX	$8,527	XX	$10,273
Total	XX	16,734	XX	14,882	XX	17,810	XX	20,188
MARYLAND								
Clays—thousand short tons	[3] 856	[3] $1,084	998	$1,462	[3] 1,078	[3] $1,252	[3] 1,152	[3] $1,369
Coal (bituminous)—do	1,222	4,367	1,305	4,548	1,447	5,318	1,368	5,261
Gem stones	NA	3	NA	3	NA	3	NA	3
Lime—thousand short tons	29	386	W	W	W	W	W	W
Natural gas—million cubic feet	696	181	621	159	864	221	978	248
Peat—short tons	W	W	W	W	5,554	94	4,481	78
Sand and gravel—thousand short tons	15,108	20,383	12,868	17,724	11,719	17,157	14,230	21,226
Stone—do	13,868	27,229	14,479	28,581	13,344	26,606	15,067	30,504
Value of items that cannot be disclosed: Cement, clays (ball clay 1966, 1968–69, fire clay 1968–69), diatomite 1969, greensand marl, potassium salts, talc and soapstone, and values indicated by symbol W	XX	20,528	XX	20,342	XX	21,193	XX	24,794
Total	XX	74,161	XX	72,819	XX	71,844	XX	83,483
MASSACHUSETTS								
Clays—thousand short tons	202	$260	W	W	257	$314	332	$624
Gem stones	NA	2	NA	$2	NA	2	NA	2
Lime—thousand short tons	182	2,712	195	3,044	198	3,380	199	3,718
Sand and gravel—do	17,321	17,846	17,881	19,504	17,799	20,106	19,456	22,950
Stone—do	6,424	17,624	6,203	17,724	6,917	19,501	7,847	22,521
Value of items that cannot be disclosed: Nonmetals and value indicated by symbol W	XX	29	XX	338	XX	37	XX	28
Total	XX	38,473	XX	40,612	XX	43,340	XX	49,843
MICHIGAN								
Cement:								
Portland—thousand 376-pound barrels	28,171	$87,413	29,645	$94,515	31,375	$99,158	30,373	$98,425
Masonry—thousand 280-pound barrels	2,032	5,221	1,995	5,296	2,006	5,527	1,904	5,473
Clays—thousand short tons	2,450	2,620	2,466	2,636	2,599	2,906	2,667	3,037
Copper (recoverable content of ores, etc.)—short tons	73,449	53,133	58,458	44,692	74,805	62,607	75,226	71,516
Gypsum—thousand short tons	1,522	5,489	1,422	5,085	1,405	5,196	1,327	5,384
Iron ore (usable)—thousand long tons, gross weight	14,377	157,377	14,130	162,610	12,699	148,890	14,058	169,756
Lime—thousand short tons	1,701	20,016	1,787	21,582	1,630	19,870	1,589	20,372
Magnesium compounds from sea water and brine (except for metal) short tons, MgO equivalent	342,482	28,105	309,446	26,388	266,406	25,087	328,047	30,604

Natural gas—million cubic feet	34,120	8,598	33,589	8,296	40,480	10,160	36,163	9,294
Natural gas liquids:								
Natural gasoline—thousand 42-gallon barrels	374	1,099	1,139	3,491	1,066	3,177	921	2,481
LP gases—do	1,898	4,385	1,414	3,444	1,384	3,432	1,197	2,561
Peat—short tons	235,842	2,175	237,107	2,292	237,513	2,919	186,278	2,724
Petroleum (crude)—thousand 42-gallon barrels	14,273	40,913	13,664	39,455	12,974	38,287	12,213	37,494
Salt—thousand short tons	4,465	38,611	4,789	42,389	4,893	44,481	4,819	45,961
Sand and gravel—do	55,123	49,521	52,310	49,616	56,663	54,979	58,092	58,968
Silver (recoverable content of ores, etc.)—thousand troy ounces	483	625	302	468	473	1,014	1,009	1,807
Stone—thousand short tons	37,864	40,380	36,432	39,910	37,279	41,092	39,186	43,572
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, gem stones, iodine, and potassium salts	XX	56,446	XX	58,039	XX	58,293	XX	58,818
Total	XX	602,127	XX	610,204	XX	627,075	XX	668,247
MINNESOTA								
Clays [3]—thousand short tons	224	$336	228	$342	240	$359	275	$412
Iron ore (usable)—thousand long tons, gross weight	55,133	499,388	49,457	468,623	51,275	508,814	56,957	570,446
Manganiferous ore (5 to 35 percent Mn)—short tons, gross weight	275,581	W	236,753	W	191,846	W	381,491	W
Peat—short tons	11,366	197	13,968	257	6,400	96	12,026	249
Sand and gravel—thousand short tons	39,331	28,972	41,212	33,132	44,674	36,414	48,121	40,191
Stone—do	4,901	11,688	4,160	11,442	4,427	13,045	5,035	14,253
Value of items that cannot be disclosed: Abrasive stones, cement, fire clay, gem stones, lime, and values indicated by symbol W	XX	9,696	XX	9,530	XX	8,699	XX	10,085
Total	XX	550,277	XX	523,326	XX	567,427	XX	635,636
MISSISSIPPI								
Clays—thousand short tons	1,727	$7,489	1,654	$7,852	1,693	$9,075	1,703	$8,660
Natural gas—million cubic feet	156,652	27,257	139,497	24,133	135,051	22,601	131,234	23,097
Natural gas liquids:								
Natural gasoline and cycle products—thousand 42-gallon barrels	566	1,483	427	1,167	459	1,277	565	1,572
LP gases—do	443	987	424	1,085	518	958	538	799
Petroleum (crude)—do	55,227	146,353	57,147	155,726	58,708	164,396	64,283	187,514
Sand and gravel—thousand short tons	12,675	13,563	14,039	15,485	11,980	12,669	11,484	12,263
Stone—do	[4] 1,532	[4] 1,641	1,879	2,055	747	833	W	W
Value of items that cannot be disclosed: Cement, iron ore (1966–67), lime, magnesium compounds, and stone (dimension sandstone 1966)	XX	12,587	XX	9,055	XX	9,146	XX	9,279
Total	XX	211,360	XX	216,558	XX	220,955	XX	243,184
MISSOURI								
Barite—thousand short tons	337	$4,280	332	$4,444	284	$4,102	304	$4,220
Cement:								
Portland—thousand 376-pound barrels	13,848	46,228	15,044	52,119	20,081	71,206	21,325	74,368
Masonry—thousand 280-pound barrels	382	1,075	372	1,172	405	1,312	427	1,319
Clays—thousand short tons	2,329	5,989	2,305	6,220	2,433	6,158	[3] 2,251	[3] 6,405
Coal (bituminous)—do	3,582	14,334	3,696	15,573	3,205	13,460	3,301	14,283
Copper (recoverable content of ores, etc.)—short tons	3,913	2,831	3,215	2,458	5,494	4,598	12,664	12,039
Iron ore (usable)—thousand long tons, gross weight	1,887	26,450	1,871	26,673	1,648	23,585	2,622	35,826
Lead (recoverable content of ores, etc.)—short tons	132,255	39,981	152,649	42,742	212,611	56,180	355,452	105,889

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MISSOURI—Continued								
Lime—thousand short tons	1,494	$17,910	W	W	W	W	W	W
Natural gas—million cubic feet	----------	----------	121	$30	[7] 107	[7] $14	126	$17
Petroleum (crude)—thousand 42-gallon barrels	97	W	W	W	W	W	W	W
Sand and gravel—thousand short tons	10,702	13,540	9,716	12,556	10,649	14,204	10,940	14,574
Silver (recoverable content of ores, etc.)—thousand troy ounces	----------	----------	226	351	341	731	1,442	2,582
Stone—thousand short tons	35,240	53,393	36,585	53,953	[r] 38,988	[r] 58,743	41,977	63,251
Zinc (recoverable content of ores, etc.)—short tons	3,968	1,151	7,430	2,057	12,301	3,321	41,099	12,001
Value of items that cannot be disclosed: Native asphalt, and values indicated by symbol W	XX	288	XX	16,662	XX	[r] 18,624	XX	20,458
Total	XX	227,950	XX	237,010	XX	[r] 276,238	XX	367,232
MONTANA								
Clays [3]—thousand short tons	53	$56	46	$50	30	$34	34	$63
Coal (bituminous and lignite)—do	419	1,290	371	996	519	1,214	1,030	2,199
Copper (recoverable content of ores, etc.)—short tons	128,061	92,639	65,483	50,063	69,480	58,151	103,314	98,219
Gem stones	NA	109	NA	109	NA	109	NA	109
Gold (recoverable content of ores, etc.)—troy ounces	25,009	875	9,786	343	13,385	[5] 525	24,189	[5] 1,004
Iron ore (usable)—thousand long tons, gross weight	12	93	10	81	12	W	13	W
Lead (recoverable content of ores, etc.)—short tons	4,409	1,333	898	251	1,870	494	1,753	522
Lime—thousand short tons	225	2,116	143	1,765	179	2,005	255	2,737
Manganese ore (35 percent or more Mn)—short tons, gross weight	W	W	W	W	4,649	213	775	26
Manganiferous ore (5 to 35 percent Mn)—do	1,755	28	2,763	16	2,063	22	----------	----------
Natural gas—million cubic feet	30,685	2,547	25,866	2,173	19,313	1,757	41,229	4,205
Petroleum (crude)—thousand 42-gallon barrels	35,380	86,273	34,959	87,543	48,460	124,488	43,954	118,359
Pumice—thousand short tons	22	5	----------	----------	93	327	134	102
Sand and gravel—do	13,816	13,523	12,339	10,655	8,762	7,754	16,595	14,383
Silver (recoverable content of ores, etc.)—thousand troy ounces	5,320	6,878	2,066	3,203	2,133	4,574	3,429	6,141
Stone—thousand short tons	4,150	5,212	4,782	6,037	3,314	4,878	7,667	10,579
Zinc (recoverable content of ores, etc.)—short tons	29,120	8,445	3,341	925	3,778	1,020	6,143	1,794
Value of items that cannot be disclosed: Antimony (1966–67), barite (1966), cement, clays (bentonite), fluorspar, gypsum, natural gas liquids, peat, phosphate rock, talc, tungsten, uranium ore (1966), vermiculite, and values indicated by symbol W	XX	23,846	XX	22,314	XX	20,566	XX	22,189
Total	XX	245,268	XX	186,524	XX	228,131	XX	282,631
NEBRASKA								
Clays—thousand short tons	153	$153	126	$142	148	$206	149	$223
Gem stones	NA	5	NA	5	NA	4	NA	5
Lime—thousand short tons	W	W	W	W	28	W	35	W
Natural gas—million cubic feet	10,196	1,621	8,453	1,454	8,129	1,423	6,989	1,209

Natural gas liquids:								
Natural gasoline—thousand 42-gallon barrels	219	653	186	578	153	456	128	387
LP gases—do	468	1,141	494	1,223	451	911	408	738
Petroleum (crude)—do	13,850	37,673	13,373	36,775	13,183	36,781	12,106	36,075
Sand and gravel—thousand short tons	13,539	14,179	11,739	10,878	r 12,742	r 12,946	12,758	13,592
Stone—do	5,055	7,916	4,846	7,483	4,416	7,435	4,665	9,494
Value of items that cannot be disclosed: Cement, pumice, and values indicated by symbol W	XX	15,180	XX	12,330	XX	14,446	XX	16,307
Total	XX	78,521	XX	70,868	XX	r 74,608	XX	78,030
NEVADA								
Antimony ore and concentrate—short tons, antimony content	68	$63	53	$35	---	---	W	W
Barite—thousand short tons	139	933	154	923	216	$1,511	320	$2,275
Copper (recoverable content of ores, etc.)—short tons	78,720	56,946	50,771	38,815	77,213	64,623	104,924	99,749
Gem stones	NA	100	NA	100	NA	100	NA	100
Gold (recoverable content of ores, etc.)—troy ounces	366,903	12,842	434,993	15,225	317,382	5 12,460	456,294	5 18,941
Gypsum—thousand short tons	594	2,023	409	1,412	552	1,534	521	1,550
Iron ore (usable)—thousand long tons, gross weight	1,000	4,931	641	2,858	569	2,917	W	W
Lead (recoverable content of ores, etc.)—short tons	3,581	1,083	1,500	420	863	228	1,420	423
Mercury—76-pound flasks	3,355	1,482	4,703	2,301	4,780	2,560	8,165	4,124
Perlite—short tons	W	W	10,712	94	9,315	79	8,998	77
Petroleum (crude)—thousand 42-gallon barrels	307	W	279	W	271	W	223	W
Pumice—thousand short tons	55	190	105	236	62	144	83	188
Sand and gravel—do	9,085	9,134	10,166	8,644	7,812	10,442	8,447	10,834
Silver (recoverable content of ores, etc.)—thousand troy ounces	867	1,122	566	877	645	1,384	884	1,583
Stone—thousand short tons	2,002	2,519	1,375	2,145	1,325	2,041	1,494	2,433
Talc and soapstone—short tons	4,715	24	2,096	17	3,029	38	6,434	81
Tungsten ore and concentrate—short tons, 60 percent WO_3 basis	W	W	W	W	25	58	34	69
Zinc (recoverable content of ores, etc.)—short tons	5,827	1,690	3,035	840	2,104	568	941	275
Value of items that cannot be disclosed: Brucite, cement, clays, diatomite, fluorspar, lime, lithium minerals, magnesite, molybdenum, peat (1966–67), pyrites (1969), salt, uranium (1966), and values indicated by symbol W	XX	17,555	XX	15,941	XX	19,354	XX	25,593
Total	XX	112,637	XX	90,883	XX	120,041	XX	168,295
NEW HAMPSHIRE								
Clays—thousand short tons	51	$51	42	$42	41	$41	44	$40
Mica, sheet—pounds	---	---	16,000	W	---	---	---	---
Peat—short tons	175	2	50	(6)	---	---	---	---
Sand and gravel—thousand short tons	7,626	4,807	8,449	5,137	7,742	5,698	6,310	5,149
Stone—do	206	2,091	473	2,887	383	3,377	320	2,888
Value of items that cannot be disclosed: Feldspar, gem stones, mica (scrap 1969), and values indicated by symbol W	XX	49	XX	51	XX	50	XX	43
Total	XX	7,000	XX	8,117	XX	9,166	XX	8,120
NEW JERSEY								
Clays—thousand short tons	488	$1,319	437	$1,189	373	$1,008	327	$1,123
Gem stones	NA	10	NA	10	NA	10	NA	10

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEW JERSEY—Continued								
Peat—short tons	36,312	$489	43,045	$542	55,786	$621	46,367	$551
Sand and gravel—thousand short tons	17,782	29,322	18,626	29,975	20,306	33,570	20,325	33,977
Stone—do	12,453	28,056	12,611	28,253	13,151	30,343	15,162	34,034
Zinc (recoverable content of ores, etc.) [9]—short tons	25,237	7,319	26,041	7,031	25,668	6,930	25,076	7,322
Value of items that cannot be disclosed: Iron ore (1966–67), lime, magnesium compounds, manganiferous residuum, greensand marl, and titanium concentrate	XX	9,080	XX	5,747	XX	4,984	XX	6,090
Total	XX	75,595	XX	72,747	XX	77,466	XX	83,107
NEW MEXICO								
Carbon dioxide, natural—thousand cubic feet	795,885	$58	771,516	$57	749,364	$52	902,186	$69
Clays—thousand short tons	W	W	46	74	66	89	70	89
Coal (bituminous)—do	2,755	9,110	3,463	12,641	3,429	13,507	4,471	16,376
Copper (recoverable content of ores, etc.)—short tons	108,614	78,571	75,008	57,345	90,769	75,968	119,956	114,040
Feldspar—long tons					98	W	W	W
Gem stones	NA	45	NA	60	NA	59	NA	60
Gold (recoverable content of ores, etc.)—troy ounces	9,295	325	5,188	182	6,630	[5] 260	8,952	[5] 372
Gypsum—thousand short tons	146	545	155	588	146	549	141	526
Helium, grade A—thousand cubic feet	95,900	3,357	71,200	2,492	39,100	1,355	13,000	260
Iron ore (usable)—thousand long tons, gross weight	W	W	W	W	17	113	W	W
Lead (recoverable content of ores, etc.)—short tons	1,596	482	1,827	512	1,363	360	2,368	705
Lime—thousand short tons	34	472	17	243	27	377	37	W
Manganese ore (35 percent or more Mn)—short tons, gross weight	W	W	W	W	6,729	W	4,855	131
Manganiferous ore (5 to 35 percent Mn)—do	47,590	324	49,323	348	50,681	379	49,146	340
Natural gas—million cubic feet	998,076	124,760	1,067,510	138,776	1,164,182	156,000	1,138,133	155,924
Natural gas liquids:								
Natural gasoline and cycle products—thousand 42-gallon barrels	8,065	19,736	8,050	20,730	8,868	23,104	9,053	24,388
LP gases—do	19,433	31,832	21,647	40,003	23,802	34,989	24,920	30,402
Peat—short tons					446	4	446	4
Perlite—do	343,334	3,423	346,586	3,424	365,481	3,706	397,987	4,493
Petroleum (crude)—thousand 42-gallon barrels	124,154	352,101	126,144	368,340	128,550	378,708	129,227	404,441
Potassium salts—thousand short tons, K_2O equivalent	2,953	108,653	2,883	91,098	2,289	63,406	2,327	62,034
Pumice—thousand short tons	245	787	220	639	243	527	226	415
Salt—do	66	716	82	1,036	W	W	W	W
Sand and gravel—do	15,503	13,029	14,672	14,336	12,262	12,396	8,574	10,422
Silver (recoverable content of ores, etc.)—thousand troy ounces	243	314	157	244	225	482	466	834
Stone—thousand short tons	2,652	4,056	1,391	2,403	2,226	3,527	2,826	3,286
Uranium (recoverable content U_3O_8)—thousand pounds	9,340	74,721	11,202	89,615	12,282	95,144	11,811	69,887
Vanadium (recoverable in ore and concentrate)—short tons	W	53	W	W	W	W	W	W
Zinc (recoverable content of ores, etc.)—do	29,296	8,496	21,380	5,919	18,686	5,045	24,308	7,098
Value of items that cannot be disclosed: Beryllium (1968–69), cement, fluorspar (1967–69), mica (scrap), molybdenum, tin (1966, 1969) and values indicated by symbol W	XX	20,328	XX	23,001	XX	23,669	XX	29,150
Total	XX	856,294	XX	874,106	XX	893,775	XX	935,746

NEW YORK								
Clays—thousand short tons	1,464	$1,726	1,506	$1,814	1,675	$1,790	1,623	$1,783
Emery—short tons	11,102	210	W	W	W	W	W	W
Gem stones	NA	10	NA	10	NA	10	NA	10
Gypsum—thousand short tons	559	2,998	570	3,118	570	2,925	492	2,945
Lead (recoverable content of ores, etc.)—short tons	1,097	332	1,653	463	1,396	369	1,686	502
Lime—thousand short tons	1,096	9,870	1,139	10,570	1,086	10,154	1,055	10,224
Natural gas—million cubic feet	2,699	837	3,837	1,201	4,632	1,390	4,861	1,458
Peat—short tons	27,211	250	23,053	232	14,888	153	14,352	178
Petroleum (crude)—thousand 42-gallon barrels	1,735	7,925	1,972	9,026	1,532	7,093	1,256	5,683
Salt—thousand short tons	4,980	36,203	5,320	41,568	5,218	42,488	5,582	45,561
Sand and gravel—do	41,903	43,091	43,500	44,499	43,439	45,812	39,806	42,518
Silver (recoverable content of ores, etc.)—thousand troy ounces	22	28	31	48	28	59	32	57
Stone—thousand short tons	34,130	54,543	33,389	56,615	35,441	63,510	37,561	66,839
Zinc (recoverable content of ores, etc.)—short tons	73,454	21,302	70,555	19,534	66,194	17,872	58,728	17,149
Value of items that cannot be disclosed: Cement, abrasive garnet, iron ore, talc, titanium concentrate, wollastonite, and values indicated by symbol W	XX	121,482	XX	110,620	XX	106,011	XX	107,432
Total	XX	300,807	XX	299,318	XX	299,636	XX	302,339
NORTH CAROLINA								
Barite—thousand short tons	----	----	1	$6	W	W	----	----
Clays [3]—do	3,381	$2,241	2,977	2,012	3,310	$2,148	3,342	$2,610
Feldspar—long tons	301,610	3,157	265,690	3,113	316,862	4,340	338,149	4,615
Gem stones	NA	15	NA	25	NA	20	NA	20
Mica:								
Scrap—short tons	63,480	2,348	69,639	1,751	69,054	1,640	67,214	1,513
Sheet—pounds	4,500	1	4,500	W	15,000	W	W	3
Sand and gravel—thousand short tons	11,601	11,132	10,014	9,962	10,771	11,178	10,562	11,437
Stone—do	[4] 22,377	[4] 36,136	24,507	41,488	24,543	42,429	26,812	47,829
Talc and pyrophyllite—short tons	113,366	576	109,393	513	100,030	520	105,728	586
Value of items that cannot be disclosed: Asbestos, cement, clay (kaolin), iron ore (1969), lithium minerals, olivine, phosphate rock (1966–68), stone (crushed and dimension marble 1966, and dimension slate 1966), and values indicated by symbol W	XX	16,272	XX	18,224	XX	20,544	XX	21,844
Total	XX	71,878	XX	77,094	XX	82,819	XX	90,455
NORTH DAKOTA								
Clays—thousand short tons	76	$100	W	W	W	W	W	W
Coal (lignite)—do	3,543	6,976	4,156	$7,967	4,487	$7,986	4,704	$8,696
Gem stones	NA	1	NA	1	NA	1	NA	1
Natural gas—million cubic feet	46,585	7,547	40,462	6,636	41,023	6,769	33,587	5,441
Natural gas liquids:								
Natural gasoline—thousand 42-gallon barrels	552	1,415	554	1,443	558	1,479	508	1,346
LP gases—do	2,188	3,859	2,111	3,901	2,156	3,622	1,951	2,868
Petroleum (crude)—do	27,126	69,170	25,315	65,818	25,040	66,106	22,703	63,568
Sand and gravel—thousand short tons	10,145	10,568	8,822	9,118	10,839	10,159	7,039	7,274

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NORTH DAKOTA—Continued								
Stone—thousand short tons	170	$305	596	$1,092	165	$326	72	$99
Value of items that cannot be disclosed: Lime, molybdenum (1966–67), peat (1966–68), salt, uranium (1966–68), and values indicated by symbol W	XX	2,327	XX	1,562	XX	1,588	XX	1,755
Total	XX	102,268	XX	97,538	XX	98,036	XX	91,048
OHIO								
Cement:								
Portland—thousand 376-pound barrels	15,181	$48,740	14,726	$46,860	15,222	$49,814	15,100	$50,071
Masonry—thousand 280-pound barrels	976	2,785	946	2,730	1,063	3,155	1,123	3,527
Clays—thousand short tons	5,089	14,522	4,670	15,185	4,750	15,216	4,587	11,693
Coal (bituminous)—do	43,341	164,444	46,014	176,921	48,323	191,427	51,242	210,082
Gem stones	NA	3	NA	3	NA	3	NA	3
Lime—thousand short tons	3,858	50,997	3,636	48,817	3,701	49,367	4,159	60,975
Natural gas—million cubic feet	43,133	10,223	41,315	9,957	42,673	10,540	49,793	12,837
Peat—short tons	5,214	84	7,301	100	6,506	94	10,848	116
Petroleum (crude)—thousand 42-gallon barrels	10,899	32,700	9,924	31,427	11,204	35,722	10,972	36,098
Salt—thousand short tons	5,138	35,735	5,407	39,549	5,713	43,172	5,844	43,519
Sand and gravel—do	43,851	52,909	43,196	52,888	46,734	57,671	49,160	63,361
Stone—do	45,002	72,900	45,458	72,534	r 48,054	r 78,772	51,792	86,570
Value of items that cannot be disclosed: Abrasive stone, gypsum, stone (dimension limestone and dolomite, 1968)	XX	1,998	XX	1,917	XX	r 1,945	XX	1,815
Total	XX	488,040	XX	498,888	XX	536,898	XX	580,667
OKLAHOMA								
Clays [8]—thousand short tons	745	$754	744	$869	726	$967	802	$1,182
Coal (bituminous)—do	843	4,935	823	4,703	1,089	6,401	1,838	10,662
Gypsum—do	785	2,212	804	2,266	931	2,565	[7] 980	[7] 3,912
Helium: Grade A—thousand cubic feet	352,400	12,333	309,100	9,835	308,600	8,700	220,500	7,717
Crude—do	----	----	----	----	----	----	132,900	1,123
Lead (recoverable content of ores, etc.)—short tons	2,999	907	2,727	764	2,387	631	605	180
Natural gas—million cubic feet	1,351,225	189,172	1,412,952	202,052	1,390,884	197,506	1,523,715	233,128
Natural gas liquids:								
Natural gasoline and cycle products—thousand 42-gallon barrels	13,717	35,715	13,545	35,846	13,905	38,829	14,621	38,931
LP gases—do	23,482	44,381	23,944	49,276	25,497	39,520	27,304	34,403
Petroleum (crude)—thousand 42-gallon barrels	224,839	654,281	230,749	676,095	223,623	668,202	224,729	701,155
Salt—thousand short tons	W	W	10	76	7	44	9	51
Sand and gravel—do	6,040	7,565	4,540	5,280	5,041	6,288	5,262	7,156
Stone—do	15,334	17,393	16,355	18,932	17,290	21,950	18,799	23,650

Zinc (recoverable content of ores, etc.)—short tons	11,237	3,259	10,670	2,954	6,921	1,869	2,744	801
Value of items that cannot be disclosed: Cement, clay (bentonite), copper, lime, pumice, silver, tripoli, and values indicated by symbol W	XX	24,484	XX	23,178	XX	23,360	XX	26,758
Total	XX	997,391	XX	1,032,126	XX	1,016,832	XX	1,090,809
OREGON								
Clays—thousand short tons	361	$362	[3] 295	[3] $295	[3] 213	[3] $284	215	$321
Diatomite—short tons	W	W	108	2	120	W	85	W
Gem stones	NA	750	NA	750	NA	750	NA	750
Gold (recoverable content of ores, etc.)—troy ounces	281	10	186	7	23	[5] 1	875	[5] 36
Lead—short tons	----	----	----	----	----	----	(6)	(6)
Lime—thousand short tons	116	2,283	99	2,059	120	2,407	115	2,337
Mercury—76-pound flasks	700	309	943	461	938	502	43	22
Nickel (content of ore and concentrate)—short tons	15,036	W	15,287	W	17,294	W	17,056	W
Peat—do	900	17	W	W	360	11	----	----
Perlite—do	W	W	8	(6)	----	----	----	----
Pumice—thousand short tons	714	1,256	834	1,195	725	977	875	1,139
Sand and gravel—do	35,327	34,986	19,630	25,250	18,260	21,457	15,740	20,491
Silver (recoverable content of ores, etc.)—thousand troy ounces	(6)	(6)	(6)	(6)	(6)	1	5	9
Stone—thousand short tons	33,288	48,335	13,201	20,256	14,312	21,168	11,662	18,897
Talc and soapstone—short tons	----	----	W	W	3	1	W	W
Value of items that cannot be disclosed: Cement, clay (fire clay 1967–69), copper (1966, 1968–69), iron ore (pigment material 1966), and values indicated by symbol W	XX	19,176	XX	16,285	XX	16,890	XX	16,162
Total	XX	107,484	XX	66,560	XX	64,449	XX	60,164
PENNSYLVANIA								
Cement:								
Portland—thousand 376-pound barrels	40,004	$114,357	40,197	$114,592	43,018	$123,176	44,893	$126,941
Masonry—thousand 280-pound barrels	2,960	7,860	2,929	7,948	3,151	8,706	3,085	8,504
Clays [3]—thousand short tons	3,293	17,033	2,994	16,703	3,034	17,679	2,727	19,637
Coal:								
Anthracite—do	12,941	100,663	12,256	96,160	11,461	97,245	10,473	100,769
Bituminous—do	81,443	425,168	79,412	419,345	76,200	408,982	78,631	461,579
Copper (recoverable content of ores, etc.)—short tons	3,178	2,299	4,401	3,365	4,850	4,059	3,382	3,215
Gem stones	NA	4	NA	4	NA	4	NA	4
Lime—thousand short tons	1,585	22,816	1,719	24,715	1,702	24,272	2,008	28,952
Natural gas—million cubic feet	90,914	25,820	89,966	25,280	87,987	24,460	79,134	21,841
Natural gas liquids:								
Natural gasoline—thousand 42-gallon barrels	76	186	28	77	27	73	22	61
LP gases—do	44	121	42	114	37	95	35	78
Peat—short tons	52,912	562	39,505	437	35,806	385	34,613	407
Petroleum (crude)—thousand 42-gallon barrels	4,337	19,300	4,387	19,701	4,160	18,698	4,448	20,086
Sand and gravel—thousand short tons	17,567	29,562	17,479	29,614	18,101	31,076	18,105	31,451
Stone—do	59,088	99,233	60,155	103,157	62,812	108,151	66,992	117,726
Zinc (recoverable content of ores, etc.) [9]—short tons	28,080	8,143	35,067	9,468	30,382	8,203	33,035	9,646
Value of items that cannot be disclosed: Clays (kaolin), cobalt, gold, iron ore, scrap mica, pyrites, pyrophyllite, silver, and tripoli	XX	30,281	XX	27,718	XX	28,780	XX	25,470
Total	XX	903,408	XX	898,398	XX	904,044	XX	976,367

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
RHODE ISLAND								
Sand and gravel—thousand short tons	2,276	$2,212	2,334	$2,416	2,291	$2,546	2,480	$3,015
Stone—do	535	1,734	481	1,618	W	W	W	1,417
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	1	XX	1	XX	1,676	XX	1
Total	XX	3,947	XX	4,035	XX	4,222	XX	4,433
SOUTH CAROLINA								
Clays—thousand short tons	2,139	$8,830	1,733	$8,048	1,936	$8,923	2,444	$10,911
Sand and gravel—do	6,016	7,668	5,248	7,178	5,662	8,074	5,692	8,229
Stone—do	8,129	12,510	[4] 8,310	[4] 12,366	8,942	13,717	8,846	13,506
Value of items that cannot be disclosed: Barite (1966), cement, feldspar, kyanite, scrap mica, peat, pyrites, stone (dimension granite 1967), and vermiculite	XX	16,585	XX	20,682	XX	21,144	XX	23,217
Total	XX	45,593	XX	48,274	XX	51,858	XX	55,864
SOUTH DAKOTA								
Beryllium concentrate—short tons, gross weight	124	$40	W	W	75	$35	46	$23
Cement:								
Portland—thousand 376-pound barrels	1,974	6,367	1,406	$4,815	1,826	6,228	1,556	5,715
Masonry—thousand 280-pound barrels	51	170	54	178	54	180	49	181
Clays—thousand short tons	231	870	199	799	226	1,119	187	1,171
Coal (lignite)—do	10	45	5	27				
Feldspar—long tons	53,810	369	61,411	420	39,077	264	29,434	194
Gem stones	NA	20	NA	30	NA	34	NA	36
Gold (recoverable content of ores, etc.)—troy ounces	606,467	21,226	601,785	21,062	593,052	[5] 23,283	593,146	[5] 24,621
Gypsum—thousand short tons	17	68	12	49	16	65	11	46
Lead (recoverable content of ores, etc.)—short tons							1	([6])
Mica, scrap—do	W	W	W	W	W	W	423	20
Petroleum (crude)—thousand 42-gallon barrels	239	479	211	502	187	401	158	362
Sand and gravel—thousand short tons	13,630	13,585	13,463	13,737	11,558	11,578	11,158	10,807
Silver (recoverable content of ores, etc.)—thousand troy ounces	110	142	121	188	138	295	124	223
Stone—thousand short tons	2,186	7,995	1,866	9,694	1,860	9,687	2,092	10,839
Value of items that cannot be disclosed: Columbium-tantalum concentrates (1967, 1969), lime, molybdenum (1966–67), tin (1966, 1969), uranium, vanadium (1966–67), and values indicated by symbol W	XX	1,796	XX	1,117	XX	917	XX	683
Total	XX	53,172	XX	52,618	XX	54,086	XX	54,921

TENNESSEE								
Barite—thousand short tons	29	$412	15	$235	21	$362	16	$295
Cement:								
Portland—thousand 376-pound barrels	8,177	25,718	8,062	25,548	8,488	27,691	9,159	29,403
Masonry—thousand 280-pound barrels	1,095	2,822	1,092	2,992	1,370	3,836	1,331	3,587
Clays—thousand short tons	[3] 1,359	[3] 4,909	1,574	5,152	[3] 1,562	[3] 5,772	[3] 1,719	[3] 7,064
Coal (bituminous)—do	6,309	23,763	6,832	26,974	8,148	29,647	8,082	30,682
Copper (recoverable content of ores, etc.)—short tons	15,410	11,148	14,600	11,162	14,196	11,881	15,353	14,596
Gold (recoverable content of ores, etc.)—troy ounces	141	5	181	6	140	[5] 5	126	[5] 5
Lead (recoverable content of ores, etc.)—short tons	181	55						
Natural gas—million cubic feet			58	11	48	9	57	11
Petroleum (crude)—thousand 42-gallon barrels	7	W	7	W	6	W	32	W
Phosphate rock—thousand short tons	3,125	23,886	2,992	22,571	3,149	23,628	W	W
Sand and gravel—do	8,628	11,142	7,975	10,679	7,344	11,140	6,175	9,709
Silver (recoverable content of ores, etc.)—thousand troy ounces	101	130	130	202	90	192	79	141
Stone [4]—thousand short tons	31,260	41,432	31,463	41,958	32,083	43,854	33,265	46,192
Zinc (recoverable content of ores, etc.)—short tons	103,117	29,904	113,065	31,303	124,039	33,491	124,532	36,363
Value of items that cannot be disclosed: Clay (fuller's earth), lime, pyrites, stone (crushed sandstone (1966–68), dimension sandstone 1967), and values indicated by symbol W	XX	7,258	XX	10,779	XX	9,826	XX	27,402
Total	XX	182,584	XX	189,572	XX	201,334	XX	205,451
TEXAS								
Cement:								
Portland—thousand 376-pound barrels	30,827	$97,188	31,944	$99,329	34,499	$107,532	36,037	$117,989
Masonry—thousand 280-pound barrels	884	2,872	888	2,847	1,059	3,371	1,110	3,873
Clays—thousand short tons	4,516	7,187	4,497	8,081	4,687	8,860	4,407	8,664
Gem stones	NA	150	NA	150	NA	150	NA	150
Gypsum—thousand short tons	899	3,258	984	3,419	1,039	3,616	1,314	4,398
Helium: Crude—thousand cubic feet	1,030,500	10,605	977,600	10,246	1,038,700	11,100	1,190,300	13,053
Grade A—do	364,100	12,744	335,900	9,900	362,100	9,400	140,500	4,917
Lime—thousand short tons	1,473	18,696	1,564	20,713	1,564	21,154	1,633	22,107
Natural gas—million cubic feet	6,953,790	903,993	7,188,900	948,935	7,495,414	1,011,881	7,853,199	1,075,888
Natural gas liquids:								
Natural gasoline and cycle products—thousand 42-gallon barrels	92,625	269,332	95,991	277,105	97,075	269,182	96,628	289,042
LP gases—do	151,425	260,755	177,367	320,326	189,162	278,068	194,599	237,411
Petroleum (crude)—do	1,057,706	3,141,387	1,119,962	3,375,565	1,133,380	3,450,707	1,151,775	3,696,328
Salt—thousand short tons	7,724	33,797	8,344	36,435	8,534	42,663	9,261	43,012
Sand and gravel—do	26,222	31,313	31,398	39,170	31,843	41,546	29,972	39,756
Stone—do	43,578	56,659	49,424	61,577	48,480	58,006	46,638	64,986
Sulfur (Frasch process)—thousand long tons	3,703	96,820	3,448	111,931	2,571	105,482	2,552	68,360
Talc and soapstone—short tons	102,399	367	90,836	356	125,880	517	163,812	668
Value of items that cannot be disclosed: Native asphalt, barite (1966), bromine, coal (lignite), graphite, iron ore, magnesium chloride (for metal), magnesium compounds (except for metal), mercury, perlite (1966–67), pumice, sodium sulfate, uranium, and vermiculite (1967–68)	XX	74,918	XX	80,286	XX	82,596	XX	79,368
Total	XX	5,022,041	XX	5,406,371	XX	5,505,831	XX	5,769,970

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
UTAH								
Carbon dioxide, natural—thousand cubic feet	94,006	$7	65,664	$5	57,747	$4	64,839	$5
Clays [3]—thousand short tons	89	240	114	288	160	476	179	1,286
Coal (bituminous)—do	4,635	26,763	4,175	24,281	4,316	24,893	4,657	29,396
Copper (recoverable content of ores, etc.)—short tons	265,383	191,978	168,609	128,905	228,245	191,027	296,699	282,066
Fluorspar—do	W	W	W	W	8,762	213	6,667	207
Gem stones	NA	75	NA	80	NA	83	NA	85
Gold (recoverable content of ores, etc.)—troy ounces	438,736	15,356	288,350	10,092	334,419	[5] 13,129	433,385	[5] 17,990
Iron ore (usable)—thousand long tons, gross weight	1,956	13,478	1,708	11,916	1,764	11,281	1,921	12,552
Lead (recoverable content of ores, etc.)—short tons	64,124	19,385	53,813	15,068	45,205	11,945	41,332	12,313
Lime—thousand short tons	200	3,640	169	3,182	174	3,439	191	3,947
Natural gas—million cubic feet	69,366	8,809	48,965	6,463	46,151	7,292	46,733	7,197
Petroleum (crude)—thousand 42-gallon barrels	24,112	63,760	24,048	63,221	23,504	62,826	23,295	65,320
Pumice—thousand short tons	W	W	W	W	8	19	10	21
Salt—do	427	3,770	403	3,525	405	3,756	481	4,439
Sand and gravel—do	12,368	12,937	9,412	8,631	10,293	9,364	19,151	16,835
Silver (recoverable content of ores, etc.)—thousand troy ounces	7,755	10,028	4,875	7,556	5,121	10,982	5,954	10,661
Stone—thousand short tons	2,246	4,269	1,831	4,108	1,953	4,312	2,582	4,434
Tungsten concentrates—short tons, 60 percent WO_3 basis			W	W	W	W	3	6
Uranium (recoverable content U_3O_8)—thousand pounds	1,225	9,797	1,287	10,300	1,712	13,175	1,140	6,824
Vanadium (recoverable in ore and concentrate)—short tons	353	1,519	471	2,024	563	2,010	W	W
Zinc (recoverable content of ores, etc.)—do	37,323	10,824	34,251	9,483	33,153	8,951	34,902	10,191
Value of items that cannot be disclosed: Asphalt (gilsonite), cement, clays (fire clay 1966–67, kaolin, 1966–68), gypsum, magnesium compounds molybdenum, natural gas liquids, perlite (1966–67, 1969), phosphate rock, potassium salts, pyrites (1966–68), and values indicated by symbol W	XX	52,243	XX	45,349	XX	44,774	XX	57,507
Total	XX	448,878	XX	354,477	XX	423,951	XX	543,282
VERMONT								
Lime—thousand short tons	W	W	W	W	W	W	2	$25
Peat—short tons	333	$5	280	$4	W	W	180	4
Sand and gravel—thousand short tons	2,323	1,744	3,718	2,178	3,587	$2,806	3,336	3,028
Stone—do	2,650	19,926	2,761	20,520	2,536	21,401	2,151	19,810
Value of items that cannot be disclosed: Asbestos, clays, gem stones, talc, and values indicated by symbol W	XX	4,235	XX	4,566	XX	4,508	XX	4,892
Total	XX	25,910	XX	27,268	XX	28,715	XX	27,759
VIRGINIA								
Clays—thousand short tons	1,486	$1,813	1,382	$1,623	1,462	$1,714	1,677	$1,504
Coal (bituminous)—do	35,565	153,341	36,721	171,183	36,966	178,946	35,555	192,802
Gem stones	NA	7	NA	7	NA	7	NA	7

Lead (recoverable content of ores, etc.)—short tons	3,078	930	3,430	960	3,573	944	3,358	1,000
Lime—thousand short tons	840	10,486	829	10,345	919	11,138	1,072	13,653
Natural gas—million cubic feet	4,249	1,275	3,818	1,149	3,389	1,013	2,846	845
Petroleum (crude)—thousand 42-gallon barrels	1	W	3	W	3	W	1	W
Sand and gravel—thousand short tons	17,191	16,635	9,863	12,494	10,859	13,644	12,140	15,954
Soapstone—short tons	3,989	10	W	W	3,928	10	4,600	12
Stone—thousand short tons	34,151	55,550	31,324	52,470	31,217	53,533	33,461	58,713
Zinc (recoverable content of ores, etc.) [9]—short tons	17,666	5,123	18,846	5,088	19,257	5,199	18,704	5,462
Value of items that cannot be disclosed: Aplite, cement, feldspar, gypsum, iron ore (pigment materials), kyanite, salt, titanium concentrate, and values indicated by symbol W	XX	29,127	XX	28,366	XX	29,515	XX	27,575
Total	XX	274,297	XX	283,685	XX	295,663	XX	317,527

WASHINGTON

Barite—thousand short tons	---	---	(6)	$1	---	---	---	---
Cement:								
Portland—thousand 376-pound barrels	6,820	$24,340	5,614	20,581	6,328	$23,030	6,356	$22,724
Masonry—thousand 280-pound barrels	60	187	65	200	56	175	58	204
Clays [3]—thousand short tons	185	249	139	203	r 255	r 253	230	434
Coal (bituminous)—do	59	514	59	517	178	823	58	480
Copper (recoverable content of ores, etc.)—short tons	34	25	21	16	22	18	18	17
Gem stones	NA	75	NA	75	NA	100	NA	150
Lead (recoverable content of ores, etc.)—short tons	5,859	1,771	2,762	773	5,655	1,494	8,649	2,577
Peat—do	25,599	136	40,608	181	40,440	159	32,684	134
Sand and gravel—thousand short tons	29,002	26,806	28,164	27,520	31,432	27,839	34,245	31,046
Stone—do	13,250	20,273	14,454	19,099	14,331	16,690	15,742	21,069
Talc and soapstone—short tons	3,880	22	4,916	26	W	W	4,228	W
Zinc (recoverable content of ores, etc.)—do	24,772	7,184	21,540	5,964	13,884	3,749	9,738	2,843
Value of items that cannot be disclosed: Carbon dioxide (1966–67), clays (fire clay), diatomite, gold, gypsum, lime, magnesite (1966–68), mercury (1968), olivine, pumice, silver, tungsten (1967), uranium (1966), vanadium (1966), and values indicated by symbol W	XX	7,514	XX	6,911	XX	7,095	XX	6,948
Total	XX	89,096	XX	82,067	XX	r 81,425	XX	88,626

WEST VIRGINIA

Clays [3]—thousand short tons	300	$334	245	$254	193	$219	247	$348
Coal (bituminous)—do	149,681	753,851	153,749	800,683	145,921	r 775,720	141,011	807,811
Lime—do	240	3,492	217	3,099	207	2,848	269	3,648
Natural gas—million cubic feet	211,610	49,940	211,460	50,962	236,971	62,086	231,759	62,575
Petroleum (crude)—thousand 42-gallon barrels	3,674	14,623	3,561	14,244	3,312	13,149	3,104	11,888
Salt—thousand short tons	1,147	5,446	1,127	5,137	1,308	4,971	1,309	4,978
Sand and gravel—do	5,448	11,569	5,827	12,167	5,657	11,900	5,890	12,666
Stone [4]—do	9,738	16,354	9,445	16,447	9,011	16,789	9,031	15,801
Value of items that cannot be disclosed: Calcium-magnesium chloride (1966–67), cement, clay (fire clay), gem stones, natural gas liquids, and stone (dimension sandstone)	XX	36,191	XX	34,865	XX	30,026	XX	28,715
Total	XX	891,800	XX	937,858	XX	917,708	XX	948,430

See footnotes at end of table.

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

Mineral	1966		1967		1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
WISCONSIN								
Clays—thousand short tons	123	$148	89	$112	17	$34	12	$24
Iron ore (usable)—thousand long tons, gross weight	----	----	----	----	----	----	36	W
Lead (recoverable content of ores, etc.)—short tons	1,694	512	1,596	447	1,126	298	1,102	328
Lime—thousand short tons	204	3,186	212	3,414	224	3,620	244	4,080
Peat—short tons	2,379	164	1,823	W	1,902	153	1,761	155
Sand and gravel—thousand short tons	41,523	30,713	42,542	32,955	39,807	30,903	42,815	35,414
Stone—do	16,150	23,735	17,122	24,863	17,000	25,223	18,954	27,571
Zinc (recoverable content of ores, etc.)—short tons	24,775	7,185	28,953	8,016	25,711	6,942	22,901	6,687
Value of items that cannot be disclosed: Abrasive stones, cement, gem stones, and values indicated by symbol W	XX	10,367	XX	9,805	XX	4,522	XX	5,533
Total	XX	76,010	XX	79,612	XX	71,695	XX	79,792
WYOMING								
Clays—thousand short tons	1,559	$15,874	1,495	$14,313	1,828	$17,275	1,992	$18,970
Coal (bituminous)—do	3,670	11,840	3,588	11,876	3,829	12,117	4,602	15,443
Gem stones	NA	120	NA	125	NA	127	NA	129
Iron ore (usable)—thousand long tons, gross weight	1,978	19,700	1,854	19,186	1,967	19,452	2,048	20,751
Lime—thousand short tons	W	W	W	W	28	W	27	W
Natural gas—million cubic feet	243,381	35,290	240,074	35,051	248,481	36,278	303,517	44,617
Natural gas liquids:								
Natural gasoline—thousand 42-gallon barrels	2,295	6,281	2,361	6,447	2,331	6,501	2,523	7,051
LP gases—do	3,954	7,308	4,139	7,648	3,917	7,090	4,428	7,085
Petroleum (crude)—do	134,470	344,243	136,312	351,685	144,250	380,589	154,945	433,846
Sand and gravel—thousand short tons	7,187	7,496	8,181	8,253	9,350	8,973	7,568	7,288
Stone—do	1,393	2,560	1,246	2,375	1,434	2,754	1,584	3,012
Uranium (recoverable content U_3O_8)—thousand pounds	4,593	36,741	4,655	37,243	5,928	44,343	6,716	40,318
Vanadium (recoverable in ore and concentrate)—short tons	W	555	W	W	----	----	----	----
Value of items that cannot be disclosed: Cement, copper (1969), feldspar (1966–68), gold (1969), gypsum, phosphate rock, pumice (1967, 1969), silver (1969), sodium carbonates and sulfates, vermiculite (1967), and values indicated by symbol W	XX	36,379	XX	36,494	XX	40,691	XX	48,932
Total	XX	524,387	XX	530,696	XX	576,190	XX	647,442

r Revised. 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 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] Based on average U.S. Treasury price ($35.00) Jan. 1, 1968 through Mar. 15, 1968; and Engelhard selling quotations Mar. 20, 1968 through 1969.
[6] Less than ½ unit.
[7] Final figure, supersedes figure given in commodity section volume I-II.
[8] Excludes salt in brine, included with "Value of items that cannot be disclosed."
[9] 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.

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

Mineral		1966		1967		1968		1969	
		Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
American Samoa:									
Pumice	thousand short tons	17	$22	28	$24	21	$51	2	$5
Sand and gravel	do	20	18	7	7	20	19	7	7
Stone	do	12	12	28	50	53	79	54	108
Total		XX	52	XX	81	XX	149	XX	120
Canal Zone:									
Sand and gravel	thousand short tons	72	91	56	94	55	77	60	97
Stone (crushed)	do	114	267	100	245	106	290	74	231
Total		XX	358	XX	339	XX	367	XX	328
Guam: Stone	thousand short tons	900	1,396	511	820	560	998	654	1,399
Virgin Islands: Stone (crushed)	do	88	303	183	851	366	1,555	411	1,682
Wake: Stone (crushed)	do	11	66	31	150	41	132	9	45

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Production data for Wake furnished by U.S. Department of Transportation, Federal Aviation Administration; Guam, by the Government of Guam: American Samoa, by the Government of American Samoa.

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

Mineral		1966		1967		1968		1969	
		Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement	thousand 376-pound barrels	7,603	$24,277	8,447	$27,397	8,923	$27,577	8,943	$27,920
Clays	thousand short tons	350	271	291	244	512	481	438	454
Lime	do	30	960	35	1,106	39	1,187	41	1,505
Salt	do	11	183	12	195	32	395	32	395
Sand and gravel	do	9,879	14,554	14,101	21,633	16,146	24,723	9,432	23,296
Stone	do	5,732	10,541	7,269	12,795	7,367	13,580	6,985	13,550
Total		XX	50,786	XX	63,370	XX	67,943	XX	67,120

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	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:				
Aluminum:				
Ingots, slabs, crude—short tons	180,279	$85,855	344,414	$172,137
Scrap—do	49,427	16,017	86,255	33,827
Plates, sheets, bars, etc—do	114,062	77,418	135,707	99,596
Castings and forgings—do	3,527	10,104	4,360	10,473
Antimony: Metals and alloys, crude short tons	109	54	207	216
Bauxite, including bauxite concentrates thousand long tons	7	360	6	456
Aluminum sulfate—short tons	18,252	571	12,274	367
Other aluminum compounds—do	r 931,104	r 80,828	1,038,680	85,850
Beryllium—pounds	93,475	622	28,951	630
Bismuth: Metals and alloys—do	120,466	r 292	447,931	1,515
Cadmium—thousand pounds	530	1,400	1,085	3,254
Chrome:				
Ore and concentrates:				
Exports—thousand short tons	13	517	49	1,915
Reexports—do	126	5,351	150	5,806
Ferrochrome—do	27	5,735	25	5,679
Cobalt—thousand pounds	2,539	4,348	3,257	5,951
Columbium metals, alloys and other forms thousand pounds	8	291	41	601
Copper:				
Ore, concentrate, composition metal and unrefined (copper content) short tons	80,739	58,481	5,517	5,113
Refined copper and semimanufactures short tons	297,992	308,098	236,914	303,386
Other copper manufactures—do	4,669	5,681	4,602	6,160
Copper sulfate or blue vitriol—do	927	718	3,127	2,385
Copper base alloys—do	98,534	98,322	94,803	111,048
Ferroalloys:				
Ferrosilicon—do	18,372	4,481	6,487	1,666
Ferrophosphorous—do	36,708	930	37,351	912
Gold:				
Ore and base bullion—troy ounces	181,385	6,765	58,867	2,434
Bullion, refined—do	23,781,006	832,394	279,434	9,853
Iron ore—thousand long tons	5,884	70,835	5,160	62,310
Iron and steel:				
Pig iron—short tons	10,941	657	43,961	2,647
Iron and steel products (major):				
Semimanufactures—short tons	1,759,527	307,885	4,806,722	641,214
Manufactured steel mill products short tons	700,215	293,775	705,579	322,826
Iron and steel scrap: Ferrous scrap, including rerolling materials short tons	6,692,058	202,849	9,289,608	305,026
Lead:				
Pigs, bars, anodes—short tons	8,281	4,740	4,968	3,913
Scrap—do	937	219	2,340	505
Magnesium:				
Metal and alloys and semimanufactured forms, n.e.c—short tons	19,457	13,049	27,372	17,961
Manganese:				
Ore and concentrate—do	18,500	2,042	19,231	1,627
Ferromanganese—do	3,710	645	1,759	483
Mercury:				
Exports—76-pound flasks	7,496	3,951	507	294
Reexports—do	103	54	108	57
Molybdenum:				
Ore and concentrates (molybdenum content)—thousand pounds	29,006	48,070	57,584	99,055
Metal and alloys, crude and scrap thousand pounds	293	217	21	70
Wire—do	26	551	61	1,083
Semifabricated forms, n.e.c. thousand pounds	118	487	229	682
Powder—do	53	170	782	469
Ferromolybdenum—do	863	1,194	1,455	2,381
Nickel:				
Alloys and scrap (including monel metal), ingots, bars, sheets, etc—short tons	28,555	56,386	29,240	64,420
Catalysts—do	3,340	7,299	3,592	7,531
Nickel-chrome electric resistance wire do	624	2,652	746	3,630
Semifabricated forms, n.e.c—do	1,162	5,336	1,180	6,487

See footnotes at end of table.

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

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued				
Platinum:				
Ore, concentrate, metal and alloys in ingots, bars, sheets, anodes, and other forms, including scrap---troy ounces--	222,998	$30,997	223,569	$30,356
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal) and alloys including scrap---troy ounces--	172,159	18,522	277,495	16,355
Platinum group manufactures, except jewelry----------	NA	2,493	NA	4,310
Rare earths:				
Cerium ore, metal, alloys and lighter flints----------pounds--	89,858	303	103,169	351
Silver:				
Ore and base bullion thousand troy ounces--	23,129	47,549	30,952	53,334
Bullion, refined----------do----	102,632	199,551	57,957	103,386
Tantalum:				
Ore, metal, and other forms thousand pounds--	171	1,899	209	2,652
Powder----------do----	84	2,668	100	2,952
Tin:				
Ingots, pigs, bars, etc.:				
Exports----------long tons--	3,813	12,734	2,362	8,459
Reexports----------do----	682	2,267	541	1,927
Tin scrap and other tin-bearing material except tinplate scrap----------do----	5,128	2,676	5,369	4,825
Titanium:				
Ore and concentrate-------short tons--	4,238	276	1,424	183
Sponge (including iodide titanium and scrap----------short tons--	2,756	1,748	2,802	1,936
Intermediate mill shapes and mill products, n.e.c----------short tons--	1,228	7,575	1,773	9,206
Dioxide and pigments----------do----	30,188	8,227	24,507	7,510
Tungsten: Ore and concentrates:				
Exports----------do----	604	1,705	6,930	19,829
Reexports----------do----	56	117	---------	---------
Vanadium ore and concentrate, pentoxide, etc. (vanadium content)---thousand pounds--	925	1,972	516	1,300
Zinc:				
Slabs, pigs, or blocks-------short tons--	33,011	9,797	9,298	2,612
Sheets, plates, strips, or other forms, n.e.c. short tons--	3,048	2,228	2,714	1,746
Scrap (zinc content)----------do----	2,293	886	1,989	716
Semifabricated forms, n.e.c------do----	15,000	3,840	28,810	6,321
Zirconium:				
Ore and concentrate----------do----	2,026	361	2,698	295
Metals and alloys and other forms pounds--	693,927	8,709	443,462	5,911
Nonmetals:				
Abrasives:				
Dust and powder of precious or semiprecious stones, including diamond dust and powder---thousand carats--	6,015	16,616	8,122	21,599
Crushing bort----------do----	26	168	45	265
Industrial diamonds----------do----	300	1,153	345	1,634
Diamond grinding wheels--------do----	594	3,010	699	3,561
Other natural and artificial, metallic abrasives and products----------	NA	39,319	NA	43,628
Asbestos: Unmanufactured:				
Exports----------short tons--	41,217	4,677	34,522	4,626
Reexports----------do----	19	2	1,651	353
Boron: Boric acid, borates, crude and refined short tons--	r 206,732	20,347	233,650	24,004
Cement----------376-pound barrels--	942	3,884	589	3,189
Clays:				
Kaolin or china clay-------short tons--	r 389,882	12,995	477,674	14,789
Fire clay----------do----	151,940	2,672	162,557	2,621
Other clays----------do----	r 977,569	r 28,466	934,237	28,358
Fluorspar----------do----	12,614	496	3,605	213
Graphite----------do----	4,169	509	5,655	682
Gypsum:				
Crude, crushed or calcined thousand short tons--	39	1,688	40	2,003
Manufactures, n.e.c----------	NA	1,868	NA	1,443
Kyanite and allied minerals-----short tons--	20,477	1,311	19,696	1,353
Lime----------do----	68,915	1,437	51,006	1,153

See footnotes at end of table.

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

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued				
Mica sheet, waste and scrap and ground pounds	27,014,321	$1,408	11,810,008	$1,274
Manufactured do	474,509	1,358	638,830	1,834
Mineral-earth pigments: Iron oxide, natural and manufactured short tons	3,321	1,257	3,992	1,439
Nitrogen compounds (major) thousand short tons	4,042	186,472	3,614	160,039
Phosphate rock do	12,083	104,559	11,369	87,418
Phosphatic fertilizers (superphosphates) thousand short tons	1,289	56,359	847	33,922
Pigments and compounds (lead and zinc):				
Lead pigments short tons	1,877	770	1,688	686
Zinc pigments do	4,940	1,483	4,865	1,641
Potash:				
Fertilizer do	1,302,875	38,353	1,232,636	33,061
Chemical do	33,397	5,114	26,620	4,712
Quartz, natural, quartzite, cryolite and chiolite do	751	168	794	165
Salt:				
Crude and refined thousand short tons	728	4,650	716	4,486
Shipments to noncontiguous Territories thousand short tons	18	1,772	14	1,200
Sodium and sodium compounds:				
Sodium sulfate thousand short tons	56	1,844	91	2,644
Sodium carbonate do	288	9,131	324	10,326
Stone:				
Dolomite, block do	102	1,518	93	1,809
Limestone, crushed, ground, broken thousand short tons	1,297	3,294	1,382	3,189
Marble and other building and monumental thousand cubic feet	NA	849	NA	863
Stone, crushed, ground, broken thousand short tons	292	3,278	284	3,569
Manufactures of stone	NA	1,030	NA	793
Sulfur:				
Crude thousand long tons	1,549	65,650	1,536	56,186
Crushed, ground, flowers of thousand long tons	53	3,855	11	1,495
Talc, crude and ground short tons	65,648	3,521	69,022	3,713
Fuels:				
Carbon black thousand pounds	263,122	28,626	196,203	22,915
Coal:				
Anthracite thousand short tons	518	6,553	627	8,420
Bituminous do	50,637	495,980	56,234	585,452
Briquets do	65	2,698	73	3,952
Coke do	792	18,613	1,629	38,510
Petroleum:				
Crude thousand barrels	1,803	4,452	1,436	3,694
Gasoline do	r 2,083	r 12,519	2,516	10,262
Jet do	r 2,092	r 6,339	1,853	10,525
Naphtha do	r 2,427	r 25,144	2,016	15,402
Kerosine do	r 613	r 5,180	154	1,334
Distillate oil do	r 1,547	r 6,884	1,753	6,626
Residual oil do	20,013	40,746	16,770	34,004
Lubricating oil do	r 18,001	r 207,732	16,397	184,205
Asphalt do	r 429	r 4,571	472	5,003
Liquefied petroleum gases do	r 10,608	r 32,514	12,798	34,292
Wax do	1,588	31,934	1,632	32,724
Coke do	r 19,497	r 68,025	23,061	74,176
Petrochemical feedstocks do	r 2,795	r 15,415	3,848	18,170
Miscellaneous do	r 1,049	r 21,756	921	18,651
Total	XX	4,671,788	XX	4,382,628

r Revised. NA Not available. XX Not applicable.

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

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:				
Aluminum:				
Metal—short tons	685,699	$298,759	468,236	$214,845
Scrap—do	37,521	12,134	28,850	11,003
Plates, sheets, bars, etc—do	62,135	41,816	57,209	38,554
Antimony:				
Ore (antimony content)—do	10,614	4,145	12,098	5,248
Needle or liquated—do	60	42	62	51
Metal—do	2,693	2,037	980	888
Oxide—do	4,801	3,540	4,715	3,852
Arsenic: White (As_2O_3 content)—do	25,195	2,626	18,171	2,064
Bauxite: Crude—thousand long tons	10,976	140,228	12,180	165,802
Beryllium ore—short tons	3,822	1,413	6,422	2,648
Bismuth—pounds	1,265,671	4,718	891,499	3,699
Boron carbide—do	227,486	575	422,133	883
Cadmium:				
Metal—thousand pounds	1,927	4,602	1,078	3,166
Flue dust (cadmium content)—do	1,605	1,796	1,115	1,495
Calcium:				
Metal—pounds	137,251	120	354,370	307
Chloride—short tons	14,069	523	9,226	350
Chromate:				
Ore and concentrates (Cr_2O_3 content) thousand short tons	499	18,189	506	20,030
Ferrochrome—do	41	14,197	42	12,958
Metal—do	1	2,053	1	2,133
Cobalt:				
Metal—thousand pounds	9,219	16,285	12,037	21,725
Oxide (gross weight)—do	1,186	2,113	1,175	2,023
Salts and compounds (gross weight) thousand pounds	107	90	131	67
Columbium ore—do	3,657	2,848	4,161	2,681
Copper: (copper content)				
Ore and concentrates—short tons	71,884	66,291	3,588	3,274
Regulus, black, coarse—do	8	4	6	17
Unrefined, black, blister—do	274,180	224,013	241,712	233,265
Refined in ingots, etc—do	403,630	438,608	131,171	132,573
Old and scrap—do	11,571	12,117	5,889	5,355
Old and clippings—do	2,131	2,042	2,035	2,109
Ferroalloys: Ferrosilicon (silicon content) short tons	10,612	3,207	16,944	4,577
Gold:				
Ore and base bullion—troy ounces	213,662	7,855	236,738	9,064
Bullion—do	5,730,853	218,408	5,624,649	227,842
Iron ore—thousand long tons	43,941	453,753	40,758	402,529
Iron and steel:				
Pig iron—short tons	785,899	r 30,481	406,568	18,513
Iron and steel products (major):				
Iron products—short tons	39,542	9,606	35,012	9,604
Steel products—do	r 17,853,087	r 1,989,377	13,983,804	1,758,171
Scrap—do	276,498	10,784	311,350	12,280
Tinplate—do	17,727	541	23,849	917
Lead:				
Ore, flue dust, matte (lead content) short tons	96,863	18,990	115,286	22,697
Base bullion (lead content)—do	8	4	1,993	699
Pigs and bars (lead content)—do	337,620	81,264	278,873	72,104
Reclaimed, scrap, etc (lead content) short tons	4,249	748	6,682	1,513
Sheets, pipe, and shot—do	893	256	518	174
Babbitt metal and solder (lead content) short tons	566	2,244	667	3,822
Manufactures—do	r 2,138	r 528	1,981	543
Magnesium:				
Metallic and scrap—do	r 4,077	r 2,203	3,515	1,913
Alloys (magnesium content)—do	r 656	r 1,228	467	1,175
Sheets, tubing, ribbons, wire and other forms (magnesium content) short tons	r 40	r 428	14	66
Manganese:				
Ore (35 percent or more manganese) (manganese content)—short tons	870,390	45,264	980,961	39,178
Ferromanganese (manganese content) short tons	r 158,304	r 21,178	234,563	31,708
Mercury:				
Compounds—pounds	33,473	47	46,944	15,499
Metal—76-pound flasks	23,246	11,164	31,924	15,207
Minor metals: Selenium and salts—pounds	582,535	3,076	563,475	3,363

See footnotes at end of table.

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

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued				
Nickel:				
Pigs, ingots, shot, cathodes--short tons--	108,158	$201,312	99,652	$209,468
Scrap--do--	r 1,974	r 2,575	3,188	8,084
Oxide--do--	6,388	8,911	4,013	6,524
Platinum group:				
Unwrought:				
Grains and nuggets (platinum) troy ounces--	r 64,972	r 10,223	67,560	9,741
Sponge (platinum)--do--	r 303,562	r 36,991	272,794	33,665
Sweepings, waste and scrap--do--	r 54,695	3,861	127,053	5,422
Iridium--do--	5,503	1,018	5,938	1,027
Palladium--do--	r 1,068,400	r 46,547	249,389	10,704
Rhodium--do--	41,026	8,868	38,077	8,615
Ruthenium--do--	r 13,162	454	7,566	391
Other platinum group metals--do--	21,722	3,593	11,602	1,696
Semimanufactured:				
Platinum--do--	68,677	8,172	58,249	8,018
Palladium--do--	96,916	4,244	382,583	14,280
Rhodium--do--	29,990	1,492	3,387	444
Other platinum group metals--do--	5,359	229	1,453	190
Radium: Radioactive substitutes	NA	3,241	NA	4,697
Rare earths: Ferrocerium and other cerium alloys--pounds--	23,003	77	17,328	91
Silver:				
Ore and base bullion thousand troy ounces--	28,786	49,587	32,332	48,115
Bullion--do--	41,923	88,213	39,544	71,247
Tantalum ore--thousand pounds--	1,230	4,164	975	3,196
Tin:				
Ore (tin content)--long tons--	2,282	5,287	---------	---------
Blocks, pigs, grains, etc--do--	57,358	181,940	54,950	185,037
Dross, skimmings, scrap, residues and tin alloys, n.s.p.f--long tons--	487	532	948	1,052
Tin foil, powder, flitters, etc	NA	2,742	NA	3,458
Titanium:				
Ilmenite--short tons--	246,109	5,167	316,574	3,907
Rutile--do--	174,366	12,653	204,907	16,207
Metal--pounds--	7,610,236	8,148	13,211,214	11,712
Ferrotitanium--do--	398,923	143	1,103,148	259
Compounds and mixtures--do--	111,080,989	19,618	111,219,610	19,220
Tungsten: (tungsten content)				
Ore and concentrate--thousand pounds--	1,743	3,272	1,503	3,445
Metal--do--	33	356	36	466
Other alloys--do--	22,951	120	20,436	139
Zinc:				
Ore (zinc content)--short tons--	r 484,803	r 68,971	565,234	79,242
Blocks, pigs, and slabs--do--	306,651	76,035	327,849	85,097
Sheets--do--	754	290	966	418
Old, dross, and skimmings--do--	1,459	182	2,486	322
Dust--do--	8,100	2,443	8,251	2,652
Manufactures	NA	447	NA	511
Zirconium: Ore, including zirconium sand short tons--	59,900	2,014	95,414	3,858
Nonmetals:				
Abrasives: Diamonds (industrial) thousand carats--	r 13,686	r 60,302	14,076	52,821
Asbestos--short tons--	737,909	72,930	694,558	76,422
Barite:				
Crude and ground--do--	662,705	5,666	616,573	5,783
Witherite--do--	r 2,054	r 76	459	22
Chemicals--do--	5,977	843	6,661	1,113
Cement--thousand 376-pound barrels--	r 7,289	r 17,378	9,687	24,376
Clays:				
Raw--short tons--	91,205	1,709	76,698	1,541
Manufactured--do--	6,177	242	5,190	209
Cryolite--do--	33,772	5,455	20,406	4,251
Feldspar: Crude--long tons--	---------	---------	46	7
Fluorspar--short tons--	1,050,107	28,699	1,149,546	32,818
Gem stones:				
Diamonds--thousand carats--	4,348	475,131	4,690	504,647
Emeralds--do--	365	10,644	309	9,175
Other	NA	51,418	NA	52,871
Graphite--short tons--	67,922	2,494	58,479	2,419
Gypsum:				
Crude, ground, calcined thousand short tons--	5,476	11,473	5,860	12,481
Manufactures	NA	1,585	NA	2,041
Iodine, crude--thousand pounds--	5,883	5,594	5,705	5,753
Kyanite--short tons--	1,450	51	2,088	88

See footnotes at end of table.

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

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued				
Lime:				
Hydrated short tons	873	$21	39,270	$542
Other do	71,632	877	144,471	1,911
Dead-burned dolomite [1] do	33,498	1,552	10,780	568
Magnesium:				
Magnesite do	131,640	8,489	113,369	7,464
Compounds do	49,344	1,326	48,719	1,251
Mica:				
Uncut sheet and punch thousand pounds	1,491	1,539	1,601	1,695
Scrap do	r 3,157	77	3,078	74
Manufactures do	5,293	3,373	5,520	3,060
Mineral-earth pigments: Iron oxide pigments:				
Natural short tons	4,442	253	2,736	225
Synthetic do	18,596	3,455	22,555	4,390
Ocher, crude and refined do	126	8	87	6
Siennas, crude and refined do	1,464	173	1,341	146
Umber, crude and refined do	4,671	178	6,240	235
Vandyke do	589	50	472	42
Nitrogen compounds (major), including urea thousand short tons	1,652	82,221	1,779	87,913
Phosphate, crude do	116	2,679	140	3,554
Phosphatic fertilizers do	44	2,222	83	3,976
Pigments and salts:				
Lead pigments and compounds short tons	32,004	6,950	32,473	7,984
Zinc pigments and compounds do	20,838	4,152	23,518	4,476
Potash do	r 3,658,158	r 78,077	3,978,363	67,034
Pumice:				
Crude or unmanufactured do	9,436	69	8,424	81
Wholly or partly manufactured do	302,240	736	375,861	819
Manufactures, n.s.p.f	NA	17	NA	61
Quartz crystal (Brazillian pebble) pounds	1,180,153	607	1,291,003	477
Salt thousand short tons	3,456	11,487	3,302	11,990
Sand and gravel:				
Glass sand do	25	144	43	194
Other sand and gravel do	729	984	854	1,253
Sodium sulfate do	305	5,108	286	4,808
Stone and whiting	NA	r 24,629	NA	29,306
Strontium: Mineral short tons	12,896	290	27,803	595
Sulfur and pyrites:				
Sulfur, ores and other forms, n.e.s. thousand long tons	1,572	64,277	1,674	57,222
Pyrites do	13	68	99	322
Talc: Unmanufactured short tons	24,313	973	20,358	749
Fuels:				
Carbon black:				
Acetylene pounds	5,343,923	915	7,097,186	1,220
Gas black and carbon black do	2,351,312	173	1,129,280	165
Coal:				
Bituminous, slack, culm and lignite short tons	224,394	1,900	108,914	1,081
Briquets do	2,891	44	1,351	18
Coke do	94,085	1,904	173,052	3,354
Peat:				
Fertilizer grade do	285,875	12,716	297,364	13,631
Poultry and stable grade do	1,725	100	2,633	121
Petroleum:				
Crude oil thousand barrels	472,323	1,067,450	513,849	1,120,191
Gasoline do	21,591	81,614	22,709	87,203
Special naphtha do	1,399	3,442	3,191	8,233
Kerosine do	190	568	965	2,567
Distillate fuel oil do	r 67,234	r 199,600	78,275	223,867
Residual fuel oil do	r 409,928	r 807,578	461,611	987,848
Military jet fuel do	7,117	21,066	5,134	15,813
Commercial jet fuel do	r 31,390	r 95,112	40,405	124,447
Liquefied gases do	11,647	19,916	12,651	20,373
Asphalt do	6,236	13,096	4,761	10,284
Unfinished oil do	29,350	71,321	38,008	87,798
Lubricants do	33	533	163	1,535
Wax do	17	74	158	799
Petrochemical feed stocks do	---	---	40	106
Total	XX	r 8,562,563	XX	8,212,755

r Revised. NA Not available. XX Not applicable.
[1] Dead-burned basic refractory material consisting chiefly of magnesia and lime.

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

Mineral	1968			1969 p		
	World r [1]	United States		World [1]	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	5,144,207	2,811,806	55	5,585,639	2,963,261	53
Coal:						
Bituminous	2,078,608	540,428	26	2,139,111	555,493	26
Lignite	811,037	4,817	1	832,677	5,012	1
Pennsylvania anthracite	202,032	11,461	6	199,602	10,473	5
Coke (excluding breeze):						
Gashouse [3]	17,975	174	1	16,755	NA	NA
Oven and beehive	346,832	63,653	18	333,747	64,757	19
Natural gas (marketable)—million cubic feet	31,071,657	19,322,400	62	33,999,154	20,698,240	61
Peat	208,423	619	(2)	218,584	572	(2)
Petroleum (crude)—thousand barrels	14,104,250	3,329,042	24	15,220,221	3,371,751	22
Nonmetals:						
Asbestos	3,290	121	4	NA	126	NA
Barite	4,017	[4] 927	23	4,188	1,077	26
Cement—thousand 376-pound barrels	3,009,950	[5] 412,273	14	3,168,951	[5] 416,889	13
China clay	12,836	[6] 4,201	33	NA	[6] 4,739	NA
Corundum	7	----------	--------	7	----------	--------
Diamonds—thousand carats	10,481	----------	--------	11,156	----------	--------
Diatomite	1,650	[7] 627	38	1,554	598	38
Feldspar—thousand long tons	2,170	668	31	2,267	674	30
Fluorspar	3,906	252	6	4,174	183	4
Graphite	481	W	NA	341	W	NA
Gypsum	53,443	10,018	19	55,195	9,881	18
Lime (sold or used by producers)	93,259	18,637	20	97,591	20,209	21
Magnesite	11,656	W	NA	12,027	W	NA
Mica (including scrap)—thousand pounds	343,468	250,661	73	363,358	266,115	73
Nitrogen, agricultural [8]	27,872	6,872	25	30,582	6,985	23
Phosphate rock	92,500	41,251	45	NA	37,725	NA
Potash (K_2O equivalent)	17,856	2,722	15	18,311	2,804	15
Pumice [9]	14,957	3,530	24	14,613	3,609	25
Pyrites—thousand long tons	22,114	872	4	21,748	W	NA
Salt	139,248	[5] 28,813	21	147,571	[5] 30,848	21
Strontium [9]	14	----------	--------	30	----------	--------
Sulfur, elemental—thousand long tons	18,619	8,814	47	19,655	8,560	44
Talc, pyrophyllite, and soapstone	4,866	958	20	5,015	1,029	21
Vermiculite [9]	419	290	69	463	310	67
Metals, mine basis:						
Antimony (content of ore and concentrate)—short tons	67,737	856	1	72,059	938	1
Arsenic, white [9]	66	W	NA	57	W	NA
Bauxite—thousand long tons	45,221	[10] 1,665	4	51,113	[10] 1,843	4
Beryllium concentrate—short tons	7,219	168	2	7,926	W	NA
Bismuth—thousand pounds	8,076	W	NA	8,465	W	NA
Cadmium—do	32,354	[11] 10,651	33	37,587	[11] 12,646	34
Chromite	5,336	----------	--------	5,635	----------	--------

Cobalt (contained)	r 23	W	NA	22	W	NA
Columbium-tantalum concentrates [9] thousand pounds	19,844	W	NA	29,192	W	NA
Copper (content of ore and concentrate)	6,024	[12] 1,205	20	6,645	[12] 1,545	23
Gold thousand troy ounces	46,154	1,478	3	46,418	1,733	4
Iron ore thousand long tons	674,440	[13] 85,865	13	712,406	[13] 88,260	12
Lead (content of ore and concentrate)	3,299	[12] 359	10	3,523	[12] 509	14
Manganese ore (35 percent or more Mn)	18,727	11	(2)	19,864	6	(2)
Mercury thousand 76-pound flasks	258	29	11	285	29	10
Molybdenum (content of ore and concentrate) thousand pounds	125,735	93,447	74	142,802	99,807	70
Nickel (content of ore and concentrate)	546	15	3	530	16	3
Platinum groups (Pt., Pd., etc.) thousand troy ounces	3,394	15	(2)	3,387	22	(2)
Silver do	275,075	32,729	12	288,601	41,906	15
Tin (content of ore and concentrate) long tons	227,935	W	NA	223,609	W	NA
Titanium concentrates:						
Ilmenite [9]	3,261	979	30	3,531	931	26
Rutile [9]	339	W	NA	414	----------	NA
Tungsten concentrate (contained tungsten) short tons	35,212	5,094	14	36,030	4,702	13
Vanadium (content of ore and concentrate) [9] do	11,799	6,483	55	11,349	5,577	49
Zinc (content of ore and concentrate)	5,499	529	10	5,827	553	9
Metals, smelter basis:						
Aluminum	8,875	3,255	37	10,019	3,793	38
Copper	6,804	[14] 1,351	20	7,304	[14] 1,585	21
Iron, pig (including ferroalloys)	425,424	91,388	21	459,697	97,593	21
Lead	3,331	[15] 467	14	3,671	[15] 639	17
Magnesium short tons	212,663	98,375	46	212,649	99,886	45
Selenium [9] thousand pounds	2,012	633	31	2,759	1,229	45
Steel ingots and castings	583,626	[16] 131,462	23	633,431	[16] 141,262	22
Tellurium [9] thousand pounds	258	121	47	427	234	55
Tin [17] long tons	230,768	[18] 3,453	1	224,458	345	(2)
Uranium oxide (U_3O_8) [9] short tons	22,772	12,338	54	21,632	10,934	51
Zinc	5,125	1,021	20	5,586	1,041	19

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

[1] Total is not strictly comparable with previous years as it does not represent total world production. Confidential U.S. data are excluded. The data includes reported figures and reasonable estimates in some instances where data were not available, no reasonable estimate could be made and none has been included except for gold, silver, and pyrites.

[2] Less than ½ unit.

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

[4] Sold or used by producers.

[5] Includes Puerto Rico.

[6] Kaolin sold or used by producers.

[7] Average annual production from the appropriate 3-year totals, 1966–68.

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

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

[10] Dry bauxite equivalent of crude ore.

[11] Includes secondary.

[12] Recoverable.

[13] Iron-nickel ore.

[14] Smelter output from domestic and foreign ores, exclusive of scrap. Production from domestic ores only, exclusive of scrap, was as follow: 1968, 1,233,951; 1969, 1,547,494.

[15] Lead refined from domestic and foreign ores, excludes lead refined from imported base bullion.

[16] Data from American Iron and Steel Institute. Excludes production of castings by companies that do not produce steel ingots.

[17] Includes tin content of alloys made directly from ores.

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

Injury Experience and Worktime in the Mineral Industries by States

By Forrest T. Moyer [1]

The safety record for all mineral mining and processing industries in 1969 showed an improvement in fatality experience but a worsening in nonfatal-injury experience. The composite frequency rate for all injuries was 3 percent worse and the injury-severity rate was 11 percent better than in 1968. Overall operating activity, as gaged by man-hours of worktime, was slightly lower in 1969.

These data comprise the injury and work experience of all personnel engaged in production, exploration, development, maintenance, repair, and force-account construction work, including supervisory and technical personnel, and working partners and owners at mineral-producing and mineral-processing establishments in the United States. Data concerning officeworkers are excluded except for the oil and gas industry for which such information is not separable. All injury rates and totals are calculated from data before rounding. The data for 1969 are preliminary except for the coke, oil and natural gas, native asphalt, peat, and slag industries, which are final. The figures represent full coverage for all industries except oil and gas for which coverage is not complete, particularly with respect to small companies.

Injury and worktime data were collected from coal producers as required by the Federal Coal Mine Safety Act as Amended (30 U.S. Code, secs. 455-482, Supp. III (1968)). Similar information was collected as required by the Federal Metal and Nonmetallic Mine Safety Act (30 U.S. Code, secs. 721-740, Supp. III (1968)) from metal, nonmetal, stone, and sand and gravel producers. Mineral and mineral fuel producers and processors, not covered under either of the acts, voluntarily reported the requested injury and worktime data.

Information on the major mineral-industry segments in this chapter is broken down to specific component industries in a companion chapter in Volume I-II of the Minerals Yearbook.

INJURY EXPERIENCE

The composite rate of occurrence of 17.32 disabling work injuries per million man-hours for all mineral industries in 1969 comprised frequencies of 0.27 for fatal and 17.05 for nonfatal injuries. The fatality rate was improved by 16 percent from that of 0.32 in 1968. For nonfatal injuries the rate of occurrence worsened by 4 percent from that of 16.44 in 1968.

The injury-severity rate of 2,427 days lost per million man-hours of worktime was better than that of 2,741 in 1968, owing primarily to the lower number of fatalities. The total of 510 work fatalities in 1969 was 97 less than in 1968. This improvement in fatality experience resulted principally from the absence of major disasters (a single accident which results in the death of five men or more) throughout 1969. In 1968, there were three major disasters with a total of 108 work fatalities; a shaft fire at a Louisiana salt mine resulted in 21 deaths, a dust explosion at a Kentucky coal mine caused nine fatalities, and a gas and dust explosion at a West Virginia coal mine resulted in 78 deaths.

[1] Chief, Office of Accident Analysis.

Nonfatal injuries for all mineral mining and processing industries totaled 32,125 in 1969 or 871 more than in the preceding year. This higher number of injuries coupled with the slightly lower worktime resulted in the worsened frequency rate for nonfatal injuries in 1969.

Industry Data.—The safety records of the separate mineral industries displayed varying trends in 1969, as shown in the summary section at the end of table 1.

The safety record of the coal mining industry improved appreciably in fatality experience but worsened slightly in nonfatal injury experience. Work fatalities in 1969 totaled 203 and occurred at a frequency rate of 0.85 per million man-hours; both are record annual low points in statistical history. The previous low records were 222 fatal injuries in 1967 and 0.90 fatality per million man-hours in 1950 and 1953. Fatality experience for the preceeding year, 1968, was 311 deaths at a frequency rate of 1.33. The better fatality record in 1969 resulted from the improved experience at bituminous coal and lignite mines, which more than offset the sharply worsened record at anthracite mines. There were no major disasters in 1969, whereas in 1968 two major disasters in bituminous coal mines claimed 87 lives. As a result of the improved fatality experience in 1969, the severity rate for all injuries was lowered appreciably to 7,309 days lost per million man-hours in 1969. The total of 9,800 nonfatal injuries was 161 higher than in 1968; as a result, the frequency rate for these injuries advanced slightly to 41.21 compared with 41.12 in 1968.

All general measures of safety performance for the metal mining and milling industry worsened in 1969. The totals of 68 fatal and 3,730 nonfatal injuries were respectively nine and 355 higher than in 1968. The frequency rates of 0.43 for fatal and 23.50 for nonfatal injuries and the severity rate of 3,760 for all injuries all compared unfavorably with the corresponding figures for 1968.

The overall safety record for the nonmetal (all nonmetals except stone and sand and gravel) mining and milling industry was improved in all respects during 1969. The totals of 27 fatal and 2,360 nonfatal injuries were respectively 12 and 112 below the corresponding figures for 1968. There was marked improvement in the fatality frequency rate, 0.28, and the severity rate of 2,615 for all injuries in 1969. The nonfatal-injury frequency rate of 24.16 was slightly better than in 1968. There were no major disasters in 1969, but in 1968 there was one which claimed 21 lives in a salt mine.

The total of 31 fatal injuries at sand and gravel plants, five more than in 1968, resulted in a worsened fatality-frequency rate of 0.33 and an overall injury-severity rate of 3,025 in 1969. For nonfatal injuries, both the total of 1,930 and the frequency of 20,49 per million manhours were slightly better than in 1968.

Fatality experience was improved, but the nonfatal injury record worsened at stone quarries in 1969. Fatalities totaled 53, or five less, than in 1968, and this reduction resulted in a lower severity rate of 2,635 for all injuries in 1969. The total of 3,390 nonfatal injuries was 130 more than in 1968, and the frequency rate for these injuries increased to 18.13 in 1969.

The totals of 95 fatal and 9,023 nonfatal injuries in the oil and gas industries during 1969 were, respectively, seven and 46 less than in 1968. However, owing to a larger proportional decline in worktime, the frequency rate for fatalities was unchanged and for nonfatal injuries was slightly higher than in 1968. The injury-severity rate of 983 was virtually the same as in 1968.

Injury experience in the coal-coking industry worsened appreciably in 1969. There were 15 fatal and 231 nonfatal injuries, respectively eight and 27 more than in 1968. As a result, the frequency rate of all injuries increased to 6.39 per million man-hours and the severity rate to 2,533 days lost per million man-hours.

All measures of injury experience at nonferrous smelting, reducing, and refining plants worsened appreciably in 1969. There were 15 fatal and 1,565 nonfatal injuries compared with four and 1,155, respectively, in 1968. The frequency rate of 12.61 for all injuries in 1969 was 19 percent higher and the severity rate of 1,293 was 78 percent higher than in 1968.

Mine Data.—The fatality record for all mines (excluding the milling activities) was appreciably better in 1969, but nonfatal-injury experience showed little change from 1968. The total fatalities, 344, were 117 fewer than in 1968, owing primarily to

the absence of major disasters in 1969. As a result, the frequency rate for fatal injuries was improved to 0.65, and the severity rate for all injuries was lowered to 5,551 in 1969. Nonfatal injuries increased by 289 to a total of 16,755 in 1969, but the frequency rate for these injuries, 31.77, was the same as in 1968, owing to the increased man-hours worked.

At all underground mines (including the associated surface shops and yards), the total of 227 fatal injuries with a frequency rate of 0.92 was appreciably better than the 1968 record of 351 fatalities with a frequency of 1.44. In 1969, there were no major disasters, whereas in 1968, there were three with a total loss of 108 lives. Because of the improved fatality experience, the severity rate for all injuries was reduced to 7,947 in 1969 from 11,358 in 1968. The total of 11,265 nonfatal injuries was 278 higher than in 1968, and the frequency rate for these injuries increased slightly to 45.59 in 1969.

At all surface mining operations, each general measure of injury experience worsened in 1969 except the frequency rate of nonfatal injuries in which there was a slight improvement. The totals of 117 fatal and 5,490 nonfatal injuries were respectively seven and 11 higher than in 1968. The fatality frequency rate of 0.42 and the severity rate of 3,439 were slightly higher than the corresponding data for 1968. The nonfatal-injury frequency rate of 19.58 was slightly better than in 1968, owing to the increased worktime which more than offset the larger number of these injuries in 1969.

Mill Data.—All general measures of safety performance in the total mineral milling, processing, and cleaning activities worsened in 1969. The totals of 38 fatal and 4,500 nonfatal injuries were respectively six and 197 higher in 1968. Similarly, the frequency rates of 0.15 for fatal and 18.02 for nonfatal injuries and the overall severity rate of 1,766 were higher than the corresponding data for 1968.

State Data.—The mineral industries of Idaho, in which metal mining is dominant, had the highest injury-frequency rate of these industries in any State during 1969. The rate of 55.68 injuries per million man-hours represented a marked retrogression from that of 46.42 in 1968. Mineral mines and processing or cleaning plants in West Virginia, where coal mining predominates, ranked second highest in injury frequency with a rate of 53.85 in 1969. In Virginia and Kentucky, the mineral industries had respective frequency rates of 43.42 and 42.97, the third and fourth highest of any State.

Mineral mines and processing plants in Idaho in 1969 had a higher injury-severity rate, 9,110 days lost per million man-hours, than these industries in any other State. The next highest injury-severity rates in 1969 were for the mineral operations in West Virginia (8,725), Colorado (8,140), and North Dakota (7,954).

The mineral industries of West Virginia had a higher total of work fatalities, 70, in 1969 than these industries in any other State. States ranking next in number of mineral industry fatalities during 1969 were Pennsylvania (43), Kentucky (40), Ohio (25), and Virginia (22).. States ranked by number of nonfatal injuries in mines and processing plants during 1969 were West Virginia (3,942), Pennsylvania (1,904), Kentucky (1,770), Virginia (1,253), and Illinois (1,017).

Of the States with major mineral industry activity (more than 10 million man-hours of worktime) in 1969, mines and plants had the lowest injury-frequency rates in Minnesota (8.81), Alabama (12.41), Florida (12.97), Louisiana (16.92), and Arizona (18.25). The most favorable injury-severity rates were for the mineral industries in Minnesota (1,023), New York (1,489), Texas (1,955), Indiana (2,050), and Arkansas (2,058).

In 1969, the relative size of the mineral mining and milling activity in the ranking States, as measured by worktime in millions of man-hours, was as follows: Pennsylvania (78.8), West Virginia (74.5), Kentucky (42.1), Ohio (37.8), and Californian (35.6). States with the largest number of man-hours worked (in millions) within the major groupings of the mineral industries were as follows: Coal, West Virginia (71.3); metal, Arizona (30.4); nonmetal, California (9.9); stone, Pennsylvania (18.7); and sand and gravel, California (10.5).

ACTIVE OPERATIONS

The active mineral-extractive and processing establishments in the United States during 1968 are shown in table 1 by States for each of the general groupings except the oil and gas industries. Similiar data for 1969 are not yet available.

Producers and processors of minerals reported 25,874 active mines, quarries, pits, dredges, brine, well, and other types of mineral-extractive operations in 1968. The largest numbers of mining establishments were in Pennsylvania (1,906), Kentucky (1,698), West Virginia (1,501), and California (1,495). Active mineral cleaning and processing plants totaled 5,469 in 1968.

WORKTIME AND WORK STOPPAGES

Total worktime of 1,884 million man-hours in the mineral industries during 1969 was slightly lower than in 1968.

A total of 531 work stoppages in the mineral industries during 1969 resulted in a time loss of nearly 2.4 million man-days of work, according to the Bureau of Labor Statistics, U.S. Department of Labor. In bituminous coal and lignite mining there were 457 stoppages during the year with a time loss of 900,600 man-days. In the refining department of the oil industry, 16 stoppages caused a loss of 992,700 man-days. Other mineral industries with appreciable loss of time from stoppages in 1969 were the copper mining, primary nonferrous smelting and refining, and cement industries (details in table 3).

SAFETY COMPETITIONS

The annual safety competitions conducted by the Bureau of Mines have been recognized as effective tools to promote accident-prevention work in the mineral industries. They are used at the enrolled operations to arouse and maintain the interest of employees in daily safe working practices as well as to provide recognition for outstanding work in safety. A total of 1,414 mineral operations participated in these contests during 1969.

In 1969, a total of 927 mines, open pits, and quarries competed in the 45th National Safety Competition (the "Sentinels of Safety" contest) cosponsored by the Bureau and the American Mining Congress. Of the participants, 410, or 44 percent of the total, operated throughout 1969 without a disabling work injury. The aggregate worktime of these injury-free plants was 30.0 million man-hours, or 19 percent of the total man-hours of exposure at all enrolled operations. The National Safety Competition comprises six groupings of plants so as to assure equality of competition among operations with relatively similar working conditions. The winning operation in each group is awarded the "Sentinels of Safety" trophy and a plant flag. In addition, each employee and official at the winning plant receives a personal "Certificate of Accomplishment in Safety" from the Bureau in recognition of his daily contribution to the winning record.

The following operations won the "Sentinels of Safety" trophies in each of the six competing groups for being worked the largest number of injury-free man-hours through 1969:

Underground Coal Mines.—No. 7 South Main mine, United States Steel Corp., Lynch District, Lynch, Ky., 367,894 man-hours.

Surface Coal Mines.—Sandow strip mine, Industrial Generating Co., Rockdale, Tex., 250,768 man-hours.

Underground Metal Mines.—Flat Gap mine, New Jersey Zinc Co., Treadway, Tenn., 281,847 man-hours.

Underground Nonmetal Mines.—Carlsbad Potash Properties, Duval Corp., Carlsbad, N. Mex., 613,615 man-hours.

Open-Pit Mines (Metal and Nonmetal).—Santa Rita mine, Kennecott Copper Corp., Chino Mines Division, Santa Rita, N. Mex., 1,099,799 man-hours.

Stone Quarries.—Calcite quarry, United States Steel Corp., Michigan Limestone Operations, Rogers City, Mich., 1,199,003 man-hours.

A total of 261 operations participated in the National Sand and Gravel Safety Com-

petition sponsored by the Bureau. There were 157 injury-free plants, 60 percent of the total number enrolled in the 1969 contest. These plants were operated 5.9 million man-hours without injuries, or 45 percent of the total worktime of all participating operations.

The following plants won top safety honors for injury-free records in 1969 in the bank or pit and the dredge groups into which the contest is divided:

Bank or pit.—Martin pit, Silver Hill Sand and Gravel Company, Silver Hill, Md., 424,844 man-hours.

Dredge.—Curry Street plant, Glacier Sand and Gravel Company, Portland, Oreg., 231,429 man-hours.

Three other annual safety competitions cosponsored with the Bureau by the National Lime Association, the National Limestone Institute, and the National Slag Association were conducted in 1969. A total of 226 operations were enrolled in these contests. Of these, 102 plants, 45 percent of all participants, had no disabling work injuries throughout 1969. The injury-free plants were operated 6.6 million man-hours, or 32 percent of the total worktime at all enrolled operations.

Table 1.—Worktime 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-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1968	
							Fatal		Nonfatal		Frequency		Severity			
	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	Mines	Mills
Alabama:																
Coal	4,866	4,925	1,064	1,106	8,503	8,813	9	5	123	100	15.52	11.91	7,351	3,892	146	19
Metal	929	1,140	284	270	2,338	2,210	------	1	22	20	9.41	9.50	1,011	3,323	20	5
Nonmetal and native asphalt	719	825	196	209	1,600	1,678	------	------	23	20	14.38	11.92	341	101	37	25
Sand and gravel	519	585	144	151	1,276	1,325	1	------	19	20	15.68	15.10	4,953	264	65	------
Stone	2,525	2,505	716	699	5,890	5,722	2	1	60	78	10.53	13.81	2,574	2,337	58	57
Total or average	9,558	9,985	2,405	2,435	19,606	19,749	12	7	247	238	13.21	12.41	4,432	2,812	326	106
Alaska:																
Coal and peat [2]	107	110	23	25	202	213	------	------	19	17	94.03	79.82	1,821	1,517	5	2
Metal	237	200	30	29	260	256	1	------	7	7	30.80	27.33	27,089	437	83	2
Nonmetal	18	15	3	3	25	20	1	------	2	------	118.18	------	237,975	------	1	1
Sand and gravel	685	885	133	145	1,181	1,157	------	------	28	26	23.71	22.47	522	521	75	------
Stone	113	135	14	22	115	197	------	------	2	3	17.34	15.24	564	437	27	25
Total or average	1,160	1,350	204	223	1,784	1,843	2	------	58	53	33.64	28.76	7,921	610	191	30
Arizona:																
Coal	4	5	1	1	4	5	------	------	------	------	------	------	------	------	1	------
Metal	10,812	12,310	3,054	3,805	24,542	30,408	12	12	502	549	20.94	18.45	3,874	3,412	272	27
Nonmetal	220	250	47	55	404	465	------	------	6	5	14.87	10.76	468	99	43	14
Sand and gravel	1,021	1,340	242	324	1,936	2,619	2	1	42	52	22.72	20.24	6,970	2,960	162	------
Stone	405	410	108	113	867	907	------	------	10	9	11.53	9.92	293	498	81	38
Total or average	12,462	14,315	3,451	4,297	27,753	34,403	14	13	560	615	20.68	18.25	3,928	3,256	559	79
Arkansas:																
Coal	109	130	21	26	164	207	------	------	7	7	42.66	33.81	1,121	879	14	------
Metal	2,098	2,135	607	608	4,853	4,861	1	1	71	54	14.84	11.31	3,019	2,012	7	5
Nonmetal	1,063	960	263	239	2,101	1,916	------	1	68	67	32.37	35.49	605	4,935	48	18
Sand and gravel	628	770	158	185	1,425	1,642	------	------	27	36	18.95	21.93	348	522	181	------
Stone	1,258	1,335	347	381	2,975	3,300	1	------	51	88	17.48	26.67	3,358	1,294	112	64
Total or average	5,156	5,335	1,395	1,439	11,518	11,926	2	2	224	252	19.62	21.30	2,309	2,058	362	87
California:																
Coal	6	5	1	1	5	6	------	------	------	------	------	------	------	------	1	------
Metal	2,458	2,365	601	585	4,790	4,689	4	2	128	188	27.56	40.52	6,419	3,757	258	26
Nonmetal and native asphalt	4,364	4,415	1,153	1,229	9,248	9,863	------	2	163	225	17.63	23.02	1,074	2,584	224	69
Sand and gravel	5,934	5,355	1,416	1,275	11,427	10,453	1	3	276	238	24.24	23.06	1,160	2,388	730	------
Stone	4,565	4,230	1,326	1,313	10,839	10,582	4	2	121	145	11.53	13.89	2,845	1,606	279	137
Peat	14	14	2	2	15	14	------	------	------	------	------	------	------	------	3	------

Total or average	17,341	16,385	4,500	4,404	36,324	35,607	9	9	688	796	19.19	22.61	2,334	2,389	1,495	232
Colorado:																
Coal	1,325	1,395	306	334	2,416	2,579	6	4	85	77	37.67	31.40	16,559	10,708	70	3
Metal	4,532	4,415	1,216	1,131	9,921	9,010	3	13	370	392	37.60	44.95	3,794	10,405	558	23
Nonmetal	510	500	89	107	709	859	------	------	15	22	21.16	25.60	332	1,356	101	18
Sand and gravel	1,376	1,495	262	310	2,125	2,530	1	1	64	49	30.59	19.76	6,435	2,835	362	------
Stone	516	525	126	119	1,024	973	------	------	19	9	18.55	9.25	1,457	282	140	32
Peat	35	25	6	3	29	17	------	------	1	1	35.03	58.28	245	466	19	------
Total or average	8,294	8,355	2,005	2,004	16,223	15,970	10	18	554	550	34.76	35.57	5,736	8,140	1,250	76
Connecticut:																
Nonmetal	138	85	39	22	314	182	------	------	10	4	31.86	21.99	335	896	5	3
Sand and gravel	456	505	97	112	785	912	------	------	11	19	14.02	20.84	516	280	82	------
Stone	384	400	106	106	888	894	------	------	20	17	22.53	19.02	550	616	24	22
Total or average	978	990	241	240	1,986	1,987	------	------	41	40	20.64	20.13	502	488	111	25
Delaware:																
Nonmetal	12	[3]	3	1	23	5	------	------	1	------	42.93	------	730	------	1	1
Sand and gravel	66	45	14	10	112	87	------	------	1	1	8.91	11.53	71	427	15	------
Stone	10	------	2	------	20	------	------	------	------	------	------	------	------	------	1	1
Total or average	88	45	19	11	155	92	------	------	2	1	12.89	10.90	161	403	17	2
Florida:																
Metal	141	150	50	53	399	422	------	------	------	------	------	------	------	------	2	------
Nonmetal	3,298	3,305	987	993	7,904	7,968	------	2	81	64	10.25	8.28	290	1,996	47	36
Sand and gravel	314	375	80	102	690	911	1	1	18	23	27.52	26.35	9,521	11,925	57	------
Stone	2,301	2,335	685	676	6,125	5,959	2	4	95	104	15.84	18.12	2,821	5,560	95	70
Peat	32	45	8	11	58	85	------	------	------	1	------	11.82	------	496	11	------
Total or average	6,086	6,215	1,809	1,835	15,176	15,345	3	7	194	192	12.98	12.97	1,722	3,906	212	106
Georgia:																
Metal	119	125	36	39	303	330	------	------	7	1	23.10	3.03	548	27	4	3
Nonmetal and peat	3,480	3,305	1,052	1,004	8,454	8,076	------	1	215	212	25.43	26.38	693	1,776	78	36
Sand and gravel	241	230	60	61	546	551	------	------	10	11	18.32	19.95	771	437	31	------
Stone	3,086	2,855	819	746	7,062	6,614	2	3	121	125	17.42	19.35	2,259	4,400	97	86
Total or average	6,926	6,515	1,967	1,850	16,365	15,572	2	4	353	349	21.69	22.67	1,369	2,806	210	125
Hawaii:																
Nonmetal	102	95	9	12	71	91	------	------	1	4	14.17	43.94	213	538	28	4
Sand and gravel	31	35	3	3	22	26	------	------	------	------	------	------	------	------	9	------
Stone	493	585	115	156	939	1,310	------	------	40	44	42.58	33.58	1,604	869	41	21
Total or average	626	715	127	171	1,032	1,427	------	------	41	48	39.72	33.64	1,475	833	78	25
Idaho:																
Metal	2,456	2,315	598	572	4,778	4,576	4	5	261	347	55.46	76.92	8,928	12,561	133	14

See footnotes at end of table.

Table 1.—Worktime 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-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1968	
							Fatal		Nonfatal		Frequency		Severity			
	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	Mines	Mills
Idaho—Continued																
Nonmetal and peat	515	485	122	108	1,032	903	------	1	25	15	24.23	17.72	1,571	6,856	25	11
Sand and gravel	352	815	63	133	505	1,066	------	------	11	19	21.79	17.82	1,085	356	158	------
Stone	202	310	36	63	298	513	------	------	6	6	20.12	11.69	902	479	30	19
Total or average	3,525	3,925	818	877	6,613	7,059	4	6	303	387	46.42	55.68	6,820	9,110	346	44
Illinois:																
Coal	8,461	8,600	2,123	2,268	16,605	17,360	15	12	712	745	43.78	43.49	8,211	6,116	69	44
Metal	48	50	13	14	104	115	------	------	8	7	76.90	60.85	1,365	1,852	5	1
Nonmetal	1,160	1,065	328	256	2,666	2,072	2	------	80	45	30.75	21.71	5,593	961	58	27
Sand and gravel	1,693	1,675	391	380	3,303	3,257	1	------	53	50	16.35	15.35	2,408	1,013	361	------
Stone	3,667	3,530	984	961	8,167	7,966	1	2	130	170	16.04	21.59	1,405	2,507	243	177
Peat	25	41	5	3	48	23	------	------	------	------	------	------	------	------	6	------
Total or average	15,054	14,965	3,844	3,881	30,894	30,795	19	14	983	1,017	32.43	33.41	5,530	4,275	742	249
Indiana:																
Coal	2,269	2,310	583	605	4,521	4,660	4	------	186	186	42.03	39.92	7,240	918	44	14
Nonmetal	790	665	212	177	1,672	1,412	1	------	22	20	13.76	14.17	3,821	789	35	18
Sand and gravel	1,010	930	243	230	2,112	2,009	1	1	38	37	18.47	18.91	3,215	4,460	225	------
Stone	2,767	3,040	747	830	6,176	6,644	2	2	125	102	20.56	15.65	2,597	2,392	130	105
Peat	30	26	6	5	45	44	------	------	1	1	22.38	22.91	2,126	641	6	------
Total or average	6,866	6,975	1,790	1,847	14,525	14,768	8	3	372	346	26.16	23.63	4,271	2,050	440	137
Iowa:																
Coal and peat	173	175	44	45	391	403	------	------	10	10	25.57	24.83	575	571	16	------
Nonmetal	625	535	169	134	1,364	1,075	------	1	53	33	38.84	31.62	1,019	6,171	27	23
Sand and gravel	1,038	925	220	191	2,011	1,762	1	1	34	28	17.40	16.46	3,311	5,326	311	------
Stone	2,568	2,470	698	676	5,971	5,844	4	1	85	87	14.90	15.06	4,388	2,429	264	123
Total or average	4,404	4,110	1,130	1,046	9,738	9,084	5	3	182	158	19.20	17.72	3,541	3,351	618	146
Kansas:																
Coal	196	235	58	73	419	529	------	------	18	18	42.98	34.06	432	341	9	4
Metal	69	30	14	7	111	57	------	------	7	4	62.79	69.69	1,839	2,230	9	------
Nonmetal	1,030	1,070	236	238	1,894	1,899	------	------	71	65	37.50	34.23	1,240	516	35	20
Sand and gravel	963	635	231	146	2,034	1,289	------	1	39	22	19.17	17.85	479	8,018	203	------
Stone	1,651	1,610	422	424	3,495	3,509	1	------	38	35	11.16	9.97	2,045	366	175	84
Total or average	3,909	3,580	960	887	7,953	7,282	1	1	173	144	21.88	19.91	1,365	1,772	431	108
Kentucky:																
Coal	22,840	22,600	4,491	4,587	35,689	36,178	58	34	1,704	1,600	49.37	45.11	13,259	7,671	1,492	58
Metal	67	45	19	11	151	92	1	------	15	11	106.03	119.88	41,101	5,166	2	1
Nonmetal	293	235	67	55	537	440	------	------	19	19	35.39	43.19	7,947	10,925	56	11

Sand and gravel	312	305	85	79	812	754	------	------	32	15	39.42	19.89	8,388	736	35	------
Stone	2,142	2,200	530	552	4,389	4,608	7	6	142	125	33.95	28.43	10,463	9,244	113	111
Total or average	25,654	25,345	5,192	5,285	41,577	42,073	66	40	1,912	1,770	47.57	42.97	12,902	7,747	1,698	181
Louisiana:																
Metal	809	1,100	296	401	2,364	3,057	------	------	11	14	4.65	4.58	145	169	------	2
Nonmetal	2,001	2,105	597	621	5,335	5,062	24	2	115	118	26.05	23.71	28,520	3,759	33	21
Sand and gravel	1,000	1,215	235	295	2,122	2,594	1	2	34	51	16.50	20.43	3,235	5,080	70	------
Stone	682	585	230	190	1,954	1,759	------	------	47	24	24.06	13.65	638	331	13	16
Total or average	4,492	5,000	1,357	1,507	11,775	12,472	25	4	207	207	19.70	16.92	13,641	2,670	116	39
Maine:																
Metal and peat	79	105	23	28	162	222	------	------	6	5	36.93	22.55	535	433	3	1
Nonmetal	83	75	18	15	148	122	------	------	3	5	20.29	40.98	162	172	15	3
Sand and gravel	1,437	625	241	124	2,084	1,105	------	------	42	23	20.15	20.82	461	386	173	------
Stone	411	200	89	63	726	521	------	------	18	12	24.79	23.05	705	311	30	24
Total or average	2,010	1,005	371	230	3,121	1,969	------	------	69	45	22.11	22.85	507	358	221	28
Maryland and District of Columbia:																
Coal and peat	336	345	71	75	571	600	------	------	6	6	10.50	10.00	954	910	82	------
Nonmetal	153	185	39	47	313	372	------	------	16	17	51.04	45.67	1,215	768	16	11
Sand and gravel	680	775	179	196	1,570	1,750	------	------	37	30	23.56	17.14	331	679	81	------
Stone	1,076	1,280	298	358	2,461	2,976	------	1	59	52	23.97	17.81	481	3,046	41	36
Total or average	2,245	2,590	588	675	4,916	5,698	------	1	118	105	24.00	18.60	535	1,945	220	47
Massachusetts:																
Nonmetal and peat	72	65	20	19	158	150	------	------	11	8	69.42	53.33	1,950	927	5	1
Sand and gravel	931	1,055	211	240	1,741	2,029	------	------	32	45	18.38	22.17	892	417	205	------
Stone	916	785	240	196	1,931	1,641	------	------	45	49	23.30	29.87	639	628	39	39
Total or average	1,919	1,905	471	454	3,831	3,820	------	------	88	102	22.97	26.70	809	528	249	40
Michigan:																
Metal	5,181	5,170	1,549	1,393	12,393	11,147	1	5	400	310	32.36	28.26	1,850	4,159	24	10
Nonmetal	1,798	1,825	494	503	3,952	4,023	------	------	84	96	21.25	23.86	635	475	63	20
Sand and gravel	2,569	2,635	554	577	4,789	4,968	------	3	104	100	21.72	20.73	963	4,924	586	------
Stone	3,412	3,435	983	993	7,918	7,941	------	2	75	59	9.47	7.68	1,134	1,980	62	52
Peat	167	183	31	35	293	332	------	------	------	1	------	3.01	------	84	25	------
Total or average	13,127	13,250	3,611	3,501	29,344	28,412	1	10	663	566	22.63	20.27	1,330	3,114	760	82
Minnesota:																
Metal	9,027	8,730	2,856	2,763	22,867	22,102	4	------	87	92	3.98	4.16	1,441	343	67	27
Nonmetal	154	155	41	40	326	324	------	------	12	11	36.78	33.99	208	578	4	4
Sand and gravel	2,147	2,655	367	456	3,282	4,095	1	1	59	70	18.28	17.34	2,252	1,973	610	------
Stone	1,414	1,390	373	361	3,060	2,960	------	2	55	83	17.98	28.72	1,663	4,845	92	58
Peat	37	32	6	2	26	17	------	------	2	1	78.25	57.33	861	229	7	------
Total or average	12,779	12,960	3,643	3,622	29,561	29,498	5	3	215	257	7.44	8.81	1,540	1,023	780	89

See footnotes at end of table.

Table 1.—Worktime 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-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1968	
							Fatal		Nonfatal		Frequency		Severity			
	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	Mines	Mills
Mississippi:																
Nonmetal	845	915	214	231	1,720	1,846	------	------	28	47	16.28	25.45	587	595	41	21
Sand and gravel	442	535	110	132	1,046	1,195	------	------	20	23	19.12	19.25	3,350	3,682	52	------
Stone	184	150	45	39	365	313	------	------	2	1	5.48	3.19	107	77	4	5
Total or average	1,471	1,600	369	402	3,131	3,355	------	------	50	71	15.97	21.17	1,454	1,646	97	26
Missouri:																
Coal	356	425	109	137	812	1,024	------	------	14	14	17.25	13.67	398	314	19	4
Metal	2,691	3,045	732	818	5,858	6,547	4	2	242	305	41.99	46.89	5,257	4,104	28	7
Nonmetal and native asphalt	917	840	217	194	1,756	1,587	------	------	57	52	32.46	32.76	770	810	177	26
Sand and gravel	564	830	135	198	1,140	1,687	------	------	20	29	17.55	17.19	774	507	89	------
Stone	4,138	4,280	1,116	1,157	9,261	9,510	3	4	191	179	20.95	19.24	2,464	3,727	219	202
Total or average	8,666	9,420	2,309	2,505	18,827	20,355	7	6	524	579	28.20	28.74	2,984	3,182	532	239
Montana:																
Coal and peat	67	70	11	12	84	90	------	------	2	2	23.93	22.16	203	199	17	------
Metal	2,960	2,985	617	838	4,946	6,699	3	2	75	128	15.77	19.41	5,151	3,084	184	12
Nonmetal	765	560	195	139	1,572	1,126	2	1	51	23	33.71	21.32	8,923	5,793	24	10
Sand and gravel	596	830	102	129	822	1,124	------	------	17	24	20.68	21.35	360	461	136	------
Stone	327	490	79	119	644	975	------	------	7	12	10.87	12.31	118	481	55	46
Total or average	4,715	4,940	1,005	1,236	8,068	10,014	5	3	152	189	19.46	19.17	4,945	2,815	416	68
Nebraska:																
Nonmetal	14	15	3	3	24	25	------	------	------	1	------	39.46	------	592	5	4
Sand and gravel	832	925	176	197	1,651	1,829	1	------	24	26	15.15	14.21	4,195	3,783	286	------
Stone	478	500	134	148	1,104	1,257	------	------	13	21	11.77	16.70	606	309	43	36
Total or average	1,324	1,440	313	348	2,779	3,112	1	------	37	48	13.67	15.42	2,732	2,353	334	40
Nevada:																
Metal	1,835	2,125	471	660	3,777	5,298	3	4	91	115	24.89	22.46	5,768	5,135	156	13
Nonmetal	748	740	186	188	1,492	1,526	------	1	41	49	27.48	32.77	456	5,025	52	16
Sand and gravel	605	620	128	113	1,014	907	------	------	20	22	19.73	24.26	471	1,045	104	------
Stone	322	200	84	55	672	453	1	------	14	7	22.33	15.46	9,385	660	22	16
Total or average	3,510	3,685	869	1,017	6,954	8,184	4	5	166	193	24.44	24.19	4,205	4,414	334	45
New Hampshire:																
Nonmetal	47	50	15	11	118	85	------	------	1	1	8.47	11.76	17	235	4	2
Sand and gravel	376	410	77	78	660	725	------	------	14	14	21.21	19.32	924	1,037	73	------
Stone	121	145	30	35	237	281	------	------	4	12	16.85	42.69	438	1,131	13	6
Total or average	544	600	121	123	1,016	1,091	------	------	19	27	18.71	24.75	705	998	90	8

New Jersey:																
Metal	174	175	51	47	413	379	1	------	22	26	55.69	68.66	15,627	2,345	2	2
Nonmetal	353	290	83	79	664	634	------	------	20	17	30.13	26.80	568	875	15	9
Sand and gravel	1,044	1,130	255	271	2,104	2,233	------	------	56	63	26.62	28.22	781	2,857	122	------
Stone	983	935	257	252	2,159	2,146	------	1	68	77	31.49	36.36	1,220	4,178	36	37
Peat	21	21	5	4	36	35	------	------	------	1	------	28.60	------	343	5	------
Total or average	2,575	2,555	651	653	5,376	5,426	1	1	166	184	31.06	34.09	2,066	3,095	180	48
New Mexico:																
Coal and peat [4]	290	305	65	71	518	553	------	------	19	17	36.71	30.75	1,148	953	11	1
Metal	4,162	4,370	1,098	1,198	8,802	9,606	4	10	257	409	29.65	43.62	3,601	7,356	169	13
Nonmetal	2,230	2,110	683	704	5,504	5,666	3	4	187	161	34.52	29.12	3,926	5,217	52	23
Sand and gravel	958	910	160	162	1,320	1,347	------	------	38	31	28.79	23.01	2,098	1,984	164	------
Stone	253	250	55	58	444	471	------	------	5	7	11.26	14.86	261	289	62	44
Total or average	7,893	7,950	2,062	2,192	16,588	17,643	7	14	506	625	30.93	36.22	3,423	5,870	458	81
New York:																
Metal	1,312	1,305	356	358	2,844	2,862	1	------	34	57	12.31	19.92	2,661	1,947	5	5
Nonmetal	2,189	2,050	576	545	4,660	4,429	------	1	120	146	25.75	33.19	1,038	2,390	37	33
Sand and gravel	2,234	2,220	467	477	3,820	3,969	1	------	88	79	23.30	19.90	2,088	559	397	------
Stone	3,365	3,215	859	864	7,066	7,082	1	1	109	80	15.57	11.44	1,701	1,262	103	104
Peat	10	13	2	2	16	17	------	------	1	1	61.94	57.53	3,097	805	4	------
Total or average	9,110	8,800	2,260	2,246	18,407	18,359	3	2	352	363	19.29	19.88	1,763	1,489	546	142
North Carolina:																
Metal	4	15	[5]	5	[5]	37	------	------	------	2	------	53.77	------	2,016	1	------
Nonmetal	1,960	1,925	505	503	4,082	4,060	1	2	122	103	30.13	24.86	2,525	3,737	69	41
Sand and gravel	896	760	204	177	1,798	1,646	1	2	39	33	22.25	21.26	3,725	7,690	129	------
Stone	1,973	1,925	461	484	3,807	4,116	2	2	50	64	13.66	16.03	7,567	3,754	100	84
Total or average	4,833	4,630	1,171	1,168	9,687	9,859	4	6	211	202	22.19	21.10	4,729	4,398	299	125
North Dakota:																
Coal and peat [2]	270	280	61	67	474	506	1	------	15	14	33.74	27.69	13,212	498	25	2
Nonmetal	37	60	10	12	77	92	------	1	7	20	90.81	227.18	1,155	69,627	3	2
Sand and gravel	842	665	135	113	1,259	1,032	------	1	23	18	18.26	18.41	390	6,139	307	------
Stone	95	5	16	1	129	7	------	------	1	------	7.74	------	108	------	13	13
Total or average	1,244	1,010	222	192	1,940	1,637	1	2	46	52	24.23	32.98	3,536	7,954	348	17
Ohio:																
Coal	7,576	7,900	1,852	1,957	14,793	15,627	13	13	423	490	29.47	32.25	7,085	6,531	358	23
Nonmetal	2,338	2,110	634	570	5,053	4,594	1	1	112	96	22.36	21.11	1,621	1,837	159	47
Sand and gravel	2,284	2,325	548	555	4,570	4,655	2	7	75	87	16.85	20.19	3,061	9,646	407	------
Stone	5,471	5,590	1,504	1,576	12,261	12,941	7	4	191	205	16.15	16.15	4,007	2,968	193	177
Peat	16	18	2	2	12	15	------	------	------	------	------	------	------	------	11	------
Total or average	17,685	17,970	4,540	4,660	36,689	37,832	23	25	801	878	22.46	23.89	4,800	5,123	1,128	247

See footnotes at end of table.

Table 1.—Worktime 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-days worked (thousands)		Man-hours worked (thousands)		Number of injuries				Injury rates per million man-hours				Count of operations 1968	
							Fatal		Nonfatal		Frequency		Severity			
	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	Mines	Mills
Oklahoma:																
Coal	263	315	65	82	503	634	------	3	20	20	39.78	36.26	1,378	29,477	15	3
Metal	351	220	98	61	776	492	------	------	33	15	42.53	30.47	767	886	34	3
Nonmetal	576	520	137	127	1,095	1,007	------	1	30	46	27.40	46.69	452	6,750	27	15
Sand and gravel	271	290	73	75	617	647	------	------	14	19	22.68	29.36	1,471	630	68	------
Stone	1,212	1,355	323	366	2,687	3,054	1	------	58	75	21.96	24.23	2,675	790	99	93
Total or average	2,673	2,700	696	711	5,678	5,835	1	4	155	174	27.48	30.51	1,740	4,928	243	114
Oregon:																
Coal and peat	5	5	1	(5)	7	2	------	------	2	1	288.35	405.02	5,911	14,581	2	------
Metal	140	110	25	20	201	164	------	------	4	3	19.87	18.34	760	134	43	2
Nonmetal	123	160	22	31	179	246	------	------	5	5	27.91	20.31	9,149	357	31	8
Sand and gravel	1,595	1,210	326	230	2,611	1,847	2	1	64	32	25.28	17.87	5,162	3,854	204	------
Stone	1,023	1,065	256	250	2,052	2,020	------	------	62	66	30.21	32.67	1,079	732	238	162
Total or average	2,886	2,550	630	532	5,051	4,280	2	1	137	107	27.52	25.24	3,470	2,043	518	172
Pennsylvania:																
Bituminous coal	22,002	21,300	5,073	5,184	40,603	41,511	30	26	897	1,010	22.83	24.96	6,089	5,583	842	73
Anthracite	6,932	6,300	1,508	1,399	11,011	10,156	4	13	504	440	46.13	44.60	4,182	9,586	538	126
Metal	1,473	1,385	441	419	3,538	3,348	1	1	32	29	9.33	8.96	2,124	2,044	3	3
Nonmetal	1,442	1,255	364	318	2,954	2,578	1	1	103	73	35.21	28.71	6,028	5,307	98	39
Sand and gravel	1,236	1,125	296	282	2,488	2,426	------	------	70	55	28.14	22.67	3,421	739	120	------
Stone	8,403	8,460	2,268	2,352	18,549	18,692	3	2	281	296	15.31	15.94	1,661	1,706	295	241
Peat	50	56	12	13	91	106	------	------	1	1	10.98	9.43	44	160	10	------
Total or average	41,538	39,895	9,961	9,967	79,234	78,817	39	43	1,888	1,904	24.32	24.70	4,517	4,864	1,906	482
Rhode Island:																
Sand and gravel	200	180	38	34	306	281	------	------	7	6	22.91	21.38	288	884	16	------
Stone	72	80	18	19	148	160	------	------	3	3	20.28	18.80	1,054	1,579	5	3
Total or average	272	260	56	53	454	440	------	------	10	9	22.05	20.44	538	1,136	21	3
South Carolina:																
Nonmetal and peat	943	925	241	236	1,942	1,917	1	------	30	41	15.96	21.39	4,157	460	61	23
Sand and gravel	359	350	90	84	807	781	------	1	16	17	19.83	23.05	503	10,428	32	------
Stone	777	760	202	200	1,665	1,584	------	------	29	28	17.41	17.68	3,365	527	18	16
Total or average	2,079	2,040	532	520	4,414	4,281	1	1	75	86	17.22	20.32	3,190	2,303	111	39
South Dakota:																
Coal	3	5	(5)	1	4	4	------	------	------	------	------	------	------	------	1	------
Metal	1,603	1,675	494	522	3,953	4,176	2	2	118	87	30.35	21.31	4,152	4,505	54	3
Nonmetal	214	175	41	37	330	315	1	1	7	10	24.22	34.90	18,846	19,860	49	5

Sand and gravel	737	760	116	130	1,049	1,190	------	------	23	26	21.93	21.86	730	581	314	------
Stone	469	495	108	116	919	984	------	1	14	19	15.23	20.32	283	8,140	39	14
Total or average	3,026	3,105	760	805	6,256	6,669	3	4	162	142	26.37	21.89	3,783	5,065	457	22
Tennessee:																
Coal	2,020	2,045	415	432	3,357	3,479	6	3	105	86	33.07	25.58	12,094	6,261	189	2
Metal	1,682	1,695	474	453	3,792	3,624	2	1	105	95	28.21	26.49	6,745	3,593	16	6
Nonmetal	680	650	167	173	1,387	1,468	------	------	35	37	25.23	25.21	1,127	424	52	28
Sand and gravel	554	550	142	146	1,217	1,280	1	------	25	30	21.37	23.44	6,891	3,341	88	------
Stone	2,750	2,880	751	751	6,175	6,727	3	2	112	112	18.62	16.95	3,363	2,351	134	110
Total or average	7,686	7,770	1,949	1,955	15,928	16,578	12	6	382	360	24.74	22.08	6,083	3,349	479	146
Texas:																
Coal	110	130	32	40	254	320	------	------	2	2	7.88	6.25	532	425	2	------
Metal	1,337	1,450	420	495	3,356	3,998	------	2	32	61	9.54	15.76	681	4,036	29	6
Nonmetal and native asphalt	3,095	3,315	893	967	7,233	7,836	------	1	175	201	24.19	25.78	1,081	1,751	144	70
Sand and gravel	1,987	1,880	515	488	4,741	4,482	4	1	118	117	25.73	26.33	5,499	2,241	266	------
Stone	4,485	4,485	1,386	1,316	11,677	10,999	1	1	221	234	19.01	21.37	1,225	1,272	239	198
Total or average	11,014	11,260	3,246	3,305	27,262	27,636	5	5	548	615	20.28	22.43	1,856	1,955	680	274
Utah:																
Coal	1,156	1,220	259	283	2,034	2,172	2	1	110	99	55.07	46.04	16,651	4,814	28	6
Metal	5,194	5,280	1,351	1,598	10,812	12,790	3	2	219	221	20.53	17.44	2,598	1,726	239	8
Nonmetal	981	870	270	239	2,159	1,914	------	1	136	70	62.98	37.10	1,054	4,133	41	19
Sand and gravel	589	725	113	140	931	1,146	------	2	20	21	21.48	20.08	7,030	10,868	178	------
Stone	375	445	97	118	775	959	1	------	5	14	7.74	14.61	7,883	628	36	18
Native asphalt	237	262	59	72	470	578	------	------	15	23	31.92	39.80	730	744	15	5
Total or average	8,532	8,795	2,148	2,450	17,181	19,558	6	6	505	448	29.74	23.21	4,495	2,757	537	56
Vermont:																
Nonmetal and peat	317	320	89	91	717	734	------	------	26	19	36.27	25.87	823	296	6	5
Sand and gravel	262	190	51	33	442	300	------	------	8	5	18.11	16.66	373	177	67	------
Stone	1,717	1,315	419	335	3,434	2,780	------	2	110	101	32.03	37.05	3,267	7,352	68	41
Total or average	2,296	1,825	559	459	4,593	3,814	------	2	144	125	31.35	33.29	2,607	5,429	141	46
Virginia:																
Coal	10,251	10,605	2,156	2,291	17,233	18,174	12	16	906	960	53.27	53.70	6,403	7,501	903	27
Metal	319	285	84	73	672	587	------	1	42	45	62.48	78.37	1,764	11,266	3	3
Nonmetal	628	600	165	160	1,314	1,273	------	------	31	35	23.58	27.49	778	1,031	30	19
Sand and gravel	553	555	136	139	1,228	1,275	------	------	17	23	13.84	18.04	370	388	83	------
Stone	3,955	3,740	1,050	985	8,629	8,053	3	5	201	190	23.64	24.21	2,693	4,581	158	139
Total or average	15,706	15,785	3,591	3,648	29,077	29,362	15	22	1,197	1,253	41.68	43.42	4,686	6,186	1,177	188

See footnotes at end of table.

Table 1.—Worktime 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-days 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		Count of operations 1968	
	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	Mines	Mills
Washington:																
Coal	55	60	11	12	89	95	------	------	------	------	------	------	------	------	6	------
Metal	198	220	53	54	426	429	------	------	42	26	98.55	60.67	2,335	3,110	19	4
Nonmetal	98	85	9	13	74	101	------	------	3	1	40.75	9.87	1,453	237	25	5
Sand and gravel	1,403	1,480	287	306	2,297	2,462	2	------	57	54	25.68	21.93	9,329	604	336	------
Stone	1,221	1,125	255	242	2,045	1,943	3	------	21	29	11.74	14.93	9,190	794	301	184
Peat	27	21	4	3	31	23	------	------	------	------	------	------	------	------	11	------
Total or average	3,002	2,990	620	630	4,962	5,053	5	------	123	110	25.80	21.77	8,328	868	698	193
West Virginia:																
Coal	42,121	42,600	9,180	8,964	72,618	71,299	150	70	3,743	3,875	53.61	55.33	15,437	9,097	1,411	153
Nonmetal	272	245	58	57	464	457	------	------	10	10	21.56	21.86	927	490	16	6
Sand and gravel	214	180	57	46	505	416	------	------	12	17	23.78	40.85	709	1,322	13	------
Stone	1,221	1,125	314	299	2,525	2,330	2	------	29	40	12.28	17.16	5,173	291	61	49
Total or average	43,828	44,105	9,609	9,366	76,111	74,503	152	70	3,794	3,942	51.85	53.85	14,910	8,725	1,501	208
Wisconsin:																
Metal	215	215	49	60	394	482	------	2	21	21	53.36	47.73	2,866	26,426	15	4
Nonmetal	99	20	11	4	91	36	------	------	1	------	11.01	------	110	------	4	3
Sand and gravel	2,055	1,850	409	370	3,572	3,281	------	1	73	70	20.43	21.64	736	3,357	474	------
Stone	1,881	1,775	401	397	3,400	3,379	1	2	81	81	24.12	24.56	2,541	4,215	333	147
Peat	10	8	2	1	18	11	------	------	------	------	------	------	------	------	2	------
Total or average	4,260	3,870	872	833	7,475	7,188	1	5	176	172	23.68	24.62	1,660	5,285	828	154
Wyoming:																
Coal	327	345	76	83	582	621	1	3	8	7	15.47	16.09	10,655	29,253	14	1
Metal	1,773	1,845	472	441	3,983	3,740	4	------	105	85	27.37	22.73	7,101	486	129	9
Nonmetal	1,252	1,495	358	448	2,894	3,618	1	1	46	36	16.24	10.23	2,841	1,861	42	17
Sand and gravel	810	775	152	131	1,252	1,141	1	------	23	24	19.18	21.04	5,666	2,111	152	------
Stone	249	225	62	52	500	420	------	------	14	11	28.02	26.18	766	483	46	13
Total or average	4,411	4,685	1,121	1,155	9,210	9,539	7	4	196	163	22.04	17.51	5,448	3,075	383	40
U.S. totals: [6]																
Coal	134,467	134,700	29,651	30,153	234,417	237,781	311	203	9,639	9,800	42.45	42.07	10,513	7,309	6,322	565
Peat	533	567	99	98	798	831	------	------	8	8	10.02	9.62	244	184	137	------
Native asphalt	399	445	103	117	837	949	------	------	23	36	27.49	37.93	672	733	19	9
Metal	66,478	68,800	18,533	19,824	148,875	158,775	59	68	3,375	3,730	23.07	23.93	3,555	3,760	2,574	250
Nonmetal	45,576	44,300	12,282	12,118	99,414	97,765	39	27	2,472	2,360	25.26	24.44	3,334	2,615	2,238	887
Sand and gravel	49,901	50,100	10,930	10,961	93,156	94,195	26	31	1,992	1,930	21.66	20.82	2,688	3,025	9,464	------
Stone	84,084	83,100	22,543	22,583	186,620	186,980	58	53	3,260	3,390	17.78	18.41	2,700	2,635	5,120	3,595
Total or average	381,438	382,000	94,142	95,852	764,116	777,270	493	382	20,769	21,255	27.83	27.84	5,340	4,334	25,874	5,306
Oil and natural gas [7]	466,652	449,606	NA	NA	986,952	939,385	102	95	9,069	9,023	9.29	9.71	985	983	NA	NA

Coke	13,093	13,617	4,696	4,824	37,546	38,520	7	15	204	231	5.62	6.39	1,875	2,533	------	71
Blast-furnace slag	1,724	1,610	454	442	3,697	3,573	1	3	57	49	15.69	14.55	2,454	6,061	------	68
Primary nonferrous smelting and refining	41,529	45,200	13,590	15,683	109,012	125,350	4	15	1,155	1,565	10.63	12.61	725	1,293	------	93
Grand total or average	904,436	892,100	NA	NA	1,901,322	1,884,100	607	510	31,254	32,125	16.76	17.32	2,741	2,427	NA	NA

NA Not available.
[1] All data for 1968 are final. Data for 1969 are preliminary, except for peat, native asphalt, oil and natural gas, coke, and slag.
[2] No peat production reported in Alaska and North Dakota during 1969.
[3] Less than 3.
[4] No peat production reported in New Mexico during 1968.
[5] Less than 500.
[6] Data may not add to totals shown because of independent rounding.
[7] Includes data on officeworkers.

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

Year	Average men working daily	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours		
					Frequency		Severity (all injuries)
			Fatal	Nonfatal	Fatal	Nonfatal	
1965	907,476	1,899,895	538	32,800	0.28	17.26	2,629
1966	915,964	1,925,695	544	32,823	.28	17.04	2,539
1967	900,240	1,863,349	512	31,360	.27	16.83	2,468
1968	904,436	1,901,322	607	31,254	.32	16.44	2,741
1969 [p]	892,100	1,884,100	510	32,125	.27	17.05	2,427

[p] Preliminary.

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

Industry and year	Work stoppages		Industry and year	Work stoppages	
	Number	Man-days lost (thousands)		Number	Man-days lost (thousands)
COAL MINING			Ferroalloy metal ores:		
Anthracite:			1965	---	---
1965	3	1.7	1966	1	(2)
1966	4	8.3	1967	1	(2)
1967	3	1.4	1968	---	---
1968	2	4.2	1969	1	5.4
1969	7	13.1	Miscellaneous metal ores:		
Bituminous and lignite:			1965	---	---
1965	145	258.0	1966	---	---
1966	160	629.0	1967	1	1.0
1967	207	[1] 158.0	1968	---	---
1968	266	[1] 956.6	1969	---	---
1969	457	900.6	Primary smelting and refining of nonferrous metals:		
CRUDE PETROLEUM AND NATURAL GAS			1965	8	51.6
1965	---	---	1966	15	182.0
1966	1	50.7	1967	12	1,420.0
1967	2	(2)	1968	11	[1] 915.0
1968	---	---	1969	7	[1] 108.2
1969	3	40.3	**MINING AND QUARRYING OF NONMETALLIC MINERALS (EXCEPT FUELS)**		
Natural gas liquids:			Dimension stone:		
1965	---	---	1965	3	[1] 2.1
1966	---	---	1966	1	(2)
1967	---	---	1967	---	---
1968	---	---	1968	1	3.4
1969	1	25.1	1969	2	5.9
Oil and gas field services:			Crushed and broken stone:		
1965	3	(2)	1965	9	38.0
1966	1	2.6	1966	7	9.2
1967	3	(2)	1967	1	9.0
1968	3	3.0	1968	11	17.1
1969	1	.2	1969	7	14.7
Petroleum refining:			Sand and gravel:		
1965	7	[1] 31.4	1965	10	3.5
1966	5	5.6	1966	7	1.9
1967	15	103.0	1967	15	[1] 26.8
1968	6	50.8	1968	6	6.3
1969	16	992.7	1969	3	[1] 4.1
METAL MINING			Clay, ceramic and refractory minerals:		
Iron:			1965	---	---
1965	3	21.9	1966	---	---
1966	---	---	1967	---	---
1967	---	---	1968	2	6.2
1968	2	32.7	1969	1	.2
1969	---	[3] 1.5	Chemical and fertilizer mineral mining:		
Copper:			1965	1	(2)
1965	3	60.5	1966	2	(2)
1966	6	25.2	1967	10	38.9
1967	7	2,660.0	1968	1	7.0
1968	6	[1] 1,453.1	1969	1	38.5
1969	6	[1] 97.4	Miscellaneous nonmetallic minerals (except fuels):		
Lead-zinc:			1965	1	(2)
1965	6	43.3	1966	---	---
1966	4	[1] 66.0	1967	1	(2)
1967	3	[1] 93.4	1968	---	---
1968	1	[1] 31.1	1969	1	.5
1969	5	9.4	Cement, hydraulic:		
Gold-silver:			1965	14	32.3
1965	---	---	1966	2	1.7
1966	---	---	1967	9	67.4
1967	2	26.9	1968	2	4.7
1968	---	[1] 31.1	1969	12	130.0
1969	---	---			

[1] Includes idleness from stoppages which began in the previous year.
[2] Less than 100 man-days.
[3] Idleness from a stoppage that began in the previous year.

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

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 H. L. Riley [1] and W. Everett Smith [2]

The value of mineral production in Alabama increased to a new high of $285 million, 10 percent above the high established in 1968. Record high values were established for coal, portland cement, sand and gravel, lime, miscellaneous clay, kaolin and bentonite.

Coal, cement, petroleum, and stone represented 87 percent of the total value of the mineral production.

Alabama ranked second among the States in the production of bauxite and masonry cement and third in kaolin and native asphalt.

Selected indicators, other than housing, showed increases in 1969. The number of persons employed in the nonagricultural sector averaged 980,800 per month, an increase of 2 percent over 1968 figures. The Bureau of Labor Statistics, U.S. Department of Labor, reported that employment in all of Alabama's nonagricultural industries, except mining, increased during the 20-year period, 1939 to 1968; mining employment, however, dropped from 26,400 to 13,200 during the same period. In 1969, total personal income and per capita income increased 9.0 and 8.7 percent, respectively. Construction activity, as measured by housing units authorized and value, decreased 9.6 and 4.5 percent, respectively. Total sales of electrical energy increased 9.9 percent. The value of export and import trade transacted through the Mobile District declined 5.8 and 6.6 percent, respectively.

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[2] Chief, Economic Geology Division, Geological Survey of Alabama, Tuscaloosa, Ala.

Table 1.—Mineral production in Alabama [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:[2]				
Masonry—thousand 280-pound barrels	2,523	$7,309	2,600	$8,520
Portland—thousand 376-pound barrels	15,514	48,147	16,527	51,251
Clays—thousand short tons	2,793	6,995	3,097	7,083
Coal (bituminous)—do	16,440	115,815	17,456	130,405
Iron ore (usable)—thousand long tons, gross weight	1,151	6,730	1,125	6,435
Lime—thousand short tons	773	8,933	747	9,870
Natural gas—million cubic feet	230	30	180	24
Petroleum (crude)—thousand 42-gallon barrels	7,635	20,385	7,701	20,793
Sand and gravel—thousand short tons	8,140	9,130	8,323	9,427
Stone—do	20,643	33,847	19,854	37,512
Value of items that cannot be disclosed: Native asphalt, bauxite, natural gasoline (1969), liquefied petroleum gases (1969), phosphate rock (1969), salt, slag cement, scrap mica, and talc	XX	2,300	XX	3,416
Total	XX	259,621	XX	284,736
Total 1967 constant dollars	XX	261,508	XX	p 269,679

p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes slag cement; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Alabama, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Autauga	W	$171	Sand and gravel.
Baldwin	W	W	Petroleum, sand and gravel, miscellaneous clay.
Barbour	$399	767	Bauxite, kaolin, sand and gravel.
Bibb	3,010	4,404	Coal, limestone, dolomite, sand and gravel, miscellaneous clay.
Blount	2,097	1,865	Coal, cement, iron ore, fire clay, sandstone.
Butler	44	-------	
Calhoun	2,556	2,140	Fire clay, limestone, miscellaneous clay.
Cherokee	W	W	Sand and gravel.
Chilton	W	W	Do.
Choctaw	2,350	2,381	Petroleum.
Clarke	W	W	Sand and gravel, petroleum.
Coffee	W	163	Sand and gravel.
Colbert	W	W	Limestone, native asphalt.
Covington	W	W	Sand and gravel, limestone.
Crenshaw	W	W	Sand and gravel.
Cullman	W	W	Coal.
Dale	W	W	Sand and gravel.
Dallas	1,122	W	Sand and gravel.
De Kalb	W	W	Limestone.
Elmore	W	W	Sand and gravel, miscellaneous clay.
Escambia	W	W	Petroleum, sand and gravel, miscellaneous clay.
Etowah	W	1,189	Limestone, coal, sand and gravel.
Fayette	W	W	Sand and gravel.
Franklin	3,811	4,463	Iron ore, limestone, sand and gravel, fire clay.
Geneva	W	W	Sand and gravel.
Hale	W	W	Do.
Henry	W	W	Kaolin, bauxite.
Houston	W	W	Sand and gravel.
Jackson	W	W	Coal, limestone.
Jefferson	105,955	111,878	Coal, cement, iron ore, dolomite, limestone, miscellaneous clay, sandstone.
Lee	W	W	Limestone.
Limestone	70	W	Phosphate rock, limestone.
Lowndes	W	W	Bentonite, sand and gravel.
Macon	918	1,126	Sand and gravel.
Madison	W	W	Limestone, miscellaneous clay.
Marengo	W	W	Cement, limestone, sand and gravel.
Marion	W	W	Coal, kaolin, natural gas.
Marshall	W	W	Limestone, sand and gravel, miscellaneous clay.
Mobile	W	W	Petroleum, cement, oystershells, sand and gravel, miscellaneous clay.
Monroe	62	52	Sand and gravel.
Montgomery	1,917	1,999	Sand and gravel, miscellaneous clay.
Morgan	W	1,599	Limestone, sand and gravel.
Pike	W	W	Iron ore.
Randolph	W	W	Mica.
Russell	W	W	Miscellaneous clay, sand and gravel.
St. Clair	W	W	Cement, limestone, coal, miscellaneous clay.
Shelby	27,898	31,804	Lime, cement, limestone, coal, dolomite, miscellaneous clay.
Sumter	W	W	Miscellaneous clay, sand and gravel.
Talladega	8,017	11,525	Marble, limestone, talc.
Tuscaloosa	4,461	10,503	Coal, sand and gravel, iron ore.
Walker	W	W	Coal, fire clay, miscellaneous clay.
Washington	W	W	Salt, limestone.
Winston	W	W	Coal.
Undistributed [2]	94,934	96,708	
Total [3]	259,621	284,736	

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

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

[2] Includes value of natural gas liquids and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Selected indicators of Alabama business activity

		1968	1969	Change, percent
Monthly average employment:				
Total nonagricultural	thousands	r 960.9	980.8	+2.1
Manufacturing	do	r 305.8	314.1	+2.7
Nonmanufacturing	do	r 655.0	666.6	+1.8
Personal income:				
Total	millions	r $8,316	$9,062	+9.0
Per capita		r $2,361	p $2,567	+8.7
Construction activity:				
Housing units authorized	thousands	16.6	15.0	−9.6
Value of construction	millions	$188.7	$180.3	−4.5
Farm marketing, cash receipts	do	r $659.7	$730.6	+10.7
Mineral production	do	$259.6	$284.7	+9.7
Utility sales or consumption:				
Sales of electric energy	million kilowatt-hours	30,198.3	33,185.8	+9.9
Consumption for industrial purposes	do	16,969	18,867	+11.2
Foreign trade, Mobile Customs District:				
Value of exports	millions	$483.8	$455.9	−5.8
Value of imports	do	r $269.3	$251.4	−6.6

p Preliminary. r Revised.

Source: U.S. Department of Commerce; Bureau of Business Research, University, Ala.

Table 4.—Worktime 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
1968:								
Coal	4,866	219	1,064	8,503	9	123	15.52	7,351
Metal	929	297	284	2,338	-----	22	9.41	1,011
Nonmetal and native asphalt	719	273	196	1,600	-----	23	14.38	341
Sand and gravel	519	278	144	1,276	1	19	15.68	4,953
Stone	2,525	284	716	5,890	2	60	10.53	2,574
Total [1]	9,558	251	2,405	19,606	12	247	13.21	4,432
1969: p								
Coal	4,925	224	1,106	8,813	5	100	11.91	3,892
Metal	1,140	232	270	2,210	1	20	9.50	3,323
Nonmetal and native asphalt	825	253	209	1,678	-----	20	11.92	101
Sand and gravel	585	259	151	1,325	-----	20	15.10	264
Stone	2,505	279	699	5,722	1	78	13.81	2,337
Total [1]	9,985	243	2,435	19,749	7	238	12.41	2,812

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Trends and Developments.—Alabama Power Company awarded a contract for a 820,000-kilowatt nuclear generating station to be erected near Dothan. Total estimated cost is $165 million. The plant is scheduled for commerical operation in 1975. The Alabama Power Co. has contracted for the driving of a mine slope at Gorgas; the mine will have a planned capacity of 1.7 million tons per year from the Mary Lee coalbed.

The Tennessee Valley Authority (TVA) has under construction at the Browns Ferry Nuclear Plant in northern Alabama three electric generating units of 1,152,000-kilowatt capacity each at an estimated cost of $466 million. Commercial operation of the first unit is planned for the fall of 1971; unit two in the spring of 1972, and unit three in the fall of 1972.

TVA awarded a $5 million contract for construction of a new synthetic ammonia unit at Muscle Shoals.

Hardy Sand Co. announced plans to construct a $1.0 milion sand plant in Tuscaloosa County to produce industrial sands; clearing of dredging and plant sites was begun.

Monsanto Co. opened a phosphate strip mine near the Elk River in Limestone County, the first phosphate rock operation in the State since before 1900.

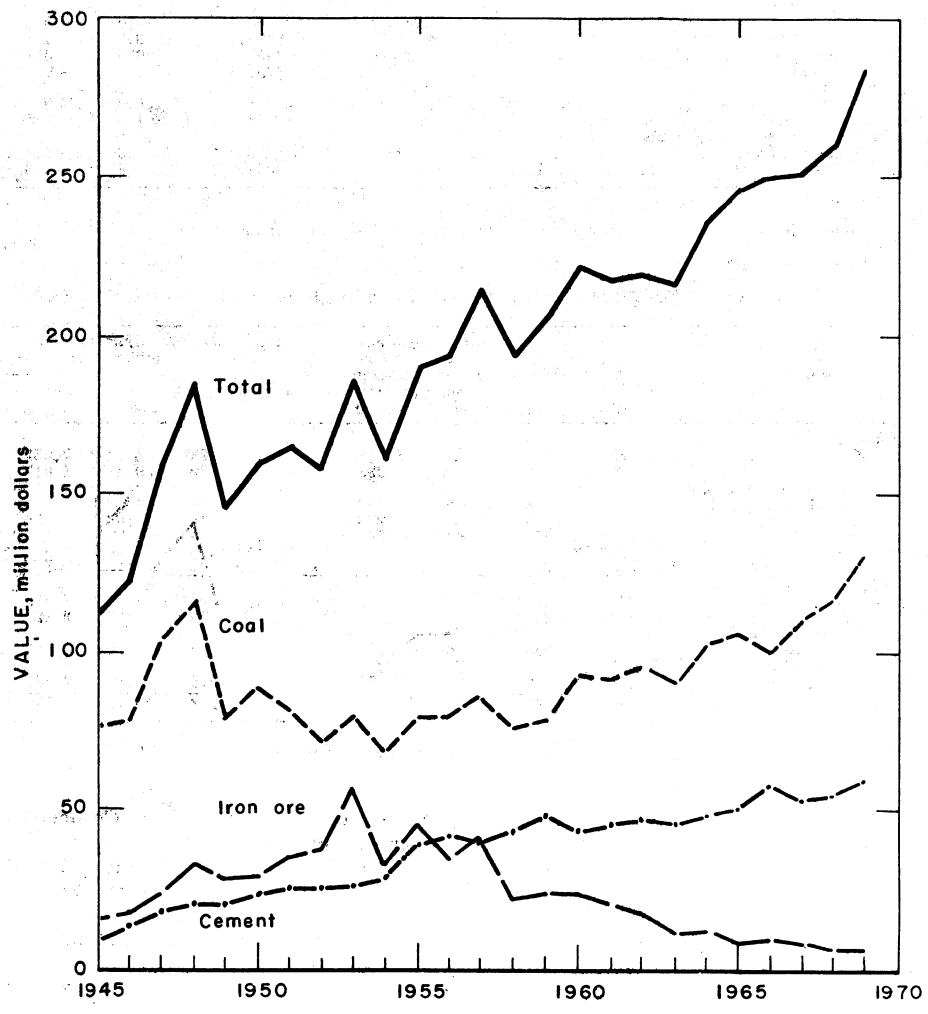

Figure 1.—Value of coal, cement, and iron ore, and total value of mineral production in Alabama.

A. P. Green Refractories Company built a new calcining plant south of Baker Hill and began mining bauxite during the latter part of the year.

Exploration for nonferrous metals continued in the State during 1969. At least three major companies were engaged in the exploration for lead and zinc in the Valley and Ridge province.

U.S. Steel Compay announced plans to build a wideflange beam and structural steel mill at its Fairfield Works.

Legislation and Government Programs.—The Alabama Surface Mining Act of 1969 was enacted to become effective in 1970. The Act requires grading to reduce the tops of peaks and ridges, the covering of toxic material, and revegetation. An air pollution act was passed, creating the State Air Pollution Control Commission and providing for enforcement powers of adopted regulations.

The Bureau of Mines published two reports [3] dealing with mineral resources in Alabama.

During the year, the Geological Survey of Alabama was engaged in 143 projects directed toward energy resources, geophysics, economic geology, paleontology, stratigraphy, geologic mapping, water resources, geochemistry, oil and gas, enviromental problems, urban planning, and remote sensing. Noteworthy of these projects were geochronology studies of the Alabama Piedmont; enviromental study of the Huntsville area, in cooperation with the U.S. Geological Survey and Bureau of Mines; drilling of a deep well for disposal of industrial wastes of U.S. Steel Corporation in Birmingham; and studies of Apollo 9 multispectral photography of Alabama areas.

During the year the Geological Survey released 15 reports dealing with geology, mineral resources, and water resources; and 16 maps describing geology and water availability in specific counties.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Mineral fuels accounted for 53 percent of the total value of the State's mineral production, the same as in 1968.

Asphalt (Native).—Native asphalt (bituminous limestone) production decreased 3 percent. Alabama ranked third among the States in native asphalt production.

Coal (Bituminous).—Bituminous coal was produced from 139 mines in 12 counties. Production increased 6 percent and

[3] Adair, Ralph B., and James S. Browning. Flotation of Muscivite From Alabama Graphitic-Mica Schist Ore. BuMines Rept. of Inv. 7263, 1969, 7 pp. Hollenbeck, Ronald P., and M. E. Tyrrell: Raw Materials for Lightweight Aggregate in Appalachian Region, Alabama and Georgia. BuMines Rept. of Inv. 7244, 1969, 21 pp.

Table 5.—Coal (bituminous) production [1] in 1969, by counties

(Thousand short tons and thousand dollars)

County	Number of mines and method of operation			Production				
	Underground	Strip	Auger	Underground	Strip	Auger	Total	
							Quantity [2]	Value
Bibb	1	3	------	W	W	------	W	W
Blount	------	2	------	------	204	------	204	W
Cullman	------	2	------	------	W	------	W	W
Etowah	------	1	------	------	W	------	W	W
Jackson	2	1	------	W	W	------	W	W
Jefferson	37	16	------	6,115	2,403	------	8,518	$68,453
Marion	24	5	------	278	274	------	553	2,874
St. Clair	------	1	------	------	W	------	W	W
Shelby	3	------	------	W	------	------	W	W
Tuscaloosa	1	12	------	W	W	------	1,868	W
Walker	6	20	1	W	W	39	4,139	32,334
Winston	------	1	------	------	W	------	W	W
Undistributed [3]	------	------	------	2,894	5,249	------	2,175	26,744
Total [2]	74	64	1	9,287	8,130	39	17,456	180,405
Earliest record to date	NA	NA	NA	NA	NA	NA	1,090,667	NA

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Excludes mines producing less than 1,000 short tons.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes production and value indicated by symbol W.

was at the highest level since 1948, in both production and value. The increased production reflects the greater consumption of elecctric power. The leading producing counties were Jefferson, Walker, and Tuscaloosa. Six companies mined 50 percent of the total coal production of the State. Average output per mine continued to increase and was 126,000 tons compared with 116,000 in 1968. Captive tonnage made up 41 percent of the total production, compared with 44 percent in 1968. Fifty-three percent of the production was from underground mines, and 47 percent from strip and auger mines. Seventy-four percent was shipped by rail and water and the balance by truck. Sixty-six percent of the coal was cleaned at 22 preparation plants.

Coke.—Metallurgical and foundry coke was produced by seven companies at eight plants in Jefferson, Etowah, Marion, and Tuscaloosa Counties.

Natural Gas.—Marketed production of natural gas decreased 22 percent. Production was from four wells in Escambia and two wells in Marion County.

Petroleum.—Production of crude petroleum increased 1 percent. Twelve fields in five counties with 550 wells were in production. The Citronelle field in Mobile County with 410 producing wells was the leading field, followed by the Choctaw Ridge field, Choctaw County with six wells. Other fields with producing wells were as follows: The Pollard field, Escambia County, 27 wells; the Gilbertown field, Choctaw County, with 63 wells; and the Toxey field, Choctaw County, 7 wells.

Table 6.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1968	1969
Baldwin	62	50
Choctaw	880	882
Clarke	116	117
Escambia	289	241
Mobile	6,288	6,411
Total	7,635	7,701
Earliest record to date	96,953	104,654

Source: State Oil and Gas Board.

Table 7.—Oil and gas well drilling

County	Drilling [1]						
	Development wells			Exploratory wells [2]		Total	
	Oil	Gas	Dry	Oil	Dry	Wells	Footage
Baldwin	1	--	1	--	1	3	21,623
Choctaw	3	--	3	2	12	20	220,343
Clarke	2	--	--	--	3	5	46,141
Conecuh	--	--	--	--	1	1	13,728
Escambia	1	1	1	1	3	7	106,631
Madison	--	--	--	--	2	2	837
Marion	--	--	1	--	--	1	1,125
Monroe	--	--	--	--	1	1	15,446
Sumter	--	--	--	--	1	1	3,727
Washington	--	--	--	--	5	5	40,030
Wilcox	--	--	--	--	2	2	10,165
Total	7	1	6	3	31	48	479,796

[1] American Association of Petroleum Geologists.
[2] No gas exploratory wells.

NONMETALS

Nonmetals accounted for 44 percent of the State's total value of mineral production, compared with 45 percent in 1968.

Cement.—Cement was produced by eight companies at 10 plants in six counties. Shipments of masonry cement increased 3 percent above 1968 and the State ranked second in the Nation. All of the companies and plants operating in the State produced masonry cement. Twenty-two percent of the masonry cement shipments had destinations in Alabama, and the remainder was shipped to the following States, in percent: Georgia, 31; Florida, 20; Louisiana, 7; Mississippi, 6; South Carolina, 4; Virginia, 4; Tennessee, 3; and other States, 3.

Seven companies produced portland cement at eight plants in five counties; shipments increased seven percent above the 1968 record year.

Leading cement producing counties were Jefferson, Mobile, and Shelby. Thirty percent of the shipments of portland cement had Alabama destinations and the remainder was shipped, in percent, to: Florida,

22; Georgia, 22; Mississippi, 8; South Carolina, 4; Virginia, 3; Louisiana, 2; Tennessee, 2; and other States, 7. Sixty-two percent of the portland cement was marketed for ready-mixed concrete; 15 percent for the manufacture of concrete products; 12 percent to highway contractors; 6 percent to builiding material dealers: and 5 percent for other uses.

Slag cement was produced by two companies at two plants—one in Jefferson and one in Blount Counties; shipments decreased 1 percent.

Clays.—Fire clay was mined by six companies at six surface and one underground mine in four counties; total production decreased 20 percent. The value of production was $2 million, a decrease of 33 percent below that in 1968. Leading producing counties were Walker and Calhoun.

Miscellaneous clay and shale were mined by 22 companies at 29 surface mines in 15 counties; total production increased 19 percent. The leading producing counties for miscellaneous clay and shale were Jefferson, Russell, and Shelby. Major uses were in the manufacture of heavy clay products, cement, and lightweight aggregate.

Table 8.—Fire clay sold or used by producers, by uses

(Short tons)

Use	1968	1969
Floor and wall tile	714	700
Firebrick and block	W	46,353
Building brick	157,168	171,269
Vitrified sewer pipe	92,106	25,448
Other uses [1]	331,711	219,050
Total	581,699	462,820

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes mortar, foundries, saggers, building block (1968), and uses indicated by symbol W.

Alabama ranked third among the States in the production of kaolin. Three companies mined kaolin at four surface mines in three counties, primarily for refractory use; total production was 12 percent above 1968, and set a new record for value. Bentonite was mined by one company in Lowndes County for use as a binder in foundry sand; production was 27 percent greater than in 1968.

Lime.—Five companies produced quicklime and hydrated lime at five plants in Shelby County. Total output decreased 3 percent. Forty-five percent of shipments were made to destinations in Alabama; other shipments, in percent, were made to Florida, 15; Georgia, 14; Tennessee, 10; Louisiana, 7; Mississippi, 4; and other States, 5.

Table 9.—Lime sold or used by producers, by uses

(Short tons)

Use	1968	1969
Construction	110,163	W
Basic oxygen convertors	W	161,354
Steel electric furnaces	22,740	[1] 20,819
Paper	228,927	[1] 228,530
Sewage	50,214	W
Sugar refining	W	[1] 3,442
Water purification	53,487	68,459
Other uses [2]	306,998	264,343
Total	772,529	746,947

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Quicklime only; hydrated lime included with other uses.
[2] Includes lime used for agriculture, alkalies, calcium carbide, coke, food, insecticides, magnesia, open-hearth furnace, metallurgical uses, petroleum, tanning, other uses, and use indicated by symbol W.

Mica.—Scrap mica was produced by one company operating two mines in Randolph County; production increased 21 percent. Among the States, Alabama ranked second in the production of scrap mica.

Salt.—Salt was produced from brine by one company for chemical manufacture; production decreased 2 percent.

Sand and Gravel.—Fifty-one commercial operators reported production of sand and gravel from 31 counties. Production increased 2 percent and the value increased 3 percent to establish a new record in both tonnage and value. Leading producing counties were Montgomery, Macon, and Clarke. Thirty-nine stationary plants, eight portable plants, and 22 dredges were in operation during the year. Nearly all of the production was washed. Of the total production, 56 percent was shipped by truck, 40 percent by rail, and 4 percent by water. The major uses of the sand and gravel were for building, paving, and fill.

Stone.—Limestone and dolomite were quarried and crushed at 45 quarries in 19 counties. Production of crushed limestone was 15.6 million tons from 40 quarries; crushed dolomite 2.1 million tons from five quarries. In previous years, crushed dolomite was included in crushed limestone production and not reported separately.

Table 10.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Autauga	1	W	W	1	256	$171
Coffee	1	W	W	1	176	163
Crenshaw	1	9	W	1	W	W
Elmore	1	437	W	1	469	W
Escambia	4	488	$570	4	465	570
Etowah	3	159	223	1	W	W
Fayette	1	79	W	1	W	W
Hale	2	26	W	1	W	W
Macon	3	648	918	3	W	1,126
Marshall	1	80	140	1	W	W
Monroe	1	45	62	1	W	52
Montgomery	5	2,248	1,776	5	2,210	W
Other counties [1]	30	3,921	5,441	30	4,750	7,346
Total [2]	54	8,140	9,130	51	8,323	9,427

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

[1] Includes Baldwin, Barbour, Bibb, Cherokee, Chilton, Clarke, Covington (1969), Dale, Dallas, Franklin, Geneva, Houston, Lowndes (1969), Marengo, Mobile, Morgan, Russell, Sumter, Talladega (1968), Tuscaloosa Counties, and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 11.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Sturctural	2,306	$2,439	$1.06	2,330	$2,471	$1.06
Paving	916	933	1.02	1,208	1,228	1.02
Fill	68	22	.32	79	31	.39
Other sands [1]	412	679	1.65	501	645	1.29
Total	3,702	4,073	1.10	4,118	4,375	1.06
Gravel:						
Structural	2,219	2,996	1.35	2,240	3,049	1.36
Paving	1,209	1,354	1.12	1,034	1,274	1.23
Other gravel [2]	1,010	707	.70	930	729	.78
Total	4,438	5,057	1.14	4,204	5,052	1.20
Total sand and gravel [3]	8,140	9,130	1.12	8,323	9,427	1.13

[1] Includes railroad ballast (1968), fire-furnace, engine, molding and other sands.

[2] Includes railroad ballast (1968), fill and other gravel, and miscellaneous gravel.

[3] Data may not add to totals shown because of independent rounding.

Leading producing counties were Jefferson, Morgan, and Shelby.

Dimension limestone was quarried by one company at an underground operation in Franklin County. Production declined 4 percent.

Three companies produced crushed and ground marble in Talladega County. Output increased 3 percent due to higher demand for extenders and fillers.

Dimension marble was quarried by one company in Talladega County. Major uses for the marble were dressed building stone and monumental stone. Production was below 1968 due to decline in demand for building stone.

Oystershell was dredged from Mobile Bay by one company at two operations. Production decreased 10 percent.

Sandstone was quarried and crushed by four companies in three counties. Production increased 42 percent.

Talc.—American Talc Company mined and ground talc in Talladega County for toilet preparations and other uses. The company also began a small talc mining operation in the Dudleyville area of Tallapoosa County.

Table 12.—Crushed limestone and dolomite sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Colbert	3	1,125	$1,339	4	W	W
Covington	1	W	W	1	W	$20
Jefferson	9	4,154	5,310	8	4,256	5,287
Limestone	1	46	70	1	18	26
Madison	4	1,462	1,439	4	W	W
Marshall	1	W	W	1	300	W
Morgan	4	2,116	2,614	4	W	W
Shelby	9	4,653	6,225	9	4,952	7,024
Other counties [1]	13	4,905	6,095	13	8,226	10,012
Total [2]	45	18,460	23,092	45	17,752	22,371

W Withheld to avoid disclosing individual company confidential data; included with "Other counties".
[1] Includes Bibb, Calhoun, De Kalb, Etowah, Franklin, Jackson, Lee, Marengo, St. Clair, Talladega, and Washington Counties, and counties indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Table 13.—Crushed limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Concrete aggregate	10,629	$13,233	$1.24	2,264	$2,709	$1,20
Bituminous aggregate	(1)	(1)	(1)	1,133	1,388	1.23
Dense graded base stone	(1)	(1)	(1)	3,828	4,673	1.22
Surface treatment aggregate	(1)	(1)	(1)	711	876	1.23
Cement manufacture	3,958	3,111	.79	3,865	3,018	.78
Lime manufacture	1,126	1,948	1.73	1,404	2,473	1.76
Fluxing stone	724	1,176	1.62	W	W	W
Agstone	985	1,599	1.62	949	1,544	1.63
Riprap	385	573	1.49	W	W	W
Railroad ballast	89	114	1.28	W	W	W
Other uses [2]	564	1,339	2.37	3,598	5,691	1.58
Total [3]	18,460	23,092	1.25	17,752	22,371	1.26

W Withheld to avoid disclosing individual company confidential data; included with "Other uses".
[1] Included in concrete aggregate in 1968.
[2] Includes unspecified construction aggregate (1969), metallurgical (1968), refractory stone, chemical stone, paper, asphalt (1969) and other fillers, rock dust for coal mines, mineral food, magnesium metal (1968), poultry grit (1968) and other uses, and uses indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

METALS

Bauxite.—Alabama ranked second among the States in bauxite production. Four companies mined crude bauxite in Barbour and Henry Counties. Production increased 3 percent.

Iron and Steel.—Production of pig iron was 5.0 million tons valued at $282 million, compared with 4.5 million tons valued at $245 million in 1968. Fourteen of 19 blast furnaces were operated during the year.

Iron ore.—Usable iron ore shipments declined 2 percent. The continued use of imported ores was reflected in the low production rates of domestic ores. Five mines produced iron ore, compared with seven mines in 1968. Iron ore used at agglomerating plants, blast and steel furnaces in the State consisted of 35 percent domestic ore and 65 percent foreign ore compared with 34 percent domestic and 66 percent foreign ore in 1968.

One company mined red iron ore in Jefferson County and another company shipped red iron ore from stockpiles in Tuscaloosa County. Four companies mined brown iron ore at four surface mines in two counties. Principal producing counties

were Franklin and Pike. Production of usable iron ore decreased 2 percent. Of the total usable iron ore shipments, only 10 percent was direct shipping ore compared with 13 percent in 1968.

Imports of iron ore, chiefly from Venezuela, were 12 percent above 1968 levels.

Magnesium.—Magnesium metal production from dolomite ceased at a plant near Selma in Dallas County.

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

	1968		1969	
	Number of mines	Long tons (thousands)	Number of mines	Long tons (thousands)
Mine production:				
By varieties:				
Hematite	1	1,078	1	1,036
Limonite	6	1,251	4	1,115
By mining methods:				
Open pit	6	1,251	4	1,115
Underground	1	1,078	1	1,036
Shipments from mines:				
Direct to consumers	1	148	1	109
To beneficiation plants	8	2,006	5	1,893

Table 15.—Usable iron ore production and shipments

	1968		1969	
	Long tons (thousands)	Iron content, natural (percent)	Long tons (thousands)	Iron content, natural (percent)
Production:				
Hematite	914	35	802	33
Limonite	411	47	389	47
Shipments:				
Direct-shipping ore	148	32	109	33
Concentrates and sinter	1,003	39	1,016	39
Total shipments	1,151	38	1,125	38

Table 16.—Principal producers

Commodity and company	Address	Type of activity	County
Alumina:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Plant	Mobile.
Aluminum smelters:			
Reynolds Metals Co	Reynolds Metals Bldg. Richmond, Va. 23218	----do	Colbert.
Asphalt (native):			
Southern Stone Co., Inc.[1]	2111 8th Ave. S. Birmingham, Ala. 35223	Quarry	Do.
Bauxite:			
Eufaula Bauxite Mining Co	Box 556 Eufaula, Ala. 36027	Open pit mine and plant.	Barbour.
A. P. Green Refractories Co	Box 608 Eufaula, Ala. 36027	----do	Do.
Harbison-Walker Refractories Co	1800 Farmers Bank Bldg. Pittsburgh, Pa. 15222	----do	Henry.
Wilson-Snead Mining Co	Box 84 Eufaula, Ala. 36027	2 open pit mines and plants.	Barbour and Henry.
Cement:			
Ideal Cement Co.[2]	420 Ideal Cement Bldg. Denver, Colo. 80202	Plant	Mobile.
Lone Star Cement Corp.[2]	Box 6237 West End Branch Richmond, Va. 23230	2 plants	Jefferson and Marengo.
National Cement Co.[2]	Box 3358 Birmingham, Ala. 35205	Plant	St. Clair.
Southern Cement Co.[2]	18th Floor Daniel Bldg. Birmingham, Ala. 35233	2 plants	Jefferson and Shelby.
United States Steel Corp.[2]	Box 2969 Pittsburgh, Pa. 15230	Plant	Jefferson.

See footnotes at end of table.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays:			
Bentonite:			
American Colloid Co	5100 Suffield Court Skokie, Ill. 60076	Open pit mine	Lowndes.
Fire:			
Dixie Clay Co	Box 361 Anniston, Ala. 36202	Open pit mine and plant.	Calhoun.
Donoho Clay Co	Box 843 Anniston, Ala. 36202	do	Do.
Glen-Gery Corp	Box 1542 Reading, Pa. 19603	Underground mine and plant.	Walker.
Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	2 open pit mines	Blount and Walker.
Marigold Coal, Inc	Jasper, Ala. 35501	Open pit mine	Walker.
Kaolin:			
Harbison-Walker Refractories	2 Gateway Center Pittsburgh, Pa. 15222	Open pit mine and plant.	Henry.
Thomas Alabama Kaolin Co	2412 Ken Oak Road Baltimore, Md. 21209	Open pit mine	Marion.
A. P. Green Refractories Co	Box 608 Eufaula, Ala. 36027	2 open pit mines and plants.	Barbour.
Miscellaneous:			
Bickerstaff Clay Products Co., Inc	Box 1178 Columbus, Ga. 31902	4 open pit mines and plants.	Jefferson and Russell.
Jenkins Brick Co	Box 91 Montgomery, Ala. 36101	2 open pit mines and plants.	Elmore and Montgomery.
Southern Cement Co	18th Floor Daniel Bldg. Birmingham, Ala. 35233	Open pit mine and plant.	Shelby.
United States Steel Corp	Box 2969 Pittsburgh, Pa. 15230	do	Jefferson.
Vulcan Materials Co	Box 7324-A Birmingham, Ala. 35223	do	Do.
Coal:			
Alabama By-Products Corp	Box 354 Birmingham, Ala. 35202	3 underground mines and 2 plants.	Do.
Peabody Coal Co	301 North Memorial Dr. St. Louis, Mo. 63102	3 strip mines and 2 plants.	Jefferson, Tuscaloosa, Walker.
Southern Electric Generating Co	600 North 18th St. Birmingham, Ala. 35203	2 underground mines and plants.	Shelby and Walker.
United States Steel Corp	Box 599 Fairfield, Ala. 35064	Underground mine and plant.	Jefferson.
Woodward Co	Woodward, Ala. 35189	2 underground mines and plants.	Do.
Coke:			
Alabama By-Products Corp	Box 6527 Tarrant, Ala. 35217	Plant	Do.
Republic Steel Corp	25 Prospect Ave., N.W. Cleveland, Ohio 44115	do	Etowah.
U. S. Pipe & Foundry Co	Box 2651 Birmingham, Ala. 35212	do	Jefferson.
United States Steel Corp	Box 599 Fairfield, Ala. 35064	do	Do.
Woodward Co	Woodward, Ala. 35189	do	Do.
Ferroalloys:			
Calumet & Hecla Corp	Calumet Ave. Calumet, Mich. 49913	do	Dallas.
Tennessee Alloys Corp	Bridgeport, Ala. 35740	do	Jackson.
Tennessee Valley Authority	Muscle Shoals, Ala. 35660	do	Colbert.
Union Carbide Corp	270 Park Ave. New York, N. Y. 10017	do	Colbert and Jefferson.
Woodward Co	Woodward, Ala. 35189	do	Jefferson.
Iron ore:			
Hematite:			
Woodward Co	Woodward, Ala. 35189	Underground mine.	Do.
Limonite:			
Shook & Fletcher Supply Co	Box 2631 Birmingham, Ala. 35202	2 open pit mines	Blount and Franklin.
U. S. Pipe & Foundry Co	Box 2651 Birmingham, Ala. 35202	Open pit mine	Franklin.
Liquefied Petroleum Gas:			
Cities Service Oil Co	Bartlesville, Okla. 74003	Plant	Mobile.
Lime:			
Alabaster Lime Co	Siluria, Ala. 35144	Limekiln	Shelby.
Cheney Lime & Cement Co	Calgood, Ala. 35013	do	Do.
Longview Lime Co	Woodward, Ala. 35189	do	Do.

See footnotes at end of table.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Lime—Continued			
Southern Cement Co	18th Floor Daniel Bldg. Birmingham, Ala. 35233	Limekiln	Shelby.
United States Gypsum Co	101 South Wacker Drive Chicago, Ill. 60606	Limekiln and plant.	Do.
Mica, scrap:			
United States Gypsum Co	101 South Wacker Drive Chicago, Ill. 60606	Open pit and plant.	Randolph.
Natural gas:			
Black Warrior Petroleum Co., Inc.	Box 1642 Mobile, Ala. 36601	Gasfield	Escambia.
Natural gasoline:			
Cities Service Oil Co	Bartlesville, Okla. 74003	Plant	Mobile.
Petroleum:			
Crude:			
Ancora Corporation	1 Jackson Place, Suite 620 San Francisco, Calif. 94111	Citronelle field	Do.
E. L. Erickson	1235 Petroleum Building Jackson, Miss. 39201	Toxey field	Choctaw.
Mobil Oil Corporation	Box 900 Dallas, Tex. 75221	Citronelle field	Mobile.
Pruett & Hughes Co	390 Petroleum Building Jackson, Miss. 39201	Choctaw Ridge field.	Choctaw.
Sun Oil Company	Box 2880 Dallas, Tex. 75221	Citronelle field	Mobile.
Refineries:			
Alabama Refining Co	Mobile, Ala. 36600	Plant	Mobile.
Chevron Asphalt Co	----do----	----do----	Do.
Hunt Oil Co	Tuscaloosa, Ala. 35401	----do----	Tuscaloosa.
Vulcan Asphalt Refining Co	Cordova, Ala. 35550	----do----	Walker.
Warrior Asphalt Co	Tuscaloosa, Ala. 35401	----do----	Tuscaloosa.
Phosphate Rock:			
Monsanto Co	800 N. Lindbergh Blvd. St. Louis, Mo. 63141	Open pit	Limestone.
Pig iron:			
Republic Steel Corp	1629 Republic Bldg. Cleveland, Ohio 44115	Blast furnaces and mills.	Etowah and Jefferson.
U. S. Pipe & Foundry Co	Box 2651 Birmingham, Ala. 35202	----do----	Jefferson.
United States Steel Corp	Box 599 Fairfield, Ala. 35064	----do----	Do.
Woodward Co	Woodward, Ala. 35189	----do----	Do.
Salt:			
Olin Mathison Chemical Corp	Box 28 McIntosh, Ala. 36553	Brine wells	Washington.
Sand and gravel:			
Alabama Gravel Co	2325 City Federal Bldg. Birmingham, Ala. 35203	2 dredges	Elmore and Montgomery.
Radcliff Materials Inc	Mobile, Ala. 36601	Dredge	Mobile.
W. T. Ratliff Co., Inc	Box 445 Knoxville, Tenn. 37901	Open pit mine	Clarke.
C. T. Thackston Sand and Gravel Co.	Box 3211 Montgomery, Ala. 36101	----do----	Montgomery.
Vulcan Materials Co	Box 7324-A Birmingham, Ala. 35223	2 open pit mines	Macon and Montgomery.
Stone:			
Dolomite:			
Alamet Corp	Box 348 Selma, Ala. 36702	Quarry	Bibb.
Dolcito Quarry Co	Box 6566 Birmingham, Ala. 35217	----do----	Jefferson.
Montevallo Limestone Co., Inc.	Box 6493 Birmingham, Ala. 35217	----do----	Shelby.
U. S. Pipe & Foundry Co	3300 First Ave. N. Birmingham, Ala. 35202	----do----	Jefferson.
U. S. Steel Corp	Box 599 Fairfield, Ala. 35064	----do----	Do.
Limestone, crushed:			
Lone Star Cement Corp	Box 6237 West End Branch Richmond, Va. 23230	3 quarries	Jefferson, Marengo, Washington.
Madison Limestone Co., Inc.	Box 46 Huntsville, Ala. 35804	----do----	Madison.
Southern Cement Co	18th Floor Daniel Bldg. Birmingham, Ala. 35223	2 quarries	Shelby.

See footnotes at end of table.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone, crushed—Continued			
Vulcan Materials Co	Box 7324-A Birmingham, Ala. 35223	6 quarries	Colbert, Etowah, Franklin, Jackson, Shelby, Talladega.
Wade Sand & Gravel Co., Inc.	Box 39048 Fairview Station Birmingham, Ala. 35208	Quarry	Jefferson.
Limestone, dimension:			
Georgia Marble Co	Russellville, Ala. 35653	----do	Franklin.
Marble, crushed:			
Georgia Marble Co	Gantts Quarry, Ala. 35069	2 quarries and plant.	Talladega.
Moretti-Harrah Marble Co	Box 330 Sylacauga, Ala. 35150	Quarry and plant	Do.
Thompson-Weinman & Co	Cartersville, Ga. 30120	Quarry	Talladega.
Marble, dimension:			
Moretti-Harrah Marble Co	Box 330 Sylacauga, Ala. 35150	Quarry and plant	Do.
Oystershell:			
Radcliff Materials, Inc	Box 1288 Mobile, Ala. 36601	2 dredges and plants.	Mobile.
Sandstone, crushed:			
Sisson & Bailey Stone Co	Route 3 Oneonta, Ala. 35121	----do	Blount.
United States Steel Corp	Box 2969 Pittsburgh, Pa. 15230	----do	Jefferson.
Enos Vann	Box 246 Trussville, Ala. 35173	----do	Do.
Talc:			
American Talc Co	Alpine, Ala. 35014	2 open pit mines and plant.	Talladega and Tallapoosa.

[1] Asphaltic limestone.
[2] Portland and masonry cement.
[3] Portland, masonry, and slag cement.

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, the Division of Mines and Geology and the Division of Oil and Gas of the Alaska Department of Natural Resources, for collecting information on all minerals.

By Kevin Malone,[1] Donald P. Blasko [2] and James A. Williams [3]

Prudhoe Bay oil, and activities related to bringing this huge new discovery in far northern Alaska to commercial production, dominated the news of the mineral industry in the State in 1969. Oil men went all out in drilling programs and allied investigations in order to amass information on which to base bids for the September lease sale of North Slope lands. The logistics involved in supplying this intense activity resulted in record barge shipments from Seattle and Canada. Fairbanks boomed. Record airfreight shipments in the months before the sale were set only to be broken in the next reporting period.

[1] Physical scientist, Bureau of Mines, Juneau, Alaska.
[2] Petroleum engineer, Bureau of Mines, Anchorage Field Office, Anchorage, Alaska.
[3] Director, Division of Mines and Geology, Department of Natural Resources, State of Alaska, College, Alaska.

Table 1.—Mineral production in Alaska [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Antimony ore and concentrate—short tons, antimony content	3	W	12	$13
Coal (bituminous)—thousand short tons	750	$4,502	667	4,366
Gold (recoverable content of ores, etc.)—troy ounces	21,262	[2] 835	21,227	[2] 881
Lead (recoverable content of ores, etc.)—short tons	W	W	2	1
Natural gas—million cubic feet	17,343	4,388	50,864	12,665
Petroleum (crude)—thousand 42-gallon barrels	66,204	186,695	73,953	214,464
Sand and gravel—thousand short tons	18,013	20,366	16,205	18,615
Silver (recoverable content of ores, etc.)—thousand troy ounces	4	8	2	4
Stone—thousand short tons	W	W	1,954	8,902
Value of items that cannot be disclosed: Barite, copper (1968), gem stones, LP gases, mercury, platinum-group metals, tin and values indicated by symbol W	XX	4,923	XX	2,865
Total	XX	221,717	XX	257,776
Total 1967 constant dollars	XX	r221,241	XX	p247,194

p Preliminary. 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] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

Table 2.—Value of mineral production in Alaska, by region [1]

(Thousands)

Region	1968	1969	Minerals produced in 1969 in order of value
Alaska Peninsula	W		
Aleutian Islands	W	W	Sand and gravel, stone.
Bristol Bay	W	W	Sand and gravel, mercury.
Cook Inlet-Susitna	$154,802	$192,658	Petroleum, sand and gravel, natural gas, stone, coal, gold, gem stones, silver.
Copper River	3,869	2,000	Sand and gravel, stone, gold.
Kenai Peninsula	44,203	46,902	Petroleum, natural gas, stone, sand and gravel.
Kodiak	W	W	Sand and gravel, stone.
Kuskokwim	1,178	W	Platinum-group metals, mercury, gold, gem stones, silver.
Northern Alaska	W	392	Petroleum, natural gas, sand and gravel.
Northwestern Alaska	129	481	Sand and gravel, gem stones.
Seward Peninsula	97	424	Sand and gravel, gold, stone, tin, gem stones, silver.
Southeastern Alaska	5,320	4,333	Sand and gravel, barite, stone, gold, silver.
Yukon River	11,480	7,968	Coal, sand and gravel, stone, gold, gem stones, antimony, silver, lead.
Undistributed	639	2,618	
Total	221,717	257,776	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] No production reported in the Bering Sea region.

Table 3.—Indicators of Alaska business activity

		1968	1969 [p]	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	100.1	107.9	+7.8
Unemployment	do	9.1	9.4	+3.8
Employment:				
Construction	do	6.0	6.7	+11.7
Aerospace [1]	do	2.5	3.1	+24.0
Lumber and wood products	do	2.5	2.5	-------
Food processing	do	3.3	3.2	−3.0
All manufacturing	do	6.9	7.0	+1.4
All industries	do	91.0	98.5	+8.2
Factory payrolls	millions	$63.3	$69.3	+9.5
Personal income:				
Total	do	$1,180.0	$1,272.0	+12.6
Per capita		$4,124.0	$4,512.0	+9.4
Construction:				
Payroll	millions	$100.1	$117.9	+17.8
Highway work completed	do	$52.1	$41.5	−20.3
Gross business receipts	do	$1,555.3	$2,077.8	+33.6
Construction	do	$352.2	$312.8	−11.2
Retail sales	do	$514.3	$596.3	+15.9
Manufacturing	do	$100.9	$110.8	+9.8
Resource production:				
Agriculture	do	$5.5	$5.0	−9.1
Fisheries	do	$217.5	$192.0	−11.7
Forest products	do	$91.0	$100.0	+9.9
Mineral	do	$221.7	$257.7	+16.2
Utility sales	million kilowatt hours	841.0	956.0	+13.7
Foreign trade:				
Exports	millions	$55.3	$92.8	+67.8
Imports	do	$23.7	$52.5	+121.5
Population:	thousands	284.9	294.6	+3.4
Civilian	do	252.3	262.2	+3.9
Military	do	32.6	32.4	−0.6

[p] Preliminary.
[1] Air transportation.

Sources: Survey of Current Business, State Department of Labor, Agricultural Crop and Livestock Reporting Service, State Department of Highways, State Department of Revenue, State Department of Economic Development.

Table 4.—Worktime 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
1968:								
Coal	107	213	23	202	--	19	94.03	1,821
Metal	237	128	30	260	1	7	30.80	27,089
Nonmetal	18	160	3	25	1	2	118.18	237,975
Sand and gravel	685	195	133	1,181	--	28	23.71	522
Stone	113	125	14	115	--	2	17.34	564
Total [1]	1,160	175	204	1,784	2	58	33.64	7,921
1969: [p]								
Coal	110	221	25	213	--	17	79.82	1,517
Metal	200	145	29	256	--	7	27.33	437
Nonmetal	15	177	3	20	--	--	--	--
Sand and gravel	885	163	145	1,157	--	26	22.47	521
Stone	135	168	22	197	--	3	15.24	437
Total [1]	1,350	165	223	1,843	--	53	28.76	610

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 5.—Expenditures by major companies for exploration, prospecting, and development

(Thousands)

Type and region	1968	1969 [p]
Metals exploration: [1]		
Arctic Alaska	[r] $710	$1,080
Interior Alaska	[r] 120	750
Western Alaska	[r] 1,240	2,500
Southwestern Alaska	[r] 50	110
South-central Alaska	[r] 850	1,320
Southeastern Alaska	[r] 1,540	3,910
General [1]	(1)	580
Total metals	[r] 4,510	10,250
Oil and gas (statewide):		
Exploration	63,600	NA
Development drilling	66,400	NA
Production	28,700	NA
Refinery construction and maintenance	55,800	NA
Pipeline construction	18,200	NA
Total oil and gas	232,700	NA
Grand total	237,210	NA

[p] Preliminary. [r] Revised. NA Not available.
[1] In 1968 general expenses were distributed elsewhere.

Source: Division of Mines and Geology, and Division of Oil and Gas, Department of Natural Resources, Alaska.

The sale itself set numerous records including some $900 million in bonus bids, a testimonial of the industry's appraisal of the 1968 discoveries. For contrast, the 1968 sale of Outer Continental Shelf lands at Santa Barbara, Calif. netted some $603 million, the previous high.

Total value of mineral production in 1969 was $257.8 million, an increase of 16 percent above the 1968 figure. Crude oil and natural gas production, $214.4 million and $12.7 million respectively, made up 88 percent of the total. Value of sand and gravel, the State's second-place mineral commodity, decreased from $20.4 million to $18.6 million. Tonnage produced was 16.2 million versus 18.0 million in 1968. Both tonnage and value of coal were down. Unit value increased to $6.54 per ton from the $6.00 figure of 1968. Gold, no

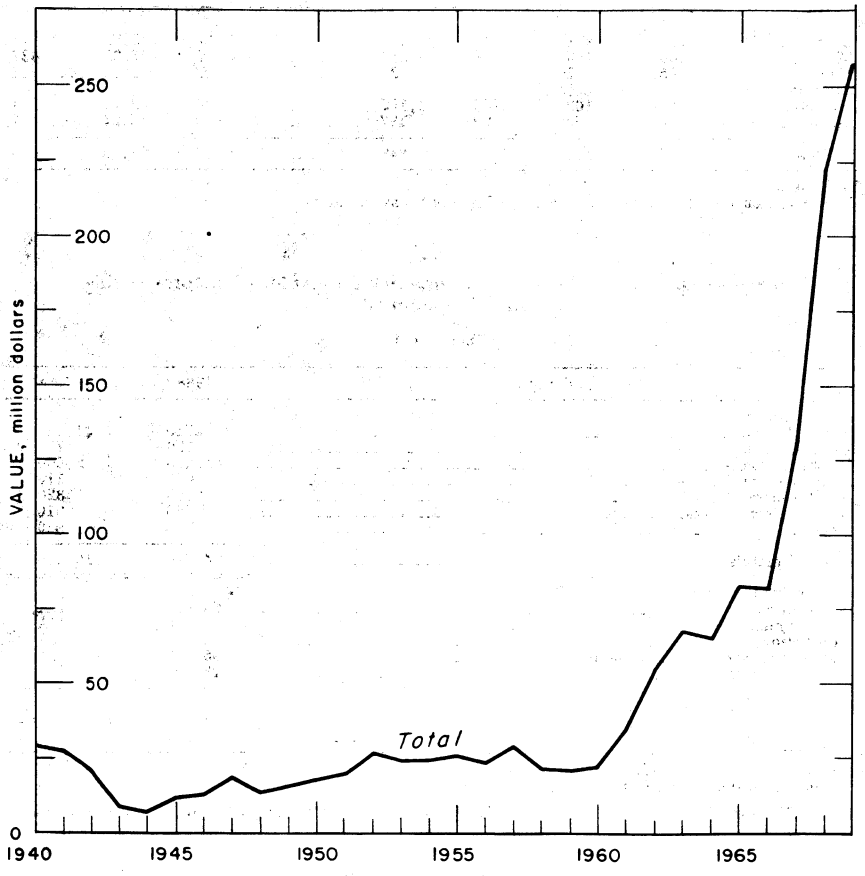

Figure 1.—Total value of mineral production in Alaska.

longer significant in the mineral figures, increased nominally in both physical volume and value.

Legislation and Government Programs.—Power needs of the State and methods of meeting these were outlined in the Federal Power Commission's Alaska Power Survey published in 1969. Initiated in the spring of 1965, the study's chief purpose was to determine how best to meet the State's load growth in the years to 1985. Patterns of development which could reduce the statewide average cost of electricity by 65 percent at 1969 dollar values were seen as a result of growth in consumption and of closer coordination of power systems, particularly in the more populated areas of the State.

Total 1965 cost of generation, transmission, and distribution by Alaska utilities was reported as 2.69 cents per kilowatt hour. By 1985 the State's economy was expected to require more than 6.1 billion kilowatt-hours annually. Civilian demand was put at 4.8 billion kilowatt-hours, 6 3/4 times the 1965 usage. The study used an annual growth rate of 3.9 percent with 1985 population reaching 550,000 (270,000 in 1968).

In the fall, the Atomic Energy Commission (AEC) successfully conducted Project Milrow. This was a calibration test of a 1 megaton device to determine the suitability of the Amchitka test site for more powerful blasts. The underground blast was at a depth of 4,000 feet, 1,700 feet deeper than the 1965 detonation of project Long Shot. The results apparently established that the Amchitka site in the Rat Islands far out on the Aleutian Chain was capable of withstanding additional and stronger detonations.

Project Milrow engendered strong opposition from diverse groups including government groups in Japan and Canada, conservationists, and Native groups. The basis for much of the opposition was fear of the blast triggering earthquakes or destructive tidal waves. A 2-year delay was expected before AEC undertook further Amchitka testing.

Under a policy of opening certain Native reservations in Alaska for mining, the Fairbanks office of the Bureau of Indian affairs issued a Notice of Availability of Nonexclusive Prospecting Permits on the Venetie-Chandalar Indian Reservation. The area, between the Chandalar and Christian Rivers north of the Yukon River and of the Artic Circle, covered lands as far north as Artic Village above the 68th parallel. Mineral prospecting permits, excluding oil and gas and sand and gravel, were available without lease option. Bids for exclusive-prospecting permits on 640-acre units, with no limit on number of units, were scheduled for opening in spring, 1970. Other areas which the Bureau was reportedly considering included Akutan, Annette Island, Diomede Islands, Karluk, Klukwan, Unalakleet, and Wales.

The Snettisham hydroelectric project 30 miles southeast of Juneau was temporarily shut down in the fall through lack of funding. Work was finished on the diversion tunnel, docks, airfields, and on a road to the powerhouse area. At yearend, with new funding arranged, bids were in process for the dam, underground powerhouse chamber, and ancillary gear. Other main contracts to be let included the transmission system and the generators.

As a result of court decisions which substantially reduced its jurisdiction in Alaska trade matters, the Federal Maritime Commission closed its Anchorage facility, transferring Alaska matters to the Washington, D.C., office. The Ninth Circuit Court of Appeals in San Francisco had ruled against the Commission and for the Interstate Commerce Commission in a case involving through-rate business. The U.S. Court of Appeals made a similar decision in another case.

Noting the rapid growth in air traffic to the North Slope, the Civil Aeronautics Board (CAB) broadened its Alaska service investigation to include traffic to the booming Prudhoe Bay area. The Board ordered a comprehensive review—the first in 10 years—of major airline routes in the State. CAB planned to examine the entire Alaska air route structure to determine changes needed to provide better public service, eliminate uneconomic and wasteful competition, improve carrier scheduling and operational flexibility, and reduce subsidy payments.

At the State level, the Legislature eliminated the discovery royalty consideration on oil and gas. The State had allowed a 10-year reduction, to 5 percent of the usual 12 1/2-percent royalty due on production from State-owned lands. In another action the Commissioner of Natural Resources announced competitive bidding

only on all future leasing on State oil and gas lands.

In a State sponsored study, Stanford Research Institute (SRI) recommended spending of interest only from the $900 million North Slope bonus windfall. SRI noted the adverse effect of sudden taxation changes on marginal oilfields and on future investment in oil development. A gradual annual increase in the severance tax to 10 percent, and an increase from 12 1/2 to 15 percent in royalty were among other Institute recommendations.

Wages and Hours.—Total insured wages in the mineral industries in the calendar year 1969, as reported by the Alaska Department of Labor, were $56.3 million ($38.0 million in 1968). Average monthly employment was 3,494 (2,452 in 1968), with 221 (154 in 1968) units reporting. In the mineral industries covered by the Employment Securities Act (operators with hired labor) monthly earnings averaged $1,346 compared with $1,293 in 1968. Monthly earnings in metal mining were $946; in nonmetal mining $1,225; in coal mining $1,430; and in oil and gas including production and exploration, $1,366. The figures for 1968 were $876, $1,140, $1,225, $1,327, respectively.

Transportation.—Service and supply requirements for North Slope drilling operations received major attention from the transportation industry in 1969. Construction of a winter road from Livengood, northwest of Fairbanks, to Sagwon in the oilfields was completed in March. Dubbed the Ice Road, the controversial project was built by the Department of Highways following rejection of all bids offered by private contractors. Extreme cold, to 70° below zero, hampered the work; 40° to 45° below was considered the maximum low working temperature. Movement of heavy construction equipment under its own power, as well as heavy freight trucked, were of major assistance to the oil industry and its contractors. Rates were essentially the same as airfreight.

At yearend State plans for a permanent road to the North Slope were announced. Alaska planned to enter into an agreement with Trans Alaska Pipeline System (TAPS) to assume ownership of the proposed gravel-surfaced road to be built for construction of the pipeline. As a part of the agreement with TAPS, the State agreed to reopen a substantial part of the Ice Road for the 1970 winter haul.

Table 6.—Coastwise receipts and foreign mineral trade

(Short tons)

Commodity	1967			1968		
	Coastwise receipts	Imports	Exports	Coastwise receipts	Imports	Exports
Bituminous coal and lignite	79			62		
Gasoline	354,348			343,107	35,428	
Kerosine, distillate, residual fuel oil	1,037,850	350,395		939,514	309,560	
Asphalt, tar, pitches	11,848			14,779		
Lubricating oils and greases	564			7,521		
Petroleum and coal products, n.e.c	7,001	89,059		7,102	120,034	
Building cement	20,904	3,321		62,365	1,690	
Building stone, unworked; crushed and broken stone	410					
Clay, ceramic and refractory materials	10,855			10,599		
Structural clay products including refractories	2,167	102	13	1,615	60	
Sulfur	36	5,775		9,608	8,732	
Sand and gravel	2,579	3,749		1,020	2,000	
Iron ore and concentrate						
Iron and steel scrap	1,423			441		
Iron and steel products	8,133	4,242		5,288	1,551	
Aluminum and aluminum alloys, unworked	133			51		
Lead and zinc including alloys, unworked				84		
Nonferrous metal ores and concentrates, n.e.c	54		16,189	36		15,197
Nonferrous metals primary smelter products, basic shapes, wire, castings and forgings, except copper, lead, zinc and aluminum	61			416		
Fertilizer materials	319					

Source: U.S. Army Corps of Engineers, Waterborne Commerce of the United States. Part 4, Pacific Coast, Alaska and Pacific Islands. Calendar years 1967–68.

Movement of freight by air to the Slope grew tremendously during the year. In what some observers saw as the largest civilian cargo airlift in history, the Federal Aviation Administration (FAA) took over air routing control and was enforcing aircraft and aircrew regulations. FAA predicted air traffic on the Slope of from 500 to 800 operations per day. Improved communications and navigational aids were seen as essential to relieve the congested air traffic incident to the oil industry's exploration and development operations.

Waterborne freight also played a major role in servicing North Slope operations. In a multicarrier operation, 19 tugs hauling 38 barges, moved some 75,000 tons, including 100,000 barrels of fuel oil from Seattle to Prudhoe Bay. The convoy, which included ancillary lightering craft, waited at Point Barrow for a path to open in the Artic icepack before proceeding on to the Prudhoe Bay unloading point. Limited time of ice-free passage, very shallow ocean depths, and improvised dockage facilities made this shipment a truly remarkable feat of waterborne transportation.

The Department of Transportation (DOT) gained Bureau of the Budget approval for its proposed study of a railroad and highway corridor to the North Slope. DOT was seeking a $3 million allocation for continuation of detailed route studies. State officials favored extension of the Alaska Railroad from Fairbanks to the Yukon River at Nenana thence north to Alatna on the Koyukuk River. From Alatna a northwest spur to the Kobuk River and Kennecott's copper exploration at Bornite was proposed as well as a northern spur through Anaktuvuk Pass to the North Slope. At yearend the survey of the Nenana to the Yukon section was about completed.

In an experiment that could have major implications on transportation in Alaska, Humble Oil & Refining Co. sent the 115,000-ton tanker SS Manhattan from Atlantic waters through the Northwest Passage to Point Barrow and return. The Manhattan was especially strengthened and fitted with icebreaking gear and was accompanied by U.S. Coast Guard and Canadian Coast Guard icebreakers. Purpose of the test was to investigate the many factors bearing on the feasibility of moving North Slope crude oil to Eastern marketing areas. Humble reported encouraging operational results from the tests, but noted factors regarding economic feasibility were still to be determined from a study of the data gained during the dual traverse.

Alaska Hydro-Train (formerly Puget Sound Alaska Van Lines) continued to add to equipment in the Alaska trade and to improve service to shippers. New rail-car barges, twin-screw, 7,000-horsepower tugs, and extended dock facilities enabled the carrier to maintain three departures per week from Seattle. The firm projected daily Seattle departures based on the rate of increase in freight destined for Alaska in 1969.

Late in the year, Sea-Land Service, Inc., announced plans to expand service between Alaska and Seattle early in 1970. A third containership was to be added to the two then in use to increase container carrying capacity by 50 percent over that of 1969. Sea-Land, which entered into Alaska service in May 1964 and was the first carrier to sail unaided through icebound Cook Inlet in December of that year, had consistently added to its Alaska services.

Small ports in the State were benefiting from a freight handling agreement between Sea-Land and Foss Tug and Barge Co. Tugs and barges of Foss were being used to deliver to the smaller ports cargo shipped to Anchorage in Sea-Land van ships. Backhaul freight from Kodiak and other way points consisted mostly of seafood products processed in the cannery ports. Transportation costs in Alaska, always high and a drag on attempts to develop the State's mineral and other resources, thus gave some promise of relative reductions as the State developed through normal growth.

Among other notable developments in transportation were investigations into the feasibility of using hovercraft-type vehicles in North Slope operations. Bell Aerosystems, Inc., at the request of Alaska's Senator Gravel, completed a 3-month study on heavy cargo hovercraft adaptable to North Slope use and produced a prototype design for cargo vehicles with capacities to 50 tons. By mid-summer Cities Service Oil Co. was using a 900-horsepower craft with capacity for 7 tons of equipment and 2 tons of fuel in North Slope exploratory operations. Passage of crews and equipment

without damage to the Arctic tundra was seen as an important feature of the experimental craft.

Alaska Airlines, which pioneered the use of the Hercules cargo plane in Alaska airfreight in 1965, made a bid for another breakthrough in proposing tourist flights to the Soviet Union from Seattle and Alaska points.

At yearend the American and Soviet governments had the airlines' applications under consideration.

In road and bridge construction, the State Division of Highways reported satisfactory progress along a number of fronts. For the first time, the Department was able to obligate the entire amount of federal funds available for highway work. More than $52 million in federal-aid money, most of it for actual highway construction, was obligated in 1969. This was a noteworthy achievement in view of the limitations imposed by the Department of the Interior's statewide land freeze on federal lands.

In spite of the land freeze and other deterrents, design work on the closing gap in the Anchorage-Fairbanks Highway was completed. Situated in the Nenana Canyon, the project was to be the largest single contract awarded by the Department of Highways. Funding was expected in time for a full season's work in 1970 with completion of construction slated for fall 1971. The new highway would provide a direct artery between Alaska's two largest cities, eliminating reliance on the circuitous Richardson and Glenn highways.

Table 7.—Freight rates, Seattle to selected Alaskan cities in 1969 Hydrotrain service [1]

(Cents per hundred pounds)

Commodity	Minimum shipment (pounds)	From Seattle to—		
		Anchorage via Whittier	Fairbanks via Whittier	Seward via Whittier
Groceries	60,000	238	302	---
Do.	80,000	189	253	---
Do.	[2] 100,000	113	178	---
Iron or steel articles	50,000	283	349	273
Do.	80,000	194	239	187
Do.	100,000	183	228	177
Machinery	60,000	269	316	254
Do.	80,000	231	278	216
Do.	100,000	220	267	205
Lumber	80,000	186	239	187
Do.	100,000	175	228	177
Do.	120,000	173	---	---
Ores and concentrates (southbound only) [3]	60,000	119	158	---
Do.	80,000	100	140	---
Do.	100,000	95	134	---
Petroleum and products	60,000	229	336	229
Do.	80,000	191	298	191
Do.	100,000	180	287	180

[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: Alaska Hydro-Train.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Tonnage of coal produced was down 11 percent from that of 1968. Value dropped only 3 percent as unit value rose to $6.54 from $6.00. Usibelli Coal Mine, Inc., and Vitro Minerals Corp., a subsidary of Vitro Corp. of America, both operating in the Nenana (Healy River) field were the major producers. Alaska Matanuska Coal Co., operating the Premier mine in the Matanuska field, produced a small quantity of coal for local use. All coal was produced from strip operations.

Cortella Coal Corp. of Cordova continued examination work on deposits in the Bering River field, north of Controller Bay on the Gulf of Alaska. The company made core drill and other tests in an attempt to establish sufficient reserves to allow ship-

ments of Bering River coal to Japan for coking use. A study of samples, made at the Mineral Industry Research Laboratory of the University of Alaska, showed ash content to as low as 2 percent using various washing techniques.

If reserves of 15 to 20 million tons could be established, economic exploitation of Bering River coals was seen. Shipment by truck, narrow-gauge railroad, or by pipeline to a loading site on the Gulf of Alaska was under study. Bering River coals were of particular interest to the Japanese because of their coking qualities.

Japanese businessmen also showed interest in the Kukpowruk River coalfields in remote northwestern Alaska. Immense coal resources, as yet only very sketchily outlined, are indicated in an area between Point Hope and Point Barrow north of Bering Strait on the Chukchi Sea. Previous work by the Bureau of Mines showed the Kukpowruk coals as capable of producing metallurgical quality coke by blending with as little as 15 percent of strongly coking coals. Morgan Coal Co. of West Virginia held coal prospecting permits on the Arctic coals; Kaiser Steel Corp. was reported as planning exploration and examination work in the 1970 season. The Alaska land freeze, an outcome of Native claims for aboriginal rights, deterred activity in this area as well as in other parts of the State.

In the Beluga coalfield on the west side of Cook Inlet opposite Anchorage, American Exploration and Mining, Inc., proceeded with examination of the company's holdings. Beluga reserves are large and well situated, but the coals are low-grade lignites with high ash and water content. Possibility of an on-site plant to convert the coals into marketable coal products was under investigation. Morgan Coal was also active in the Beluga field. The Bureau of Mines explored and reported[4 5] on the Beluga coals in the early 60's.

New contracts awarded by the Department of Defense for coal to supply the Northern military bases in fiscal year 1970 were 417,000 tons at a cost of $2.7 million. The figures for fiscal year 1969 were 420,000 tons and $2.6 million, respectively. Usibelli Coal Mine, Inc., was awarded a contract for 176,000 tons at $6.65 per ton. Vitro Minerals Corp, received a contract for 241,000 tons at $6.51. Both companies operated in the Nenana field. Vitro also received the University of Alaska contract, bringing its estimated output to over 300,000 tons. Usibelli, supplying City of Fairbanks and Golden Valley Electric Association Inc. needs, expected to produce 325,000 tons.

Petroleum and Natural Gas.—Crude oil production in Alaska, which had doubled that of the previous year in 1967 and again in 1968, grew by a more modest 12 percent in 1969. Production, including 60,000 barrels refined on the North Slope for local use, was 74.0 million barrels compared with 66.2 million in 1968. Except for the small North Slope output noted, all production was from the Cook Inlet basin. This area had four producing offshore fields and the Swanson River field on the Kenai Peninsula.

At the Swanson River field, the initial discovery (1957) in the Cook Inlet basin, average monthly production showed a decline of 4 percent from the 1968 figures. Standard Oil Company of California, operator of the field, continued the gas repressurization program started in 1964. In No-

[4] Geer, M. R., and F. D. Fennessy. Washability of Coals From the Matanuska Valley and Beluga River Fields. BuMines Rept. of Inv. 6017, 1962, 33 pp.

[5] Warfield, Robert S. Investigation of a Subbituminous Coal Deposit Suitable for Opencut Mining, Beluga River Coalfield, Alaska. BuMines Rept. of Inv. 6238, 1963, 100 pp.

Table 8.—Production of crude petroleum and natural gas

Year	Crude petroleum		Natural gas [1]	
	Thousand 42-gallon barrels	Value (thousands)	Million cubic feet	Value (thousands)
1965	11,128	$34,073	7,255	$1,799
1966	14,358	44,007	11,267	2,794
1967	29,126	91,164	14,438	3,610
1968	66,204	186,695	17,343	4,388
1969	73,953	214,464	50,864	12,665

[1] Figures represent "Marketed production" of natural gas, which includes gas sold and used on lease but does not include gas flared, lost, or injected.

Table 9.—Oil and gas lease acreage under Federal supervision

Year	Acres (thousands)
1965	10,184
1966	9,275
1967	7,135
1968	6,841
1969	6,936

Source: 1965–1969, Oil and Gas and Mineral Leases, Licenses, and Permits Public, Acquired, Indian, Naval Petroleum Reserve, and Outer Continental Shelf Under Supervision December 31, Conservation Division, U.S. Geological Survey, U.S. Department of the Interior.

vember, Standard announced the production of the 100 millionth barrel of Swanson River crude. Average monthly production in 1969 was 1,095,906 barrels.

Daily production per well from the offshore fields, which had peaked at 1,541 barrels early in 1968, continued to decline in the first half of 1969. Cook Inlet operators chose water flooding to augment reservoir pressures. At yearend water was being injected into the producing formations of two of the four offshore fields, and injection wells were being prepared for the two remaining fields. Daily production per well began climbing midway through the year; by the end of the year an increasing production trend was established.

The McArthur River field was Alaska's major producer. An average of 40 producing wells grossed 32.4 million barrels valued at $84.4 million. Swanson River, with 13.1 million barrels and $39.1 million from 42 wells was a distant second. Other major producing fields were Granite Point, 9.2 million barrels and $24.6 million from 37 wells; Middle Ground Shoal, 8.5 million barrels and $23.3 million from 34 wells; and Trading Bay, 8.9 million barrels and $22.1 million from 32 wells.

As the decade of the 60's drew to a close, Alaska's oil and gas industry had recorded impressive production figures. In the 12-year period from 1958 to 1969, following the 1957 discovery at Swanson River, cumulative value of oil and gas production reached $699 million. For contrast, the entire mineral production of the State from the beginning of record keeping in 1880 to 1957 amounted to $1,162 million. Numerous adjustments and allowances were required, of course, to compare such figures. Their relative magnitudes, nevertheless, gave a guage of the industry's accomplishments and of its impact on the economy of the State and of the Nation. Exploitation of the North Slope discoveries in the next decade was expected to result in production far outstripping previous output.

No new oil or gas discoveries were recorded for the State in 1969. On the North Slope, where much of the drilling accomplished was on tight-hole basis (i.e., no results made public) and where producing formations were in the early stages of delineation, some wells might later be classified as successful wildcats or as discovery wells. In the Gulf of Alaska, Tenneco Oil Co. and associates drilled the first well in the Gulf area since 1963 and the first offshore Gulf well. The wildcat, about 3 miles east of Middleton Island, was plugged and abandoned after drilling more than 12,000 feet. Panoil Co. and Arabian Shields also spudded a well near Katalla. The well was drilled to 400 feet and suspended over the winter. Katalla was the scene of the earliest oil production in Alaska from shallow formations. The minor output was refined on site for local use in fishing boats; it ceased in 1933 when fire destroyed the small topping plant.

In the Copper River basin, Consolidated Oil & Gas with allied companies, drilled west of Glennallen. The well was at 4,000 feet and drilling at yearend. On the Alaska Peninsula near Port Moller, Pan American Petroleum Corp. plugged and abandoned the David River No. 1–A wildcat. The well, bottomed at 13,750 feet, was the first test on the Peninsula since 1967.

Eleven exploratory wells were drilled in the Cook Inlet Basin during the year. Three were in the Susitna River Valley, six on the west side of Cook Inlet, one on the Kenai Peninsula, and one was drilled from an offshore platform.

In summary, 68 exploratory wells including 53 in the Prudhoe Bay area were drilled. Some of the Prudhoe Bay wells may eventually be classed as development. Twenty-three of the North Slope wells were oil wells; one, drilled by Pan American Petroleum Corp., was classed as the discovery well for the Kavik gasfield. Of the remaining 44 wells, 18 were plugged and abandoned; 13 were suspended; and 13 were drilling at yearend. Additionally, 14 locations were staked for new wells, 13 of these on the North Slope. Exploratory footage for the year was 583,518; develop-

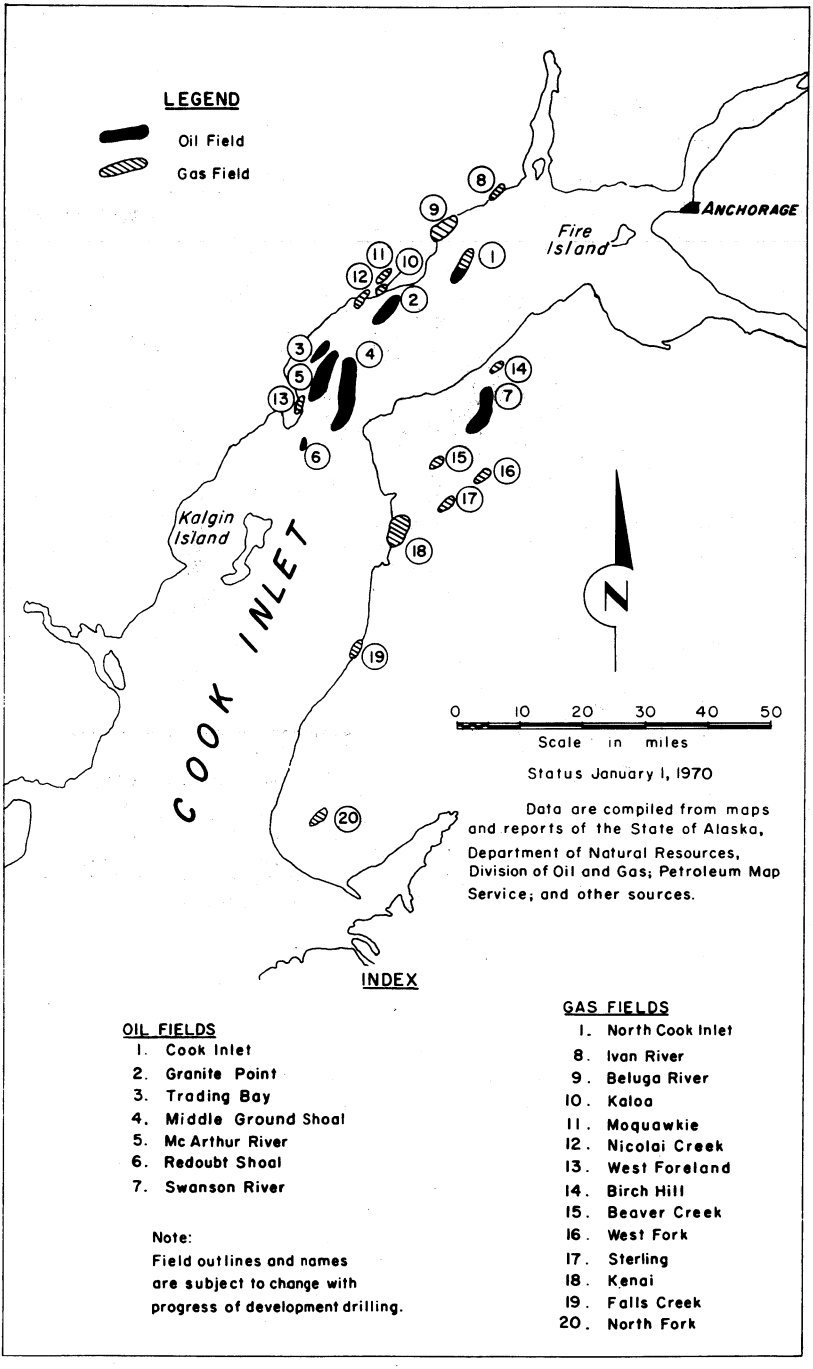

Figure 2.—Cook Inlet Oilfields and Gasfields.

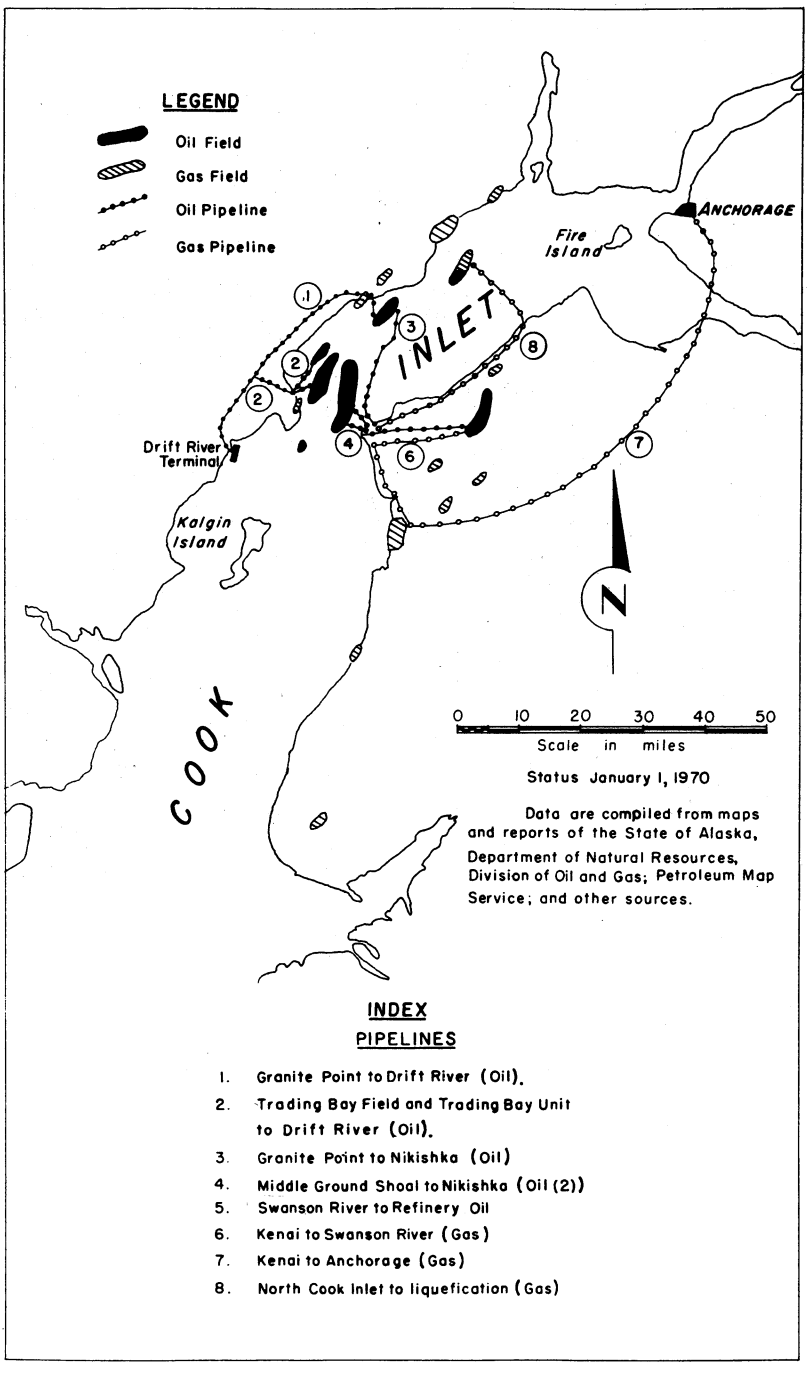

Figure 3.—Cook Inlet oil and gas pipelines.

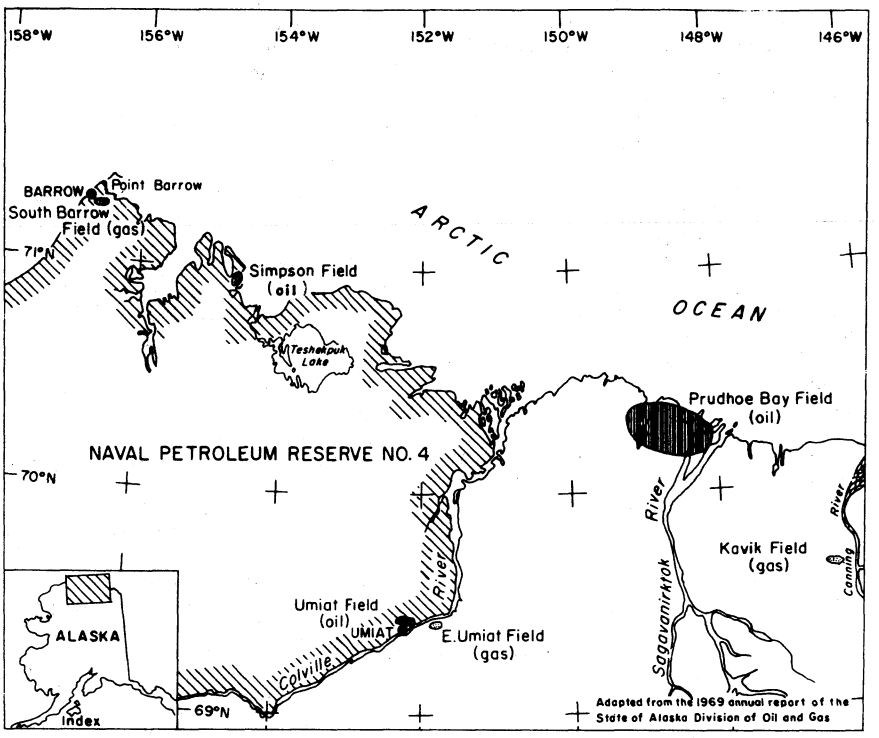

Figure 4.—Oilfields and Gasfields of the Artic North Slope.

Table 10.—Exploratory drilling in Alaska

Province	Oil	Gas	Suspended	Plugged and abandoned	Drilling	Total wells
North Slope	23	1	11	8	10	53
Cook Inlet Basin	0	0	1	8	2	11
Gulf of Alaska	0	0	1	1	0	2
Alaska Peninsula	0	0	0	1	0	1
Copper River Basin	0	0	0	0	1	1
Total	23	1	13	18	13	68

ment footage, for a total of 1,223,614 feet, was 640,096. The 1968 figures were 172,444 exploratory, 1,002,399 development, and 1,174,843 total.

Production of both dry and associated gas increased significantly in 1969. The Collier Carbon and Chemical Corp. prilled urea and ammonia plant processed 12.2 million thousand cubic feet from the Kenai gasfield. Phillips Petroleum Co. processed 9.0 million thousand cubic feet from the Kenai and the North Cook Inlet fields with the bulk coming from the offshore Cook Inlet field. Phillips' liquefied natural gas, totaling approximately 1 million barrels, was shipped to Japan. Increased volumes of gas for reservoir pressure maintenance were injected at Swanson River.

The Collier Carbon chemical complex, under tests as the year began, made its first shipment of ammonia in May. Ammonia and urea were barged to distribution outlets in the Pacific Northwest. Collier, a subsidiary of Union Oil Company of California, owned the ammonia producing facilities outright. Japan Gas-Chemical had a 50-percent participation in the urea processing facilities.

At midyear the first and only base load liquefied natural gas plant in the United States went on stream on the Kenai Peninsula. Phillips Petroleum Co., associated with Marathon Oil Co., was operator of the plant. Marathon was a partner with Union Oil of California in the Kenai unit gasfield, a major source of feedstock for the liquefacation plant. The installation was designed to manufacture 45,000 barrels per day of liquefied natural gas. Shipment, to Tokyo Electric Power Co. and Tokyo Gas Co., were made in two specially designed cryogenic tankers, each of 450,000 barrel capacity. The average round trip, Kenai to Tokyo, was 20 days.

Announcement of the purchase of Alaska Oil and Refining Co. by Tesoro Petroleum Co. was made early in 1969. Alaska Oil started construction of a 15,000-barrel-per-day refinery on the Kenai Peninsula late in 1968. Tesoro completed work on the project and had the plant under test as the year ended. Feed for the refinery was purchased from the State of Alaska. The State took some of its royalties in kind rather than in cash to allow the independent operation.

Marathon Oil Co. as operator with six associated companies[6] was finishing construction of a liquid extraction plant on the west side of Cook Inlet as the year came to an end. The new plant was to process associated gas, previously flared, to extract the butanes and heavier portions. The latter were to be added to crude oil produced from offshore wells. The project was more one of resource conservation than one with an economic incentive. Flaring of associated gas from offshore wells, patently evident to air travelers into Anchorage, had drawn severe criticism to the oil industry and had resulted in some threats at the legislative level of punitive measures if the industry failed to act on its own.

Tank storage at the Drift River terminal of the Cook Inlet pipeline was increased by 270,000 barrels to 1.89 million barrels. Severe winter icing conditions in Cook Inlet had caused tanker loading delays. Limited storage capacity under such winter conditions resulted in curtailment of production from offshore wells.

Earth Resources Co. of Dallas announced plans for a $30 million oil refinery and powerplant complex in the Fairbanks area. Proposed were a 15,000 barrel per day refinery and a 45,000-kilowatt powerplant probably fueled by North Slope oil. The refinery was to produce jet and heating fuels and automotive gasoline. Earth Resources, through a subsidiary, Vitro Minerals Corp., was operator of the Cripple Creek coal mine in the Nenana coalfields.

The Trans Alaska Pipeline System (TAPS), one of the proposed transits to get North Slope crude to market, ran into severe opposition from conservation groups as well as being stymied by the Department of the Interior's land freeze. The latter was a result of Native land claims. TAPS, a combine of numerous participants in North Slope operations including Atlantic Richfield Co., Humble Oil and Refining Co., and British Petroleum Oil Corp., proposed an 800-mile 48-inch pipeline from Prudhoe Bay to Valdez on Prince William Sound. Initial estimates put the cost at $900 million. At yearend, a permit for the pipeline had been approved at the Congressional level; protection of the environment, Native land claims, and other elements had not been resolved.

Other outlets for North Slope oil were under study. Humble Oil and Refining in a $40 million test, sent the converted SS Manhattan through the Northwest Passage in an attempt to establish the feasibility of such a route. The Manhattan, accompanied by U.S. and Canadian icebreakers, made the run from the East Coast to Point Barrow and return. Study and interpretation of the results of the trip were in process with the possibility of the need of additional data from a second trip noted as the year ended.

A combine of Trans-Canada Pipe Lines, Ltd.; American Natural Gas Co.; and Peoples Gas Co. was investigating the possibility of putting a pipeline from the North Slope, through Canada, to the East

[6] Union Oil Co. of California, Atlantic Richfield Co., Pan American Petroleum Corp., Phillips Petroleum Co., Skelly Oil Co., Standard Oil Co. of California.

Coast. Other projects under study included a line from the Slope to Edmonton, Alberta; a line south to the West Coast markets; and use of submarine tankers in the Northwest Passage.

The September competitive oil and gas lease sale of North Slope lands set a number of records, both State and National. As previously noted, the total of $900 million in bonus bids was a record, some $297 million higher than the total for Federal offshore lands at Santa Barbara, Calif. in 1968. A $72.3 million bid on a 2,560-acre tract was not only a record total bid but also a record per acre. The previous high per acre was established in a Federal offshore sale off the coast of Louisiana in the Gulf of Mexico in 1967. The $900 million total on bids accepted by the State compared with a gross of $98.3 million from the preceding 22 competitive lease sales held. The $72.3 million high bid compared with a previous high of $19.4 million established in the 20th sale of offshore lands in Cook Inlet in 1967.

METALS

Antimony.—At the Stampede mine north of Mt. McKinley in the Kantishna district, Earl R. Pilgrim produced 20 tons of concentrates and 2 tons of hand-cobbed ore. Pilgrim shipped the above and 25 tons of previously stockpiled concentrates to Nagoya, Japan, at a reported price of $5.25 per short ton unit f.o.b. Seward. The combined shipment assayed 52.5 percent metallic antimony.

Southern Lead Co. shipped 70 tons of ore from the Sawtooth Mountains area to Dallas. The ore was mined in the early 1950's before the road between Livengood and Manley Hot Springs was completed. It was mined from the Fred Wackwitz property on the crest of the Sawtooth Mountains at the head of Chocolate Creek.

Tillicum Mining Co., holding the Klemm mine in the Petersburg district, reported assessment work. Other antimony claim holders around the State did not respond to Bureau of Mines canvasses. Despite the poor response, rising prices stimulated considerable interest in antimony deposits throughout the State.

Copper.—Alaska's copper potential, under the stimulus provided by the trends to nationalization in much of the free world, drew important interest from major mining firms. Southeastern Alaska showed an estimated $4 million spent on exploration and 1,041 new claims staked during the year. Copper was in the forefront among the mineral commodities sought. International Nuclear Minerals Corp., (subsidiary of International Nuclear Corp.) active in the McCarthy district and in the Kushokwim, had an intensive program in Southeastern Alaska. The corporation had crews operating out of a base camp with full-time helicopter support. The base camp included an atomic adsorption unit providing daily analyses of stream sediment, soil, and rock samples. International's main interest in Southeastern Alaska was copper-nickel.

El Paso Natural Gas Co., moving to the Alaska scene, opened a year-round minerals exploration office and laboratory in Ketchikan. A full-time staff of six or seven was available to backup field crews operating on Prince of Wales Island and the mainland. Among other companies showing interest in copper in Southeastern Alaska were Humble Oil and Refining Co., American Smelting and Refining Co., Newmont Mining Corp., Paramount Mining Co., Dynasty Exploration, Inc., Phelps Dodge Corp., Utah Construction and Mining Co., Falconbridge Nickel Mines, Copper Range Co., and Mobil Oil Co. Altogether a blue ribbon list of North American firms in mineral resources.

In other activity in copper, Cities Service Mineral Corp. (subsidiary of Cities Service Co.) did further work on the Denali prospect about 70 miles southeast of Healy in the Maclaren River area. The company accomplished additional diamond drilling and underground exploration. Cities Service also had reconnaissance crews examining south of the Alaska Range.

In northwestern Alaska, Bear Creek Mining Co. (subsidiary of Kennecott Copper Corp.) had crews prospecting the southern flank of the Brooks Range. The company staked claims north of the Bettles River in the Koyukuk district, Yukon River region. At Bornite, Kennecott's new copper camp in the Shungnak district, Northwestern Alaska region, Bear Creek did additional core drilling and geological work. Early in the year, Kennecott had transferred the Bornite operation from the New Mines Division to Bear Creek, the corporation's exploration entity. The disastrous flooding of

the Ruby Creek shaft late in 1966 had been a serious setback to planned development.

In the McCarthy area, Copper River region, Hanna Mining Co. examined the Mother Lode property, an important producer in earlier years when Kennecott was mining adjacent bonanza ores in the Nizina district. International Nuclear was another organization with strong interest in the McCarthy area. The company staked 50 claims for copper in the 1969 field season. Private Salt Lake City, Utah interests made detailed studies including geological mapping of the Orange Hill deposit some 13 miles southeast of Nabesna at the head of Nabesna Glacier. This huge low-grade deposit with a small molybdenum content gave some promise of future economic production. British Columbia's Lornex Mining Corp. Ltd. deposit in Highland Valley was slated to go into production in 1972 with Japanese smelters and trading companies reported as taking the entire output of concentrates for a 12-year period. Lornex reserves were put at 283 million tons running 0.427 percent copper and 0.014 percent molybdenum. The U.S. Geological Survey had earlier reported more than 200 million tons at Orange Hill carrying 0.4 percent copper and 0.02 percent molybdenum and accompanied by minor quantities of gold, silver, and zinc.

St. Eugene Mining Corp., an affiliate of Falconbridge Nickel Mines, Ltd., proceeded with examination of the Kasna Creek deposits near the south shore of Lake Kontrashibuna, some 160 miles southwest of Anchorage. Large low-grade copper-iron deposits in a strongly mineralized contact metamorphic zone of considerable length had been known for years. St. Eugene also made reconnaissance surveys in other areas of the State.

Gold.—Physical output of gold was virtually unchanged from that of 1968; value, reflecting a full year at an average New York selling price of $41.51 per ounce, increased by 6 percent. Gold in the first two and one-half months of 1968 was valued at the Treasury's $35 price. Of the total 21,227 ounces produced, more than 99 percent was from placer operations. A few ounces of byproduct gold resulted from lode work in the Fairbanks district and a small quanitity was recorded in the Juneau district from cleanup of an idle property.

Placers of the Yukon River region accounted for 86 percent of gold produced. U.S. Smelting Refining and Mining Co.'s Hog River dredge was the leading producer in the region and in the State. The Seward Peninsula region was a poor second followed by the Kuskokwim River region. Alaska placer miners washed 1.08 million cubic yards at an average recovery of 81.2 cents per yard (68.5 cents at the old $35 value for gold).

Activity and interest in offshore placers was again strong in 1969. Shell Oil Co. and American Smelting & Refining Co. returned to the Nome area for additional exploratory work. Shell had been active in the area since the early 1960's. Rowan Drilling Co. put down 45 test holes for a gross footage of 5,000 feet around the perimeter of Safety Sound east of Nome. Others prospecting or drilling offshore in the Nome area included Amerada Hess Corp., Auric Mining Co., Inlet Oil Co., Ocean Science and Engineering, Inc., and Occidental Mineral Corp.

Off Bluff on the north side of Norton Sound on the Seward Peninsula, Aurora Mining Co. mounted a notable effort to mine offshore placers. Three oceangoing

Table 11.—Placer production of gold

Year	Mines producing [1]	Material treated (thousand cubic yards)	Gold recovered		
			Troy ounces	Value (thousands)	Average value per cubic yard
1965	69	1,785	38,686	$1,354	$0.758
1966	55	1,828	26,532	929	r.508
1967	50	1,888	22,948	803	.425
1968	37	r1,208	21,124	829	r.687
1969	30	1,081	21,146	878	.812

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

craft with specially designed mining gear for extracting gold from the submerged deposits arrived in the Bluff area from the lower states. A severe Artic storm left the tug on bottom in shallow water of Golovnin Bay and the dredge-processing unit marooned on the beach near Bluff; the auxiliary craft was beached at Golovin relatively undamaged. Aurora, with some 800,000 acres under prospecting leases, had spent 3 years in prospecting and in design and development of the special mining gear.

In the Chandalar district north of the Arctic Circle and midway between Fairbanks and Prudhoe Bay, Chandalar Gold Mining and Milling Co. completed mill construction and put the plant through a shakedown run. The mill treated an unreported tonnage of ore from the Mikado vein; concentrates were to be milled in 1970. These rich Chandalar lodes, known since early in the century, appeared ready for economic exploitation. The operators planned to work placer deposits in the district as well as the lodes.

Iron Ore.—Alaska's iron resources continued to receive attention from major mining organizations. Marcona Corp., a joint enterprise of Cyprus Mines Corp. and Utah Construction and Mining Co. was negotiating with Japanese interests toward shipment of pelletized concentrates from the Snettisham deposits some 30 miles south of Juneau. Marcona did geological work, several thousand feet of diamond drilling, and took sizeable samples which were shipped out for metallurgical tests.

In the early 1950's, the Bureau of Mines drilled the Snettisham deposits and later made beneficiation tests.[7] [8] Bureau work showed a large tonnage running close to 20 percent total iron with 2.6 percent titania. A high-grade titaniferous magnetite concentrate was obtained using standard, comparatively low-cost beneficiation methods.

Snettisham's titania content had been a block to exploitation of the deposit. With changing steel technology, titanium, once deleterious in the steelmaking process, enhanced the value of these ores in some processes. Japanese steel producers were using titaniferous black sand concentrates obtained by dredging beach sands. Nearing the end of that resource, the Japanese saw Snettisham as a possible source of feed for plants geared to use a titanium-bearing concentrate.

Trans-Pacific Resources, Inc., of Spokane merged with Alaska Mining and Smelting Inc. The latter held active claims on iron deposits near the head of Tuxedni Bay on the west coast of Cook Inlet. Trans-Pacific completed an extensive mapping program on some 28 claims covering approximately 90 percent of the upland surface of Magnetic Island. Two separate deposits were delineated. To the west, a massive body showed strong mineralization with iron as magnetite. At the eastern end, magnetite disseminated in hornfels was found in two parallel lodes with a 20-foot band of waste intervening.

At other deposits around the State, only assessment work was reported for the 1969 season.

Mercury.—The liquid metal showed a distinct pickup in both interest and activity in 1969. The Red Devil mine, a major producer in the early part of the decade, had no production, but was under exploration for much of the year. At the close of the year, Alaska Mines and Minerals, Inc., lessee of the Red Devil, was in the process of raising capital to reopen the mine. The company filed a registration with the Securities Exchange Commission for 3.5 million shares of which 1.6 million was to be offered publicly at $3 per share. Red Devil also had mercury claims at DeCourcy Mountain in the Iditarod district.

Diamond Shamrock Corp., examining the Russell Shaefer deposits on Beaver and Cinnabar Creeks in the Aniak district (Georgetown subdistrict), had appreciable mercury production. The company did not authorize the Bureau of Mines to release actual figures. High-grade cinnabar occurrences had been mined in past years from the Lucky Day and Broken Shovel groups. The deposits were 85 miles southwest of Sleetmute on the Holitna side of the divide between the Holitna and Aniak Rivers in particularly inaccessible country.

At Marsh Mountain in the Tikchik district, Bristol Bay region, renewed activity resulted in production of 20 flasks from the Red Top mine. High-grade stringers of

[7] Holmes, Wesley T., and Lloyd H. Banning. Electric Smelting of Titaniferous Iron Ores From Alaska, Montana, and Wyoming. BuMines Rept. of Inv. 6497, 1964, 23 pp.

[8] Thorne, R. L., and R. R. Wells. Studies of the Snettisham Magnetite Deposit, Southeastern Alaska. BuMines Rept. of Inv. 5195, 1956, 41 pp.

cinnabar occur in a brecciated zone of greywacke over a width of 100 feet or more. The mine is at an elevation of 1,000 feet, 3 miles east of Aleknagik and 17 miles north of Dillingham.

Lyman Mining Co. continued activity at the White Mountain deposit 70 miles southeast of McGrath between the Big and Tatlawiksuk Rivers. The company maintained the steady production first begun in 1964. High-grade concentrates, both hand-cobbed and upgraded by gravity methods, were flown out to Anchorage for shipment and subsequent refining in the lower 48.

International Nuclear reported some work in the Kuskokwim mercury belt.

The Parks deposit (Alice and Bessie) reported no production for 1969. Except for the required assessment work, the Egnaty Creek deposits were inactive.

Nickel.—Newmont Exploration Ltd. (Newmont Mining Corp.) made additional studies toward possible exploitation of the Brady Glacier deposit in Glacier Bay National Monument. Newmont had been working on this deposit for a number of years; in 1965 the company had acquired patents to its claims. The 1969 work included a feasibility study, reportedly in conjunction with Union Pacific Railroad.

International Nuclear Minerals Corp., which had a rather extensive exploration program in various parts of the State for numerous minerals, listed its major effort as a search for copper-nickel in the southeastern region. The company sought copper-nickel mineralization in the norite-gabbro ultrabasic rocks of the region but tested samples for all minerals of possible economic importance.

Platinum-Group Metals.—The Salmon River dredging operations of Goodnews Bay Mining Co. were again the only primary producer of platinum in the State and in the Nation. The company, operating in the extreme southwestern part of the Kuskokwim River region, showed both increased physical volume and value of output. Permission to reveal operating figures was not given.

Inlet Oil Co. was active in offshore placer exploration at Goodnews Bay as well as at other points in the State. The company used the research vessel White Plume and a core drilling barge to test submerged lands held under prospecting permits. Inlet planned stepped-up offshore exploration in the 1970 field season.

Scrap.—Minor quantities of ferrous and nonferrous scrap were shipped in Seattle. Nearly historic high prices for nonferrous scrap had little effect in bringing out scrap in Alaska. The State's scrap figures had no significance in National totals.

Tin.—Lee Brothers produced about 25 tons of cassiterite concentrates, estimated at 65 to 70 percent tin, from Goodwin Gulch in the Cape Mountain area of the Port Clarence district on the Seward Peninsula. The operation used a small dredge to mine tin-bearing gravels. There was no production in 1969 from Cape Creek. Arrangements were reported for an operation on the Cape Creek placers in the 1970 field season.

At Lost River, Grothe and Pearson reported production of 17.5 tons of concentrate running 35 percent tin from 20,000 cubic yards of gravel washed in a dozing and sluicing operation. The concentrates were shipped to Rotterdam, Netherlands for reduction.

Late in the year optioning of the Lost River deposits by PCE Exploration, Ltd., of Toronto was announced. Grothe and Pearson, who acquired the property in a 1960 General Services Administration sale, had maintained appreciable placer tin production for a number of years. U. S. Tin Co. operated the lode deposits in the 1950's but was not able to achieve economic production. Lost River had beryllium and fluorite potential as well as lode and placer tin.

Uranium.—Newmont Exploration Ltd., in an attempt to extend ore reserves, accomplished considerable diamond drilling at the Ross-Adams deposit on Bokan Mountain, Prince of Wales Island. Results were reported as encouraging with further work slated for the 1970 field season. In 1968, Newmont made an agreement with Kendrick Bay Mining Co. (Standard Metals Corp.) for further development and operation of the mine. According to published reports of the mining press, Kendrick Bay Mining produced more than 39,000 tons of 1 percent U_3O_8 ore between 1957 and the closing in 1964.

NONMETALS

Asbestos.—Early in the year the U. S. Geological Survey announced an asbestos discovery in the Yukon-Tanana upland near Eagle on the Alaska-Yukon Territory

border. The Eagle showings were about 60 miles west of the newly opened Clinton Creek deposit of Cassiar Asbestos, an important British Columbia supplier to West Coast markets. Following staking of claims by both United States and Canadian interests, Cassiar negotiated for a 50 percent stake in the combined U.S.-Canadian group. Because of the U.S. Department of the Interior land freeze then in effect in Alaska, the validity of the claims was questioned.

Barite.—Forty-one claims were filed on a promising barite deposit 30 miles upstream on the Yukon from Circle City. Some of these were within the Rampart powersite withdrawal area and thus not subject to Interior's land freeze. Some appeared to be on ground subject to the freeze.

Production of barite from Alaska Barite Co.'s Red Cliff holdings on Castle Island, 25 miles west of Petersburg in southeastern Alaska increased nominally over that of 1968. Crude ore from the Red Cliff was barged to Kenai in the Cook Inlet area where a floating plant processed it into material suitable for drilling mud for the State's booming oil well drilling industry.

At midyear, Inlet Oil Corp. and associates purchased the assets of Alaska Barite Co. in a reported $2 million transaction. Inlet oil was quite active in exploration of offshore placer deposits in Alaska waters. Upon taking over the Red Cliff holdings, the company began underwater mining of barite off Castle Island. The operation was said to be one of the few, if not the only, undersea lode mining operation in the world.

Sand and Gravel.—Sand and gravel output in 1969 declined 10 percent in quantity and 9 percent in value from 1968 totals. Of the total, 94 percent was from government-and-contractor operations with the remainder from commercial operations. Declines were noted in shipments to all end use categories except for paving. Because of increased highway construction activity, the quantity of sand and gravel used for paving purposes was more than 2.5 times larger than that used for this purpose in 1968.

Table 12.—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	1968		1969	
	Quantity	Value	Quantity	Value
Construction:				
Building:				
Sand	154	$316	34	$89
Gravel	625	679	129	295
Paving:				
Sand	644	822	1,142	2,097
Gravel	1,220	1,562	3,931	6,212
Fill:				
Sand	840	475	147	173
Gravel	14,519	16,490	10,822	9,749
Railroad ballast: Gravel	7	5	------	------
Other:				
Sand	3	14	------	------
Gravel	1	3	------	------
Total	18,013	20,366	16,205	18,615
Commercial:				
Sand	113	354	47	128
Gravel	1,451	1,369	897	996
Government-and-contractor: [1]				
Sand	1,528	1,273	1,276	2,231
Gravel	14,921	17,370	13,985	15,260

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

Table 13.—Principal producers

Commodity and company	Address	Type of activity	Region
Barite: Inlet Oil Corp	Dallas, Tex	Open pit	Southeastern Alaska.
Coal:			
Usibelli Coal Mine, Inc	Usibelli, Alaska	Strip mine	Yukon River.
Vitro Minerals Corp	Fairbanks, Alaska	do	Do.
Alaska Matanuska Coal Co	Palmer, Alaska	do	Cook Inlet-Susitna.
Gold:			
U.S. Smelting Refining and Mining Co.	New York, N.Y	Dredge	Yukon River.
Ruby Mining Co	Ruby, Alaska	Nonfloat	Do.
Prince Creek Mining Co	Flat, Alaska	do	Do.
Natural gas:			
Mobil Oil Corp	Anchorage, Alaska	Gas fields	West side Cook Inlet.
Phillips Petroleum Co	do	do	Offshore Cook Inlet.
Standard Oil Co. of California	do	do	Kenai Peninsula.
Texaco Inc	do	do	West side Cook Inlet.
Union Oil Co. of California	do	do	Kenai Peninsula.
Petroleum-crude:			
Atlantic Richfield Co	do	Oil fields	North Slope.
Mobil Oil Corp	do	do	Offshore Cook Inlet.
Pan American Petroleum Corp	do	do	Do.
Shell Oil Co	do	do	Do.
Texaco Inc	do	do	Do.
Standard Oil Co. of California	do	do	Kenai Peninsula.
Union Oil Co. of California	do	do	Offshore Cook Inlet.
Platinum-group metals:			
Goodnews Bay Mining Co	Fairbanks, Alaska	Dredge	Kuskokwim River.
Sand and gravel:			
Alaska Department of Highways	Juneau, Alaska	Open pit	Various.
State Division of Aviation	Anchorage, Alaska	do	Do.
U.S. Army Corps of Engineers	do	do	Do.
Stone:			
Alaska Department of Highways	Juneau, Alaska	Open quarrying	Do.
S. S. Mullen, Inc	Seattle, Wash	do	Southeastern Alaska.
U.S. Army Corps of Engineers	Anchorage, Alaska	do	Various.
Petroleum refining: Standard Oil Co. of California.	Nikiski, Alaska	Refinery	Kenai Peninsula.

The Mineral Industry of Arizona

This chapter was 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 William R. Hardwick [1] and William C. Henkes [2]

The value of mineral production in Arizona established a new alltime high, reaching $859.3 million, 39 percent above the $617.5 million of 1968. Income from the mineral industry ranked second among the major sources of Arizona income; manufacturing was first.

Copper accounted for $761.8 million, 89 percent of the total value of minerals produced. The copper mining industry continued to expand and provide a firm industrial base for Arizona's economic growth. The State was first in the Nation in copper output, 801,363 tons; second in silver, 6.1 million troy ounces; third in molybdenum, 12.7 million pounds; and fourth in gold, 110,878 troy ounces. Arizona also led in the production of pumice (910,000 tons).

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[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in Arizona [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Clays—thousand short tons	77	$347	120	$394
Copper (recoverable content of ores, etc.)—short tons	627,961	525,566	801,363	761,840
Diatomite—do	W	W	725	W
Gem stones	NA	149	NA	153
Gold (recoverable content of ores, etc.)—troy ounces	95,999	[2] 3,769	110,878	[2] 4,603
Gypsum—thousand short tons	W	W	83	424
Helium, grade A [3]—thousand cubic feet	64,800	1,600	56,300	1,126
Iron ore (usable)—thousand long tons, gross weight	16	124	18	136
Lead (recoverable content of ores, etc.)—short tons	1,704	450	217	65
Lime—thousand short tons	260	4,561	283	5,074
Mercury—76-pound flasks	192	103	W	W
Molybdenum (content of concentrate)—thousand pounds	12,127	19,207	12,699	20,947
Natural gas (marketed)—million cubic feet	881	142	1,136	199
Petroleum (crude)—thousand 42-gallon barrels	3,370	9,606	2,433	7,056
Pumice—thousand short tons	1,033	974	910	814
Sand and gravel—do	13,981	14,423	16,481	18,066
Silver (recoverable content of ores, etc.)—thousand troy ounces	4,958	10,633	6,141	10,997
Stone—thousand short tons	3,293	6,239	2,827	5,812
Tungsten concentrate (60-percent WO_3 basis)—short tons	1	3	1	2
Uranium (recoverable content U_3O_8)—thousand pounds	295	[4] 1,923	W	W
Zinc (recoverable content of ores, etc.)—short tons	5,441	1,469	9,039	2,639
Value of items that cannot be disclosed: Asbestos, cement, coal (bituminous, 1968), feldspar, mica (scrap), perlite, pyrites, vanadium, vermiculite, zeolite, and values indicated by symbol W	XX	r 16,253	XX	18,956
Total	XX	r 617,541	XX	859,303
Total 1967 constant dollars	XX	580,802	XX	p724,791

p Preliminary. 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] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.
[3] Bureau of Mines estimate from noncompany sources.
[4] Estimate based on $8 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales.

Table 2.—Value of mineral production in Arizona, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Apache	$12,190	$9,002	Petroleum, helium, clays, natural gas, sand and gravel, pumice, stone, vanadium, uranium.
Cochise	W	65,157	Copper, lime, silver, stone, gold, sand and gravel, lead, zinc.
Coconino	r 6,061	3,452	Sand and gravel, pumice, uranium, stone, copper, gold, silver.
Gila	61,248	99,637	Copper, lime, molybdenum, asbestos, stone, silver, sand and gravel, gold, clays.
Graham	r 159	W	Sand and gravel, lead, zinc, copper, zeolite, pumice, silver, gold.
Greenlee	92,925	134,492	Copper, lime, silver, stone, gold, sand and gravel.
Maricopa	7,134	8,403	Sand and gravel, lime, stone, mercury, clays, gold, mica, silver, copper, lead, vermiculite.
Mohave	31,535	35,326	Copper, molybdenum, silver, sand and gravel, stone, zinc, feldspar, gold, lead, tungsten concentrate.
Navajo	W	W	Sand and gravel, iron ore, stone, pumice.
Pima	198,077	251,563	Copper, cement, molybdenum, silver, sand and gravel, gold, stone, zinc, clays, lead, mica.
Pinal	129,325	212,540	Copper, molybdenum, silver, sand and gravel, gold, perlite, lime, gypsum, stone, diatomite, pyrites, pumice.
Santa Cruz	W	W	Sand and gravel, copper, lead, tungsten concentrate, silver, stone, gold, zinc.
Yavapai	30,312	35,503	Copper, cement, zinc, stone, sand and gravel, molybdenum, lime, silver, gypsum, clays, gold, lead, iron ore, pumice, tungsten concentrate.
Yuma	W	W	Sand and gravel, copper, stone, silver, lead, gold, zinc.
Undistributed [1]	48,580	4,230	
Total [2]	r 617,541	859,303	

r Revised.
[1] Includes gem stones that cannot be assigned to specific counties, and values indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Arizona business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total nonagricultural employment	thousands	471.9	510.1	+8.1
Services and miscellaneous	do	78.0	83.7	+7.3
Trade	do	106.3	115.0	+8.2
Mining	do	15.2	18.6	+22.4
Construction	do	26.4	31.8	+20.5
Manufacturing	do	84.7	93.0	+9.8
Government	do	110.0	113.1	+2.8
All other	do	51.3	54.9	+7.0
Payroll:				
Copper mining	millions	$112.1	$147.4	+31.5
Construction	do	$235.4	$321.8	+36.7
Manufacturing	do	$534.6	$640.7	+19.8
Retail trade	do	$287.1	$336.1	+17.1
Personal income:				
Total	do	$5,034.0	$5,648.0	+12.2
Per capita		$3,020	$3,336	+10.5
Construction activity:				
Total value of construction contracts	do	$491.2	$727.7	+48.1
Residential	do	$211.5	$327.4	+54.8
Nonresidential	do	$162.2	$243.0	+49.8
Nonbuilding	do	$117.5	$157.3	+33.9
Highway construction contracts awarded	do	$46.0	$80.0	+73.9
Cement shipments to and within the State	thousand 376-pound barrels	4,440	5,417	+22.0
Business receipts:				
Retail sales	millions	$2,539.0	$2,902.9	+14.3
Farm marketing receipts	do	$555.2	$643.9	+16.0
Mineral production	do	$617.5	$859.3	+39.2
Utility production and consumption:				
Production of electric energy	million kilowatt hours	11,286.3	12,746.8	+12.9
Natural gas consumption	billion cubic feet	151.3	175.4	+15.9
Export trade	millions	$53.1	$56.6	+6.6
Import trade	do	$115.2	$152.1	+32.0

p Preliminary.

Sources: U.S. Dept. of Commerce, Survey of Current Business; Division of Economic and Business Research, University of Arizona; Engineering News-Record, v. 184, No. 16, Apr. 30, 1970, pp. 12–13; El Paso Natural Gas Co.; U.S. Bureau of Mines.

Table 4.—Major sources of income in Arizona [1]
(Thousands)

Source of income	1968	1969	Change, percent
Manufacturing	$1,820,000	$2,010,000	+10
Mining [2]	617,541	859,303	+39
Tourism	500,000	530,000	+6
Crops	301,536	316,508	+5
Livestock	285,651	327,344	+15

[1] Valley National Bank Research Department, Phoenix, Ariz., July 1970.
[2] U.S. Bureau of Mines.

Table 5.—Valuations on centrally assessed groups of property in Arizona [1]

Group	1968	1969	Change, percent
Utilities	$1,129,758,596	$1,213,550,555	+7
Mines	506,517,672	602,912,091	+19
Pipelines	352,410,353	321,537,000	−9
Railroads	182,054,000	172,162,000	−5
Airlines	14,722,302	19,843,669	+35
Oil and gas	6,950,126	8,947,297	+29

[1] Pay Dirt. No. 360, June 23, 1969, p. 3.

Compared with 1968, the values of 17 mineral commodities increased, and 12 declined. The value of metals increased $238.5 million to a total of $801.8 million; nonmetals increased $6.7 million to a total of $49.1 million; and the value of fuels decreased $2.9 million.

The value of producing mines for tax purposes increased 19 percent to $602 million (table 5). The increase was due largely to the use of a 5-year weighted average price of copper for valuation computations instead of the 10-year average used in previous years. Two major new mines were added—the San Xavier mine of American Smelting and Refining Co. valued at $2.6 million, and the Lakeshore mine of El Paso Natural Gas Co. valued at $2.0 million. The value of producing oil and gas interests increased 29 percent to $8.9 million. The total value of mines ranked second after utilities among the centrally assessed groups of property in Arizona.

Employment and Injuries.—Final statistics for 1968 on employment and injuries in the mineral industries, excluding the petroleum and natural gas industries, and preliminary data for 1969 compiled by the Bureau of Mines, are given in table 6.

Table 6.—Worktime 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
1968:								
Coal	4	140	1	4	--	--	-----	-----
Metal	10,812	278	3,054	24,542	12	502	20.94	3,874
Nonmetal	220	216	47	404	--	6	14.87	468
Sand and gravel	1,021	237	242	1,936	2	42	22.72	6,970
Stone	105	266	108	867	--	10	11.53	293
Total [1]	12,462	273	3,451	27,753	14	560	20.68	3,928
1969: [p]								
Coal	5	153	1	5	--	--	-----	-----
Metal	12,310	305	3,805	30,408	12	549	18.45	3,412
Nonmetal	250	219	55	465	--	5	10.76	99
Sand and gravel	1,340	241	324	2,619	1	52	20.24	2,960
Stone	410	276	113	907	--	9	9.92	498
Total [1]	14,315	296	4,297	34,403	13	615	18.25	3,256

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Legislation and Government Programs.—Highway construction contracts awarded during 1969 totaled $80 million, up $34 million (74 percent) from the $46 million reported in 1968. The contracts awarded included $59 million for road construction in the National System of Interstate and Defense Highways; $12 million for Federal-aid primary and secondary (ABC) highway systems and their urban extensions; $9 million for State financed roads. An additional $7.5 million was awarded by the State of Arizona for road maintenance.[3]

REVIEW BY MINERAL COMMODITIES[4]

METALS

Ninety mines yielded 128 million tons of ore from which 3.06 million tons of concentrates were produced, excluding uranium. Forty-five mines produced copper ore; 33 mines produced gold, gold-silver, or silver ore; one produced copper-lead ore; one copper-zinc ore; eight mines lead ore, and one lead-zinc ore.

Paralleling the national trend, air pollution became an issue in Arizona. Because smelters have been cited as major sources of pollution, legal limits on sulfur dioxide emissions from copper smelters were established by the Arizona State Board of Health. Consequently, large expenditures for sulfur dioxide removal were announced by all companies operating smelters in the State.

Copper.—Mines producing copper in Arizona yielded 801,363 short tons, slightly more than 51 percent of the domestic primary copper production. All mines were operated at capacity; forty-five classed as copper mines, yielded 127.8 million tons of ore from which 738,760 tons of copper were recovered, an average of 11.5 pounds per ton of ore. The remainder of the copper was recovered from leaching and from copper-lead, copper-zinc, lead, lead-zinc, and other miscellaneous ores.

Pima County continued to lead all other counties in tons of copper output (236,267); Pinal ranked second (210,869), followed by Greenlee (136,773), Gila (100,612), Cochise (62,315), and Mohave (29,985).

Fourteen major open pits yielded 628,373 tons of copper (78 percent) from 101.6 million tons of ore. Four underground mines yielded 150,975 tons of copper (19 percent); 3 percent came from a number of small copper mines and as a byproduct from other mining operations.

A total of 102,560 tons or 12.8 percent of the State's production was from leach operations: Dump and in-place leaching yielded 83,418 tons of precipitates containing 58,001 tons of copper; heap and vat leaching yielded 44,549 tons of copper.

Approximately seventy-four percent, 594,166 tons of copper, was produced from 11 mines owned by five companies—Phelps Dodge Corp., (33 percent), Magma Mining Co. (14 percent), Kennecott Copper Corp. (9 percent), American Smelting and Refining Co. (Asarco), (9 percent), and Pima Mining Co. (9 percent).

The Phelps Dodge Corp. open pit mine at Morenci was the State's leading source, yielding 54.1 million tons of material, in-

[3] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1970 and Budgets for Maintenance. V. 184, No. 16, Apr. 30, 1970, pp. 12–13.

[4] Portions of the material in this section were obtained from engineering and trade journals, company annual reports, and other related sources.

Table 7.—Total value of mineral production in Arizona and production and value of copper in Arizona and the United States

Year	Arizona			United States		Arizona	
	Total value mineral production (thousands)	Copper production		Copper production		Percent of U.S. copper production	Percent of world copper production
		Short tons	Value (thousands)	Short tons	Value (thousands)		
1965	$583,118	703,377	$497,991	1,351,734	$957,028	52.0	12.7
1966	622,079	739,569	535,004	1,429,152	1,033,850	51.7	12.7
1967	465,255	501,741	383,591	954,064	729,401	52.6	9.1
1968	r 617,549	627,961	525,566	1,204,621	1,008,195	52.1	10.7
1969	859,475	801,363	761,840	1,544,579	1,468,400	51.9	12.1

r Revised.

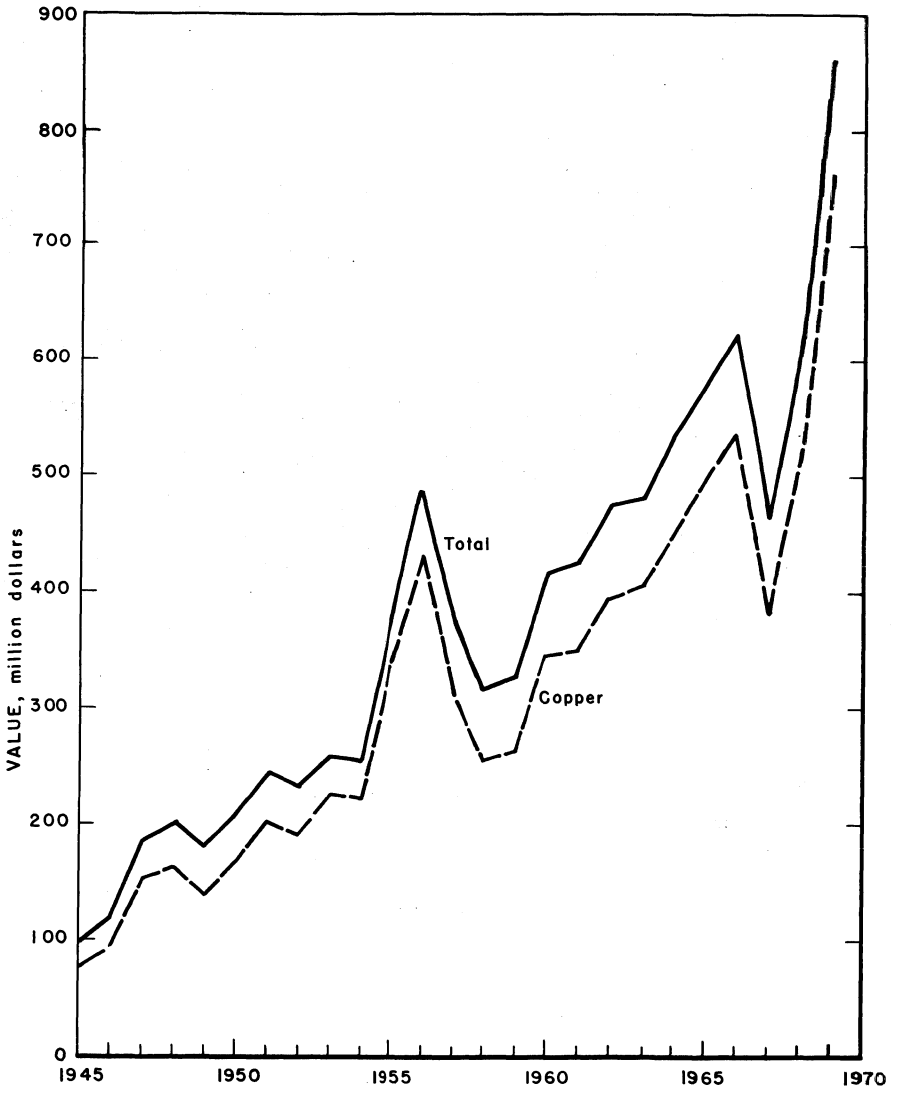

Figure 1.—Value of mine production of copper and total value of mineral production in Arizona.

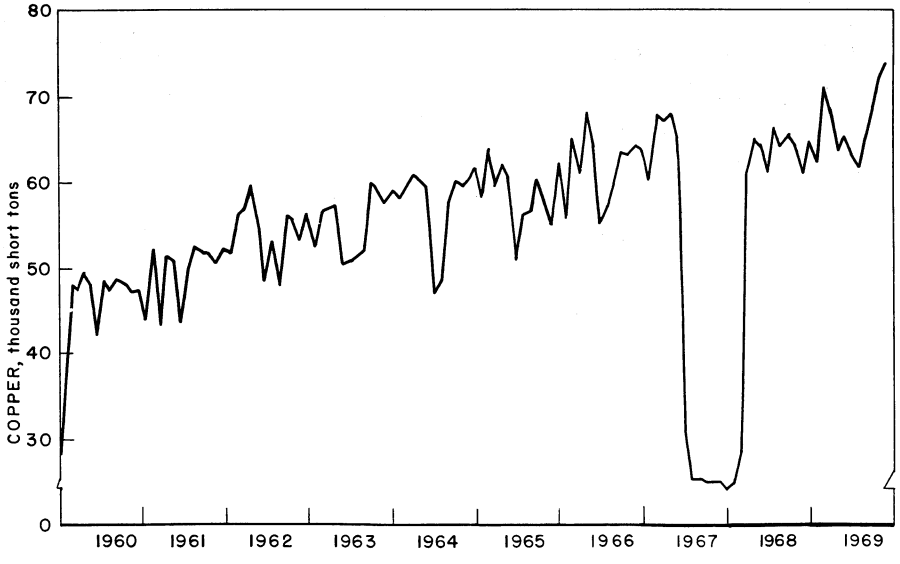

Figure 2.—Mine production of copper in Arizona, by month, in terms of recoverable metal.

Table 8.—Fifteen leading copper producing mines, in order of output

Rank in 1969	Rank in 1968	Mine	District	County	Operator	Source of copper in 1969
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	Pima	Pima	do	Pima Mining Co.	Copper ore.
6	6	Copper Queen, Lavender Pit	Warren	Cochise	Phelps Dodge Corp.	Copper ore, copper precipitates.
7	8	Inspiration	Globe-Miami	Gila	Inspiration Consolidated Copper Co.	Do.
8	7	Mission	Pima	Pima	American Smelting and Refining Co.	Copper ore.
9	9	Mineral Park	Wallapai	Mohave	Duval Corp	Copper ore, copper precipitates.
10	10	Silver Bell	Silver Bell	Pima	American Smelting and Refining Co.	Do.
11	13	Copper Cities	Globe-Miami	Gila	Tennessee Corp.	Do.
12	11	Esperanza	Pima	Pima	Duval Corp	Do.
13	14	Magma	Pioneer	Pinal	Magma Copper Co.	Copper ore.
14	12	Bagdad	Eureka	Yavapai	Bagdad Copper Corp.	Copper ore, copper precipitates.
15	--	Twin Buttes	Pima	Pima	The Anaconda Company.	Copper ore.

Table 9.—Ore mined, waste material removed, leach material placed in dumps, and total copper production at principal copper open-pit and underground mines

Mine	Ore mined (thousand short tons)		Waste material removed (thousand short tons)		Leach material placed in dumps (thousand short tons)		Total copper produced from all sources [1] (short tons)	
	1968	1969	1968	1969	1968	1969	1968	1969
OPEN PIT								
Morenci	15,474	19,271	13,788	19,330	13,527	15,544	106,857	136,773
Ray	6,746	12,209	[2] 18,745	--------	[3]	27,724	[4] 58,030	[4] 96,190
New Cornelia	9,018	10,736	16,774	16,856	--------	--------	58,544	67,792
Pima	13,000	14,235	[5] 17,871	[5] 17,525	--------	--------	[6] 61,500	[6] 67,000
Inspiration	6,167	8,855	[r] 6,314	11,419	2,719	4,204	34,862	51,757
Mission	6,010	7,940	16,120	20,478	--------	--------	39,144	50,034
Lavender Pit	4,715	5,550	14,439	7,439	6,706	14,994	24,701	35,528
Mineral Park	6,233	6,034	6,284	4,791	5,183	5,870	[7] 28,704	[7] 28,721
Copper Cities	3,359	4,645	292	405	5,579	7,900	[7] 17,284	[7] 22,446
Esperanza	5,480	5,488	1,105	463	6,494	8,631	[7] 24,413	[7] 22,288
Silver Bell	3,923	3,870	5,376	7,809	2,242	752	[7] 24,999	[7] 20,599
Bagdad	2,099	2,030	4,524	4,745	3,325	3,423	[r] [7] 18,238	[7] 17,624
UNDERGROUND								
San Manuel	11,368	15,203	--------	--------	--------	--------	72,074	100,100
Copper Queen	623	783	--------	--------	--------	--------	22,605	29,555
Magma	334	422	--------	--------	--------	--------	14,706	18,217

[r] Revised.
[1] Includes copper recovered from leaching of material in place and in dumps.
[2] Total of waste and leach material; breakdown unavailable.
[3] Included with waste material, breakdown unavailable.
[4] Gross metal content in copper precipitates and electrowinning copper.
[5] Thousand cubic yards.
[6] Gross metal content in concentrates shipped.
[7] Gross metal content in concentrates and precipitates shipped.

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)
1965	92	2	93,466	150,431	$5,265	6,095	$7,881
1966	92	1	102,068	142,528	4,988	6,339	8,196
1967	76	1	74,742	80,844	2,830	4,588	7,112
1968	87	1	101,565	95,999	3,769	4,958	10,633
1969	90	1	128,350	110,878	4,603	6,141	10,997
1890–1969	NA	NA	NA	13,751,290	369,922	409,192	347,419

Year	Copper		Lead		Zinc		Total value [3] (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	703,377	$497,991	5,913	$1,845	21,757	$6,353	$519,335
1966	739,569	535,004	5,211	1,575	15,985	4,636	554,399
1967	501,741	383,591	4,771	1,336	14,330	3,967	398,835
1968	627,961	525,566	1,704	450	5,441	1,469	541,887
1969	801,363	761,840	217	65	9,039	2,639	780,143
1890–1969	23,152,662	11,032,412	651,522	129,092	1,029,834	251,794	12,130,638

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings and slimes re-treated, and ore, old tailings, and copper precipitates shipped to smelters.
[2] Does not include gravel washed or tonnage of precipitates shipped.
[3] Data may not add to total shown because of independent rounding.

Table 11.—Mine production of gold, silver, copper, lead, and zinc, 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 (thousands)	Troy ounces	Value (thousands)
Cochise	5	--	6,372,138	31,948	$1,326	861,006	$1,542
Coconino	1	--	163	16	1	225	(3)
Gila	15	--	21,726,457	5,250	218	298,218	534
Graham	4	--	41,867	2	(3)	1,767	3
Greenlee	3	--	19,315,709	13,455	559	727,230	1,302
Maricopa	3	--	300	487	20	1,182	2
Mohave	9	1	6,288,024	251	10	535,015	958
Pima	11	--	43,697,924	29,835	1,238	2,451,502	4,390
Pinal	9	--	27,550,832	29,037	1,205	1,139,788	2,041
Santa Cruz	5	--	144	2	(3)	470	1
Yavapai	18	--	3,031,703	587	24	111,517	200
Yuma	7	--	324,644	8	(3)	13,072	23
Total:							
1969 [4]	90	1	128,349,904	110,878	4,603	6,141,022	10,997
1968	87	1	101,565,300	95,999	3,769	4,958,162	10,633

County	Copper		Lead		Zinc		Total value [4] (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Cochise	62,315	$59,241	29	$8	8	$2	$62,120
Coconino	29	27	-----	-----	-----	-----	28
Gila	100,612	95,650	-----	-----	-----	-----	96,402
Graham	25	24	105	31	94	28	86
Greenlee	136,773	130,027	-----	-----	-----	-----	131,888
Maricopa	2	2	2	(3)	-----	-----	25
Mohave	29,985	28,506	6	2	61	18	29,494
Pima	236,267	224,614	27	8	183	53	230,304
Pinal	210,869	200,469	-----	-----	-----	-----	203,716
Santa Cruz	3	3	6	2	(3)	(3)	6
Yavapai	23,080	21,941	32	10	8,692	2,538	24,713
Yuma	1,404	1,335	12	3	(3)	(3)	1,362
Total:							
1969 [4]	801,363	761,840	217	65	9,039	2,639	780,143
1968	627,961	525,566	1,704	450	5,441	1,469	541,887

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as mines; also excludes count of uranium mine.
[2] Does not include tonnage of gravel washed, of precipitates shipped, or uranium ore milled.
[3] Less than ½ unit.
[4] Data may not add to totals shown because of independent rounding.

Table 12.—Mine production of gold, silver, copper, lead, and zinc by class of ore or other source material, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Dry gold	7	512	500	25	5	-----	-----
Dry gold-silver	8	63,565	139	4,245	1,057	-----	-----
Dry silver	18	104,272	153	83,110	677	13	(2)
Total [3]	33	168,349	792	87,380	1,738	13	(2)
Copper	45	127,848,828	108,718	5,899,843	1,477,520	1	478
Copper-lead and lead-zinc [4]	2	2,945	4	3,674	28	241	208
Copper-zinc	1	103,838	26	36,460	6,404	34	17,307
Lead	8	571	106	5,224	1	126	8
Total [3]	56	127,956,182	108,854	5,945,201	1,483,953	403	18,001
Other "lode" material:							
Gold-silver tailings	1	59,199	533	21,211	176	-----	-----
Gold-silver cleanup	(5)	20	2	25	1	-----	-----
Silver tailings	1	32,142	341	85,723	-----	-----	-----
Copper cleanup	(5)	178	6	213	37	-----	-----
Copper precipitates	15	83,418	-----	-----	116,023	-----	-----
Copper tailings	1	133,617	-----	-----	749	-----	-----
Lead cleanup, zinc cleanup, and uranium ore [4]	(5)	[6] 217	345	1,269	48	18	76
Total [3]	18	308,791	1,227	108,441	117,034	18	76
Total "lode" material	90	128,433,322	110,873	6,141,022	1,602,726	434	18,078
Placer	1	-----	5	-----	-----	-----	-----
Total all sources	91	128,433,322	110,878	6,141,022	1,602,726	434	18,078

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Less than ½ unit.
[3] Data may not add to totals because of independent rounding.
[4] Combined to avoid disclosing individual company confidential data.
[5] From properties not classed as mines.
[6] Excludes uranium ore tonnage.

Table 13.—Mine production of gold, silver, copper, lead, and zinc, by methods of recovery and type of material processed, in terms of recoverable metals

Method of recovery and type of material processed	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Amalgamation	400	-----	-----	-----	-----
Cyanidation	18	5,503	-----	-----	-----
Concentration and smelting of concentrates: Ore [1]	104,613	5,794,250	1,375,752	279	17,966
Total	105,031	5,799,753	1,375,752	279	17,966
Direct smelting:					
Ore	4,630	233,021	21,639	137	36
Cleanup	338	1,314	40	18	76
Precipitates	-----	-----	116,023	-----	-----
Old tailings	874	106,934	176	-----	-----
Total [2]	5,842	341,269	137,877	155	112
Other:					
Vat, tank, and heap leaching:					
Ore	-----	-----	88,348	-----	-----
Tailings	-----	-----	749	-----	-----
Total	-----	-----	89,097	-----	-----
Placer	5	-----	-----	-----	-----
Grand total [2]	110,878	6,141,022	1,602,726	434	18,078

[1] Includes concentrate from uranium ore.
[2] Data may not add to totals shown because of independent rounding.

cluding 19.3 million tons of ore. The plant produced 136,773 tons of copper. The New Cornelia plant at Ajo yielded 27.6 million tons of material, including 10.7 million tons of ore from which 67,792 tons of copper was recovered. The Lavender pit at Bisbee yielded 27.9 million tons of material—5.6 million tons being ore from which 32,528 tons of copper were obtained. The Copper Queen underground mines yielded 29,555 tons of copper from 783,000 tons of ore.

The total material from Phelps Dodge mines in Arizona was 109.7 million tons—73.4 million tons of waste and leach material, and 36.3 million tons of ore. A total of 266,648 tons of copper, 33 percent of the State output, was produced from company mines in Arizona. An additional 559 tons were recovered from miscellaneous sources for a total of 267,207 tons, a record high from the company's Arizona plants.

Phelps Dodge Corp. announced in June 1969 the development of the Metcalf, a new mine on the east side of Chase Creek, northeast of the Morenci mine. The project, estimated to cost well over $100 million, is expected to exceed 50,000 tons of copper production per year, and will utilize open pit and block-caving methods. Production from the new mine is scheduled to begin in late 1972 or early 1973. Reserves are estimated to be sufficient for production at the planned rate into the next century.

Phelps Dodge Corp., continuing to develop a deposit near Safford, Ariz., completed a 1,860-foot shaft, installed pumps and equipment, and started a 4,000-foot drift from the shaft into the ore body.

According to Newmont Mining Corp.'s annual report, Magma Copper Co., formerly a Maine corporation 80.6 percent owned by Newmont, was merged on May 9, 1969, into Newmont. All of the Magma assets and liabilities were immediately transferred to the present Magma Copper Co., organized in Delaware and wholly owned by Newmont. The San Manuel and Superior Divisions, operating at normal levels throughout 1969, yielded 113,300 tons of copper, 14 percent of the State total.

At the San Manuel Division, the expansion program to increase daily mine and plant capacity from 40,000 to 60,000 tons of ore continued on schedule. Ore reserves of the San Manuel mine were estimated as of Dec. 31, 1968 to be 500 million tons of 0.728 percent sulfide copper and 130 million tons of 0.70 percent total copper, including 0.47 percent oxide copper. In addition the Kalamazoo property, purchased in 1968, is estimated to contain 565 million tons of ore averaging 0.72 percent sulfide copper. In September 1969, the company authorized construction of a $34 million electrolytic refinery designed to treat 200,000 tons of copper per year.

At Magma Copper Co.'s Superior Division, a program to modernize and expand the mill and related facilities to a daily production rate of 3,000 tons continued on schedule. The program includes a new 4,800-foot mine shaft and a 9,100-foot haulage tunnel to provide access to newly developed ore bodies estimated at 10.4 million tons of 5.7 percent copper. The existing smelter will be shut down and the concentrate smelted at the San Manuel smelter.

At Kennecott Copper Corp.'s Ray Mines Division, the new silicate leaching and electrowinning plant began operation. According to the company annual report, the Division yielded 73,388 net tons of salable copper from all sources, slightly more than 9 percent of the State's total production. Ore mined, milled, and treated was 12.2 million tons of 0.837 percent copper. Important additional reserves have been developed, and plans are under consideration to increase capacity significantly.

Pima Mining Co. operated at a record rate of slightly less than 39,000 tons of ore per day, and copper content of concentrate produced during the year was 67,000 tons, 9 percent of the State's total. The company is considering enlarging facilities to achieve a daily capacity of 53,000 tons of ore—80,000 tons of copper per year. As of January 1, 1969, Pima's ore reserves were estimated to be 216 million short tons with an average copper content of 0.56 percent.

The Mission and Silver Bell mines of Asarco were operated at full capacity. The Mission mine yielded 7.94 million tons of ore from which the mill produced 183,015 tons of concentrate containing 50,034 tons of copper. The Silver Bell mine yielded 3.87 million tons of ore from which the mill produced 80,112 tons of concentrate containing 20,599 tons of copper. An additional 2,638 tons of copper was produced from leaching mine dumps. Asarco's San

Xavier mine, 2½ miles from the Mission mine, yielded 69,684 tons of copper-bearing siliceous ore. Oxide ore reserves were estimated to be 10.8 million tons averaging 1 percent copper. Plans were announced to build a 4,000-ton-per-day leach plant to treat the ore with sulfuric acid from a new acid plant under construction at the company's Hayden smelter. Two new deposits were discovered northwest of Casa Grande.

Duval Corp., a subsidiary of Pennzoil United, Inc., operated two open pit copper mines in Arizona during 1969—Esperanza and Mineral Park. The Esperanza property, 35 miles southwest of Tucson, has been operated by Duval for the production of copper and molybdenum since 1959. The Mineral Park property near Kingman in northwestern Arizona, has been a source of copper and molybdenum to the company since 1964. A metals poducer for only 10 years, Duval will rank among the top five domestic producers of both copper and molybdenum when the copper mine of Duval Sierrita Corp., a subsidary of Duval, reaches full production.

Development of the new Sierrita copper mine was nearly completed by the end of 1969; production is planned for the first quarter of 1970. Designed to treat 72,000 tons of ore per day, the mill is expected to produce 65,000 tons of copper, 13 million pounds of molybdenum, and 500,000 ounces of silver annually. The company's output will approximately double with full production from Sierrita. Ore reserves developed by the preliminary development program were 414 million tons with an average copper content of 0.35 percent and an average molybdenum content of 0.036 percent. Present development plans provide for removal of 634 million tons of waste; 131 million tons were removed by the end of 1969. One billion tons of overburden and ore—twice the tonnage excavated for construction of the Panama Canal—will be removed during the property's life.

The Inspiration Consolidated Copper Co. operated the Thornton, Live Oak, Red Hill, and Black Copper mines in the Inspiration area; 11.4 million tons of waste and 8.9 million tons of ore were mined. The ore processed in the plant yielded 46,883 tons of copper; an additional 4,874 tons was recovered from leaching waste dumps and mined out areas. At the Ox Hide mine 350,060 tons of waste was removed, 4.1 million tons of low-grade oxide ore mined, and 3,621 tons of copper recovered by leaching. At the Christmas open pit mine 1.9 million tons of ore was mined and milled; 10,651 tons of copper recovered; and 8.4 million tons of waste removed. Copper produced by the company totaled 66,029 tons.

The Anaconda Company Twin Buttes open pit copper mine began producing in September. Pre-production stripping required removal of 266.5 million tons of waste. The plant, designed to treat 30,000 tons of ore per day, is expected to produce 60,000 tons of copper per year. The mine is probably the most highly automated mine in the world. Ore is removed from the pit by a network of conveyor belts, the longest of which is 8,300 feet. Control towers route the ore as needed to the crushers or to stockpiles. Sulfide ore is currently being mined and processed, and oxide ore is being stockpiled for future treatment.

Between 1966, when an interest in the property was acquired, and 1968, El Paso Natural Gas Co. discovered a major new copper deposit at its Lakeshore property 28 miles south of Casa Grande, on the Papago Indian Reservation. El Paso Natural Gas Co. entered into an agreement in September 1969 with Hecla Mining Co. to develop and operate the property. Reserves were estimated in February 1969 to be 241 million tons of disseminated sulfide ore containing 0.70 percent copper, 207 million tons of disseminated oxide ore containing 0.71 percent copper, and 23.6 million tons of tactite sulfide ore containing 1.69 percent copper.

By December plans were announced to develop the deposit and construct an 8,000-ton-per-day concentrator, to be in production within 3 years. The mine will be opened by twin inclines on a 15° slope. Length of the incline to a point beneath the ore is estimated to 7,500 feet. Ore will be moved to the surface on a conveyor belt.

All copper, 4,396 tons from the Bluebird mine owned by Ranchers Exploration and Development Co., was high purity cathode copper from the new solvent extraction-electrowinning plant. The process involves three basic steps: mixing copper-acid solutions from the leaching heaps with a solvent which separates the copper; stripping the copper from the solvent with a high acid solution; and precipitating the copper on

starting sheets in a cell by passing an electric current through the solution. The reserves of the Bluebird mine were reported as 15.8 million tons of ore with a copper content of 0.52 percent.

Bagdad Copper Corp. produced 10,234 tons of copper from sulfide ore and 7,390 tons of cement copper from dump leach operations, of which 3,134 tons were processed in the company's refinery and sold as refined copper. The company announced construction of a solvent extraction-electrowinning plant to be completed by mid-1970. The present ore reserves at the Bagdad mine are estimated at 46 million tons, with a grade of 0.69 percent copper and a 1 to 1 stripping ratio. Drilling has indicated an additional 200 million tons of 0.50 percent copper material on the perimeter of the ore body. Stripping ratio would be about 1.5 to 1. Part of the stripping would consist of 110 million tons of leachable ore with a copper content of 0.4 percent.

Tennessee Corp., a Cities Service Co. subsidary and operator of the Miami mine, announced the discovery of a new copper deposit. Encountered at a depth of 3,000 feet, mineralization averaged 1.5 percent copper for a thickness of 500 feet. The company plans to deepen the Miami shaft and drift to confirm the discovery.

Eight primary smelters in the State were opened principally on concentrate, precipitates, and ores produced by the operating companies. Four of the smelters—Phelps Dodge Corp. at Douglas, Inspiration Consolidated Copper Co. at Inspiration, Magma Copper Co. at Superior, and Asarco at Hayden—also treated ore on a custom or toll basis.

Gold.—Output of gold was 110,878 troy ounces. The State ranked fourth in the Nation. Seven mines yielded 512 tons of dry gold ore from which 500 troy ounces of gold, 25 troy ounces of silver, and 4,700 pounds of copper were recovered. Some gold production resulted from treatment of gold-silver, silver, copper-lead, copper-zinc lead, and lead-zinc ores. The largest production, 108,718 troy ounces, was a byproduct from large copper mines.

Iron Ore.—Shipments of iron ore were 12 percent more than 1968. CF&I Steel Corp. continued to explore and develop the Apache pit in Navajo County; Sovereign Iron and Steel, Inc., continued to develop the Black Mountain property near Florence. The latter firm, a subsidary of Sovereign Industries, Inc., contracted an evaluation of its Black Mountain iron deposits to DeWitt Smith & Co. Plant feasibility and in-depth engineering studies were done for the company by Swendell Dressler, a division of Pulman Co. Large samples of concentrate, pelletized by Allis Chalmers Manufacturing Co. in Milwaukee, were shipped to Monterey, Mexico, for conversion to sponge iron and steel by the HyL direct reduction process. Construction of a plant is contemplated.

Iron oxide produced in Yavapai County was sold as a coloring agent.

Lead.—Production of lead decreased 87 percent to 217 tons valued at $65,000. Most of the output was from 14 mines that also produced gold and silver.

Mercury.—Mercury was shipped from two mines in the Mezatzal Mountains in Gila and Maricopa Counties.

Molybdenum.—All production of molybdenum was a byproduct from large copper mines. A total of 12.7 million pounds valued at $20.9 million was reported from 10 mines. The State was third in the Nation in output. Production from the new Sierrita mine of Duval Sierrita Corp., estimated to be 12 million pounds per year, is scheduled to begin early in 1970.

Silver.—Most silver production in Arizona was a byproduct from large copper mines. The State ranked second in the Nation, yielding 6.1 million ounces, an increase of 24 percent over 1968.

Tungsten.—Small quantities of tungsten concentrate (60 percent WO_3) were recovered from processing tungsten ores at three properties. The average grade of the 48 tons of ore mined was 1.6 percent WO_3. The value of the product sold decreased 33 percent.

Uranium.—Two companies produced ore from mines in Apache and Coconio Counties from which uranium was recovered.

Vanadium.—The quantity of vandium decreased 80 percent, and the value decreased 75 percent. Vanadium is recovered as a byproduct from treatment of uranium ore; the decrease resulted from a corresponding decline in the production of uranium ore.

Zinc.—Eleven mines in seven counties yielded 9,039 short tons of zinc valued at $2.6 million, an increase of 66 percent in quantity and 80 percent in value over that of 1968. Three mines in Yavapai County

yielded 96 percent of the production. Pima County was second (two mines); Graham was third (one mine); and Mohave County was fourth (two mines). Much of the increase was due to the first full year of production from the Cyprus Mines Corp. Bruce mine in Yavapai County.

NONMETALS

The value of nonmetals mineral production increased 15 percent to $49.1 million. The commodities with their percentage increases in value were asbestos (15), masonry cement (49), portland cement (16), clays (14), diatomite (50), gem stones (3), gypsum (5), lime (11), perlite (12), and sand and gravel (25). Decreases in value were registered for feldspar (53 percent), mica (17 percent), pumice (16 percent), pyrites (95 percent), and stone (7 percent).

Asbestos.—Chrysotile asbestos was produced from an underground mine, mine tailings, and government stockpiles by two companies in Gila County. The quantity of fiber increased 1,132 tons (30 percent), and the value increased $84,000 (15 percent). The greatest demand was for the shorter grades: filter, shorts, sand, waste, and tailings. At yearend, one company was posting a delay in delivery for some of these grades. The sale of No. 1 and No. 2 crude was slow. Prices for Arizona fiber, as quoted by the March 1970 issue of Asbestos Magazine, remained in the range established on August 1, 1968.

Cement.—Production and value of masonry cement increased 107,000 barrels (49 percent) and $342,000 (49 percent), respectively. Production of portland cement increased 572,000 barrels (13 percent) and the value $2.2 million (16 percent). Output was by Arizona Portland Cement Division, California Portland Cement Co., at its Rillito plant in Pima County and by the Phoenix Division, American Cement Corp., at its Clarkdale plant in Yavapai County. Virtually all output was used within the State.

Of the total portland cement shipped, 73 percent was by truck, and 27 percent was by rail; 87 percent was transported in bulk, and 13 percent was in containers. The largest use was for ready-mix concrete (64 percent). Other markets were concrete-product manufacturing plants (14 percent), building material supply firms (9 percent), highway and other contractors (5 percent), and miscellaneous other uses (8 percent).

Clays.—Including miscellaneous clay and shale, bentonite, and fire clay, nine companies mined 120,000 tons, an increase of 56 percent. The value increased 14 percent to $394,000. Common clay for the manufacture of brick was produced by Phoenix Brick Yard and by Wallapai Brick and Clay Products, Inc., both in Maricopa County; and Grabe Brick Co., Inc., Tucson Pressed Brick Corp., and Phoenix Brick Yard, all three in Pima County. American Cement Corp. produced common clay for manufacturing cement in Yavapai County. The Filtrol Corp. and McCarrell & Gurley mined bentonite in Apache County; Arizona Gypsum Corp. mined bentonite in Yavapai County. Fire clay was mined by McKusick Mosaic Co. in Gila County.

Diatomite.—Arizona Gypsum Corp. obtained crude diatomite from the White Cliffs mine near Mammoth in Pinal County. The value of the material sold increased 50 percent over 1968. Of the 725 tons sold, 375 tons were for use as a filler and 350 for use in lightweight mortar.

Feldspar.—The production of feldspar decreased 52 percent; value of the material sold decreased 53 percent from 1968. International Minerals and Chemical Corp., Industrial Minerals Division, the only producer, sold feldspar from the Taylor mine in Mohave County. The material was ground and sold for use in pottery and enamel manufacture in various States and two foreign countries.

Gem stones.—Collecting gem stones continued to interest numerous individuals, societies, and dealers. They reported an estimated sales value of $153,000 in 1969, a 3-percent increase. Agate, petrified wood, turquoise, chrysocolla, and obsidian were the important gem stones collected during the year.

Gypsum.—Four open pit mines, three in Pinal County and one in Yavapai County, yielded 83,000 short tons of crude gypsum valued at $424,000. Gypsum was sold as crude for portland cement retarder and agricultural use, or calcined and used for manufacturing building materials. Arizona Gypsum Co., Pinal Mammoth Gypsum Co., and National Gypsum Co. produced crude gypsum from mines in lower San Pedro Valley deposits near Winkelman. Arizona Gypsum Co. also produced from a deposit near Camp Verde.

Lime.—The production of quick and hydrated lime in Arizona is closely related to the copper industry. Output increased 23,000 tons (9 percent) to 283,000 tons valued at $5.1 million, an increase of 11 percent in value. Lime was produced by seven plants, two in Gila County, and one each in Cochise, Greenlee, Maricopa, Pinal, and Yavapai Counties. Most of the lime was used as a reagent by the copper industry; the remainder was used in sugar refining, open hearth furnaces, soil stabilization, manufacturing paper and pulp, and mason's lime. Most of the lime was used in Arizona; however, small amounts were sold in nearby States and Mexico. Approximately 564,000 tons of limestone were used in manufacturing lime.

Home-Stake Production Co. announced that a new plant is to be constructed to process limestone from a quarry in the Helvetia district, 20 miles south of Tucson. Plans were announced to produce calcined lime and crushed limestone for high-quality specialty uses.

Mica.—Four mines in Maricopa County and one in Pima County yielded scrap mica. The quantity increased 10,176 tons, eightfold over production in 1968; the value of all mica sold decreased $4,000 or 17 percent. Buckeye Mica Co., operating two mines in Maricopa County, was the largest producer, followed by V. B. West in Maricopa County and San Antonio Mine Co. in Pima County. Buckeye Mica Co. also operated a mill at Buckeye. The mica was sold for use in the manufacture of roofing paper.

Perlite.—Crude perlite was produced by Arizona Perlite Roofs, Inc., and Harborlite Corp. from open pit mines near Superior in Pinal County. Production increased by 5,185 tons (13 percent) and value increased by $39,000 (12 percent). Supreme Perlite Inc. operated a plant in Maricopa County to expand crude ore. It is marketed for production of lightweight concrete and plaster aggregate, masonry and cavity fill insulation, and horticultural aggregates.

Pumice and pumicite.—Nine companies operated 26 mines and six plants to produce 910,000 short tons of pumice, pumicite, and volcanic cinders valued at $814,000. Production decreased 123,000 tons, 12 percent, and the value decreased $160,000, 16 percent from 1968. Production included 139 tons of pumice valued at $238; the remainder was volcanic cinders. Arizona ranked first in the Nation, followed in order by Oregon, California, Hawaii, and New Mexico. Mines were operated in Apache, Coconino, Graham, Navajo, Pinal, and Yavapai Counties. The material was used about equal in amounts for railroad ballast, road construction, and concrete aggregate.

Pyrite.—A small amount of pyrite recovered as a byproduct at the Magma Copper Co. mill in Superior was sold to Ray Mines as supplemental feed for its sulfuric acid plant. The amount sold decreased 20,000 tons (95 percent); the value decreased $102,000 (95 percent) because primary feed for the acid plant was sulfur dioxide from the smelting of Ray concentrates. The sulfuric acid was used to leach waste dumps.

Sand and Gravel.—Production of sand and gravel sold or used increased 19 percent in quantity to 16.5 million short tons and 25 percent in value to $18.1 million. Output was reported from 142 operators (two or more being in each county)—79 commercial, seven Federal, 41 State, 10 county, and four municipal operations. Of the total, 4.9 million tons was classed as sand and valued at $5.5 million; 11.6 million tons was gravel, valued at $12.6 million.

Commercial operators produced and processed 10.0 million tons of material in 57 stationary and 24 portable plants and sold 321,000 tons of unprocessed material. The average values were $1.23 per short ton for all material, $0.53 for unprocessed material, and $1.25 for processed material. Trucks moved 10.3 million tons and railroads moved 19,000 tons of material to consumers. Of the materials sold, 3.7 million tons valued at $4.4 million was classed as sand; and 6.7 million tons, valued at $8.3 million, as gravel.

Government-crew and contractor output consisted of 6.1 million tons of material valued at $5.3 million—1.2 million tons valued at $1.0 million was classed as sand, and 4.9 million tons valued at $4.3 million was classed as gravel.

More than 99 percent of the sand and gravel was used for construction; paving absorbed the largest portion (54 percent), followed by building (33 percent), and fill (12 percent). A small amount of industrial sand was used for sandblast, oil-formation fracturing, engine sand, and filtration.

Table 14.—Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Apache	256	$377	W	W
Cochise	529	476	W	W
Coconino	1,302	1,429	1,904	$1,735
Gila	80	135	112	257
Graham	64	78	76	90
Greenlee	73	87	117	142
Maricopa	7,328	6,718	6,785	7,858
Mohave	548	368	180	235
Navajo	419	471	503	602
Pima	2,239	2,979	2,570	3,014
Pinal	502	560	1,487	1,421
Santa Cruz	41	69	141	282
Yavapai	258	276	715	701
Yuma	342	400	1,650	1,457
Undistributed	-----	-----	130	272
Total [1]	13,981	14,423	16,481	18,066

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Data may not add to totals shown because of independent rounding.

Table 15.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	2,917	$3,164	2,076	$2,978
Paving	604	586	917	1,069
Railroad ballast	(1)	(1)	------	------
Fill	630	182	629	199
Other	[1] 124	[1] 330	[1] 46	[1] 178
Industrial:				
Blast	(1)	(1)	(1)	(1)
Engine	(2)	12	10	12
Filtration	------	------	(1)	(1)
Oil (hydrafrac)	(1)	(1)	(1)	(1)
Total [3]	4,275	4,274	3,678	4,435
Gravel:				
Construction:				
Building	2,269	2,951	3,420	4,437
Paving	1,510	1,888	2,098	2,469
Railroad ballast	[4] 39	[4] 70	------	------
Fill	1,174	707	1,140	1,379
Other	(4)	(4)	3	1
Miscellaneous	(4)	(4)	12	29
Total [3]	4,992	5,616	6,673	8,316
Total sand and gravel	9,267	9,890	10,351	12,751
Government-and-contractor operations:				
Sand:				
Building	401	401	------	------
Paving	620	595	1,139	990
Fill	70	68	35	36
Total	1,091	1,064	1,174	1,026
Gravel:				
Building	600	601	(2)	(2)
Paving	2,908	2,756	4,739	4,038
Fill	115	112	216	250
Total [3]	3,623	3,469	4,955	4,289
Total sand and gravel	4,714	4,533	6,129	5,315
All operations:				
Sand	5,366	5,338	4,852	5,462
Gravel	8,615	9,085	11,628	12,604
Total [3]	13,981	14,423	16,481	18,066

[1] Railroad ballast (1968), other, blast, filtration (1969), and oil (hydrafrac) sand combined to avoid disclosing individual company confidential data.
[2] Less than ½ unit.
[3] Data may not add to totals shown because of independent rounding.
[4] Railroad ballast, other, and miscellaneous gravel combined to avoid disclosing individual company confidential data.

Sand and gravel was produced in all 14 counties, ranging from a few thousand tons in Apache County to 6.8 million tons in Maricopa County. Output in excess of 1 million tons was reported in Coconino, Maricopa, Pima, Pinal, and Yuma Counties.

Of the 79 commercial sand and gravel operations in Arizona, two produced over 1 million tons each; three between 500,000 and 1 million tons each; 18 between 100,000 and 500,000 tons each; and 56 less than 100,000 tons each.

Stone.—The quantity of stone produced in 1969 decreased 466,000 tons (14 percent) to 2.8 million short tons. The value decreased 7 percent to $5.8 million. Of the 68 quarries reporting, 24 produced less than 100,000 tons, 22 produced between 100,000 and 500,000 tons, and 22 produced more than 500,000 tons but less than 800,000 tons. Limestone, quartz and quartzite, traprock, marble, granite, sandstone, and miscellaneous stone were mined and sold as crushed and broken stone. Sandstone, marble, quartz, and miscellaneous stone were also sold as dimension stone. Uses of crushed and broken stone included cement, flux, lime, roadbase, surface treatment, poultry grit, riprap, terrazzo, acid neutralizer, whiting, and concrete and roofing aggregate. Some dimension stone was used as house stone veneer, flagging, irregular shaped stone, and rough block.

Table 16.—Stone sold or used by producers, by county

County	1968		1969	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Apache	1,930	$3	5,710	$23
Cochise	449,835	1,151	504,001	1,364
Coconino	W	W	191,828	453
Gila	145,617	284	199,653	564
Graham	1,570	3	----	----
Greenlee	W	W	365,099	865
Maricopa	10,769	21	W	W
Mohave	W	W	W	W
Navajo	4,056	16	500	10
Pima	W	W	W	W
Pinal	98,995	271	76,552	153
Santa Cruz	1,570	3	300	(1)
Yavapai	W	W	W	W
Yuma	12,096	107	W	W
Undistributed	2,566,559	4,380	1,482,969	2,380
Total	3,292,997	6,239	2,826,612	5,812

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Less than ½ unit.

Table 17.—Stone sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind of stone	1965		1966		1967		1968		1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Granite	237	$362	----	----	35	$117	18	$24	1	$1
Limestone	1,602	2,147	1,590	$2,262	1,449	1,934	2,761	4,663	2,340	3,893
Marble	W	W	21	279	23	290	([1] [2])	[2] 11	W	W
Quartz, quartzite, and sandstone	460	1,234	318	884	211	705	351	1,043	438	1,569
Quartz and quartzite	NA	NA	NA	NA	NA	NA	344	930	427	1,394
Sandstone	NA	NA	NA	NA	NA	NA	7	113	11	175
Traprock	W	W	10	31	146	368	W	W	23	67
Other stone	175	429	330	636	46	77	163	499	25	282
Total [3]	2,474	4,171	2,271	4,091	1,910	3,491	3,293	6,239	2,827	5,812

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Other stone."
[1] Less than ½ unit.
[2] Excludes crushed marble; included with "Other stone."
[3] Data may not add to totals shown because of independent rounding.

Table 18.—Stone sold or used by producers, by use

Use	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension stone:				
Irregular-shaped stone—short tons	370	$2	2,671	$50
Rubble—do	W	W	715	5
Other rough—do	1,046	10	W	W
Rough architectural—cubic feet	W	W	[1] 31,124	46
Dressed architectural—do	2,889	8		
Flagging—do	1,640	2	[1] 50,976	44
Other dressed—do	56	8		
Total (approximate, in short tons)	8,000	132	12,300	201
Crushed and broken stone:				
Riprap—short tons	46,783	84	13,375	36
Metallurgical—do	503,190	1,156	629,125	1,709
Concrete aggregate and roadbase—do	W	W	W	W
Surface treatment aggregates—do	29,990	58	20,758	58
Lime—do	495,630	1,268	529,818	1,245
Other—do	[2] 2,209,447	[2] 3,541	[3] 1,621,256	[3] 2,563
Total—do	3,285,040	6,107	2,814,332	5,611
Total stone (approximate, in short tons)	3,293,000	6,239	2,826,600	5,812

W Withheld to avoid disclosing individual company confidential data; included in "Total" in dimension stone, and in "Other" in crushed and broken stone.
[1] Combined in 1969 to avoid disclosing individual company confidential data.
[2] Includes stone used in abrasives, cement, concrete aggregate, exposed aggregate, landscaping, poultry grit, refractories, roadbase, roofing aggregates, and terrazzo.
[3] Includes stone used in acid neutralizers, cement, concrete aggregate, poultry grit, roadbase, roofing aggregates, terrazzo, and whiting.

Vermiculite.—Ari-Zonolite Co. exfoliated at its mill in Phoenix vermiculite concentrates received from out of State. The product was used for block insulation and roofing aggregate. Solomon's Mines, Inc., mined and exfoliated a small quantity of vermiculite near Buckeye.

Zeolite.—A small amount of zeolite was produced in Graham County and used for experimental purposes.

MINERAL FUELS

Coal (Bituminous).—Coal production has not been significant in Arizona in past years; however, its importance appears to be increasing. The Navajo Tribal Council approved a contract with Peabody Coal Co. in 1966 to develop and place in production a large-capacity strip mine in the Black Mesa district of Navajo County and on the Navajo reservation. Coal will be delivered to a preparation plant, ground, mixed with water, and pumped 273 miles through an 18-inch pipeline to the Mohave Generating Station, which is under construction by Bechtel Corp. on the Colorado River in Clark County, Nev. The pipeline was nearing completion at year-end, and development of the mine was on schedule. The powerplant is expected to start operation in late 1970. The Peabody Coal Co. became a subsidiary of Kennecott Copper Corp. during 1969.

During the year, an agreement was reached among the Salt River Project Agricultural Improvement and Power District, Arizona Public Service Co., Tucson Gas and Electric Co., Los Angeles Department of Water and Power, and the Nevada Power Co. covering requirements for the new Navajo Generating Plant to be built near Page, Ariz. An agreement was made with Peabody Coal Co. to supply coal for this plant. This will be hauled 80 miles by rail from the mine at Kayenta to the plant near Page. Starting date was expected to be in 1974. With this new requirement, in addition to the 5.2 million tons per year to the Mohave Generating Plant, the production rate of the mine is expected to reach 13.6 million tons per year. Reserves are extensive.

Helium.—Based on calculations from State data on helium-bearing gas, the quantity of Grade A helium produced declined 13 percent; value was down 29.6 percent. First shipment of helium from the plant of the Arizona Helium Corp. at Navajo was made in May. Raw helium gas for the plant was obtained from three wells in the East Navajo Springs field. The Teec Nos Pos plant of Air Reduction Co.

(Airco) ceased operations in September when Airco closed the Shiprock, N. Mex., plant and returned it to the Navajo Indian Tribe; crude helium from the Teec Nos Pos plant had been sent to Shiprock for purification.

Natural gas.—Marketed natural gas had a 29-percent increase in quantity and a 40-percent increase in value. The Arizona Oil and Gas Conservation Commission reported that 1.6 billion cubic feet of natural gas was produced in 1969, 25 percent more than in the previous year.[5] (This figure did not include helium-bearing natural gas.) Approximately 55 percent of the gas output was sold; the rest was flared or used for lease fuel.

El Paso Natural Gas Co. and Transwestern Pipeline Co. completed construction of new facilities enabling them to increase their gas supply to markets in southern California. El Paso built 670 miles of 30- and 36-inch line in Arizona, New Mexico, and Texas; Transwestern built 281 miles of 30-inch loop on its mainline in Arizona and New Mexico.

Petroleum.—Output of petroleum declined 28 percent as the "flush-production" at Dineh bi Keyah field came to an end, and normal depletion of the reservoir began. Dineh bi Keyah yielded 2,280,301 barrels, down 30 percent from the previous year; the field accounted for 94 percent of the State oil output.

East Boundary Butte field ranked second in the State with output of 104,998 barrels, nearly three times the production of the previous year. The great increase resulted from a development drilling program that added seven new producing wells to the field; one well was completed for an initial potential of 744 barrels of oil daily; another for a daily gage of 576 barrels.

Drilling activity was at a record high with a total of 49 wells drilled. All of the 32 exploratory wells were unsuccessful. Of the 17 development wells, nine were completed as oil wells and two as gas wells. Seven of the oil wells were in East Boundary Butte field, and two were in Dineh bi Keyah field. The two gas wells were in the Pinta Dome helium-producing field.

[5] State of Arizona Oil and Gas Conservation Commission. Monthly Oil, Gas, and Helium Production. December 1968 and December 1969.

Table 19.—Oil and gas well drilling, by county

County	Oil	Gas	Dry	Total	Footage	County	Oil	Gas	Dry	Total	Footage
1968:						1969:					
Exploratory completions:						Exploratory completions:					
Apache	1	--	20	21	61,967	Apache	--	--	21	21	76,601
Cochise	--	--	1	1	------	Coconino	--	--	4	4	8,770
Coconino	--	--	2	2	10,197	Yavapai	--	--	7	7	7,764
Navajo	--	--	2	2	5,188						
Yavapai	--	--	3	3	2,946	Total	--	--	32	32	93,135
Yuma	--	--	3	3	5,575						
Total	1	--	31	32	85,873						
Development completions:						Development completions:					
Apache	5	1	3	9	34,273	Apache	9	2	6	17	66,777
Total all drilling	6	1	34	41	120,146	Total all drilling	9	2	38	49	159,912

Sources: Petroleum Information Corp., 1968 and 1969 Résumés, Oil and Gas Operations in the Rocky Mountain Region.

Table 20.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos: Jaquays Mining Corp	1219 South 19th Ave. Phoenix, Ariz. 85009	Underground mine and crushing, screening, and air-separation plant.	Gila.
Cement:			
American Cement Corp., Phoenix Division	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Dry process, 3-rotary-kiln plant	Yavapai.
Arizona Portland Cement Co., a division of California Portland Cement Co.	612 South Flower St. Los Angeles, Calif. 90017	----do	Pima.
Clays:			
Arizona Gypsum Corp	Box 6675 Phoenix, Ariz. 85005	Open pit mine and plant	Yavapai.
Filtrol Corp	3250 East Washington Blvd. Los Angeles, Calif. 90023	Open pit mine	Apache.
McCarrell & Gurley	Box 1377 Gallup, N. Mex. 87301	----do	Do.
Phoenix Brick Yard	1814 South 7th Ave. Phoenix, Ariz. 85007	----do ----do	Maricopa. Pima.
Tucson Pressed Brick Corp	Box 2592 Tucson, Ariz. 85702	----do	Do.
Copper:			
American Smelting and Refining Co	120 Broadway New York, N.Y. 10005	3 open pit mines, 2 mills, leach dumps, and precipitation plant.	Do.
The Anaconda Company	Box 127 Sahuarita, Ariz. 85629	Open pit mine and mill	Do.
Arizona Ranch and Metals Co	218 West Main Scottsdale, Ariz. 85251	Open pit mine, heap leaching, and precipitation plant.	Yuma.
Bagdad Copper Corp	Box 245 Bagdad, Ariz. 86321	Open pit mine, mill, leach dumps, precipitation plant, and copper powder refinery.	Yavapai.
Cyprus Mines Corp., Bruce Mine Division	Box 457 Bagdad, Ariz. 86321	Underground mine and mill	Do.
Duval Corp	Box 1271 Kingman, Ariz. 86401	Open pit mine, mill, leach dumps, and precipitation plant.	Mohave.
	Box 38 Sahuarita, Ariz. 85629	----do	Pima.
El Paso Natural Gas Co	Box 1492 El Paso, Tex. 79999	Open pit mine and mill	Mohave.
Inspiration Consolidated Copper Co	Inspiration, Ariz. 85537	4 open pit mines, 2 mills, leach dumps and in place leaching, heap leaching, precipitation plant, rod plant rolling mill, custom smelter, electrolytic refinery.	Gila.
Kennecott Copper Corp., Ray Mines Division	Hayden, Ariz. 85235	Open pit mine, leach dumps and in place leaching, electrowinning plant, and precipitation plant.	Pinal.
		Mill and smelter	Gila.
Magma Copper Co.:			
San Manuel Division	Box M San Manuel, Ariz. 85631	Underground mine, mill, and smelter	Pinal.
Superior Division	Box 37 Superior, Ariz. 85273	Underground mine, mill, and custom smelter	Do.
McAlester Fuel Co	Box 907 McAlester, Okla. 74501	Open pit mine, heap leaching, and precipitation plant.	Yavapai.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Copper—Continued			
Phelps Dodge Corp.:			
Copper Queen Branch	Drawer K Bisbee, Ariz. 85603	Open pit mine, underground mine, mill, leach dumps and in place leaching, and precipitation plant.	Cochise.
Morenci Branch	Douglas, Ariz. 85607	Custom smelter	Do.
	Morenci, Ariz. 85540	Open pit mine, mill, leach dumps, precipitation plant, and smelter.	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, Ariz. 85321	Open pit mine, mill, and smelter	Pima.
Phelps Dodge Corp., (Big Hole Mining Co., lessee)	Box 125 Jerome, Ariz. 86331	Open pit mine, leach dumps, and precipitation plant.	Yavapai.
Pima Mining Co	Box 7187 Tucson, Ariz. 85713	Open pit mine and mill	Pima.
Ranchers Exploration and Development Corp	Box 6217 Albuquerque, N. Mex. 87107	Open pit mine, heap leaching, and electrowinning plant.	Gila.
Tennessee Corp., Miami Copper Co. Division	Box 100 Miami, Ariz. 85539	Open pit mine, mill, leach dumps and in place leaching, and 3 precipitation plants.	Do.
Diatomite: Arizona Gypsum Corp	Box 6675 Phoenix, Ariz. 85005	Open pit mine and plant	Pinal.
Feldspar: International Minerals & Chemical Corp., Industrial Minerals Division.	Administration Center Old Orchard Road Skokie, Ill. 60079	----do	Mohave.
Gold:			
Inspiration Consolidated Copper Co	Inspiration, Ariz. 85537	*See* Copper	Gila.
Kennecott Copper Corp., Ray Mines Division	Hayden, Ariz. 85235	----do	Pinal.
Magma Copper Co.:			
San Manuel Division	Box M San Manuel, Ariz. 85631	----do	Do.
Superior Division	Box 37 Superior, Ariz. 85273	----do	Do.
Phelps Dodge Corp.:			
Copper Queen Branch	Drawer K Bisbee, Ariz. 85603	----do	Cochise.
Morenci Branch	Morenci, Ariz. 85540	----do	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, Ariz. 85321	----do	Pima.
Tennessee Corp., Miami Copper Co. Division	Box 100 Miami, Ariz. 85593	----do	Gila.
Gypsum:			
Arizona Gypsum Corp.:			
Verde Division	Box 6675 Phoenix, Ariz. 85005	Open pit mine and plant	Yavapai.
Winkelman Division	----do	----do	Pinal.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Do.
Helium:			
Kerr-McGee Corp., Gas Processing Department	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	6 wells and plant; Pinta Dome field	Apache.

Eastern Petroleum Co	Box 291 Carmi, Ill. 62821	2 wells; Navajo Springs field	Do.
Iron ore: CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Open pit mine	Navajo.
Lime:			
Paul Lime Plant, Inc	Drawer T Douglas, Ariz. 85607	5 rotary-kiln plant	Cochise.
Phelps Dodge Corp., Morenci Branch	Morenci, Ariz. 85540	1 rotary-kiln, 1 fluidized-bed-kiln plant	Greenlee.
Mercury:			
Phoenix Sunflower Industries, Inc	220 West 3d St. Scottsdale, Ariz. 85251	Open pit mine, crusher, and furnace	Maricopa.
Posey Mining Co	Box 590 Mesa, Ariz. 85201	----do	Do.
Mica: Buckeye Mica Co	Box 416 Buckeye, Ariz. 85326	2 open pit mines, stationary crushing and screening plant, wet grinding mill.	Do.
Molybdenum:			
American Smelting and Refining Co	120 Broadway New York, N.Y. 10005	*See* Copper	Pima.
Bagdad Copper Corp	Box 245 Bagdad, Ariz. 86321	----do	Yavapai.
Duval Corp	Box 1271 Kingman, Ariz. 86401	----do	Mohave.
Inspiration Consolidated Copper Co	Inspiration, Ariz. 85537	----do	Gila.
Kennecott Copper Corp., Ray Mines Division	Hayden, Ariz. 85235	----do	Pinal.
Magma Copper Co., San Manuel Division	Box M San Manuel, Ariz. 85631	----do	Do.
Pima Mining Co	Box 7187 Tucson, Ariz. 85713	----do	Pima.
Tennessee Corp., Miami Copper Co. Division	Box 100 Miami, Ariz. 85539	----do	Gila.
Natural gas and petroleum:			
Consolidated Oil & Gas, Inc	1300 Lincoln Tower Bldg. 1860 Lincoln St. Denver, Colo. 80203	Crude oil and natural gas wells; East Boundary Butte field.	Apache.
Humble Oil & Refining Co	2000 Classen Center-North Oklahoma City, Okla. 73106	----do	Do.
Kerr-McGee Corp	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Crude oil and natural gas wells; Dineh bi Keyah field.	Do.
Perlite:			
Arizona Perlite Roofs, Inc	Rte 1, Box 720 Miami, Ariz. 85539	Open pit mine	Pinal.
Harborlite Corp	Box 458 Escondido, Calif. 92025	----do	Do.
Pumice:			
Apache County Highway Department	Box 428 St. Johns, Ariz. 85936	----do	Apache.
Atchison, Topeka & Santa Fe Railway Co	Winslow, Ariz. 86047	Open pit mine and plant	Coconino.
Superlite Bldrs. Supply, Inc	5201 North 7th St. Phoenix, Ariz. 85014	Open pit mine	Do.
Pyrites: Magma Copper Co., Superior Division	Box 37 Superior, Ariz. 85273	*See* Copper	Pinal.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and Gravel (commercial):			
Arizona Sand & Rock Co	Box 20067 Phoenix, Ariz. 85036	2 pits and plants	Maricopa.
Tucson Sand & Soil, Inc	2430 West Curtis St. Tucson, Ariz. 85705	Pit and plant	Pima.
Union Rock & Materials Corp., Bentson Contracting Co. Division.	2800 South Central Ave. Phoenix, Ariz. 85040	3 pits and plants	Maricopa.
San Xavier Rock & Materials Division	2800 South Central Ave. Phoenix, Ariz. 85040	2 pits and plants	Pima.
United Metro Materials & Concrete Co., Inc	Box 13309 Phoenix, Ariz. 85002	5 pits and plants 2 pits and plants Pit and plant	Maricopa. Pinal. Yuma.
Silver:			
American Smelting and Refining Co	120 Broadway New York, N.Y. 10005	*See* Copper	Pima.
The Anaconda Company	Box 127 Sahuarita, Ariz. 85629	----do	Do.
Bagdad Copper Corp	Box 245 Bagdad, Ariz. 86321	----do	Yavapai.
Cyprus Mines Corp., Bruce Mine Division	Box 457 Bagdad, Ariz. 86321	----do	Gila.
Duval Corp	Box 1271 Kingman, Ariz. 86401	----do	Mohave.
	Box 38 Sahuarita, Ariz. 85629	----do	Pima.
E. E. Lewis, Inc	Box 1481 Grand Junction, Colo. 81501	Underground mine	Greenlee.
Inspiration Consolidated Copper Co	Inspiration, Ariz. 85537	*See* Copper	Gila.
Kennecott Copper Corp., Ray Mines Division	Hayden, Ariz. 85235	----do	Pinal.
Magma Copper Co.:			
San Manuel Division	Box M San Manuel, Ariz. 85631	----do	Do.
Superior Division	Box 37 Superior, Ariz. 85273	----do	Do.
Magma Copper Co., (McFarland & Hullinger, lessee)	Box 238 Tooele, Utah 84074	Dump	Do.
Phelps Dodge Corp.:			
Copper Queen Branch	Drawer K Bisbee, Ariz. 85603	*See* Copper	Cochise.
Morenci Branch	Morenci, Ariz. 85540	----do	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, Ariz. 85321	----do	Pima.
Pima Mining Co	Box 7187 Tucson, Ariz. 85713	----do	Do.
Tennessee Corp., Miami Copper Co. Division	Box 100 Miami, Ariz. 85539	----do	Gila.
Turney Associates	Box 183 Aurora, N.C. 27806	Dump	Greenlee.

Stone:			
American Cement Corp., Phoenix Division	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Quarry and plant	Yavapai.
Arizona Portland Cement Co., a division of California Portland Cement Co.	612 South Flower St. Los Angeles, Calif. 90017	----do	Pima.
Paul Lime Plant, Inc	Drawer T Douglas, Ariz. 85607	----do	Cochise.
Uranium: Cotter Corp	Box 468 Golden, Colo. 80401	Underground mine	Coconino.
Vanadium: A. F. Skalla	Box 65 Norwood, Colo. 81423	----do	Apache.
Zeolite: Union Carbide Corp., Mining & Metals Division	270 Park Ave. New York, N.Y. 10017	Open pit mine	Graham.
Zinc: Cyprus Mines Corp., Bruce Mine Division	Box 457 Bagdad, Ariz. 86321	*See* Copper	Yavapai.

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 William G. Park [1]

With a 4.7 percent increase over the 1968 value ($198.7 million), mineral value in Arkansas exceeded $200 million for the first time. Bromine, with an output valued at $28.3 million, an increase of 36 percent over 1968 was the largest contributor to the increase and became the second most important commodity in the State in terms of value. Although petroleum production and value declined 7.3 and 3.9 percent, respectively, petroleum continued as the leading commodity. Natural gas and bauxite ranked third and fourth in value, and these four commodities constituted 63 percent of the State's total mineral value. Nonmetals value in 1969 again exceeded mineral fuels, which registered a net loss. Bauxite value increased 7 percent but had a slightly lower average unit price. The only other metal produced—vanadium—declined in value 16 percent. Other gains in mineral value were from barite, clays, coal, gypsum, sand and gravel, and stone.

[1] Physical scientist, Bureau of Mines, Dallas, Tex.

Table 1.—Mineral production in Arkansas [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite—short tons	166,183	$3,839	209,817	$4,616
Bauxite—thousand long tons, dried equivalent	1,582	23,058	1,755	24,706
Bromine—thousand pounds	95,499	20,790	145,100	28,287
Clays—thousand short tons	919	2,134	992	2,426
Coal (bituminous)—do	211	1,576	228	1,802
Gem stones	NA	30	NA	24
Lime—thousand short tons	206	3,058	184	2,748
Natural gas—million cubic feet	156,627	24,456	169,257	26,743
Natural gas liquids:				
Natural gasoline and cycle products—thousand 42-gallon barrels	753	2,192	692	2,049
LP gases—do	1,435	2,899	1,279	2,098
Petroleum (crude)—do	19,464	53,137	18,049	51,079
Sand and gravel—thousand short tons	12,997	14,643	12,674	14,949
Stone—do	16,322	22,256	16,463	23,134
Value of items that cannot be disclosed: Abrasive stone, cement, gypsum, soapstone, tripoli, and vanadium	XX	24,655	XX	23,465
Total	XX	198,723	XX	208,126
Total 1967 constant dollars	XX	197,460	XX	p204,602

p Preliminary. 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 Arkansas, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Arkansas	$3	-------	
Ashley	403	$261	Sand and gravel, lime.
Baxter	199	250	Sand and gravel, stone.
Benton	W	W	Stone, sand and gravel.
Boone	305	559	Do.
Bradley	444	336	Petroleum, sand and gravel.
Calhoun	933	783	Sand and gravel, petroleum, stone.
Carroll	W	564	Stone, sand and gravel.
Chicot	1	157	Sand and gravel.
Clark	278	244	Sand and gravel, stone, clays.
Clay	146	136	Sand and gravel, stone.
Cleburne	101	31	Stone.
Cleveland	28	35	Sand and gravel.
Columbia	29,607	30,229	Bromine, petroleum, natural gas, natural gas liquids, sand and gravel.
Conway	2,000	669	Stone, natural gas, sand and gravel.
Craighead	314	585	Sand and gravel, clays, stone.
Crawford	4,763	4,925	Natural gas, stone, sand and gravel.
Crittenden	W	73	Clays, sand and gravel, stone.
Cross	1,205	509	Sand and gravel.
Dallas	61	170	Do.
Desha	1	157	Do.
Drew	132	106	Do.
Faulkner	956	586	Stone, sand and gravel.
Franklin	8,356	9,232	Natural gas, stone, coal, sand and gravel.
Fulton	50	150	Stone, sand and gravel.
Garland	W	W	Vanadium, abrasives, tripoli, sand and gravel, gem stones.
Grant	89	119	Sand and gravel.
Greene	261	230	Do.
Hempstead	147	281	Sand and gravel, clays, petroleum.
Hot Spring	4,841	5,852	Barite, clays, sand and gravel, stone.
Howard	5,926	W	Cement, gypsum, stone, clays, sand and gravel.
Independence	3,017	2,898	Stone, lime, sand and gravel.
Izard	W	2,463	Stone, sand and gravel.
Jackson	207	155	Sand and gravel, stone.
Jefferson	505	306	Sand and gravel.
Johnson	3,285	3,672	Natural gas, coal, stone, sand and gravel, clays.
Lafayette	14,189	15,934	Petroleum, natural gas, natural gas liquids, sand and gravel.
Lawrence	W	830	Stone, sand and gravel.
Lee	12	19	Sand and gravel.
Lincoln	73	65	Sand and gravel.
Little River	W	W	Cement, stone, sand and gravel, clays.
Logan	1,598	1,671	Natural gas, stone.
Lonoke	W	765	Stone, clays, sand and gravel.
Madison	r 81	77	Sand and gravel.
Marion	110	237	Sand and gravel, stone.
Miller	6,454	6,213	Petroleum, sand and gravel, natural gas, clays, stone.
Mississippi	94	17	Sand and gravel.
Monroe	2	120	Do.
Montgomery	W	W	Stone, sand and gravel.
Nevada	2,241	2,015	Petroleum, sand and gravel, stone.
Newton	57	224	Stone, sand and gravel.
Ouachita	8,460	8,743	Petroleum, sand and gravel, clays.
Perry	W	160	Stone, sand and gravel.
Phillips	8	90	Sand and gravel.
Pike	771	896	Sand and gravel, gypsum, tripoli, gem stones, stone.
Poinsett	W	376	Sand and gravel, stone.
Polk	139	191	Stone, clays, tripoli, sand and gravel.
Pope	1,375	1,422	Natural gas, stone, sand and gravel, clays.
Prairie	234	-------	
Pulaski	9,064	9,672	Stone, sand and gravel, clays.
Randolph	30	126	Stone, sand and gravel.
St. Francis	W	W	Sand and gravel.
Saline	25,674	26,866	Bauxite, lime, sand and gravel, clays, talc, stone.
Scott	406	244	Natural gas, sand and gravel.
Searcy	14	3	Sand and gravel.
Sebastian	3,941	4,231	Natural gas, stone, sand and gravel, coal, clays.
Sevier	W	73	Sand and gravel.
Sharp	18	70	Stone, sand and gravel.
Stone	122	46	Do.
Union	27,206	30,329	Bromine, petroleum, sand and gravel, natural gas, clays.
Van Buren	W	245	Stone, sand and gravel.
Washington	502	W	Stone, natural gas, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Arkansas, by counties—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
White	W	W	Stone, sand and gravel.
Woodruff	$7	$9	Sand and gravel.
Yell	289	150	Sand and gravel, stone.
Undistributed	r 26,988	29,273	
Total [1]	198,723	208,125	

r Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed".
[1] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Arkansas business activity

		1968	1969 p	Change, percent
Annual average labor force and employment:				
Total labor force	thousands	704.6	728.7	+3.4
Unemployment	do	29.9	30.3	+1.3
Employment:				
Food and kindred products	do	23.7	24.8	+4.6
Lumber and wood products	do	21.9	22.3	+1.8
Chemicals and allied products	do	5.8	5.5	−5.2
Petroleum refining and related industries	do	1.9	1.9	------
Stone, clay, and glass products	do	4.2	4.4	+4.8
Primary metal industries	do	4.5	4.7	+4.4
Mining	do	4.7	4.5	−4.3
Contract construction	do	30.2	29.5	−2.3
All industries	do	674.7	698.4	+3.5
Factory payrolls	millions	$734.0	$744.9	+1.5
Personal income:				
Total	do	$4,611.0	$5,027.0	+9.0
Per capita		$2,325.0	$2,520.0	+8.4
Construction activity:				
Building permits, total private nonresidential	millions	$45.0	$57.0	+26.7
Construction contracts	do	$396.6	$354.0	−10.7
Cement shipments to and within Arkansas	thousand 376-pound barrels	4,436.8	3,844.8	−13.3
Farm marketing receipts	millions	$986.4	$1,064.8	+7.9
Mineral production	do	$198.7	$208.1	+4.7

p Preliminary.
Sources: Survey of Current Business, U.S. Department of Commerce; Bureau of Business and Economic Research, University of Arkansas; State Employment Security Division, Department of Labor, Arkansas; Farm Income Situation, U.S. Department of Agriculture.

Completion of Bromet Co.'s bromine plant, Columbia County, ranked Arkansas number one in bromine plant capacity in the United States. About 145 million pounds of bromine and bromine compounds was produced by five plants from approximately 73 million barrels of brine obtained from the Smackover Formation.

Discovery of the Walker Creek oilfield last year caused continued exploration for Smackover (Jurassic) production. Results of the increased activity were a large increase in the total footage drilled over 1968 and discovery of two new fields, three new pools in existing fields, and one rediscovery—all in the Smackover Formation. The most significant of these was Welcome oilfield discovered in February, which at yearend had four producing wells that produced 46,760 barrels of oil and 334 million cubic feet of gas.

New acts, passed by the Arkansas Legislature during 1969, which affected the State's mineral industries dealt generally with pollution and land reclamation. Adoption of the "Arkansas Air Pollution Control Code," effective July 30, 1969, established control over emissions of contaminants into the air both by amount and by type. Compliance is mandatory for all new installations, and operators of existing facilities have 6 months to comply or submit a written program and schedule for achieving compliance by November 30, 1969. Act 641 was enacted to encourage and provide rules for the proper development and use of underground water and became effective June 30, 1969. Act 147 created the Arkansas Land Reclamation Commission, which will submit recommendations and draft of an act to effect mining land reclamation by September 30, 1970, at which time the Commission will cease to exist. The Commission will study the need, develop re-

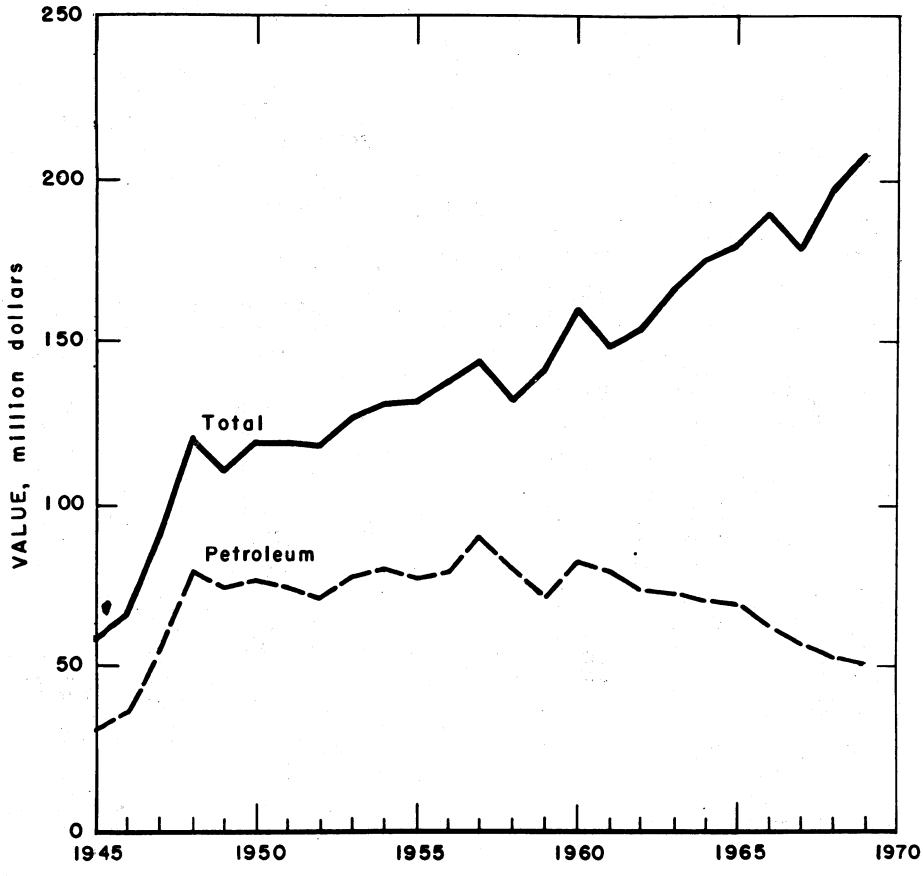

Figure 1.—Value of petroleum and total value of mineral production in Arkansas.

quirements and standards, and hold hearings for land restoration and reclamation. The Director of the Arkansas Geological Commission is the ex officio Secretary of the Commission.

The $28 million Southwest Experimental Fast Oxide Reactor (SEFOR), a nuclear research center under construction since September 1965, was dedicated on May 7. This was the Nation's first fast-breeder reactor fueled with plutonium-uranium oxide. In 1969 a series of experiments to test scientific data as a necessary prelude to the creation of fast-breeder reactors for the electric industry was begun.

Most of the coal produced in 1969 was shipped out of State, and completion of navigational facilities on the Arkansas River during the year made available a new mode of transportation for future shipments. Leasing of coal reserves reflected renewed interest in Arkansas deposits.

The Arkansas Geological Commission worked on several projects during 1969. After collecting samples of mercury ore in Pike County, chemical analyses were run on the samples by the Commission's laboratory. Results are to be presented in a publication. Magnetic surveys were conducted in various parts of the State, including the mercury district of Pike County. Work continued on a new geological map of Arkansas with publication scheduled in 1973. A program for evaluating iron deposits in north Arkansas was planned to begin in 1970.

Rutile from the Magnet Cove area, Hot Spring County, was investigated for com-

mercial usability in strategic applications. Battelle Memorial Institute prepared 456 pounds of rutile concentrate which assayed 93.4 percent titanium oxide and 1.56 percent columbium. Under terms of the contract with Battelle, the Bureau of Mines arranged for end-use tests of the rutile by commercial users. A final report was scheduled at the end of the tests.

The Arkansas River channel was opened for navigation from the Mississippi River to Little Rock, Ark., on December 31, 1968, and during 1969 almost 2.5 million tons of material was barged on the new waterway. Preliminary figures released by the Corps of Engineers in Little Rock showed 714,930 tons of upstream, 842,934 tons of downstream, and 891,876 tons of local shipments. Mineral commodities constituted the major part of the shipments. Sand, gravel, and crushed stone made up 29 percent of the total tonnage; bauxite imports accounted for 25 percent. Other shipments included waterway improvement material, chemicals, iron and steel, agricultural products, petroleum, and miscellaneous products.

By February 1969, 10 barge lines were approved by the Interstate Commerce Commission to operate as common carriers on the Arkansas River, and six more were seeking authority to operate on the 445 miles of waterway from the Mississippi River to Catoosa, Okla. Docking facilities and prime sites for navigation-related industrial development were in various stages of planning, construction, and operation at yearend.

On December 29, 1969 the navigational facilities were officially opened between Little Rock and Fort Smith, making the Arkansas River navigable through the State. With completion of navigational facilities on the Arkansas River, construction by the Corps of Engineers was principally bank stabilization and dredging operations. Two contract dredges were operating on Ozark reservoir and three on Dardanelle reservoir. Cement consumption in Arkansas declined 13 percent to 3.8 million barrels (table 3), reflecting reduction in demand for concrete in locks and dams and in highway construction.

Employment.—Out of a total labor force of 728,700, there were 698,400 employed, and the average unemployment rate was 4.2 percent. Chemicals, mining, and contract construction had reductions in the average number of employees, but the total for all industries reflected a net gain of 23,700 workers. Personal income rose 9 percent to $5,027 million indicating a higher average salary per individual.

Table 4.—Worktime 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
1968:								
Coal	109	189	21	164	--	7	42.66	1,121
Metal	2,098	289	607	4,853	1	71	14.84	3,019
Nonmetal	1,063	247	263	2,101	--	68	32.37	605
Sand and gravel	628	251	158	1,425	--	27	18.95	348
Stone	1,258	276	347	2,975	1	51	17.48	3,358
Total [1]	5,156	270	1,395	11,518	2	224	19.62	2,309
1969: [p]								
Coal	130	200	26	207	--	7	33.81	879
Metal	2,135	285	608	4,861	1	54	11.31	2,012
Nonmetal	960	248	239	1,916	1	67	35.49	4,935
Sand and gravel	770	240	185	1,642	--	36	21.93	522
Stone	1,335	285	381	3,300	--	88	26.67	1,294
Total [1]	5,335	270	1,439	11,926	2	252	21.30	2,058

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Total value of mineral fuels was $83.8 million, a net loss of almost $500,000 from 1968. Of the mineral fuels, only natural gas and coal increased in value; natural gas increased 9.4 percent, and coal 14.3 percent. Natural gas production was up from both

the dry gas fields of north Arkansas and from gas associated with oil in south Arkansas. Petroleum continued to be the most important single mineral in the State's economy although production was the lowest since 1937 when 11.8 million barrels was produced.

Carbon Black.—Columbia Carbon Co., the sole producer of carbon black in Arkansas, increased production by almost 5 percent. Slightly higher average unit price was reflected in the 5.5-percent increase in total value. Carbon black was manufactured by the furnace process utilizing hydrocarbon liquids and natural gas as feedstock.

Coal (Bituminous).—Production from six strip and two slope mines in three counties totaled 228,062 short tons, an 8 percent increase over 1968. Seventy-three percent of the coal was from strip mines. Value increased by 14 percent, indicating a higher average unit price. Johnson County, which contained the two slope mines, accounted for 56 percent of the coal output from four mines, followed by Franklin (41 percent) and Sebastian Counties (3 percent). Most of the coal was shipped out of Arkansas for coking purposes, and the remainder was sold for local consumption. Leasing activity for coal acreage was carried on by several companies. New Federal mine safety regulations, which became effective in 1970, will affect coal mine operations in Arkansas but to what extent was not known at yearend. There were no fatal accidents in the State's coal mines during 1969.

Table 5.—Coal (bituminous) production[1]
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	226	$1,643
1966	236	1,640
1967	189	1,427
1968	211	1,576
1969	228	1,802

[1] Excludes mines producing less than a thousand short tons.

Natural Gas.—Natural gas production continued to increase, reaching an alltime high of 169,257 million cubic feet. Production and value increased 8 and 9 percent, respectively. Gas production from the dry gas fields of the Arkoma Basin in northwest Arkansas was 116,805 million cubic feet. At yearend there were 63 gas fields in the area, six of which did not have pipeline outlets. Casinghead gas produced with oil and condensate from the reservoirs of southern Arkansas was 2 percent greater than in 1968. Most of the increase came from the new Walker Creek field and the Magnolia field, which was in the blow-down stage. For the second year total reserves of natural gas declined, according to the American Gas Association, Inc., and were 2,632,773 million cubic feet, 3 percent below the 1968 reserve.

Table 6.—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]
1965	57,500	46,500	104,000	82,831	$12,922	20,155	1,014
1966	63,100	58,479	121,579	105,174	16,407	15,196	1,209
1967	81,491	46,038	127,529	116,522	17,828	10,010	997
1968	110,898	51,257	162,155	156,627	24,456	4,633	895
1969	119,230	56,105	175,335	169,257	26,743	4,752	1,326

[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.

Pipeline Construction.—Construction of pipelines during 1969 in Arkansas included facilities for transporting gas, liquids, and petrochemicals. Arkansas Louisiana Gas Co. (Arkla) was working on several lines including 80 miles of 30-inch loop line in the Arkoma Basin of northwest Arkansas and eastern Oklahoma. Gulf Central Pipeline Co. completed the major portion of a 2,000-mile ammonia transportation system from the Gulf Coast to Nebraska; the Arkansas portion was comprised of 10-inch pipe.

Natural Gas Pipeline Co. of America laid 38 miles of 36-inch gas line in Nevada, Clark, Grant, Saline, Jackson, and Lawrence Counties. Various other companies, including Columbia Gulf Transmission Co., Mississippi River Transmission Corp., and Texas Gas Transmission Corp., had projects planned, approved, or underway.

Natural Gas Liquids.—Output of natural gas liquids declined 10 percent to about 2 million barrels, and value decreased 18.5 percent to $4,147,000. Of the six plants processing gas, Arkla Chemical Corp's Hamilton plant produced the most liquids. According to the American Gas Association, Inc., reserves of natural gas liquids including condensate, natural gasoline, and LP gases were 13.2 million barrels at yearend.

Petroleum.—Production of petroleum declined for the ninth consecutive year to the lowest point in over 30 years. Output declined 7.3 percent, and value declined 3.9 percent. Petroleum however, continued to remain the State's most important mineral, accounting for 24.5 percent of the total mineral value. Six refineries, with total capacity of 93,500 barrels per calendar day, processed 30.3 million barrels of crude oil in 1969, of which 13.8 million barrels was received from adjoining states. According to American Petroleum Institute, crude oil reserves declined 20 percent to 127.3 million barrels.

There were 7,059 producing wells, including 34 wells in temporarily abandoned zones, that produced in south Arkansas during 1969. Production of 18 million barrels of oil and condensate was from 143 fields. Sixty-four unitized projects were in operation at yearend and accounted for approximately 40 percent of the total oil production. Besides water injection projects, there were two steam and one in situ combustion projects unitized and approved during the year; gas was also used in secondary-recovery and pressure-maintenance operations. The Magnolia field (Smackover reservoir), which had been under pressure maintenance, was in the blow-down stage at yearend. Smackover field was the leading producer with 2.9 million barrels of oil, followed by Midway (1.5 million), Stephens (1.4 million), and Magnolia (1.3 million).

Table 7.—Natural gas liquids production
(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	662	$1,578	1,661	$3,139	2,323	$4,717
1966	763	1,923	1,540	3,233	2,303	5,156
1967	656	1,780	1,279	3,009	1,935	4,789
1968	753	2,192	1,435	2,899	2,188	5,091
1969	692	2,049	1,279	2,098	1,971	4,147

Table 8.—Crude petroleum production, indicated demand, and stocks in 1969, by months
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Arkansas
January	1,543	1,302	1,118
February	1,486	1,849	755
March	1,535	1,620	670
April	1,530	1,512	688
May	1,529	1,203	1,014
June	1,475	1,535	954
July	1,479	1,602	831
August	1,502	1,501	832
September	1,469	1,538	763
October	1,517	1,513	767
November	1,477	1,483	761
December	1,507	1,512	756
Total:			
1969	18,049	18,170	XX
1968	19,464	19,516	XX

XX Not applicable.

During the year there were 442 salt water disposal wells in operation that disposed of 238 million barrels of salt water. An additional 39 million barrels of produced salt water was injected in secondary-recovery projects. Of the 297 million barrels of salt water produced with oil or gas, 93.3 percent was injected into underground reservoirs and 6.7 percent was disposed of by surface facilities.

Bigheart Pipeline Corp. acquired the crude oil pipeline system of Service Pipe Line Co. The system consists of 435 miles of gathering and transmission lines in south Arkansas and north Louisiana, and handles about 37,000 barrels of oil daily. The acquisition more than doubled Bigheart's crude handling facilities.

Petroleum and Natural Gas Exploration and Development.—Exploratory and development drilling resulted in the discovery of six new fields and 11 new pools. Five of the fields and nine of the pools were in south Arkansas; the others were in the Arkoma Basin of northwest Arkansas. The most significant discovery was in the Smackover Formation at Welcome field, Columbia County, by Union Producing Co. The Bodcaw well 1, the discovery well, flowed 324 barrels of 45.2° API gravity oil daily through perforations between 11,170 and 11,174 feet. Also a new producing depth record was established in the State with completion of W. H. Hunt's Nations well 1 in the Welcome field, which produced through perforations between 11,149 and 11,195 feet.

Active exploration in search of Smackover production increased during 1969 and resulted in total footage of 2.3 million feet drilled, a 45-percent increase over 1968. Average depth of wildcat wells drilled during 1969 was approximately 5,800 feet, a large increase over the 3,600-foot average of 1968. Results of the deeper drilling were evident in the discovery of new fields and pools in the Smackover Formation.

During 1969 drilling activity increased 10 percent over 1968, breaking a 3-year decline, and overall success ratio was slightly better at 49 percent. Union County again ranked first in successful oil well completions, and 36 percent of the total wells drilled were in the county. The number of wells drilled in the gas-producing area of northwest Arkansas declined, but the success ratio remained the same as in 1968 at 54 percent. Drilling in Johnson County resulted in 24 gas wells and nine dry holes, and other activity was in Sebastian and Franklin Counties.

Table 9.—Oil and gas drilling in 1969, by counties

County	Development			Exploratory			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Ashley	---	---	---	---	---	3	3
Bradley	---	---	---	---	---	2	2
Calhoun	3	---	3	---	---	5	11
Columbia	18	---	14	2	---	10	44
Conway	---	---	2	---	---	1	3
Crawford	---	7	4	---	---	---	11
Drew	---	---	---	---	---	5	5
Franklin	---	9	7	---	---	1	17
Johnson	---	24	9	---	---	---	33
Lafayette	16	2	11	1	---	16	46
Lincoln	---	---	---	---	---	1	1
Little River	---	---	---	---	---	1	1
Logan	---	---	3	---	---	4	7
Lonoke	---	---	---	---	---	1	1
Miller	---	---	4	---	---	12	16
Nevada	6	---	4	---	---	9	19
Ouachita	6	---	5	---	---	5	16
Pope	---	---	3	---	---	---	3
Scott	---	1	---	---	---	---	1
Sebastian	---	11	2	---	1	---	14
Union	85	---	36	2	---	20	143
White	---	---	---	---	---	1	1
Total:							
1969	134	54	107	5	1	97	398
1968	114	54	85	2	2	104	361

Source: Arkansas Oil and Gas Statistical Bulletin. V. 28, No. 12, December 1968 through v. 30, No. 2, February 1970.

Table 10.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves Dec. 31, 1968	Changes in proved reserves, due to revisions, extensions, and new discoveries in 1969	Proved reserves, Dec. 31, 1969 (production was deducted)	Change from 1968 (percent)
Crude oil—thousand barrels	159,283	−14,953	127,346	−20.1
Natural gas liquids [1]—do	13,096	+1,709	13,161	+0.5
Natural gas—million cubic feet	2,715,065	+77,802	2,632,773	−3.0

[1] Includes condensate, natural gasoline, and LP gases.

Sources: American Gas Association, Inc., and American Petroleum Institute.

Petrochemicals.—Georgia Pacific Corp. began construction on a new formaldehyde plant at Crossett. Production from the new facility will increase the company's formaldehyde output at Crossett from 50 to 150 million pounds annually. Completion is scheduled for early 1970. Formaldehyde is a prime ingredient in making waterproof resin adhesives used in laminating plywood and particle board products. Other petrochemical plants at Helena, Blytheville, and El Dorado continued producing various products of ammonia, phosphate, and nitrogen.

NONMETALS

For the second consecutive year, total value of nonmetals surpassed mineral fuels, with bromine again accounting for the largest gain ($7.5 million). Stone ranked second in value, and the two (bromine and stone) accounted for over 50 percent of the total value for the nonmetals group. All of the nonmetallic minerals increased in both production and value over 1968 except abrasive stone, cement, lime, soapstone, and tripoli, each of which declined. Sand and gravel increased in value but declined in quantity.

Abrasive Stone.—Six operators mined novaculite in Garland County for manufacture into oilstones used to sharpen various types of cutlery. Volume declined 7 percent, and value was 24 percent lower than in 1968. Arkansas Oilstones Co., Inc., processed crude novaculite at its plant in Hot Springs, and Norton Co. shipped novaculite out of Arkansas for finishing into whetstones.

Barite.—Barite tonnage and value increased 26 and 20 percent, respectively, over 1968. National Lead Co., Baroid Division, operated an underground mine and mill near Magnet Cove, Hot Spring County. Ore from Dresser Minerals adjoining mine was hauled by rail to its mill at Malvern. Average unit price for the 209,817 short tons after processing was $22. Barite mined in Missouri was processed by The Milwhite Co., Inc., at Bryant, Saline County. Reported use was for drilling mud requirements for oil and gas wells.

Bromine.—In 1969 bromine became the second most important mineral commodity in value to Arkansas. Production of bromine and bromine compounds was over 145 million pounds, a 52-percent increase over that of 1968, and value increased 36 percent. The average unit price of $.19 per pound was lower than in 1968 ($.22). With completion of the Bromet Co. plant near Magnolia, Columbia County, the bromine production capacity in Arkansas reached 311 million pounds per year, 70 percent of the U.S. total. Ethylene dibromide was the principal compound manufactured and comprised over 60 percent of the total output; elemental bromine ranked second in the State. Nationally, Arkansas ranked second in bromine production.

Brine production from the Smackover limestone averaged about 200,000 barrels per day, a 48-percent increase over that of 1968. Average recovery was about 2 pounds of bromine per barrel of brine processed. At yearend, there were 42 brine supply wells for five plants operating in the State; 19 of these supplied the new Bromet plant.

Cement.—Portland and masonry cement shipped by the State's two producers declined 6 percent, but because of higher unit prices, value declined only 3 percent. About 95 percent of the cement shipped was portland, and almost 75 percent went to ready-mix concrete companies and highway contractors. Other consumers of portland cement included building material dealers, concrete product manufacturers, and other contractors. Ninety-five percent of the portland cement was shipped in bulk form by trucks or rail with truck haulage conveying the major portion.

Cement consumption in Arkansas declined from 4.4 to 3.8 million barrels, a

Table 11.—Primary barite sold or used by producers

Year	Quantity (short tons)	Value (thousands)
1965	249,233	$2,379
1966	232,856	2,266
1967	229,344	2,266
1968	166,183	3,839
1969	209,817	4,616

Table 12.—Bromine and bromine compounds sold or used by primary producers

(Thousand pounds and thousand dollars)

Year	Quantity		Value
	Gross weight	Bromine content	
1967	64,450	60,147	$14,885
1968	95,499	86,426	20,790
1969	145,100	129,550	28,287

13.3-percent decrease. Major causes of the decline were decreased construction work and completion of the locks and dams on the Arkansas River.

Clays.—Clay production was reported from 17 counties, and in addition the U.S. Forest Service produced clay for road construction in various counties. Total clay production (composed of fire, kaolin, and common clay) increased 8 percent, and value increased 14 percent. The five leading clay producing counties (Hot Spring, Lonoke, Pulaski, Little River, and Johnson) accounted for 70 percent of the total output. Production of kaolin used for chemicals and refractory products again rose sharply (42 percent) and accounted for much of the total increase. Common clay was utilized for manufacture of building brick, block, tile, sewer pipe, cement, and other heavy clay products by nine companies, and one company produced lightweight aggregate at two plants (England and West Memphis). Fire clay was produced in Hot Spring County. Eureka Brick and Tile Co. at Clarksville began automation of part of its brickmaking process with completion scheduled for 1970. Acme Brick Co. converted from truck to scraper haulage of clay for its Perla plant, which reduced pit costs and increased efficiency. Reclamation of mined-out pits was continuing with leveling and grass seeding.

Gypsum.—The quantity and value of gypsum production was over one-third greater than in 1968. Weyerhaeuser Co. acquired the gypsum strip mine and wallboard plant at Briar, Howard County, by acquisition of Dierks Forest, Inc., in mid-1969. New addition at the Briar plant included a soaker, dryer, and covered storage. Besides increased plant capacity, wallboard quality was improved. Dulin Bauxite Co., Inc., strip mined gypsum in Pike County for use in the manufacture of cement.

Lime.—Lime output declined 10.7 percent in quantity and 10.1 percent in value from that of 1968. Quicklime was made from limestone mined in Izard County by Aluminum Co. of America (Alcoa) and by Reynolds Metal Co. at plants in Saline County for use in the reduction of bauxite to alumina. Rangaire Corp., Batesville White Lime Division, was the only producer of both quick and hydrated lime manufactured from limestone mined in Independence County. Hydrated lime was used by the construction and paper industries.

Sand and Gravel.—Output declined 2.5 percent to 12.7 million short tons, but value increased 2.1 percent to $14.9 million. Two counties, Miller and Pulaski, each produced over 1 million tons. The five counties leading in output accounted for only 31 percent of the total; in descending order Crawford, Cross, and Calhoun Counties followed the two leaders. The principal user of sand and gravel was the Arkansas Highway Department. With completion of the Arkansas River channel to Fort Smith, the U.S. Army Corps of Engineers used less of the commodity than in 1968 in the State.

Commercial production (10.1 million short tons) accounted for 79 percent of the total output. The average unit value was $1.28 per ton, an increase of $0.08 per ton over 1968. Government-and-contractor output of sand and gravel again decreased in unit value (from $0.80 per ton to $0.78).

At yearend there were six commercial dredge operations on the Arkansas River, and one company was waiting for permit approval from the Corps of Engineers. Expansions and additions of new equipment by some of these companies increased sand and gravel output capacity as well as efficiency of operations. Arkhola Sand and Gravel Co. at Fort Smith operated a 414-ton-per-hour dredge with plant and stockpile facilities on the riverbank. Other dredge operators were Criss and Shaver, Inc.; Jeffrey Sand Co.; Mobley Construction Co., Inc.; Pine Bluff Sand and Gravel

Table 13.—Sand and gravel sold or used by producers
(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	9,559	$12,001	3,247	$3,835	12,806	$15,836
1966	11,677	15,656	4,379	5,382	16,056	21,038
1967	10,202	13,113	4,037	2,414	14,239	15,531
1968	10,682	12,795	2,315	1,848	12,997	14,643
1969	10,067	12,919	2,608	2,030	12,674	14,949

[1] Data may not add to total shown because of independent rounding.

Table 14.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,144	$1,402	1,444	$1,807
Paving	2,441	2,354	2,187	2,343
Other [1]	562	1,146	805	1,485
Total sand [2]	4,147	4,902	4,436	5,637
Gravel:				
Building	1,263	2,087	1,675	2,821
Paving	5,135	5,685	3,722	4,175
Other [3]	137	121	233	285
Total gravel [2]	6,535	7,893	5,630	7,282
Total sand and gravel [2]	10,682	12,795	10,067	12,919
Government-and-contractor operations:				
Sand:				
Building	1	1	4	2
Paving	466	361	561	325
Total sand [2]	467	362	564	327
Gravel:				
Building	2	2	5	5
Paving	1,650	1,386	2,038	1,697
Fill	196	98	------	------
Total gravel [2]	1,848	1,486	2,043	1,703
Total sand and gravel [2]	2,315	1,848	2,608	2,030
Grand total	12,997	14,643	12,674	14,949

[1] Includes fill, other construction sand, and industrial sand (ground and unground).
[2] Data may not add to totals shown because of independent rounding.
[3] Includes fill, railroad ballast (1969), other construction gravel, and miscellaneous gravel.

Co.; and Ft. Smith Construction and Transport Co. In April, Criss and Shaver purchased the ready-mix concrete and sand and gravel operations of Big Rock Stone and Material Co.

Soapstone.—For the second year tonnage and value declined about 18 and 16 percent respectively. The Milwhite Co., Inc., the only producer, mined and processed soapstone in Saline County for use as a filler in insecticides and for roofing compounds.

Stone.—After 3 years of decline, stone output increased slightly (almost 1 percent), and value increased 4 percent. The increase was not sufficient to keep it from dropping to fifth in mineral value. Limestone was the most important in value, followed by sandstone and granite.

Limestone production increased from 4.9 to 5.7 million tons. Value increased 34 percent, reflecting a higher average unit price. Both underground and open pit methods were used in mining limestone, and 40 mines were reported by 32 companies operating in 20 counties. Principal use of limestone was for concrete and road aggregate. Limestone also was used in the manufacture of cement and lime. Sandstone output and value declined 11 percent and was used for road and concrete aggregate, riprap, and railroad ballast. Over 50 percent of the sandstone production was from four counties (Crawford, Franklin, Pulaski, and White). Other stone production included granite (syenite), slate, and marble. All the syenite was from Pulaski County, and all the marble was from Independence County. Slate, produced in Montgomery and Saline Counties, was used principally for roofing granules.

Sulfur (Recovered Elemental).—Bromet Co., at its Columbia County bromine ex-

Table 15.—Stone sold or used by producers
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	21,241	$26,778
1966	19,109	24,588
1967	17,454	23,236
1968	16,322	22,256
1969	16,463	23,134

traction plant began recovery of sulfur released from hydrogen sulfide during the processing of brines as a pollution control measure. Three other plants treated sour gas for sulfur recovery. Total gross shipments from the four plants was 25,656 long tons, valued at $572,723. Olin Corp. was the leading producer.

Tripoli.—Output and value decreased 25 percent. At yearend two producers, Malvern Minerals Co. and Hercules Minerals Corp., were operating open pit mines in Garland and Pike Counties. Over 77 percent of the tripoli was used for abrasives; most of the remainder went into fillers. Industrial Minerals, Inc., ceased operations, and its tripoli operations became part of Hercules Minerals Corp.

METALS

Bauxite, the principal ore of aluminum, continued to be the most important metallic ore produced in Arkansas. The Arkansas Geological Commission concluded chemical analysis of samples collected from mercury (cinnabar) deposits in Pike County. Union Carbide Corp.'s vanadium mine-mill complex at Wilson Springs completed its first full year of operations, and production of ore declined.

Aluminum.—Reynolds Metals Co. continued to be the only producer of aluminum from alumina in Arkansas with operation of its reduction plants in Malvern and Arkadelphia. Aluminum metal was rolled, extruded, and drawn into various semifabricated shapes at several plants. Industries utilizing aluminum constitute a growing part of the State's economy.

Bauxite.—Output of bauxite increased 11 percent, and value increased 7 percent. The value of $24.7 million was second only to the value in 1943 ($29.4 million) since bauxite production began in 1899. Ninety-five percent of the Nation's domestic bauxite was produced in Arkansas.

Four companies mined bauxite in Arkansas, and all of the mines were in Saline County. Reynolds Mining Corp., the leading producer, operated both underground and strip mines; Alcoa, American Cyanamid Co., and A. P. Green Refractories Co. produced from open pit operations. Bauxite was calcined by American Cyanamid Co. and Norton Co. at plants in Saline County. Porocel Corp. and Stauffer Chemical Co. produced activated bauxite at plants in Pulaski County. Alumina from Reynolds Metals Co's Hurricane Creek plant and Alcoa's plant near Bauxite was used primarily for the production of aluminum. Other uses for alumina were in abrasives, chemicals, refractories, ceramics, and other products. Reynolds Metals Co. began an expansion program to increase the rated capacity of ceramic alumina production by 150 tons per day at the Hurricane Creek plant with completion scheduled for mid-1970.

Mercury.—The Arkansas Geological Commission concluded sampling and chemical analysis of samples from mercury deposits in Pike County, and results are being compiled for publication. No mercury production was reported during 1969.

Vanadium.—Union Carbide Corp. was the only producer of vanadium oxide in the State from its Wilson Springs plant in Garland County. Production of ore from the open pit mines was well below the 1968 level, and vanadium oxide output was also lower, resulting in a 16 percent reduction in value. At yearend mine operations were curtailed so that stockpiles of ore could be reduced. The vanadium oxide was shipped to Marietta, Ohio, for processing into vanadium compounds.

Core hole drilling of the vanadium deposit has proved substantial reserves. Ore from the two open pits was extracted by shovels and trucked to the mill stockpiles. Reclamation of waste dump areas was carried out with planting of grasses.

Table 16.—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
1965	1,911	1,593	$17,974	2,100	1,803	$20,786
1966	2,060	1,718	19,439	1,986	1,708	20,258
1967	1,943	1,571	18,269	2,137	1,815	21,927
1968	1,961	1,582	23,058	2,097	1,756	26,040
1969	2,116	1,755	24,706	2,181	1,875	27,002

Table 17.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Arkansas Oilstone Co., Inc	P. O. Box 1426 Hot Spring, Ark. 71901	Mine and plant	Garland.
Norton Pike Division, Norton Co	Littleton, N. H. 03561	Mine	Do.
Hiram A. Smith Whetstone Co	11 Snider St. Hot Spring, Ark. 71901	----do	Do.
Barite:			
Dresser Minerals	P. O. Box 6504 Houston, Tex. 77005	Mine and plant	Hot Spring.
National Lead Co	P. O. Box 1675 Houston, Tex. 77001	----do	Do.
Bauxite:			
Aluminum Co. of America	1036 Alcoa Bldg. Pittsburgh, Pa. 15219	Mine	Saline.
American Cyanamid Co	Berdan Avenue Wayne, N. J. 07472	Mine and plant	Do.
A. P. Green Refractories Co	Mexico, Mo. 65265	Mine	Do.
Norton Co	One New Bond Street Worcester, Mass. 01606	Plant	Do.
Porocel Corp	Menlo Park, N. J. 08837	----do	Pulaski.
Reynolds Mining Corp	P. O. Box 398 Bauxite, Ark. 72011	Mine	Saline.
Stauffer Chemical Co	P. O. Box 9509 Little Rock, Ark. 72209	Plant	Pulaski.
Bromine:			
Arkansas Chemicals, Inc	Route 6, Box 98 El Dorado, Ark. 71730	Brine wells and plant.	Union.
Bromet Co	P. O. Box B Magnolia, Ark. 71753	----do	Columbia.
The Dow Chemical Co	Midland, Mich. 48640	----do	Do.
Great Lakes Chemical Corp	P. O. Box 2200, West Lafayette, Ind. 47901	----do	Union.
Michigan Chemical Corp	2 N. Riverside Plaza Chicago, Ill. 60606	----do	Do.
Carbon Black: Columbian Carbon Co	380 Madison Avenue New York, N. Y. 10017	Furnace	Do.
Cement:			
Arkansas Cement Corp	P. O. Box 398 Foreman, Ark. 71836	Plant and quarry.	Little River.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	----do	Howard.
Clays:			
Acme Brick Co	P. O. Box 425 Fort Worth, Tex. 76101	Mine and plant	Hot Spring and Sebastian.
Arkansas Cement Corp	P.O. Box 398 Foreman, Ark. 71836	----do	Little River.
Arkansas Lightweight Aggregate Corp.	P. O. Box 99 England, Ark. 72046	----do	Crittenden and Lonoke.
W. S. Dickey Clay Manufacturing Co.	P. O. Box 13125 Kansas City, Mo. 64199	----do	Miller and Polk.
El Dorado Brick Co	P. O. Box 335 El Dorado, Ark. 71730	----do	Union.
Eureka Brick & Tile Co	Clarksville, Ark. 72830	----do	Johnson.
A. P. Green Refractories Co	Mexico, Mo. 65265	----do	Pulaski and Saline.
Hope Brick Works	Hope, Ark. 71801	----do	Clark, Hempstead and Ouachita.
Coal:			
Dixie Construction Co	P. O. Box 477 Fort Smith, Ark. 72901	Strip mine	Johnson.
Excelsior Valley Coal Co	P. O. Box 114 Midland, Ark. 72945	----do	Sebastian.
Garland Coal & Mining Co	P.O. Box 186 Fort Smith, Ark. 72901	----do	Franklin.
Hackett Coal Co	Hackett, Ark. 72937	----do	Sebastian.
Hilton Coal Co., Inc	Route 1, Box 285 Clarksville, Ark. 72830	----do	Johnson.
Johnson Coal Co., Inc	P. O. Box 508 Clarksville, Ark. 72830	Underground mine.	Do.
Ozark Mining Corp	P. O. Box 7312 Little Rock, Ark. 72207	Strip mine	Franklin.
Prairie Coal Co., Inc	415 Grandview Clarksville, Ark. 72830	Underground mine.	Johnson.
Gypsum:			
Dulin Bauxite Co., Inc	835 Valley Hot Spring, Ark. 71901	Mine and plant	Pike.
Weyerhaeuser Co	810 Whittington Avenue Hot Spring, Ark. 71901	----do	Howard.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Lime:			
Aluminum Co. of America	1124 Alcoa Bldg. Pittsburgh, Pa. 15219	Plant	Saline.
Georgia Pacific Corp	Crossett, Ark. 71635	----do	Ashley.
Rangaire Corp, Batesville White Lime Division.	P. O. Box 1311 Batesville, Ark. 72501	Plant	Independence.
Reynolds Metals Co	6603 W. Broad Street Richmond, Va. 23226	----do	Saline.
Roofing Granules:			
Bird and Son, Inc	East Walpole Mass. 02032	----do	Montgomery.
Minnesota Mng & Mfg Co	3 M Center (220–13W) St. Paul, Minn. 55101	----do	Pulaski.
Sand and Gravel:			
Arkansas Rock & Gravel Co	P. O. Box "I" Murfreesboro, Ark. 71958	Stationary	Pike.
Arkhola Sand & Gravel Co	323 Merchants Bank Bldg. Fort Smith, Ark. 72901	----do	Crawford.
Belvedere Sand & Gravel Co.	P. O. Box 243 Benton, Ark. 72015	----do	Saline.
Big Rock Stone & Material Co.	P. O. Box 28 Little Rock, Ark. 72203	----do	Pulaski.
Braswell Sand and Gravel Co., Inc.	P. O. Box 798 Minden, La. 71055	----do	Little River.
Gifford-Hill & Co., Inc	P. O. Box 47127 Dallas, Tex. 75247	----do	Lafayette and Miller.
Greenville Gravel Co	P. O. Box 220 Greenville, Miss. 28701	----do	Chicot and Desha.
Jeffrey Sand Co	P. O. Box 5054, North Little Rock, Ark. 72114	----do	Pulaski and Franklin.
Malvern Gravel Co	P. O. Box 337 Malvern, Ark. 72104	----do	Hot Spring.
Mobley Construction Co., Inc	P. O. Box 109 Morrilton, Ark. 72110	Portable	Jackson, Pope, Monroe and Yell.
Pine Bluff Sand & Gravel	P. O. Box 7008 Pine Bluff, Ark. 71601	Stationary	Ouachita and Jefferson.
St. Francis Material Co	P. O. Box 999 Forrest City, Ark. 72335	----do	Ashley, Calhoun, Craighead and Poinsett.
Silica Products Co., Inc	P. O. Box 248 Guion, Ark. 72540	----do	Izard.
Stone:			
Arkansas Cement Corp	P. O. Box 398 Foreman, Ark. 71836	Quarry	Howard.
Arkhola Sand & Gravel Co	323 Merchants Bank Bldg Fort Smith, Ark. 72901	----do	Crawford.
Big Rock Stone & Material Co.	P. O. Box 28 Little Rock, Ark. 72203	----do	Pulaski.
Freshour Corp	P. O. Box 77 Sweet Home, Ark. 72164	----do	Carroll, Fulton, Independence, Izard, Lawrence, Newton, Polk, Randolph, Sharp, Stone, and Van Buren.
Ben M. Hogan Co., Inc	P. O. Box 2860 Little Rock, Ark. 72203	----do	Conway, Lonoke, Pope, and Franklin.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	----do	Howard.
Jeffrey Stone Co., Inc	P. O. Box 185, North Little Rock, Ark. 72114	----do	Pulaski.
McClinton Brothers Co	P. O. Box 790 Fayetteville, Ark. 72701	----do	Baxter, Benton, and Washington.
McGeorge Contracting Co	P. O. Box 7008 Pine Bluff, Ark. 71601	----do	Pulaski and Van Buren.
Missouri City Stone Co	1961 N. Industrial Blvd. Dallas, Tex. 75207	----do	Perry and Pulaski.
Rangaire Corp	P. O. Box 1311 Batesville, Ark. 72501	----do	Independence and Izard.
Talc and Soapstone: The Milwhite Co., Inc.	P. O. Box 15038 Houston, Tex. 77020	Mine and plant	Saline.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Tripoli:			
Hercules Minerals Corp	114 National Old Line Bldg. Little Rock, Ark. 72201	Mine	Pike.
Industrial Minerals, Inc	National Old Line Bldg. Little Rock, Ark. 72201	----do	Polk.
Malvern Minerals Co	P. O. Box 1246 Hot Spring, Ark. 71901	----do	Garland.
Vermiculite: W. R. Grace and Co	62 Whittemore Avenue Cambridge, Mass. 02140	Exfoliating	Pulaski.
Natural Gas Liquids:			
Arkla Chemical Corp	Magnolia, Ark. 71753	Plant	Columbia.
Austral Oil Co., Inc	Stamps, Ark. 71860	----do	Lafayette.
Phillips Petroleum Co	----do	----do	Do.
Sun Oil Co., DX Division	----do	----do	Do.
Petroleum:			
American Oil Co	El Dorado, Ark. 71730	Refinery	Union.
Berry Petroleum Co	Magnolia, Ark. 71753	----do	Columbia.
Cross Oil & Refining Co. of Arkansas.	Smackover, Ark. 71762	----do	Union.
Lion Oil, Div. Monsanto Co	El Dorado, Ark. 71730	----do	Do.
Macmillan Ring-Free Oil Co., Inc.	Norphlet, Ark. 71759	----do	Do.
Vanadium:			
Union Carbide Corp	Route 2, Box 563 Hot Spring, Ark. 71901	Mine	Garland.

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 Conservation, Division of Mines and Geology.

By Brinton C. Brown [1]

California's mineral production reached another alltime high of $1.85 billion in 1969, surpassing the previous record of $1.80 billion in 1968 by 3 percent. Although the combined value of ten metals produced decreased 6 percent, that of the 25 nonmetals produced increased 6 percent. The combined value of seven mineral fuels increased 1.6 percent despite quantity and value declines for fuels other than petroleum. The value of petroleum output rose 4 percent despite a slight decrease in quantity produced. Mineral fuels retained dominance of the State's mineral production, accounting for 64 percent of overall production value; nonmetals accounted for 31 percent and metals for 5 percent.

Consumption, Trade, and Markets.—California led all States in diversity of mineral production and in value of raw materials consumed. Despite its abundance of mineral resources California was not self-sufficient in minerals, particularly mineral fuels. Refinery receipts (all sources) rose 8 percent and natural gas receipts (pipeline) from out-of-State increased 3 percent compared with 1968. Plants within the State processed 210 billion cubic feet more wet gas than in 1968. The liquefied output of these plants declined 4 percent, however. California was third highest in petroleum production but consumed more petroleum products than any other State and was sixth in output of natural gas, yet received nearly 1,453 billion cubic feet from sources outside the State.

California supplied the entire domestic demand for boron minerals and compounds plus large quantities for export and was the leading producer of short-fiber asbestos, portland cement, diatomite, mercury, rare-earth concentrate, salt cake, sand and gravel, and tungsten concentrate. California's position as the leading sand and gravel producing State was evidenced by the fact that six of the 10 largest plants in the Nation were operated in the State, including the two largest. Moreover, 28 of the 100 largest sand and gravel plants were in California. Many nonmetal ores produced in other States, principally Arizona and Nevada, were processed in California.

Trends and Developments.—The minerals industry in California was influenced by the emphasis on preservation of the environment and concern for ecology. Dozens of bills were introduced in the State Legislature to improve the quality of air and water and prevent unsightly damage to the landscape. To comply with State and local pollution control requirements, millions of dollars were spent by the minerals industry to improve dust-collecting facilities and treat waste-water effluent. Solid-waste disposal became increasingly expensive. More expenditures were anticipated because the standards were being raised. Mining profits were narrowed by soaring real estate values and zoning regulations and a number of quarries and placer deposits were priced out of business. As a result of the population growth in some areas, housing developments and recreational facilities were encroaching on valuable mercury, gold, and other mineral deposits. Despite the fact that Utah Construction and Mining Co. agreed to 25 conditions stipulated by the Alameda County Planning Commission and

[1] Mining engineer, Bureau of Mines, San Francisco Mineral Supply Field Office.

Table 1.—Mineral production in California [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Asbestos—short tons	75,592	$6,139	75,828	$5,956
Boron minerals—do	r 963,000	r 76,535	1,020,000	81,261
Cement—thousand 376-pound barrels	47,595	151,961	50,610	170,612
Clays—thousand short tons	2,755	6,630	2,993	7,443
Copper (recoverable content of ores, etc.)—short tons	1,182	989	1,129	1,073
Gem stones	NA	200	NA	200
Gold (recoverable content of ores, etc.)—troy ounces	15,682	[2] 616	7,904	[2] 328
Gypsum—thousand short tons	1,360	3,603	1,210	3,339
Lead (recoverable content of ores, etc.)—short tons	4,001	1,057	2,518	750
Lime—thousand short tons	568	9,301	585	9,666
Magnesium compounds from sea-water bitterns (partly estimated)—short tons, M_gO equivalent	81,622	7,229	76,220	7,143
Mercury—76-pound flasks	21,417	11,470	18,480	9,333
Natural gas—million cubic feet	714,893	221,077	677,689	207,440
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels	13,403	42,963	12,954	39,944
LP gases—do	8,589	18,749	8,238	17,646
Peat—short tons	W	W	11,395	106
Perlite—do	8,806	80	11,419	105
Petroleum (crude)—thousand 42-gallon barrels	375,496	883,644	375,291	920,060
Pumicite, and volcanic cinder thousand short tons	776	1,312	866	1,229
Salt (common)—do	1,901	W	1,895	W
Sand and gravel—do	124,655	153,360	124,718	155,883
Silver (recoverable content of ores, etc.) thousand troy ounces	598	1,282	492	881
Stone [3]—thousand short tons	36,125	52,671	38,033	57,757
Sulfur ore—long tons	3,125	46	----------	----------
Talc, pyrophyllite, and soapstone—short tons	165,396	2,075	145,158	2,329
Zinc (recoverable content of ores, etc.)—do	3,525	952	3,327	971
Value of items that cannot be disclosed: Barite, bromine, calcium chloride, carbon dioxide, coal (lignite), diatomite, feldspar, iron ore, lithium minerals, mica (scrap) (1968), molybdenum, phosphate rock, platinum-group metals (1968), potassium salts, rare-earth metals, sodium carbonate, sodium sulfate, tungsten concentrates, wollastonite, and values indicated by symbol W	XX	150,914	XX	149,062
Total	XX	r 1,804,855	XX	1,850,517
Total 1967 constant dollars	XX	r 1,796,270	XX	p 1,788,209

p Preliminary. 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] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

[3] Includes slate.

Table 2.—Value of mineral production in California, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Alameda	$26,628	$25,744	Sand and gravel, salt, stone, clays, petroleum.
Alpine	W	W	Silver, gold, sand and gravel, zinc, copper, lead.
Amador	3,394	4,093	Sand and gravel, clays, coal (lignite), gold, silver.
Butte	3,025	3,400	Natural gas, sand and gravel, volcanic cinder, stone.
Calaveras	14,558	16,673	Cement, asbestos, stone, sand and gravel, clays.
Colusa	4,234	3,775	Natural gas, mercury, sand and gravel.
Contra Costa	13,813	15,200	Natural gas, stone, petroleum, sand and gravel, lime, clays, peat, mercury.
Del Norte	534	251	Sand and gravel, stone.
El Dorado	2,490	2,897	Stone, lime, sand and gravel, soapstone.
Fresno	64,309	57,217	Petroleum, sand and gravel, natural gas, asbestos, stone, natural gas liquids, gold, clays, mercury, silver.
Glenn	4,184	3,914	Natural gas, sand and gravel, lime.
Humboldt	2,406	2,108	Sand and gravel, natural gas, stone.
Imperial	4,058	4,301	Gypsum, sand and gravel, lime, clays, stone, copper, gold, silver.
Inyo	28,585	27,086	Tungsten, talc, copper, zinc, silver, molybdenum, lead, stone, sand and gravel, mercury, perlite, boron, gold, volcanic cinder, clays.

See footnotes at end of table.

Table 2.—Value of mineral production in California, by counties—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Kern	$451,751	$464,738	Petroleum, boron, natural gas, cement, natural gas liquids, sand and gravel, stone, gypsum, sodium sulfate, clays, salt, carbon dioxide, pumicite and volcanic cinder, iron ore, gold, silver.
Kings	13,917	10,282	Natural gas, natural gas liquids, petroleum, sand and gravel, mercury.
Lake	957	1,329	Sand and gravel, mercury, volcanic cinder, stone.
Lassen	1,197	690	Sand and gravel, volcanic cinder.
Los Angeles	380,444	415,842	Petroleum, natural gas, sand and gravel, natural gas liquids, stone, clays, lead, soapstone, gold, zinc, copper, silver.
Madera	1,964	766	Natural gas, stone, sand and gravel, volcanic cinder, clays, tungsten.
Marin	2,955	3,459	Stone, mercury, sand and gravel, clays.
Mariposa	161	104	Sand and gravel, stone, gold, silver.
Mendocino	671	660	Sand and gravel, mercury, stone.
Merced	W	2,666	Sand and gravel, gypsum, gold, silver.
Modoc	496	330	Sand and gravel, volcanic cinder, stone, gold, silver.
Mono	747	450	Sand and gravel, clays, pumice, pyrophyllite, stone, gold, silver.
Monterey	36,286	32,695	Petroleum, magnesium compounds, lime, sand and gravel, stone, feldspar, natural gas, mercury.
Napa	3,025	3,018	Stone, salt, clays, mercury, sand and gravel, diatomite, pumice.
Nevada	739	1,029	Sand and gravel, stone, gold.
Orange	113,394	107,622	Petroleum, sand and gravel, natural gas, natural gas liquids, clays, lime, salt, peat.
Placer	958	1,028	Sand and gravel, clays, stone, gold.
Plumas	232	456	Sand and gravel, stone, gold.
Riverside	74,416	74,544	Iron ore, cement, sand and gravel, stone, clays, natural gas, petroleum, wollastonite.
Sacramento	29,719	20,162	Natural gas, sand and gravel, petroleum, gold, clays, silver.
San Benito	12,081	11,334	Cement, stone, mercury, asbestos, sand and gravel, petroleum, clays, natural gas.
San Bernardino	r 123,051	136,770	Cement, boron, sand and gravel, rare-earth minerals, stone, sodium sulfate, sodium carbonate, potassium salts, salt, lime, iron ore, calcium chloride, lithium minerals, petroleum, bromine, talc and pyrophyllite, tungsten, clays, pumice and volcanic cinder, gold, natural gas, gypsum, silver, lead, copper, zinc.
San Diego	16,262	19,608	Sand and gravel, stone, magnesium compounds, salt, clays, pyrophyllite.
San Francisco	W	W	Sand and gravel.
San Joaquin	14,059	16,499	Natural gas, sand and gravel, lime, gold, silver.
San Luis Obispo	5,876	6,147	Petroleum, mercury, stone, natural gas, sand and gravel, gypsum, clays.
San Mateo	14,805	14,588	Cement, magnesium compounds, stone, salt, sand and gravel, clays, petroleum, mercury, natural gas.
Santa Barbara	124,943	113,979	Petroleum, diatomite, natural gas, natural gas liquids, sand and gravel, mercury, lime, stone, phosphate rock.
Santa Clara	34,916	38,969	Cement, stone, sand and gravel, mercury.
Santa Cruz	13,938	13,757	Cement, sand and gravel, stone, clays.
Shasta	7,307	5,945	Cement, sand and gravel, stone, clays, barite, volcanic cinder, gold, silver.
Sierra	1,302	210	Gold, sand and gravel, silver, zinc.
Siskiyou	2,203	2,371	Sand and gravel, pumice and volcanic cinder, stone, gold.
Solano	16,591	18,296	Natural gas, stone, petroleum, sand and gravel, mercury.
Sonoma	4,902	5,401	Sand and gravel, mercury, stone, clays, natural gas.
Stanislaus	1,445	2,163	Sand and gravel, lead, gold, clays, mercury, silver, copper.
Sutter	11,656	11,584	Natural gas, sand and gravel, clays.
Tehama	1,596	1,903	Natural gas, sand and gravel, volcanic cinder, stone.
Trinity	1,287	606	Stone, sand and gravel, mercury.
Tulare	2,412	2,991	Sand and gravel, stone, natural gas, petroleum, barite, clays.
Tuolumne	1,216	2,022	Stone, lime, sand and gravel, gold.
Ventura	93,521	83,142	Petroleum, natural gas, natural gas liquids, sand and gravel, clays, stone, gypsum.
Yolo	3,883	4,050	Sand and gravel, lime, natural gas, mercury.
Yuba	1,525	1,376	Sand and gravel, stone, gold, clays, silver.
Undistributed [1]	7,831	28,277	
Total	r 1,804,855	1,850,517	

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

[1] Includes Federal offshore petroleum and natural gas, gem stones, mercury, and tungsten that cannot be assigned to specific counties and values indicated by symbol W.

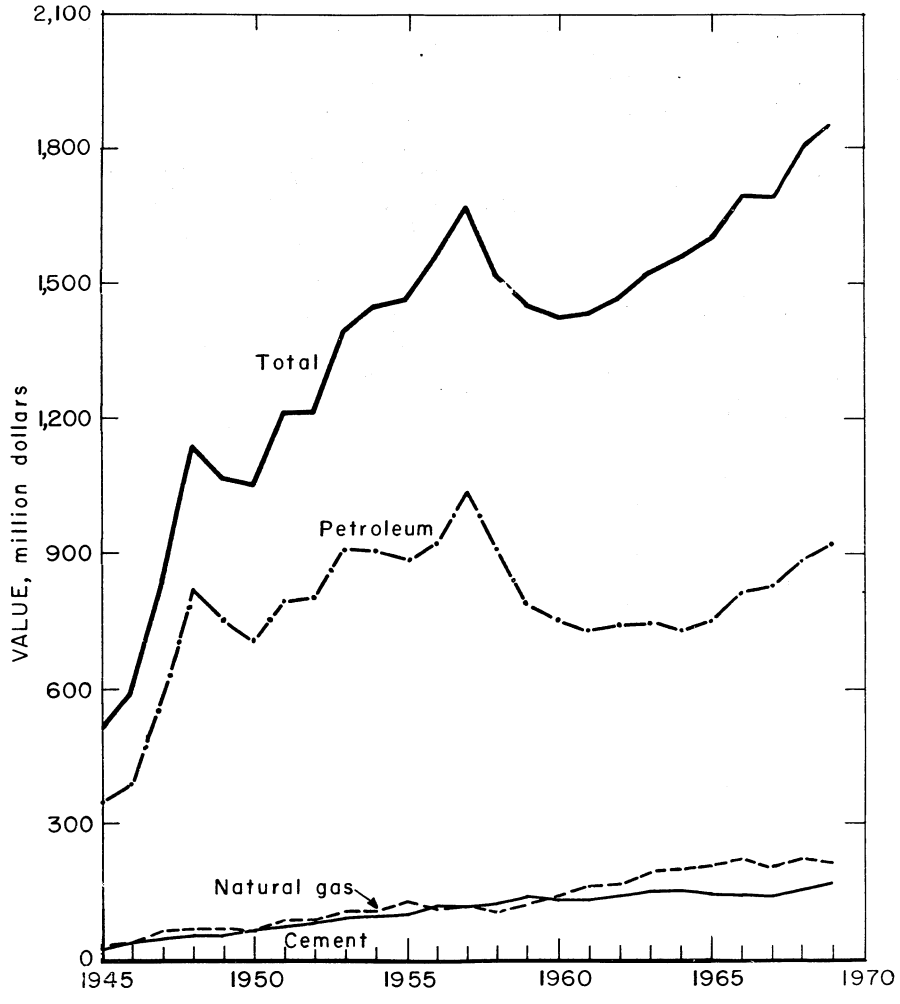

Figure 1.—Value of petroleum, natural gas, cement, and total value of mineral production in California.

Table 3.—Indicators of California business activity

		1968	1969 [p]	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	[r] 8,094	8,367	+3.4
Unemployment	do.	366	372	+1.6
Civilian employment	do.	[r] 7,728	7,994	+3.4
Agriculture, forestry, and fisheries	do.	320	318	−0.6
Mineral extraction	do.	[r] 34	34	------
Contract construction	do.	354	366	+3.4
Manufacturing	do.	[r] 1,685	1,700	+0.9
Government	do.	1,334	1,387	+4.0
Trade	do.	[r] 1,613	1,687	+4.6
Services	do.	[r] 1,540	1,615	+4.9
All others	do.	[r] 848	887	+4.6
Payroll data, annual insured wages:				
Agriculture, forestry, and fisheries	millions	$1,014	$1,074	+5.9
Mineral extraction	do.	$303	$323	+6.6
Contract construction	do.	$2,857	$3,178	+11.2
Manufacturing	do.	$13,887	$14,819	+6.7
Transportation, communication, and utilities	do.	$3,387	$3,787	+11.8
Wholesale and retail trade	do.	$8,484	$9,291	+9.5
Services	do.	[r] $5,727	$6,043	+5.5
State and local governments [1]	do.	[r] $137	$163	+19.0
Personal income:				
Total	do.	[r] $76,581	$82,970	+8.3
Per capita		[r] $3,916	$4,179	+6.7
Construction activity:				
Portland cement plant capacity, Dec. 31	million barrels	64	64	------
Portland cement plant production	do.	47	51	+8.5
Portland cement shipments from mills	do.	48	51	+6.3
Portland cement estimated consumption	do.	45	47	+4.4
Business receipts:				
Business taxable sales (tangible goods and services, including wholesale)	millions	$39,007	$42,378	+8.6
Retail sales (taxable and nontaxable)	do.	[r] $35,673	$38,589	+8.2
Farm market cash receipts (excluding government transfers)	do.	[r] $4,274	$4,379	+2.5
Mineral production	do.	[r] $1,805	$1,851	+2.5
Utility sales:				
Revenues of 4 privately owned electric utilities [2]	do.	$1,271	$1,356	+6.7
Revenues of 4 privately owned natural gas utilities [3]	do.	$888	$1,005	+13.2
Exports through California ports	do.	[r] $3,067	$3,910	+27.5
Imports through California ports	do.	[r] $3,108	$3,917	+26.0

[p] Preliminary.
[r] Revised.
[1] Includes nonclassifiable establishments.
[2] Constitutes 99 percent of total electrical utility sales.
[3] Constitutes 99 percent of total natural gas utility sales.
Sources: California Department of Employment, California Department of Finance, California Department of Industrial Relations, Public Utilities Commission, Economic Report to the Governor.

Table 4.—Worktime 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
1968:								
Coal	6	110	1	5	------	------	----------	---------
Peat	14	131	2	15	------	------	----------	---------
Metal	2,458	245	601	4,790	4	128	27.56	6.419
Nonmetal	4,364	264	1,153	9,248	------	163	17.63	1,074
Sand and gravel	5,934	239	1,416	11,427	1	276	24.24	1,160
Stone	4,565	291	1,326	10,839	4	121	11.53	2,845
Total [1]	17,341	259	4,500	36,324	9	688	19.19	2,334
1969: [p]								
Coal	5	120	1	6	------	------	----------	---------
Peat	14	124	2	14	------	------	----------	---------
Metal	2,365	247	585	4,689	2	188	40.52	3,757
Nonmetal and native asphalt	4,415	278	1,229	9,863	2	225	23.02	2,584
Sand and gravel	5,355	238	1,275	10,453	3	238	23.06	2,388
Stone	4,230	310	1,313	10,582	2	145	13.89	1,606
Total [1]	16,385	269	4,404	35,607	9	796	22.61	2,389

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 5.—Principal custom mills, commercial grinding plants, and primary smelters in 1969

Company	County	Nearest city or town	Minerals processed	Remarks
American Smelting & Refining Co.	Contra Costa	Selby	Lead, zinc, silver, gold.	Smelter, refinery and fuming plant.
The Wilbur Ellis Co	Fresno	Fresno	Nonmetals	Commercial grinding.
Standard Industrial Minerals, Inc.	Inyo	Bishop	do	Do.
Paramount Pacific, Inc	Kern	Rosamond	do	Do.
American Minerals Co	Los Angeles	Los Angeles	do	Do.
Industrial Minerals Co	Sacramento	Florin	do	Do.
Kaiser Steel Corp	San Bernardino	Fontana	Iron ore	Blast furnaces, steel plants, and fabricating plants.
Chas. Pfizer & Co., Inc	do	Victorville	Nonmetals	Commercial grinding.
Western Talc Co	do	Dunn	do	Do.

received the Commission's approval for a permit to quarry basalt rock on Apperson Ridge, east of San Francisco Bay, the County Supervisors nevertheless denied the application for a quarrying permit.

Public protests following a major oil spill from an offshore well in the Santa Barbara Channel in January 1969 contributed to a partial moratorium on drilling. The oil company involved reportedly spent $5 million for containment and cleanup of the temporary pollution. As a result the Code of Federal Regulations was revised to control all forms of pollution in the oceans and fixed the responsibility for pollution upon the polluter.

Petroleum (crude oil and condensate) production dropped less than 1 percent to slightly below the 1968 level but exceeded 1 million barrels per day for the second consecutive year. Exploratory and development drilling decreased sharply from that of preceding years. Notices to drill new wells dropped 25 percent from the 1968 figure to 2,005 wells. More than 66 percent of the new wells completed to production were in thermal recovery projects and 14 percent on offshore leases. Drilling moratoriums in the offshore Santa Barbara Channel and severe storms in January and February contributed to a reduction in offshore exploration and development. Oil production from State and Federal offshore fields comprised 27 percent of the California total, up from 24 percent in 1968 and 20 percent in 1967. Production from the Wilmington field, the State's largest, increased 13 percent to more than 89 million barrels.

A number of newly active and well-staffed exploration groups, some with laboratory facilities, re-examined and explored idle mines and mineral deposits in California, particularly in the desert regions. In 35 counties, 113 exploration projects were reported in search of 18 different mineral commodities. Gold was most actively sought with 40 projects, followed by mercury with 20, copper 11, talc 10, lead and silver with seven each, tungsten six, barite two, and boron, gypsum, iron ore, mica, rare earths, soapstone, sulfur, uranium, zinc and zirconium with one each. Ten commodities were sought in Inyo County in 24 exploration programs and eight commodities were sought in San Bernardino County where 17 projects were conducted.

Continuing interest in gold was displayed by the large number of exploration projects, mostly in the Mother Lode region. Under an Office of Minerals Exploration (OME) contract, McGilvrays drilled 15 holes totaling 2,079 feet at the Telegraph mine east of Baker, San Bernardino County. The old Mono Diggings, Conway Summit, Mono County, were reactivated.

New Idria Mining and Chemical Co. began installing a 100-ton-a-day rotary furnace at its newly acquired New Almaden property in Santa Clara County. New Idria also acquired the 215-acre Alpha-Guadalupe mercury property adjoining the New Almaden and conducted exploration and development work on both. Exploration at the New Idria mine in San Benito County centered around the Molino workings, the Sulfur Springs area, and San Carlos workings. Other mercury producing districts were explored. Louis Knepper explored the Aurora mine. Socrates Enterprise Associates resumed development in the Socrates mine. Others drilled the nearby Eureka and Mohawk mines in Sonoma County. The main shaft at the Altoona mine, Trinity County, was deepened from the 450- to the 800-foot level. International Resources explored

the Abbott mine, Lake County, while operating furnaces on ore from the Rathburn and Juniper mines near Wilbur Springs, Colusa County. One Shot Mining Co. installed a 50-ton-per-day furnace at the Manhattan mine, Napa County, to process waste dumps from former operations.

In Siskiyou County Jason Explorers Ltd. reopened the Blue Ledge copper-zinc mine and the Standard Slag Co. drilled the Grayeagle copper mine. Norandex Corp. optioned the Walker mine, located more than 80 claims surrounding the patented claims, conducted magnetometer and geochemical surveys and drilled exploration holes. U. S. Smelting and Refining Co. explored the area south and west of the Walker mine, Plumas County. American Exploration and Mining Co. continued to explore in the vicinity of the Engels and Superior mines, Plumas County. The Arizona-Nevada Mining Co. commenced exploration near Ward Creek between the Walker and the Engels and Superior mines. In Shasta County, Phillips Petroleum Co. continued drilling in the vicinity of the Balaklala and Early Bird mines. Modern Minerals Corp. drilled at the north end of the Foothill copper belt east of Marysville in Yuba County. In Calaveras County, Eagle-Picher Co. drilled at the Penn mine and conducted a geochemical prospecting program. Imperial Copper Corp. shipped 11 tons of copper ore from its Gavilan prospect in southeastern Imperial County. Stauffer Chemical Co. recovered cement copper from acid water originating in the Iron Mountain underground workings, Shasta County, primarily for stream pollution abatement.

Western Ventures explored for silver-lead ore at the Kelley mine at Red Mountain, San Bernardino County. A 125-ton ball mill was installed at the Fairplay mill-site by Triple S Investment Co. to treat development ore from the Amalie and Cowboy-Gold Point silver deposits in Kern County.

Hoisting equipment was installed at the Union Carbide Corp. Pine Creek mine to connect the upper and lower level tungsten mines in Inyo County. New mill modifications included installation of a 9 by 16-foot rod mill and a 10 by 10-foot ball mill with a series of 20-inch cyclones for classification. A new flotation circuit was scheduled for completion in 1970. U.S. Borax expanded facilities, adding a flexible crystallizer "swing line," a "fusing line," and thickeners at its Boron plant, Kern County. Johns-Manville Products Corp. added a fifth calcining unit to its plant in Santa Barbara and increased its diatomite processing capacity 25 percent. Tungsten Corporation of America announced plans for a rare-earth metals refinery near San Bernardino. Owens-Illinois Glass Co. opened the Volcano limestone deposit in Amador County to supply limestone to glass manufacturers.

Calaveras Cement Division, The Flintkote Co., started construction of a 17.6 mile pipeline to convey slurry from the quarry to the cement plant in Calaveras County. Pacific Cement and Aggregates, Inc., announced plans for a $30 million automation and expansion program, including a 3-mile covered conveyor for transporting limestone to its plant in Santa Cruz County. Kaiser Cement and Gypsum Corp. installed new dust collecting facilities, using glass bags at its Permanente plant, Santa Clara County.

Blue Diamond Division, the Flintkote Co., opened a new 3,500-ton-per-hour sand and gravel processing plant, replacing an old plant, in the San Gabriel Valley, Los Angeles County. Kaiser Sand and Gravel Co. began to replace its plant at Radum, the largest sand and gravel plant in the United States, with a $10 million facility. Azusa Western, Inc., the fourth largest sand and gravel plant in the nation, completed a major modification of pit and primary crushing facilities.

In February, Schnitzer Steel Products began operating northern California's only junk automobile pulverizer. Working 8 hours per day, the machine had the capacity to produce shredded steel from 250,000 cars per year.

Legislation and Government Programs.—Federal Public Law 91–58 (83 stat. 101), "An Act to Designate Ventana Wilderness, Los Padres National Forest, California," was signed August 18 and Public Law 91–82 (83 Stat. 131), An Act to Designate Desolation Wilderness, El Dorado National Forest, California," was passed October 20 for inclusion in the national wilderness system. Public Law 91–173 (83 Stat. 742), "Federal Coal Mine Health and Safety Act of 1969," was approved Decem-

ber 30, 1969. Following the oil spillage in the Santa Barbara Channel, the Code of Federal Regulations, Title 30, Chapter II, Part 250, was revised on February 17 to establish the responsibility of lessees for the cost of cleanup and for damages from oil pollution resulting from operations under the Outer Continental Shelf Lands Act (67 Stat. 462, 469; 43 U.S.C. 1341). Public Land Order 4587, March 21, established the Santa Barbara Channel Ecological Preserve and withdrew certain areas from mineral leasing. Public Law 87-347 (75 Stat. 766), The Lead-Zinc Small Producers Stabilization Act of 1961, as amended, providing for stabilization payments to small domestic producers of lead and zinc ores and concentrates, expired December 31. California's only participant received $4,311 for production of 286 tons of lead in 1969. During the program (1962-69), stabilization payments totaling $60,902 were made to four California producers for production of 2,038 tons of lead ($58,693) and 76 tons of zinc ($2,209).

The State Legislature passed 11 bills relevant to the mineral industry that became chapters of the Statutes of 1969. Five of them dealt with oil and gas operations: Chapter 553 (AB 1920) provided that specified reports of oil and gas operators filed with the Division of Oil and Gas shall be open to inspection by the State Board of Equalization and county assessors; Chapter 1426 (AB 1161) required the State Lands Commission to include in oil and gas leases of tide or submerged lands or beds of navigable rivers or lakes a provision prohibiting all impairment of, and interference with, developed shoreline recreational or residential areas; Chapter 1238 (AB 622) required prior notice of 60 days to city and county officials before granting permits for geological and geophysical surveys for oil and gas leases on State Lands and allowed leasing of certain tide and submerged lands along the Pacific Coast for production of oil and gas; Chapter 1430 (SB 57) regulated prospecting and drilling in specified sections along the Pacific Coast in Los Angeles, Santa Barbara, San Luis Obispo, Monterey, Santa Cruz, Humboldt, and Mendocino Counties and regulated tideland oil and gas leases and permits in Montery and Santa Cruz Counties; Chapter 409 (AB 687) regulated substances used for cleaning up oil in State waters to prevent water pollution and harm to fish.

Other bills that became Statutes included: Chapter 568 (AB 1713) regulated the transportation, storage and use of explosives; Chapter 1014 (AB 704) provided for multiple use of school lands wherein mineral rights are reserved to the State; Chapter 377 (AB 380) exempted persons primarily engaged in the extraction of minerals from water standby charges in certain districts; Chapter 1296 (AB 1955) regulated exercise of mineral rights in San Francisco Harbor lands; Chapter 1043 (SB 947) increased penalties for water pollution by certain substances; and Chapter 422 (AB 413) revised laws governing water quality and water pollution control and provided for a maximum fine of $6,000 a day for individuals or industries that pollute water until the contamination is cleaned up.

California Division of Industrial Safety issued a proposed revision of the General Safety Orders pertaining to explosives.

Rules and regulations for leases and prospecting permits for geothermal resources were proposed by the State Lands Commission. Lands subject to lease are those within a known geothermal resource area, and prospecting permits are issued for lands outside of these areas. The land encompassed would be limited by the permits or leases to not less than 640 acres nor more than 2,560 acres (5,760 acres for submerged and tide lands). Regulations would restrict applicants with direct and indirect interest in State geothermal leases to 25,600 acres. Leases would be issued for a primary term of 20 years and would be subject to renewal for a maximum of 99 years. Prospecting permits would be limited to 3 years with possible extension for an additional 2 years. In addition to protection of other resources, provisions would insure against air, water, and land pollution.

An unprecedented decision by the U.S. Tax Court in Washington, D.C., overruled the Commissioner of Internal Revenue in a decision issued in July and declared that geothermal steam is a natural gas and, therefore, eligible for the 27-1/2 percent depletion allowance (22 percent as of Jan. 1, 1970) permitted for tax purposes to producers of natural gas and petroleum. The cost of producing steam for power

generation will be lowered as a result of the decree. Also, operators will be permitted to deduct the intangible cost of drilling and developing steam fields from income.

A Committee on Surface Mining, appointed by the Governor, held hearings in Sacramento and Los Angeles. The Committee was to make recommendations to the State Legislature and to provide background information to be used in enactment of laws governing solid waste disposal and of laws to prevent and control adverse effects to the environment resulting from surface mining.

In September the State Air Resources Board established ambient air quality standards for carbon monoxide, hydrogen sulfide, nitrogen dioxide, oxidant, sulfur dioxide, and particulate matter to prevent and abate air pollution. In November, it adopted more stringent standards for sulfur dioxide and particulate matter.

Public land orders restored more than 4,900 acres of land in eight counties to mineral location and leasing under U.S. mining laws. Other land orders withdrew 17,942 acres in 15 counties from mine location for use by Federal agencies, principally the U.S. Forest Service of the Department of Agriculture. California received U.S. Treasury checks amounting to $2,931,107 representing 37-1/2 percent of Federal revenues collected within the State from mineral leasing bonuses, rentals, and royalties on public land.

The San Francisco Petroleum Research Office of the U.S. Bureau of Mines continued research to develop better methods for recovering additional oil from California fields. Encouraging progress was made to develop a method to recover black viscous oil by injecting a hot light oil (similar to kerosine) into the reservoir. In the proposed process, the mixture of oil and solvent was recovered through the same well used for injection of the solvent. The light oil was removed from the mixture produced and reinjected for the next cycle of recovery. New computer methods were developed to describe how oil moves through a reservoir when water is injected for secondary recovery. A study was made of the possibility of using explosives placed in horizontal holes to "rubbelize" oil shale in preparation for in-place retorting.

During 1969 the rationale for marine minerals research was re-examined at the Bureau of Mines Marine Minerals Technology Center, at Tiburon, Marin County. As a result, new priority was placed on learning how to predict and prevent environmental disturbances that may be triggered from domestic offshore mining. Subsystems research continued on such problems as multiphase vertical lifting, but the principal effect was directed towards the difficulty of characterizing seafloor mineral deposits. In-house research on drill sampling and geophysics was augmented by cooperative agreements with industry and universities.

The Bureau of Mines San Francisco Office of Mineral Resources studied the resource potential of the Tertiary gold-bearing gravels of California that provided a basis for mining and metallurgical research. Subsequently, the Bureau's Mine Systems Engineering Group and Mining Research Centers, in a cooperative effort, rehabilitated a drift mine in the San Juan Ridge area, installed measuring instruments, obtained samples for metallurgical testing, and collected data for studies to determine optimum mining and milling methods. Field investigations of mineral resources continued in the Salmon-Trinity Alps Primitive Area and were completed in the Agua Tibia Primitive Area. These areas were proposed for inclusion in the National Wilderness Preservation System. As part of an interagency Type I Comprehensive Framework Study of River Basins, the Bureau continued to compile data for mineral resource appendixes for the California and Great Basin hydrologic regions. Initial system design was underway for a Bureau-wide computerized mineral information storage and retrieval system. Costs of drilling and production offshore California were compiled and submitted for inclusion in a national report on offshore oil studies.

Information on scrap gold and waste were submitted for inclusion in a 1970 Bureau of Mines staff publication Information Circular 8447, "Secondary Gold in the United States." Work began on a proposed publication on small-scale placer gold prospecting and mining. As part of a national study to identify available secondary resources from present and future accumulations of steel-furnace flue dust, steel plants in California were visited to obtain data and collect samples of dust for metallurgical evaluation. During the year, the San Francisco Office of Mineral Resources was

assigned national surveillance responsibilities for boron, diatomite, gypsum, mercury, and marine mineral resources.

The Region II Field Office, Office of Minerals Exploration (OME), U.S. Geological Survey, received 10 applications from individuals interested in exploring for minerals in California under the OME program. One new contract was executed for exploration of mercury in San Luis Obispo County for an estimated total cost of $24,000, with Government participation of $18,000. Seven contracts, active from the preceding year, were completed or terminated and six contracts were in force at yearend.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS [2]

Carbon Black.—Columbian Carbon Co. commenced operation of a new 60-million-pound-per-year plant producing carbon black by the furnace process near Mojave in Kern County. The plant, Columbian Carbon's eighth U.S. carbon black facility, was to supply rubber manufacturers on the West Coast. The new operation contributed to a slight increase in the quantity of carbon black produced over that of 1968. Other producers were Continental Carbon Co. and Ashland Chemical Co. also in Kern County. Total production value increased 13 percent. Increases were reported in all grades except FEF and ISAF (fast extrusion furnace and intermediate abrasion furnace grades). Carbon black also was recovered from a storage pond by Shell Chemical Co. at Pittsburg in Contra Costa County where thermal grade carbon was produced from byproducts of an ammonia manufacturing facility that ceased operating in 1967.

Carbon Dioxide.—Production of carbon dioxide was down more than 50 percent from 1968 figures. Standard Oil Co. of California extracted carbon dioxide from natural gas at a natural gasoline plant near Taft, Kern County. The product was sold for use in the manufacture of dry ice. A Getty Oil Co. plant, producing in 1968, did not extract carbon dioxide in 1969.

Coal (Lignite).—Production of lignite remained unchanged in quantity and value from the 1968 figures. Alpco Division of Interpace Corp., the sole producer, processed lignite mixed from an open pit in Amador County to recover industrial waxes. This was the only plant in the United States producing montan wax.

Coke.—Kaiser Steel Corp. operated California's only coking facility at Fontana, San Bernardino County. The coke was consumed in company blast furnaces, and coke breeze was used in the agglomerating plant. Consumption of coke increased 1 percent while that of coke breeze decreased 9 percent compared with 1968 levels. The coking coal was obtained from the York Canyon Mine in Mexico and the Sunnyside Mine in Utah and shipped by unit trains to Fontana.

Natural Gas.—Marketed production of natural gas was down 5 percent in quantity and 6 percent in value from 1968 figures. The greatest decrease was in dry gas, which was 26,391 million cubic feet less than 1968 despite a 1.5 percent increase in the number of dry gas wells. Gas wells completed during 1969 totaled 63, including 10 in the Malton field, Glenn and Tehama Counties; six, each, in the Grimes field, Colusa and Sutter Counties, and Rio Vista field, Solano, Sacramento, and Contra Costa Counties; and four, each, in the Lindsey Slough field, Solano County, and Saxon field, Yolo County. The Van Sickle Island field in Solano County, discovered in 1968, began producing. A new reservoir was discovered during 1969 in the Cache Slough gasfield, Solano County but no production was recorded.

Exploratory drilling of 105 wells in northern California resulted in discovery of one new gasfield, the Green's Lake, in Yolo County. Four new productive zones and three extensions of older fields also were discovered. Sales of oil well gas, which decreased slightly, constituted about 58 percent of total natural gas sales. Natural gas stored in seven storage fields totaled 110 billion cubic feet, an increase of almost 2 billion over the 1968 volume. Natural gas was produced in 27 counties (see table 2).

Natural Gas Liquids.—The quantity and value of natural gas liquids declined in most of the seven producing counties. The exceptions were in production of liquified petroleum gas (LPG) in Kern County (up

[2] Prepared by Richard B. Smith, petroleum engineer, Bureau of Mines, San Francisco, Calif.

Table 6.—Natural gas (marketed production) and petroleum produced in 1969, by counties

County	Number of producing wells		Petroleum		Natural gas, marketed production			
					Oil zones		Dry gas zones	
	Oil (average)	Dry gas (maximum)	Production (thousand barrels)	Value (thousands)	Million cubic feet	Value (thousands)	Million cubic feet	Value (thousands)
Alameda	5	--	162	$466	--	--	--	--
Butte	--	29	--	--	--	--	7,706	$2,273
Colusa	--	86	--	--	--	--	11,598	3,421
Contra Costa	44	58	[1] 682	2,256	3,055	$901	16,440	4,850
Fresno	2,727	2	17,244	45,764	14,190	4,186	605	178
Glenn	--	97	--	--	--	--	10,872	3,207
Humboldt	--	21	--	--	--	--	3,144	927
Kern	21,300	83	[2] 120,684	278,552	152,203	52,663	6,864	2,072
Kings	164	22	613	1,855	14,589	4,304	3,177	858
Los Angeles	7,498	7	133,548	338,933	106,495	31,417	944	278
Madera	--	23	--	--	--	--	1,730	510
Monterey	891	--	10,512	18,176	2,337	689	--	--
Orange	3,696	1	35,939	89,719	18,011	5,313	79	23
Riverside	6	3	42	96	(3)	(3)	593	166
Sacramento	--	135	[1] 17	50	--	--	40,170	11,850
San Benito	26	3	63	202	34	10	71	21
San Bernardino	23	--	167	515	57	17	--	--
San Joaquin	--	103	--	--	--	--	40,636	11,988
San Luis Obispo	173	--	2,083	3,671	1,146	338	--	--
San Mateo	11	--	22	59	1	(3)	--	--
Santa Barbara	1,611	16	[1] 22,137	51,781	44,048	12,994	34,278	10,112
Solano	--	168	[1] 97	290	--	--	56,615	16,702
Sonoma	--	5	--	--	--	--	22	7
Sutter	--	148	--	--	--	--	38,902	11,476
Tehama	--	40	--	--	--	--	5,228	1,542
Tulare	21	30	38	82	--	--	1,898	513
Ventura	2,800	4	21,626	61,481	30,571	9,018	485	143
Yolo	--	26	--	--	--	--	2,872	847
Other: Federal offshore	60	--	9,615	26,112	6,023	1,626	--	--
Total	41,056	1,110	375,291	920,060	392,760	123,476	284,929	83,964

[1] Includes field condensate.
[2] Includes plant condensate.
[3] Less than ½ unit.

35 percent) and Santa Barbara County (up 47 percent) and in production of natural gasoline in Los Angeles County (up 139 percent). The total output of LPG declined 4 percent in quantity and about 6 percent in value. Decreases also were reported for natural gasoline production—3 percent in quantity and 7 percent in value. Condensate production, from two plants in Kern County, was down 8 percent. Natural gas liquids also were extracted in Fresno, Kings, Orange, and Ventura Counties.

Peat.—Production of peat was 4 percent in quantity above that in 1968, but value was down 15 percent because of the marketing of about one-fifth of the production as unprepared peat for mixed fertilizer. Two deposits in Contra Costa County produced 87 percent of the total as reed-sedge material and one operator produced humus in Orange County. All peat was used for soil improvement.

Petroleum.—Production from an average of 41,056 wells, 666 less than in 1968, decreased less than 1 percent in quantity and increased 4 percent in value compared with 1968. A 17.1-million-barrel decrease in onshore production was almost offset by increases of 8.9 million barrels from State offshore fields and 7.4 million barrels from Federal offshore fields. More than 27 percent of total production was from offshore fields. Offshore drilling increased, despite drilling restrictions in the Santa Barbara Channel, from 0.8 percent of the wells drilled in the State in 1968 to 4.6 percent.

Major increases in production were recorded in the Wilmington field, Los Angeles County (up 10.3 million barrels), the Carpinteria offshore field, Santa Barbara County (up 4.5 million barrels), and Dos Cuadras field, Southeast of Santa Barbara (3.2 million barrels of oil during its first year of production). Lesser increases in production rates were achieved in the McKittrick field, Kern County (up 200,000 barrels) and the Ventura field, Ventura County (up 185,000 barrels). Petroleum was produced in 18 counties (see table 2).

Table 7.—Production of natural gas liquids, by counties

(Thousand 42-gallon barrels and thousand dollars)

County	LP gases and ethane			Natural gasoline and isopentane		Plant condensate	
	Number of plants	Quantity	Value	Quantity	Value	Quantity	Value
1968:							
Fresno	[1] 1	W	W	W	W	-------	-------
Kern	[r] 18	2,250	$5,323	4,211	$14,003	575	$1,956
Kings	2	W	W	W	W	-------	-------
Los Angeles	[r] 22	2,076	4,550	1,958	5,938	-------	-------
Orange	[r] 4	1,325	2,852	599	1,755	-------	-------
Santa Barbara	[r] 5	998	2,242	2,308	7,254	-------	-------
Ventura	[r] 8	1,327	2,349	2,071	5,636	-------	-------
Undistributed	-----	613	1,433	1,681	6,421	-------	-------
Total	[r] 60	8,589	18,749	12,828	41,007	575	1,956
1969:							
Fresno	1	W	W	W	W	-------	-------
Kern	17	3,045	6,523	3,561	10,978	530	1,796
Kings	2	W	W	W	W	-------	-------
Los Angeles	21	1,693	3,628	4,685	14,362	-------	-------
Orange	4	W	W	665	2,040	-------	-------
Santa Barbara	5	1,466	3,140	1,602	4,910	-------	-------
Ventura	8	1,105	2,366	1,354	4,151	-------	-------
Undistributed	-----	929	1,989	557	1,707	-------	-------
Total	58	8,238	17,646	12,424	38,148	530	1,796

[r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

Table 8.—Oil and gas well drilling in California in 1969

County	Drilling [1]							
	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Alameda	2	------	------	------	------	3	5	17,511
Butte	-----	------	4	------	------	3	7	26,238
Colusa	-----	4	4	------	------	5	13	111,330
Contra Costa	3	------	3	------	------	9	15	90,250
Fresno	91	------	8	1	------	10	110	322,239
Glenn	-----	8	1	------	1	3	13	71,884
Humboldt	-----	------	------	------	------	2	2	11,131
Kern	789	3	58	3	1	66	920	1,692,501
Kings	-----	1	2	------	------	7	10	44,989
Lassen	-----	------	------	------	------	2	2	1,541
Los Angeles:								
Onshore	104	1	7	3	------	12	127	764,283
Offshore [2]	106	1	1	------	------	------	108	542,740
Madera	-----	------	------	------	------	2	2	7,010
Merced	-----	------	------	------	------	6	6	53,294
Monterey	73	------	1	------	------	13	87	155,068
Nevada	1	------	------	------	------	------	1	790
Orange:								
Onshore	92	------	7	------	------	3	102	219,589
Offshore [2]	20	------	1	------	------	------	21	76,680
Riverside	2	------	1	2	------	1	6	16,636
Sacramento	-----	1	1	------	1	4	7	57,556
San Benito	1	------	------	------	------	------	1	560
San Bernardino	8	------	1	1	------	1	11	50,992
San Joaquin	-----	4	------	------	------	24	28	202,446
San Luis Obispo	21	------	------	------	------	3	24	80,808
Santa Barbara:								
Onshore	55	------	------	------	------	11	66	233,129
Offshore [2]	5	------	2	------	------	------	7	43,132
Santa Cruz	-----	------	------	------	------	1	1	6,219
Solano	1	10	2	------	2	15	30	246,270
Stanislaus	-----	------	------	------	------	3	3	26,646
Sutter	-----	4	10	------	------	5	19	120,853
Tehama	-----	6	2	------	------	9	17	90,755
Tulare	-----	1	------	------	------	3	4	19,240
Ventura:								
Onshore	79	------	4	6	------	7	96	635,004
Offshore [2]	-----	------	------	------	------	1	1	582
Yolo	-----	8	12	1	2	14	37	230,461
Other: Federal offshore	66	------	9	7	------	9	91	469,989
Total	1,519	52	141	24	7	257	2,000	6,740,346

[1] Does not include 9 stratigraphic and core tests (83,447 feet), 158 service wells (419,152 feet), or 44 wells standing suspended at yearend (250,905 feet).

[2] State leases, Federal offshore shown separately.

Sources: American Association of Petroleum Geologists and U.S. Bureau of Mines.

New wells drilled in all counties and on State and Federal offshore leases totaled 2,000, a decrease of 8.7 percent from 1968. The Midway Sunset field led with 378 new wells, followed by the Kern River field with 223. Average depth of all new wells was 3,370 feet, about 400 feet deeper than in 1968.

The California Division of Oil and Gas reported 211 active waterflood projects in 1969 with 2.4 million barrels of water being injected daily into 1,723 wells, 116 more wells than in 1968. Nine new projects were started. About 226 million cubic feet of gas per day was injected into 78 wells on 25 projects in 21 fields to increase oil recovery.

Exploratory drilling in 288 wells seeking new production totaled over 1.7 million feet, a decrease of 18 percent from the footage in 1968. Of the 288 wells drilled, 31 were discovery wells for a success ratio of 10.8 percent, up from 7.6 percent in 1968. New oilfields or new reservoirs in older fields were discovered by 24 of these wells and seven wells disclosed new gasfields or pools. New Oilfields included the Lyon Canyon in Los Angeles County, Oak Park in Ventura County, Pinole Point in Contra Costa County, and three fields on Federal Outer Continental Shelf leases in the Santa Barbara Channel. These were the Dos Cuadras, Gaviota Offshore, and Point Hueneme Offshore. New pools were discovered in the following oilfields: Wilmington and Union Station in Los Angeles County; San Miguelito and Rincon in Ventura County; West Bellevue, West Edison, and Fruitvale in Kern County; Huasna in San Luis Obispo County; and Mahala in San Bernardino County. New gas reservoirs were discovered at Black Butte in Glenn County; Los Angeles downtown in Los Angeles County; Van Sickle Island, Cache Slough, and Maine Prairie in Solano County; and Green's Lake and Todhunters Lake in Yolo County.

Crude-oil refining capacity increased 7 percent, to 1,631,000 barrels per calendar day, with about 30,000 barrels per day of crude oil capacity under construction at yearend. Most of the gain in capacity resulted from completion of a Humble Oil & Refining Co. refinery at Benicia, Contra Costa County. Other major capacity increases were for Standard Oil Co. of California at El Segundo (20,000 barrels per day) and Shell Oil Co. at Martinez (9,100 barrels per day).

NONMETALS

Asbestos.—Production of asbestos was nearly 83,000 tons, up 19 percent from that in 1968. California continued to lead the Nation in sales of chrysotile fiber. The output came from open-cut mines of Pacific Asbestos Corp., Calaveras County; Atlas Asbestos Co. and Coalinga Asbestos Co., Fresno County; and Union Carbide Corp., San Benito County. Union Carbide prepared the crude material by a wet process in its Monterey County plant. The product, a short-fiber concentrate, was said to be desirable for special uses. As an example, the pure fiber was combined with a polyester resin for making glue especially suited for securing highway buttons to the pavement. Pacific Asbestos milled and shipped groups 4, 5, 6, and 7 fibers for asbestos-cement pipe and sheets and for asphalt tile; the others produced group 7 fibers. Exceptionally white fibers come from the deposits near Coalinga. The quantity of sales remained virtually the same as last year but the value decreased 3 percent.

Barite.—Crude barite sold and used remained about the same in quantity compared with that of 1968; however, the value increased significantly. Barite from the Yuba Minerals and Milling Co. Castella mine, Shasta County, was processed at the company mill in Sutter County. L. G. Embree shipped barite from the Bald Mountain deposit, Tulare County, to the Rosamond mill, Kern County. All of the output was sold for use in drilling mud.

Six grinding plants—one each in Fresno, Kern, Los Angeles, Sacramento, Stanislaus, and Sutter Counties— processed crude barite supplied principally from Nevada producers. About 10 percent of the ground barite output from California plants came from crude mined within the State. The ground material sold or used increased 14 percent compared with that in 1968 and the value rose 16 percent. About 50 percent of the crushed and ground barite was used to produce barium chemicals, 44 percent for well drilling mud, and nearly 4 percent for ship ballast and heavy aggregate.

Boron Minerals and Compounds.—California continued to be the principal world

source, and the only domestic source, of boron minerals and compounds. Sales increased about 6 percent in quantity and value. Nearly all of the output came from two locations: The large open pit mine of United States Borax & Chemical Corp. near Boron, Kern County; and Searles Lake, San Bernardino County, where two companies, American Potash & Chemical Corp. (Division of Kerr-McGee Corp.) and Stauffer Chemical Co. extracted borates from brines pumped from wells below the dry lake surface. U.S. Borax operations included processing plants at the mine site and at Wilmington, Los Angeles County. Stauffer, in addition to its plant at Searles Lake, produced boron products at a San Francisco plant from purchased sodium borates. A small tonnage of colemanite was produced from underground and open pit operations in the Furnace Creek area of Death Valley, Inyo County, and sold to the U. S. Atomic Energy Commission.

U. S. Borax expanded facilities at its Boron plant, adding a new crystallizer line and an additional fusing line. Also several more thickener tanks were being added to provide more settling capacity for the washed, semi-processed borate product. In the Death Valley area, Tenneco Corp. developed colemanite deposits of potentially large extent and good quality. Open pit and underground operations were anticipated.

Bromine and Bromine Compounds.—American Potash and Chemical Corp. recovered elemental bromine from Searles Lake brines at its Trona plant, San Bernardino County, and sold it to the chemical and pharmaceutical industries. The quantity sold declined 22 percent from that in 1968, reflecting shutdown of the FMC Corp. plant in Alameda County in August 1968. However, the value increased about 7 percent.

Calcium Chloride.—Production of calcium chloride declined 18 percent in quantity and 19 percent in value from 1968 figures. General Earth Minerals acquired an option on the Sinclair No. 4 property from Chloride Products Co., Inc. and produced calcium chloride from well brines in Imperial County. Leslie Salt Co. and National Chloride Company of America recovered liquid calcium chloride from Bristol Lake brines in San Bernardino County.

Cement.—A record 50.6 million barrels of portland cement was shipped from 14 plants operated by nine companies in nine counties. About 4.5 million barrels went to customers in 16 States and nearly 0.7 million barrels was exported to foreign countries and U. S. territories and possessions. California received 1.1 million barrels of cement from producers outside the State. Total consumption of cement in California was at an alltime high of 46.5 barrels. The record demand for cement was attributed chiefly to use in construction of public works facilities and commercial high-rise structures. Bulk shipments from plants continued to increase and reached 46.3 million barrels, compared with 42.7 million barrels in 1968. Bag shipments declined from 4.9 million barrels in 1968 to 4.3 million barrels.

Table 9.—Finished portland cement

(Thousand 376-pound barrels and thousand dollars)

District [1]	Active plants	Rated capacity Dec. 31	Production	Shipments from mills			Stocks at mills Dec. 31	Apparent consumption [2]
				Quantity	Value			
					Total	Average per barrel		
1968:								
Northern California	6	21,700	18,426	18,967	$61,682	$3.25	1,446	17,783
Southern California	8	42,600	28,650	28,628	90,279	3.15	1,780	26,848
Total	14	64,300	47,076	47,595	151,961	3.19	3,226	44,631
1969:								
Northern California	6	21,700	19,527	19,309	64,974	3.36	1,648	17,733
Southern California	8	42,600	31,238	31,301	105,638	3.37	1,928	28,781
Total	14	64,300	50,765	50,610	170,612	3.37	3,576	46,514

[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.

[2] Includes receipts from other States. Excludes imports from foreign countries.

Table 10.—Source and destination of shipments of portland cement
(Thousand 376-pound barrels)

Destination	Source					
	Northern California mills		Southern California mills		Total	
	1968	1969	1968	1969	1968	1969
Northern California	15,725	15,387	1,141	1,264	16,866	16,651
Southern California	438	537	26,384	28,221	26,822	28,758
Nevada	114	176	727	895	841	1,071
Oregon	W	W	W	W	(1)	(2)
Arizona	------	------	146	285	146	285
Other	[3] 2,690	[3] 3,209	[4] 230	[4] 636	2,920	3,845
Total	18,967	19,309	28,628	31,301	47,595	50,610
Building material dealers	1,005	1,219	1,730	2,588	2,735	3,807
Concrete product manufacturers	1,617	1,618	3,274	3,536	4,891	5,154
Ready-mixed concrete	12,207	12,717	18,376	19,095	30,583	31,812
Contractors and government agencies	3,958	3,504	4,717	5,250	8,675	8,754
Miscellaneous and own use	180	251	531	832	711	1,083
Total	18,967	19,309	28,628	31,301	47,595	50,610

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Included with "Other;" total 1,239,825 barrels shipped from northern and southern California to Oregon.
[2] Included with "Other;" total 1,372,535 barrels shipped from northern and southern California to Oregon.
[3] Includes Alaska, Colorado (1968), Hawaii, Idaho (1969), Oregon ,Utah (1968), Washington, foreign countries, and U.S. Possessions and Territories.
[4] Includes Colorado, Hawaii, Idaho, Iowa, Kansas (1968), Michigan, Mississippi, Missouri, New Mexico, Ohio, Oregon, Texas, Utah, Washington, Wyoming (1968), and foreign countries.

American Cement Corp. operated the Crestmore plant, Riverside County, and a plant at Oro Grande, San Bernardino County. The firm produced the only white cement manufactured on the West Coast at its Crestmore plant. Calaveras Cement Div., The Flintkote Co., operated plants near Redding, Shasta County, and San Andreas, Calaveras County. Calaveras Cement installed a 17.6-mile pipeline to convey limestone slurry from its quarry to the plant at San Andreas. Construction of crushing and grinding facilities at the quarry was scheduled to begin in 1970. When the facilities are completed, the slurry will be ground to 90 percent minus 200-mesh and pumped through a 7-inch pipeline, assisted by gravity (1,500-foot vertical drop), to the kilns. Water for the new mill at the quarry will be supplied by a 4-mile pipeline.

California Portland Cement Co. operated plants in Colton, San Bernardino County, and near Mojave, Kern County. Ideal Cement Co. produced cement at Redwood City, San Mateo County, from oyster shells dredged from San Francisco Bay and at San Juan Bautista, San Benito County. Kaiser Cement and Gypsum Corp. operated plants at Cushenbury, San Bernardino County, and Permanente, Santa Clara County. A new dust collecting facility using glass bags was installed at Permanente, the fourth largest plant in the United States. A new 8-cubic-yard electric shovel was placed in operation at the quarry. Two 32,000-barrel-capacity ocean-going barges were purchased to supply cement to Kaiser's Alaska and Pacific Coast terminals. Pacific Cement and Aggregates, a division of Lone Star Cement Corp., began construction of a 3-mile covered conveyor system to transport limestone from the quarry to the plant at Davenport, Santa Cruz County. General Portland Cement Co., Dallas, Tex., announced plans to acquire the Pacific Western Industries, Inc., 3.3-million-barrel plant at Los Robles, Kern County. Monolith Portland Cement Co. produced cement at Monolith, Kern County, and Southwestern Portland Cement Co. operated a plant at Victorville, San Bernardino County.

Clays and Shale.—Production of clays and shale increased 9 percent in quantity and 12 percent in value above 1968 figures. Material mined at captive operations decreased 14 percent; however, the quantity sold increased 109 percent to account for the net increase. Shale, amounting to about 53 percent of the total output, was produced at 21 mines in 16 counties. Most of the shale was processed for lighweight aggregate or went into the manufacture of portland cement. About 63 percent of the shale was produced in Ventura, Orange,

Santa Cruz, Calaveras, and Alameda Counties. Miscellaneous clay accounted for 32 percent of the total output followed by fire clay and bentonite (14 percent) and kaolin and ball clay (1 percent). Miscellaneous clay was produced at 37 mines in 20 counties, with the largest production from seven mines in Riverside County. Contra Costa, Kern, and San Mateo Counties were major sources of miscellaneous clay. Fire clay production declined. It was mined at seven properties in Riverside County, three in Amador County, two each in Placer and Sacramento Counties, and one in Kern County. Bentonite production declined sharply because the largest producer in 1968 did not operate its underground mine in San Bernardino County. Bentonite was produced at two mines in Inyo County and one each in Imperial, Kern, and San Benito Counties. Kaolin production also declined. Output came from one mine in Mono County and two in Orange County. Production of ball clay, mined in San Bernardino and Stanislaus Counties, decreased 71 percent.

In summary, 49 companies operated 77 clay and shale mines in 30 counties. About 29 percent of all production was used to manufacture building brick, pipe, tile, and similar products; 29 percent was used in making portland cement; 26 percent for lightweight aggregates; and the remaining for refractory and other uses including floor and wall tile, pottery, filler, drilling mud, and as an absorbent.

Diatomite.—Sales of crude and prepared diatomite rose 2 percent in quantity and 7 percent in value. The average price for all products increased $3.25 per short ton. Johns-Manville Products Corp. remained the leading producer, not only in the State but in the Nation, with its large open pit mine and processing plant near Lompoc, Santa Barbara County. GREFCO, Inc., second largest producer, operated its Tolbert mine and mill, southwest of Lompoc, also Santa Barbara County, making products chiefly for filtration, fillers, and insulation. Diatomic Chemical Co. produced lesser quantities of calcined and screened diatomite for absorbents at its plant southeast of Lompoc. Pozzolan Products, Inc., with a mill southeast of Santa Barbara and the Airox mine, produced calcined and ground diatomite for pozzolan. The firm also sold some crude for use in lightweight aggregates. Basalt Rock Co., Inc., produced pozzolan from diatomite at its plant in Napa County. Shelley Mining Corp. reported exploration and development work at its open pit diatomite property near Lake Britton, Shasta County.

Johns-Manville completed the first major expansion in 16 years at its Lompoc plant. Capacity was increased 20 to 25 percent with addition of a fifth calcining unit. The new unit comprised a 10- by 125-foot rotary kiln and auxiliary equipment.

Feldspar.—Del Monte Properties Co. and Owens-Illinois, Inc., processed feldspathic dune sands near Pacific Grove, Monterey County. Total marketable feldspar sold and used increased 11 percent in quantity and 23 percent in value above that in 1968. Both companies produced feldspar and silica concentrates; Del Monte used flotation and Owens-Illinois utilized magnetic separation to beneficiate the raw material. Sand and feldspar were sold and used for making glass ceramics.

Gem Stones.—Thousands of rock hounds, gem dealers, and weekend prospectors collected more than 90 varieties of gem materials and mineral specimens at many localities in the State. No attempt was made to obtain complete statistics on the materials produced.

The Green Dragon claim in Charcoal Flat, 1 mile north of the former Bagby townsite, Mariposa County, was worked by Otis Oil and Gas Co. of San Francisco to produce 270 tons of nephrite occurring in discontinuous ore bodies from an open pit. About one-third of the material was in large fragments ranging in weight from 0.1 to 10 tons. The product was cut in the San Francisco Bay area and was used for jewelry and decorative stone for table tops, lamps, and fireplaces.

Gem tourmaline and specimen materials were produced from the Stewart mine, one of San Diego County's oldest and best known gem mines. Pala and Mesa Grande, two important gem mining districts in San Diego County and important sources of tourmaline, spodumene, beryl topaz, garnet, and quartz crystals from pegmatite deposits, were not very active. Some beryl and spodumene were produced from the Pala district and some material was collected from old mine dumps at Mesa Grande. Topaz and garnet were mined in the Ramona district.

Gypsum.—Production of crude gypsum and gypsite amounted to 1.2 million tons. Output was 150,000 tons less than in 1968

chiefly because of less demand for agricultural gypsum (gypsite) from potato and cotton growers in central and southern California.

Gypsite was mined by six companies at seven open pit mines: Four in Kern County and one each in Merced, San Bernardino, and San Luis Obispo Counties. More than 95 percent of gypsite was mined in Kern County by H. M. Holloway, Inc., Lost Hills (the largest producer); Temblor Gypsum Co., Richfield Lake Station; C. L. Fannin, Wasco; and Superior Gypsum Co., Bitterwater mine. Byproduct gypsum was produced in Contra Costa, Fresno, and San Joaquin Counties. A previous producer in Alameda County shipped from stockpile. Valley Nitrogen Producers, Inc., Fresno County and Occidental Chemical Co., San Joaquin County were the largest producers of byproduct gypsum which they obtained in the manufacture of phosphoric acid. Registered sales of agricultural gypsum in California totaled 985,000 tons including crude ore from out-of-State and byproduct gypsum from magnesia and phosphoric acid plants. Gypsum for plaster and board products was quarried at the Fish Creek Mountain deposit in Imperial County by United States Gypsum Co., the State's largest producer. Monolith Portland Cement Co. discontinued gypsum mining in Ventura County in March 1969.

Kaiser Cement and Gypsum Co. operated facilities in San Mateo County for distributing gypsum imported from its mine on San Marcos Island, Mexico for use in Northern California as a portland cement retarder.

Nearly 874,000 tons of calcined gypsum was produced by five companies at seven plants processing crude ore from mines in California, Nevada, and Mexico. In Alameda County, Blue Diamond Gypsum Division of The Flintkote Co. manufactured wallboard from gypsum shipped from its Arden, Nev., mine, and Fiberboard Corp. produced wallboard from gypsum mined at the Apex mine, near Las Vegas, Nev., until operations were discontinued on July 31. Kaiser Cement and Gypsum Co. and National Gypsum Co. each produced gypsum products in Contra Costa County and in Los Angeles County from material imported from Mexico. United States Gypsum Co. produced plaster and wallboard at its Plaster City plant in Imperial County. Johns-Manville Corp., formerly using gypsum from the Apex mine in Nevada, closed its plant in Los Angeles County in February 1969.

The tonnage of gypsum calcined in 1969 was the highest in 5 years and the rise was attributed principally to increased demand for wallboard for construction of hotels, office buildings, and apartment houses. An estimated 44 percent of the total gypsum produced and imported was used for agriculture, 46 percent for plaster and board products, and 10 percent for portland cement retarder.

Iodine.—Crude iodine was not produced in 1969. However, Deepwater Chemical Co., Ltd., at Compton Los Angeles County, produced potassium and silver iodide; potassium, calcium, and silver iodate; and resublimed iodine from imported crude iodine.

Kyanite.—Kyanite was mined in 1968 but not in 1969.

Lime.—Production of lime and dead-burned dolomite increased from 568,000 tons in 1968 to 585,000 tons, and value rose nearly 4 percent from that of 1968. Although the largest increase in use of lime was for sugar refining, demand also increased for use in manufacturing glass and magnesium compounds and in soil stabilization. Declines were reported in use for manufacturing steel and in preparing insecticides and food products.

Nine companies produced lime at 15 plants in 11 counties. Nine of the plants produced lime exclusively for use in their own sugar refineries in Glenn, Imperial, Monterey, Orange, San Joaquin, Santa Barbara, and Yolo Counties. U.S. Lime Division, The Flintkote Co., operated plants in Contra Costa and Tuolumne Counties and in mid-December started its new lime hydrating facility at City of Industry, Los Angeles County. Quicklime from the company's Nevada operations was hydrated primarily for soil stabilization of roads, runways, and building foundations. Diamond Springs Lime Co. produced lime in El Dorado County. Sierra Lime Products Corp. lime plant at Cool was idle during 1969. Chas. Pfizer & Co., Inc. and Stauffer Chemical Co operated lime plants in San Bernardino County. Kaiser Aluminum & Chemical Corp. produced dead-burned dolomite at Natividad, Monterey County, which was used mostly as a precipitant in its Moss Landing magnesia-from-seawater

plant. The magnesia was used for manufacturing refractories.

Producers used 360,000 tons of lime in their own operations and sold 225,000 tons, of which 10 percent went to out-of-State customers in six States and Canada. California consumers received 261,000 tons of lime shipped from seven States. Total consumption of primary lime in California was 824,000 tons or 47,000 tons more than in 1968. About 80 percent of the State's lime production was used for chemical or industrial purposes; 11 percent for construction (mostly soil stabilization); 8 percent for refractories; and the remainder for agriculture. Nearly 34 percent of the lime production was used to treat sea water to extract magnesia; 30 percent for refining sugar; 8 percent as a flux for steelmaking and for concentrating ores; and 8 percent for other uses, including water treatment, glass manufacturing, and in the petroleum, insecticide, tanning, and paper industries.

Lithium Compounds.—Dilithium sodium phosphate was recovered from Searles Lake brines at Trona, San Bernardino County, by American Potash & Chemical Corp. and converted to lithium carbonate. Production declined 8 percent in quantity and 5 percent in value from levels in 1968.

Magnesium Compounds.—Production and sales of magnesium compounds were 7 percent lower in tonnage than in 1968, although the value declined only 1 percent. The decline was attributed to lower sales of refractories and discontinuance of operations by FMC Corp., at Newark, Alameda County. FMC Corp. continued to produce magnesia and magnesium chloride from salt-works bitterns in San Diego County. Kaiser Aluminum & Chemical Corp. produced magnesia in Monterey County by using dolomite calcined at its Natividad plant and then reacting the dolomite with sea water at its Moss Landing plant. Kaiser consumed most of its own output in the manufacture of refractories which were used in its steel and cement operations. Merck and Co., Inc., produced magnesia from sea water at its plant in San Mateo County and manufactured magnesium carbonate and magnesium trisilicate. In addition to refractories, other principal uses for magnesium compounds included pulp and paper, rubber, and electrical products and medicinals.

Kaiser Aluminum & Chemical Co. commenced work on an expansion at Moss Landing to include a new high-fired rotary kiln for producing specialized refractories.

Mica.—No crude mica was mined in California in 1969. Crude material shipped from Los Angeles County in 1968 was processed by Paramount Pacific, Inc., in Kern County and sold for use in oil-well drilling mud.

Perlite.—Perlite production from American Perlite Co. Inyo County increased 30 percent in quantity and 31 percent in value from that of 1968. The crude perlite was processed in the company's plant and in three expanding plants owned by others. All of the plants were in Los Angeles County.

Seven perlite expansion plants were in operation—five in Los Angeles County and one each in San Diego and Sonoma Counties. Crude perlite from Arizona, Colorado, and Nevada was expanded in some of the plants. Sales and use of expanded perlite declined 58 percent in quantity but increased 16 percent in value compared with 1968. About 37 percent of the expanded perlite was used for filter aid, 27 percent for plaster aggregate, 11 percent for soil conditioner and horticultural aggregate, 9 percent for concrete aggregate, and 16 percent for other uses including fillers and insulation.

Phosphate Rock.—Production and sales of phosphatic shale by Cuyama Phosphate Corp., the State's only producer, increased 147 percent in quantity and 160 percent in value over the 1968 figures. The material averaged about 5 percent P_2O_5 and was mined from an open cut near New Cuyama in Santa Barbara County and processed for agricultural use. West of Ojai, Ventura County, United States Gypsum Co. continued to explore for phosphate rock and gypsum in the Santa Margarita Formation.

Potassium Salts.—Potassium compounds were produced by American Potash & Chemical Corp. at Trona, San Bernardino County. The company extracted potassium chloride (muriate) from Searles Lake brines and converted part of the output to potassium sulfate. Overall production was about 4 percent below that of 1968 but sales, including material from stockpiles, increased 7 percent.

Pumice.—Combined output of pumice, pumicite, scoria, and volcanic cinder increased 12 percent in quantity but declined 6 percent in value compared with

1968. Siskiyou and Lassen Counties produced about half of the State's total. Forty-two operations were reported in 13 counties—nine in Siskiyou; five in Lassen, Modoc, and Tehama; four in Mono; three each in Lake and Shasta; two each in San Bernardino and Kern; and one each in Inyo, Madera, Butte, and Napa. Pumice was produced at four properties in Mono County, two plants in Siskiyou County, and one plant each in San Bernardino and Napa Counties. One plant in Kern County prepared pumicite. The other 33 operations produced volcanic cinder and some scoria. Federal, State, and County agencies produced more than half of the combined total for road construction. About 76 percent of the total was used in road construction, 13 percent for concrete aggregate, 6 percent for landscaping, and 5 percent for other uses, including abrasives, filler material, insulation, railroad ballast, roofing granules, and soil conditioner. Only 21 percent of the combined output was crushed, screened, and/or ground before being used.

Salt.—Salt production declined slightly in tonnage from the record high established in 1968 and decreased 3 percent in value. Five companies and the Metropolitan Water District of Southern California operated 12 plants in seven counties to recover salt by solar evaporation. Western Salt Co. ceased operation in Orange County in May because of damage by winter floods in 1968 but continued to operate plants in Kern and San Diego Counties. Most of the salt was recovered from sea water evaporating ponds in the San Francisco Bay Area by Leslie Salt Co. in Alameda, San Mateo, and Napa Counties. Oliver Bros. Salt Co. also produced salt in Alameda County. Other production by solar evaporation of brines from dry lakes and sea water came from operations by Leslie Salt Co., Pacific Salt and Chemical Co., Standard Salt Co., and the Metropolitan Water District of Southern California in San Bernardino County and from one operation each in Kern and San Diego Counties. Rock salt (halite) was produced by Leslie Salt Co. at Bristol Lake, San Bernardino County. In addition to producing salt by solar and vacuum pan evaporation methods, Leslie Salt Co. processed the salt produced into pressed blocks and all grades including table salt. Consumers within the State received 55 percent of the output and the remainder was shipped to Arizona, Hawaii, Nevada, Oregon, and Washington; significant quantities were exported to Japan and Canada. The salt was marketed for a wide variety of uses, but the chemical, water softening, and food processing industries were the major consumers.

Sand and Gravel.—California continued to lead the Nation in production of sand and gravel. Output was at a record level of 124.7 million tons, virtually the same as in 1968, and its value increased 2 percent. Sand and gravel was produced in all 58 counties from 666 active operations, 34 fewer than in 1968. Of these, 374 were classified as commercial and 292 as Government-and-contractor. Production ranged from 2,000 tons in Alpine County to 22.9 million tons in Los Angeles County. Alameda and San Bernardino Counties produced more than 10 million tons each. Twenty-three commercial operations produced more than 1 million tons each; 44,

Table 11.—Pumice [1] sold or used by producers in 1969, by counties

County	Crude		Prepared		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Butte	3,000	$1,500	-------	-------	3,000	$1,500
Inyo	-------	-------	W	W	W	W
Kern	-------	-------	W	W	W	W
Lake	11,166	22,332	W	W	11,166	22,332
Lassen	225,304	229,152	W	W	225,304	229,152
Madera	-------	-------	W	W	W	W
Modoc	120,215	119,826	-------	-------	120,215	119,826
Mono	-------	-------	11,491	$56,412	11,491	56,412
Napa	729	2,424	-------	-------	729	2,424
San Bernardino	43,039	45,191	104	520	43,143	45,711
Shasta	28,943	39,694	5,286	8,521	34,229	48,215
Siskiyou	196,384	226,299	W	W	196,384	226,299
Tehama	54,334	42,083	W	W	54,334	42,083
Undistributed	-------	-------	166,473	434,551	166,473	434,551
Total	683,114	728,501	183,354	500,004	866,468	1,228,505

W Withheld to avoid disclosing company confidential data; included with "Undistributed."
[1] Includes pumicite and volcanic cinder.

between 500,000 and 1 million tons each; 107, between 100,000 and 500,000 tons each; and 200, less than 100,000 tons each.

Production of ground and unground industrial sands increased 16 percent in that of 1968. The increases were mostly for glass manufacturing, porcelain, and abrasives.

Blue Diamond Division of the The Flintkote Co. opened a new 3,500-ton-per-hour sand and gravel plant in San Gabriel Valley, Los Angeles County, to replace an older facility.

Nearly 96 percent of the commercial sand and gravel was shipped by truck and 4 percent by railroad.

Table 12.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Sand		Gravel		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	48,536	$58,152	69,774	$78,075	118,310	$136,227
1966	48,930	57,144	71,762	82,013	120,692	139,157
1967	48,739	59,284	67,386	79,928	116,125	139,212
1968	50,726	64,158	73,929	89,202	124,655	153,360
1969	49,831	65,628	74,887	90,255	124,718	155,883

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Glass	W	W	1,366	$6,533
Molding	58	$272	W	W
Building	21,904	27,926	22,916	28,988
Paving	13,993	16,913	13,706	15,893
Blast	276	1,294	263	1,288
Engine	64	185	71	184
Filter	W	W	W	W
Other	5,775	9,601	4,895	5,784
Total	42,070	56,191	43,217	58,670
Gravel:				
Building	25,335	33,214	24,984	33,190
Paving	30,418	37,419	30,086	38,139
Railroad ballast	85	102	70	92
Other	2,587	2,915	3,656	4,441
Total	58,425	73,650	58,796	75,862
Total sand and gravel	100,495	129,841	102,013	134,532
Government-and-contractor operations: [1]				
Sand:				
Building	40	50	209	221
Paving	7,550	6,863	5,773	6,127
Fill	1,030	1,017	628	606
Other	36	37	4	4
Total	8,656	7,967	6,614	6,958
Gravel:				
Building	44	48	508	522
Paving	10,513	12,309	15,123	13,425
Fill	4,802	3,040	460	446
Other	145	155	--------	--------
Total	15,504	15,552	16,091	14,393
Total sand and gravel	24,160	23,519	22,705	21,351
All operations:				
Sand	50,726	64,158	49,831	65,628
Gravel	73,929	89,202	74,887	90,255
Grand total	124,655	153,360	124,718	155,883

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes figures for State, counties, municipalities, and other Government agencies.

Table 14.—Sand and gravel production in 1969, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Alameda	11,049	$14,072	Placer	408	$728
Alpine	2	2	Plumas	360	431
Butte	713	1,125	Riverside	4,252	6,084
Colusa	274	164	Sacramento	6,387	8,221
Contra Costa	871	1,037	San Bernardino	13,175	12,843
Del Norte	229	237	San Diego	9,147	16,706
El Dorado	274	332	San Joaquin	2,966	3,917
Fresno	3,938	4,569	San Luis Obispo	95	153
Glenn	520	460	Santa Barbara	1,262	1,537
Humboldt	855	1,119	Santa Clara	3,247	3,652
Imperial	1,630	1,843	Santa Cruz	2,200	2,352
Inyo	230	378	Shasta	786	867
Kern	4,941	7,789	Sierra	45	47
Kings	517	383	Siskiyou	2,171	1,916
Lake	501	693	Solano	71	62
Lassen	390	447	Sonoma	2,362	2,987
Los Angeles	22,904	25,371	Stanislaus	1,633	2,126
Madera	70	76	Tehama	187	276
Marin	225	182	Trinity	133	159
Mariposa	62	81	Tulare	1,361	1,666
Mendocino	391	658	Ventura	4,708	4,127
Merced	1,885	2,659	Yolo	2,149	2,266
Modoc	161	151	Yuba	1,125	1,240
Mono	214	203	Other counties [1]	2,408	5,056
Monterey	864	2,682			
Napa	66	95	Total	124,718	155,883
Nevada	626	1,007			
Orange	7,678	8,649			

[1] Includes Amador, Calaveras, San Benito, San Francisco, San Mateo, Sutter, and Tuolumne Counties.

Sodium Compounds.—Sales and use of sodium compounds were slightly above levels of 1968; however, production of sodium carbonate (soda ash) and sodium sulfate (salt cake) declined. United States Borax & Chemical Corp. produced salt cake as a byproduct in the processing of crude borates at its Wilmington refinery, Los Angeles County. The borates were mined in Kern County. American Potash & Chemical Corp. and Stauffer Chemical Co. each produced salt cake and soda ash from Searles Lake brines, San Bernardino County. Stauffer also recovered anhydrous sodium sulfate as a byproduct from processing purchased Kern County sodium borates in its San Francisco plant.

Stone.—Stone production was 38.0 million tons, an increase of 5 percent in quantity and 10 percent in value over that in 1968. The increase was attributed to greater demand for limestone in portland cement manufacture, concentrate aggregates, road base, and paving materials. Material was quarried in 43 counties by 129 operators at 255 quarries and two oystershell dredging operations. The State Highway Division operated 14 quarries; nine cities and counties operated 17; and three Federal agencies operated 69, most of which were operated by the U.S. Forest Service. Only eight quarries produced 1 million tons or more of rock each; four were in San Bernardino County (limestone) and one each were in Alameda (trap rock), Kern (limestone), San Benito (granite), and Santa Clara (limestone) Counties. Another 83 quarries produced between 25,000 and 1 million tons each, and 166 produced less than 25,000 tons each. San Bernardino and Santa Clara Counties each produced more than 6 million tons of stone; Contra Costa and Kern Counties had outputs exceeding 3 million tons each; Alameda County yielded more than 2 million tons; and seven other counties each had outputs exceeding 1 million tons. The total stone quarried was comprised of 9 percent granite, 6 percent basalt, 49 percent limestone and oystershells, 11 percent sandstone and quartz, and 25 percent miscellaneous stone.

Principal uses of stone were: 43 percent for concrete aggregate, road base, and paving materials; 40 percent for manufacturing portland cement and lime; 6 percent for riprap; and 11 percent for metallurgical, chemical, and other industrial applications.

Trucks transported 76 percent of the stone; railroads, 9 percent; waterways, 3 percent; and other methods, including conveyor belts, 12 percent.

After the Alameda County Planning Commission approved Utah Construction & Mining Company's proposal to quarry 100 million cubic yards of basalt on Apperson

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]	
1965	4,286	$6,193	2,480	$3,035	15,840	$22,959
1966	4,862	5,855	2,218	3,202	16,130	23,890
1967	4,755	7,274	2,130	2,542	14,307	21,216
1968	4,052	6,296	1,471	1,840	16,904	24,548
1969	3,588	5,516	2,207	2,868	18,590	26,164
	Sandstone [2]		Other stone [3]		Total	
1965	4,061	$7,202	15,908	$20,279	42,575	$59,668
1966	3,569	7,080	16,272	21,309	43,051	61,336
1967	3,663	6,563	12,331	17,668	37,186	55,263
1968	3,036	5,805	10,662	14,182	36,125	52,671
1969	4,241	8,419	9,407	14,790	38,033	57,757

[1] Includes dolomite, limestone, and oystershell used in cement and lime as follows (in thousand short tons and thousand dollars): 1965, 12,993 tons, $13,870; 1966, 12,771 tons, $14,000; 1967, 11,593 tons, $12,911; 1968, 13,356 tons, $15,209; 1969, 14,468 tons, $16,196.

[2] Includes quartz and quartzite.

[3] 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.

Table 16.—Stone sold or used by producers, by uses

Use	1968		1969	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction and rubble—cubic feet	1,873,282	$355,741	470,512	$247,043
Approximate equivalent in—short tons	159,229	----------	31,275	----------
Rough architectural—cubic feet	98,583	463,582	84,005	369,519
Approximate equivalent in—short tons	8,067	----------	6,957	----------
Monuments and mausoleums—cubic feet	12,896	120,168	10,815	232,441
Approximate equivalent in—short tons	1,138	----------	952	----------
Flagging—cubic feet	21,003	35,648	9,506	27,980
Approximate equivalent in—short tons	1,599	----------	808	----------
Other stone—cubic feet	15,476	76,935	315,115	291,655
Approximate equivalent in—short tons	1,299	----------	26,581	----------
Total dimension stone approximate, in short tons	171,332	1,052,074	66,573	1,168,638
Crushed and broken stone:				
Agricultural purposes—short tons	180,407	1,136,184	203,621	926,381
Construction and maintenance purposes—do	16,400,608	22,386,330	18,978,641	27,481,644
Cement and lime manufacture—do	13,355,893	15,208,627	15,165,404	17,124,321
Metallurgical purposes—do	W	W	W	W
Other uses [1]—do	6,016,996	12,887,406	3,619,176	11,055,694
Total crushed and broken stone—do	35,953,904	51,618,547	37,966,842	56,588,040
Grand total approximate—do	36,125,236	52,670,621	38,033,415	57,756,678

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

[1] Includes whiting substitute, fillers, glass, fill, sugar refining, miscellaneous, and crushed and broken stone uses indicated by symbol W.

Table 17.—Stone [1] production in 1969, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Alameda	2,678	$2,192	San Benito	W	W
Butte	(2)	(2)	San Bernardino	6,062	$8,885
Calaveras	W	W	San Diego	1,325	2,379
Contra Costa	3,234	5,281	San Luis Obispo	W	W
Del Norte	18	14	San Mateo	1,330	2,628
El Dorado	535	1,889	Santa Barbara	5	42
Fresno	301	323	Santa Clara	6,301	5,318
Humboldt	61	62	Santa Cruz	1,133	1,709
Imperial	W	W	Shasta	W	W
Inyo	W	W	Siskiyou	126	130
Kern	3,474	3,882	Solano	W	W
Lake	1	2	Sonoma	407	894
Los Angeles	1,264	1,574	Tehama	1	1
Madera	W	W	Trinity	392	392
Marin	W	W	Tulare	692	706
Mariposa	2	22	Tuolumne	W	W
Mendocino	(2)	1	Ventura	233	774
Modoc	38	59	Yuba	W	W
Mono	10	10	Other counties	6,768	13,809
Monterey	W	W	Total	38,033	57,757
Napa	W	W			
Nevada	22	22			
Placer	W	W			
Plumas	16	24			
Riverside	1,604	4,733			

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes stone used in cement and lime.
[2] Less than ½ unit.

Ridge over a period of 30 years, the County Supervisors rejected an application for a quarrying permit.

Sulfur.—No sulfur ore was mined in California in 1969. Magna-minerals, Inc., closed its Crater mine and North American Resources continued exploration and assessment work at the Crater Sulphur deposit in Inyo County.

Eight companies recovered elemental sulfur from sour natural gas and refinery gases at nine plants in three counties—Monsanto Co., Shell Oil Co., and Union Oil Co. in Contra Costa County; Collier Carbon & Chemical Corp., Douglas Oil Co., Gulf Oil Corp., Powerine Oil Co. and Stauffer Chemical Co. in Los Angeles County; and Union Oil Co. in San Luis Obispo County. The Claus process or modified Claus process was used to recover the sulfur. Sales and consumption rose 21 percent above the 1968 level.

Five companies produced hydrogen sulfide at six plants—Phillips Petroleum Co. and Standard Oil Company of Calif. in Contra Costa County and Atlantic Richfield Oil Co., Mobil Oil Corp., Shell Oil Co. and Standard Oil Co. in Los Angeles County. Four plants used the diethanolamine absorption process and two plants utilized the Girbotol process. American Smelting and Refining Company produced liquid sulfur dioxide at its Selby smelter in Contra Costa County. Sulfur recovery at all seven plants was virtually the same as in 1968.

Talc, Soapstone and Pyrophyllite.—Combined production of talc, soapstone, and pyropyllite totaled 145,000 tons, a decrease of 12 percent in quantity compared with that of 1968; however, the value rose 12 percent. Crude talc was shipped from 20 mines; 12 in Inyo County and eight in San Bernardino County. Shipments were made from stockpiles at another three properties and one 1968 producer in San Bernardino County and two others in Inyo County were idle in 1969. Soapstone was shipped from two mines in El Dorado County and one in Los Angeles County. Two soapstone mines that produced in 1968 were idle; one each in Amador and El Dorado Counties. Pyrophyllite was shipped from one mine in Mono County and from a mine stockpile in San Bernardino County. Inyo County produced 76 percent of the combined total crude talc, soapstone, and pyrophyllite, followed by San Bernardino County with 19 percent.

Fourteen grinding plants processed crude material from California, Nevada, and Montana in six counties: Alameda (one talc and one soapstone), Inyo (one talc and one talc and phrophyllite), Los Angeles (three talc, one soapstone, and one pyrophyllite), Sacramento (one talc), San Ber-

nardino (two talc and one talc–soapstone–and pyrophyllite), and San Diego (one pyrophyllite). Production and sales of ground material increased 11 percent above 1968 levels and of the total, 37 percent was used in paints, 23 percent in ceramics, 14 percent in insecticides, 8 percent as asphalt filler, 5 percent by the rubber industry, and 13 percent by the cosmetic, rice polishing, foundry, textile, paper, and other industries. Less than 1 percent of the talc was exported.

The Chas. Pfizer & Co., Inc. Bonny mine, Inyo County, was converted from an underground to open pit mine.

Wollastonite.—Production and sales of wollastonite from a quarry north of Blythe, near Midland, Riverside County by Chas. Pfizer & Co., Inc., declined slightly. The material was trucked to the company plant at Victorville and processed for use in the ceramic industry.

Water.—Rules and regulations for leases and prospecting permits for geothermal resources and a tax court decision declaring that geothermal steam is a natural gas and eligible for depletion allowance are summarized at the biginning of the chapter under the heading—Legislation and Government Programs.

Near The Geysers, Sonoma County, Union Oil Co. in a joint venture with Magma Power Co. and Thermal Power Co. deepened one well, drilled five wells to depths of 4,450, 6,638, 5,570, 6,639, and 6,426, respectively, and started a sixth well. The group had completed 57 wells and extended significantly the known geothermal field in an area estimated to have steam reserves equivalent to about 1.5 million kilowatts. One well tested at a rate of 225,000 pounds of superheated dry steam per hour, the equivalent of 11,000 kilowatts.

Steam was sold under contract to Pacific Gas and Electric Co. (PG&E) for generation of electricity. PG&E, installed a new 28,000 kilowatt generating unit, thus increasing its total power-generating capacity to 82,000 kilowatts, and began constructing power facilities to add another 55,000 kilowatts of capacity in 1971.

Signal Oil Co's. discovery of geothermal steam in the castle Rock Springs area, Lake County, extended the proven field eastward more than 1 mile. Signal drilled four wells to depths of 7,276, 5,478, 5,180, and 8,049 feet, respectively.

Geothermal Resources International (GRI) entered into a joint venture with Systems Capital Corp. and Vanderbilt Corp. to invest $36 million to drill 30 wells and build generating plants to supply 300,000 kilowatts of power to the Northern California Power Association of 11 municipally owned utilities. The power contract was contingent upon GRI obtaining use of established power transmission lines, an unresolved problem. A well started by GRI near The Geyers was not completed at yearend.

Water condensed from steam during power generation contained borate, a suspected pollutant of Sulphur Creek, a natural stream at The Geysers. To comply with regulation of the State Water Quality Control Board, tests were made to determine the feasibility of injecting condensate water into an abandoned well 2,900 feet deep that had lacked sufficient steam flow and pressure for use as a power source. About 10,000 barrels per day of concentrate was injected with no apparent effect on adjacent steam wells.

In the Casa Diablo geothermal field, Mono County, Magma Power Co. drilled a shallow exploration well at Mammoth Lake. At Kelley Hot Springs, Modoc County, GRI drilled an unsuccessful test steam well.

Other Nonmetals.—Crude vermiculite, obtained from out-of-State, was exfoliated at plants in Alameda, Los Angeles, and Orange Counties. Production and sales increased 38 percent over those in 1968, with the main uses for insulation, aggregate, and agricultural products.

Production of natural and manufactured iron oxide pigments in Alameda County by the C. K. Williams Div. of Chas. Pfizer & Co., Inc., increased 8 percent in quantity and 9 percent in value. Although most of the output was manufactured red, brown, and yellow oxides, the company also used out-of-State raw materials to produce natural brown and red oxides, Venetian red, ocher, sienna, umber (burnt and raw), and vandyke brown.

Fontana Slag Co. acquired Mineral Wool Insulation Co., a processer of blast furnace slag at Fontana, San Bernardino County. Production of slag for use in ballast, concrete aggregate, roofing granules, filter media, and road paving materials was more than double that of 1968.

Great Lakes Carbon Corp., in a plant in Antelope Valley Kern County, manufactured graphite from petroleum coke. The graphite was used for anodes, electrodes, crucibles, and other vessels. Production increased 22 percent above that of 1968.

METALS

Antimony.—No antimony was produced; however, assessment work was preformed in Kern County.

Copper.—Production of copper as a byproduct from the treatment of tungsten ore, gold-silver ore, lead-zinc ore, mine dumps and mill tailings and from exploration was recorded by 11 operators in five counties—seven in Inyo, one in San Bernardino, and one each in Alpine, Imperial, and Stanislaus. More than 99 percent of the output came from Inyo County where Union Carbide Corp., the largest producer, recovered copper from the treatment of tungsten ore from its Pine Creek Mine, and the Darwin Group (West Hill Exploration Inc.) recovered copper as byproduct from treatment of lead-zinc ores. Production declined nearly 5 percent from that of 1968 but value increased more than 8 percent.

A number of companies conducted exploration projects for copper and related metals (see partial list under Trends and Developments). Such projects were underway in the following counties: Calaveras, Imperial, Plumas, Shasta, Siskiyou, and Yuba.

Gold.—Although lode gold production increased 107 percent above that of 1968, total production declined nearly 50 percent because of a drop in placer gold production. The latter decreased 80 percent, reflecting the cessation of gold dredging in California when Yuba Consolidated Industries shut down the old "Yuba 21" dredge on October 1, 1968. Lode gold shipments were reported by 24 operators in 11 counties—eight in Inyo, four in Sierra, two each in Amador, Sacramento and San Bernardino, and one each on Alpine, Imperial, Kern, Mariposa, Modoc, and Nevada. About 71 percent of the lode gold was produced from the Oriental Mine in Sierra County by Dickey Exploration Co. Three other mines produced more than 100 ounces of gold each: Vanderbilt mine operated by Heavy Metals Tech. Corp., San Bernardino County; Darwin Group lead-zinc mine operated by West Hill Exploration Inc., Inyo County; and Zaca gold-silver mine, Alpine County.

Most of the placer gold was recovered as a byproduct from sand and gravel operations in eight counties—three in Fresno, two each in Sacramento and Shasta, and one each in Los Angeles, Merced, San Joaquin, Stanislaus and Yuba. Small production by one bucketline dredge, two drift mines, two nonfloating washing plants, one suction dredge, and eight small-scale hand and mechanical operations was reported in nine counties—three in Sierra, two each in Placer, Plumas, and Yuba, and one each in Mono, Nevada, Siskiyou, Stanislaus, and Tuolumne. Seven operations produced more than 100 ounces of placer gold each in the following counties: Two each in Sacramento and Yuba and one each in Fresno, San Joaquin, and Stanislaus.

Iron Ore.—The quantity and value of iron ore production declined 7 percent below levels of 1968. Exports decreased 23 percent. Three companies mined iron ore by open pit methods in three counties—Pacific Western Industries, Inc. produced ore in Kern County for use in its cement plant. American Exploration & Mining Co. discontinued operations in October at the Iron Age mine in San Bernardino County. Kaiser Steel Corp. beneficiated iron ore at the Eagle Mountain mine, Riverside County, and shipped the concentrates to its steel plant at Fontana, to the Los Angeles harbor for export, and to cement plants.

Lead.—Although lead production fell 37 percent in quantity its value was only 29 percent below that of 1968, reflecting a rise in metal price. Lead shipments were reported by 17 operators in five counties—eight in Inyo, six in San Bernardino, and one each in Alpine, Sacramento, and Stanislaus. Nearly 91 percent of the lead was produced in Inyo County by four mines—Darwin Group, the largest producer, Jubilee, Santa Rosa, and Pennsylvania mines.

Lead also was recovered from two secondary sources in Los Angeles County: Slag from a scrap-lead reverberatory furnace and flue dust from a steel furnace.

Table 18.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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
Inyo	10	--	104,502	492	$20,423	474,923	$850,430
Mariposa	1	--	40	22	913	5	9
Modoc	1	--	8	10	415	10	18
Plumas	--	2	--	11	457	--	--
Sacramento	2	--	35	573	23,785	43	77
San Bernardino	5	--	1,200	W	W	1,596	2,858
Sierra	3	3	2,603	3,896	161,723	926	1,658
Siskiyou	--	1	--	2	83	--	--
Stanislaus	--	1	138	276	11,457	180	322
Undistributed [3]	5	7	2,959	2,622	108,841	14,244	25,507
Total	27	14	111,485	7,904	328,097	491,927	880,879

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Inyo	1,126	$1,070,608	2,283	$680,240	3,319	$969,279	$3,590,980
Mariposa	--	--	--	--	--	--	922
Modoc	--	--	--	--	--	--	433
Plumas	--	--	--	--	--	--	457
Sacramento	--	--	--	--	--	--	23,862
San Bernardino	W	W	4	1,311	1	307	28,933
Sierra	--	--	--	--	[4]	15	163,396
Siskiyou	--	--	--	--	--	--	83
Stanislaus	[4]	95	49	14,538	--	--	26,412
Undistributed [3]	3	2,614	182	54,024	7	1,884	168,413
Total	1,129	1,073,317	2,518	750,113	3,327	971,485	4,003,891

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] Does not include gravel washed.
[3] Includes Alpine, Amador, Fresno, Imperial, Kern, Los Angeles, Merced, Mono, Nevada, Placer, San Joaquin, Shasta, Tuolumne, and Yuba Counties, and counties indicated by symbol W.
[4] Less than ½ unit.

Table 19.—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)
1965	51	27	20	62,885	$2,201	196,787	$254
1966	52	25	25	64,764	2,267	189,989	246
1967	29	25	15	40,570	1,420	144,515	224
1968	34	11	76	15,682	616	597,961	1,282
1969	27	14	111	7,904	328	491,927	881
1848–1969	NA	NA	NA	106,258,263	2,421,261	121,099,564	100,386

Year	Copper		Lead		Zinc		Total value (thousands) [4]
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	1,165	$825	1,810	$565	225	$66	$3,911
1966	1,078	780	1,976	597	335	97	3,987
1967	788	602	1,735	486	441	122	2,854
1968	1,182	989	4,001	1,057	3,525	952	4,896
1969	1,129	1,073	2,518	750	3,327	971	4,004
1848–1969	647,225	214,612	278,285	56,484	158,672	37,816	2,830,560

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer operations); ore milled; old tailings; tungsten ore; and ore, old tailings, and slag 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] Data may not add to totals shown because of independent rounding.

Table 20.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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 (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Amalgamation: Ore	1,869	418	------	------	------
Concentration and smelting of concentrates:					
Ore [1]	1,860	449,657	2,239	3,512	6,206
Tailings	------	122	------	2	(2)
Total [3]	1,860	449,779	2,239	3,514	6,207
Direct smelting:					
Ore	1,503	41,011	15	1,063	435
Cleanup and old slag	22	383	4	460	12
Total	1,525	41,394	19	1,523	447
Placer	2,650	336	------	------	------
Grand total [3]	7,904	491,927	2,258	5,036	6,654

[1] Includes tungsten ore concentrates.
[2] Less than ½ unit.
[3] Data may not add to totals shown because of independent rounding.

Table 21.—Mine production of gold, silver, copper, lead, and zinc in 1969, by classes of ore or other source materials in terms of recoverable metals

Source	Number of mines	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Dry gold and dry gold-silver [1 2]	12	6,252	4,737	15,953	2	7	2
Dry silver	4	165	3	679	-------	1	1
Total	16	6,417	4,740	16,632	2	8	3
Copper, lead, and lead-zinc [1 3]	10	104,463	393	425,985	187	4,567	6,639
Other lode material:							
Gold cleanup, lead cleanup, lead slag, and tungsten [1]	(4)	[5] 555	121	48,852	2,070	460	12
Lead tailings	1	50	-------	122	-------	2	(6)
Total	1	605	121	48,974	2,070	462	12
Total lode material [7]	27	111,485	5,254	491,591	2,258	5,036	6,654
Placer	14	(8)	2,650	336	-------	-------	-------
Total all sources	41	111,485	7,904	491,927	2,258	5,036	6,654

[1] Combined to avoid disclosing individual company confidential data.
[2] 11 gold mines and 1 gold-silver mine.
[3] 2 copper mines, 7 lead mines, and 1 lead-zinc mine.
[4] From properties not classed as mines; excludes one tungsten mine from which gold, silver, and copper were recovered as a byproduct.
[5] Excludes tungsten ore tonnage.
[6] Less than ½ unit.
[7] Data may not add to totals shown because of independent rounding.
[8] 122,529 cubic yards. Does not include material washed at commercial gravel plants to produce 2,174 ounces of byproduct gold and 290 ounces of byproduct silver included in placer totals.

Mercury.—Production declined at the New Idria mine, the largest producer of mercury in the State and Nation because lower grade ores were encountered. California production, totaling 18,480 flasks, was 2,937 flasks lower than in 1968, a decline of 14 percent; the value decreased 19 percent. Declines took place despite an increase from 53 to 72 in the number of mines reporting. Most of the additional mines were producers of only a few flasks each employing simple retorts for processing.

The most important increases were at the Abbott, Gilbraltar, Guadalupe, and Culver-Baer mines, while significant decreases were reported at the Altoona, El Capitan (Last Chance), Knoxville, and

New Idria mines. The drop at the Altoona was the result of development work on a shaft that interfered with normal production, but production recovery was expected to increase in 1970 with an expansion scheduled in output. The El Capitan mine was operated under lease by a Spokane, Wash., firm for most of the year. During the year, the average ore grade declined to where it became unprofitable to haul by truck to the furnace plant, which was located some distance away alongside State Highway 58, west of Tehachapi, Calif. At the Knoxville mine, a labor dispute reportedly disrupted operations for much of the year.

Six California mines produced 1,000 flasks or more in 1969, two produced 500 to 1,000 flasks each, and 11 produced 100 to 500 flasks each. Mines producing 100 flasks or more accounted for all but 4 percent of total California output. The six leading producers, with combined outputs comprising nearly three-fourths of the total production were: New Idria Mining & Chemical Co., San Benito County; Buena Vista Mines, Inc., San Luis Obispo County; Sonoma Mines, Inc., (Mt. Jackson mine) Sonoma County; Guadalupe Mining Co., Santa Clara County; Sunbird Mines, Inc. (Gibraltar mine), Santa Barbara County; and Buttes Gas and Oil Co. (Gambonini mine), Marin County. The Abbott mine of International Resources, Inc., in Lake County rose to the rank of producers of between 500 and 1,000 flasks. If the several separate smaller mines, which fed into the company's furnacing plant, were counted together, International Resources ranked among producers of 1,000 flasks or more for the year.

Production by furnacing alone was reported at 17 mines, by retorting alone at 51 mines, and by both furnacing and retorting at three mines. Some mercury was recovered from mine dumps during the year, either by flotation of cinnabar and retorting or by direct furnacing of the low-grade material. Producing properties of record were distributed by counties, as follows: Lake (eight); San Luis Obispo and Sonoma (seven each); Napa and San Benito (five each); Santa Clara (four); Colusa and Marin (three each); Inyo, Santa Barbara, and Trinity (two each); Contra Costa, Fresno, Kings, Mendocino, Monterey, San Mateo, Solano, Stanislaus, and Yolo (one each). Locations of 15 other properties remained undetermined.

Development continued on properties acquired by New Idria Mining & Chemical Co. in the Almaden area of Santa Clara County, southwest of San Jose. A new 100-ton-per-day rotary furnace being installed was due for operation early in 1970. Work was nearly complete on an exploration project at the New Idria mine conducted under an Office of Minerals Exploration loan. Development was underway at the Sulphur Bank mine, on the shores of Clear Lake in Lake County, and at the Reed mine, in Yolo County, in joint programs by Franciscan Mining Co. and Earth Resources Co. The One Shot Mining Co. brought a new furnace plant and its Manhattan and One Shot Mines, north of the Knoxville mine, Napa County, into production, and produced nearly 100 flasks of mercury. Phelan Sulphur Co. explored the Little King mine in Kings County. Sovereign Industries, Inc., worked the Harrison mine in Yolo County, processed low-grade surface ore for part of the year, and then discontinued operations. Corduroy belt concentrators were employed at the Harrison mine and at the Manzanita mine, Colusa County. A new mill and rotary furnace were planned at the Chileno Valley mine in Marin County. The Up-and-Down mine, several miles south of the El Capitan mine, in the Last Chance Range north of Death Valley, operated on a small scale, with ore trucked to a Nevada mill for processing. A 60-ton-per-day rotary furnace was scheduled for installation at the Guadalupe mine.

Molybdenum.—Molybdenite and powellite were recovered by Union Carbide Corp. as byproducts in the processing of tungsten ores from the Pine Creek underground mine, Inyo County. Recovery of both oxides (powellite) and sulfides (molybdenite) was lower than in 1968. Shipments of oxides more than doubled those of 1968 but shipments of sulfides were much lower. Total shipments, all to domestic consumers, increased 76 percent in quantity and 88 percent in value.

Pig Iron and Ferrous Scrap.—Four blast furnaces at the Kaiser Steel Corp. integrated steel plant near Fontana, San Bernardino County, produced all of the State's pig iron. Production was slightly above that of 1968. Plants of United States Steel

Table 22.—Mercury production, by method 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]
1965	84	137,079	11,219	21,060	2,168	17	13,404	$7,650,333
1966	72	136,693	13,714	16,292	2,344	12	16,070	7,100,047
1967	78	184,656	13,942	67,895	2,438	5	16,385	8,018,164
1968	53	176,502	19,494	r 40,380	1,918	5	21,417	11,470,089
1969	72	215,495	16,093	37,199	2,387	W	18,480	9,333,139

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Furnaced."

[1] Includes ore and mercury from dumps not separable.

[2] Includes mercury recovered from old surface ores, dumps, and placers.

[3] Value calculated at average New York price.

Corp. at Torrance and Bethlehem Steel Corp. at Vernon, Los Angeles County, used pig iron shipped from other States to mix with iron and steel scrap to make steel in open-hearth and electric-arc furnaces. Kaiser used pig iron and scrap to make steel in open-hearth furnaces and in the State's only basic-oxygen furnace. Six smaller plants operated on ferrous scrap alone: Armco at Torrance, Southwest Steel Rolling Mills at Watts, and Soule' Steel Co. at Long Beach, Los Angeles County; Judson Steel Corp. at Emeryville and Pacific States Steel Corp. at Union City, Alameda County; and Etiwanda Steel Producers, Inc., San Bernardino County. Pacific States Steel Corp. operated open-hearth furnaces; all the other plants operated electric arc furnaces.

Kaiser Steel Corp. announced a $6 million expansion program to increase pig-iron production by 500,000 tons per year and raw steel capacity (ingots) to 3.4 million net tons per year. The project, to be completed in 1972, will not involve new furnace construction.

Platinum.—No platinum has been produced in the State since Yuba Consolidated Gold Fields, Yuba County, shut down its gold dredge in October 1968.

Rare-Earth Minerals.—Mill production, including partial processing of rare-earth oxides contained in bastnaesite concentrate, at Mountain Pass, San Bernardino County, totaled 27.3 million pounds according to the 1969 Annual Report of the Molybdenum Corporation of America (Molycorp). The output was about 20 percent higher than that of 1968 because of increased demand for phosphors used in color television sets and increased use of rare-earth oxides for petroleum-cracking catalysts and in the manufacture of glass and ductile iron products. Bastnaesite ore contained mainly "light" rare-earths, principally cerium (Ce), lanthanum (La), neodymium (Nd), and praseodymium (Pr), but also small amounts of samarium (Sm), gadolinium (Gd), and europium (Eu). In 1969, 19.6 million pounds of bastnaesite flotation concentrate was processed at the company's chemical plant where it was roasted and treated with hydrochloric acid; then the rare-earth oxides were selectively extracted by use of a liquid-liquid ion exchange process (also known as solvent extraction). The remaining 7.7 million pounds of concentrate was sold to processors in the United States and in foreign countries. Cerium was used as an ingredient in specialty glass, as a glass-polishing compound, and in ductile steels and metal alloys. Lanthanum and praseodymium were additives in glass. A mixed compound of lanthanum and several other rare-earth oxides was used as a catalyst in cracking petroleum crude oil. Gadolinium and europium were used for neutron shielding in the nuclear energy industry. Europium was used to produce the red phosphor in television tubes.

Silver.—Production of silver declined 18 percent in quantity and 31 percent in value from that of 1968. More than 90 percent of the silver was produced in Inyo County as a byproduct of treatment of lead-zinc ores and a tungsten ore. Silver production was reported at 29 lode mines in 11 counties—11 in Inyo, five in San Bernardino, three in Sierra, two each in

Amador and Sacramento, and one each in Alpine, Imperial, Kern, Mariposa, Modoc and Stanislaus. Four mines produced more than 10,000 ounces each: Darwin Group, the largest producer (primarily a lead-zinc mine), Pine Creek (tungsten mine), and Santa Rosa (lead mine), all three in Inyo County, and the Zaca (gold-silver mine) in Alpine County. A small amount of silver was recovered in gold placer operations.

Tungsten.—Production of scheelite ore was down 13 percent; treatment and shipments of concentrates declined 10 percent in quantity and 4 percent in value compared with 1968. The number of producers dropped from 28 in 1968 to 15—three in Inyo, two in San Bernardino, one in Madera County, and nine at undetermined locations. The Pine Creek underground mine in Inyo County, owned by Union Carbide Corp., was the nation's largest tungsten producer. Union Carbide purchased concentrates from smaller mine operators in California, Arizona, Nevada, Ohio, and Utah and from the U.S. Government stockpile. A few producers in Inyo and Madera Counties sent concentrates to Kennemetal, Inc., in Nevada.

Nine mines that had reported production in 1968 were idle—two each in Fresno and Tulare and one each in Inyo, Kern, Madera, San Bernardino, and Tuolumne Counties. Two mines in Tulare County and two in Inyo County reported severe storm and flood damage. New Idria Mining and Chemical Co. sold the Strawberry mine in Madera County to Quad Metals Corp., and the mine was idle during the year.

Zinc.—Zinc production declined 6 percent in quantity but rose 2 percent in value above that of 1968. Zinc was produced by 16 operators in four counties—eight in Inyo, six in San Bernardino, and one each in Alpine and Sierra. More than 99 percent of the zinc was produced in Inyo County by Darwin Group, the largest producer, and the Santa Rosa mine operated by Bare and Sherrod.

A small quantity of secondary zinc was recovered from steel-furance flue dust and scrap-lead reverberatory furnace slag.

Table 23.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Atlas Asbestos Co	P.O. Box 805 Coalinga, Calif. 93210	Open pit mine	Fresno.
Coalinga Asbestos Co	P.O. Box 1045 Coalinga, Calif. 93210	----do	Do.
Pacific Asbestos Corp	P.O. Box 127 Copperopolis, Calif. 95228	----do	Calaveras.
Union Carbide Corp	P.O. Box K King City, Calif. 93930	----do	San Benito.
Barite:			
L. G. Embree	P.O. Box 217 Wofford Heights, Calif. 93285	----do	Tulare.
Yuba Minerals & Milling Co.	P.O. Box 1721 Bakersfield, Calif. 93302	----do	Shasta.
Boron minerals and compounds:			
American Potash & Chemical Corp.	OMB–508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines	San Bernardino.
Stauffer Chemical Co	636 California St. San Francisco, Calif. 94119	----do	Do.
United States Borax & Chemical Corp.	P.O. Box 75128, Stanford Station Los Angeles, Calif. 90005	Open pit mine	Inyo, Kern.
Bromine and bromine compounds:			
American Potash & Chemical Corp.	OMB–508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines	San Bernardino.
Calcium chloride:			
Leslie Salt Company	P.O. Box 364 Newark, Calif. 94560	----do	Do.
National Chloride Company of America.	Suite 803-Wilflower Bldg. 615 S. Flower Street Los Angeles, Calif. 90017	----do	Do.
Carbon dioxide:			
Standard Oil Co	225 Bush Street San Francisco, Calif. 94120	Natural gasoline processing plant.	Kern.
Cement;			
American Cement Corp	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Dry process portland cement plants.	Riverside, San Bernardino.
Calaveras Cement Co	315 Montgomery St. San Francisco, Calif. 94104	Wet and dry process portland cement plants.	Calaveras, Shasta.
California Portland Cement Co.	612 S. Flower St., Mobil Bldg. Los Angeles Calif. 90017	Dry process portland cement plants.	Kern, San Bernardino.
Ideal Cement Co	620 Denver National Bldg. Denver, Colo. 80202	Wet process portland cement plants.	San Benito, San Mateo.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, Calif. 95104	----do	San Bernardino, Santa Clara.
Monolith Portland Cement Co.	Box 65677 Glassell Station Los Angeles, Calif. 90065	----do	Kern.
Pacific Cement & Aggregates Division, Lone Star Cement Corp.	400 Alabama St. San Francisco, Calif. 94110	Dry process portland cement plant.	Santa Cruz.
Pacific Western Industries, Inc.	3810 Wilshire Blvd. Los Angeles, Calif. 90005	----do	Kern.
Southwestern Portland Cement Co.	1034 Wilshire Blvd. Los Angeles, Calif. 90017	Wet and dry process portland cement plant.	San Bernardino.
Clays:			
American Cement Corp	P.O. Box 832 Riverside, Calif. 92501	Open pit mine	Orange, Riverside, San Bernardino.
Atkinson Brick Co	13633 S. Central Avenue Los Angeles, Calif. 90059	----do	Los Angeles.
Basalt Rock Co., Inc	8th & River Streets Napa, Calif. 94458	----do	Napa.
Calaveras Cement Div., The Flintkote Co.	San Andreas, Calif. 95249	----do	Amador, Calaveras, Shasta.
California Non-Metallics	P.O. Box 328 Trabuco Canyon, Calif. 92678	----do	Orange.
Corona Clay Co	628 Lancer Lane Corona, Calif. 91720	----do	Riverside.
Crestlite Inc., Div. of Susquehanna-Western, Inc.	Camino De Estrella San Clemente, Calif. 92672	----do	Orange.
Davidson Brick Co	4701 E. Floral Avenue Los Angeles, Calif. 90022	----do	Los Angeles.
Excel Mineral Co	3451 E. 26th Street Los Angeles, Calif. 90023	----do	Kern.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colorado 80202	----do	San Mateo, Santa Cruz.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays—Continued			
International Pipe & Ceramics Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	Open pit mine	Amador, Placer, Riverside, San Bernardino, Sutter, Yuba.
Kaiser Industries Corp	300 Lakeside Drive Oakland, Calif. 94612	do	Alameda.
Lightweight Processing Co	650 S. Grand Avenue Los Angeles, Calif. 90017	do	San Bernardino, Ventura.
Lincoln Clay Products	P.O. Box 367 Lincoln, Calif. 95648	do	Placer.
L. P. McNear Brick Co	P.O. Box 1380 San Rafael, Calif. 94902	do	Marin.
Mission Valley Brick Co	P.O. Box 3217 San Diego, Calif. 92103	do	San Diego.
Pacific Cement & Aggregates.	400 Alabama Street San Francisco, Calif. 94110	do	Santa Cruz.
Pacific Clay Products	1255 W. 4th Street Los Angeles, Calif. 90017	do	Amador, Orange, Riverside.
Port Costa Products Co	P.O. Box 5 Port Costa, Calif. 94569	do	Contra Costa.
Standard Industrial Minerals.	Rte. 4, Box 1 Bishop, Calif. 93514	do	Mono.
Wilbur-Ellis Co	P.O. Box 1286 Fresno, Calif. 93715	do	San Benito.
Coal (lignite):			
Alpco Division of Interpace Corp.	P.O. Box 787 Ione, Calif. 95640	Strip mine	Amador.
Copper:			
Union Carbide Corp., Mining & Metals, Div.	270 Park Ave., 38th Floor New York, N.Y. 10017	Underground mine	Inyo.
West Hill Exploration Inc., T. A. C. Darwin Mines Dept.	Lone Pine, Calif. 93545	do	Do.
Diatomite:			
GREFCO, Inc	630 Shatto Place Los Angeles, Calif. 90005	Open pit mine	Santa Barbara.
Johns-Manville Products Corp.	Lompoc, Calif. 93436	do	Do.
Pozzolan Products, Inc	1321 Westwood Blvd. Los Angeles, Calif. 90024	do	Do.
Feldspar:			
Del Monte Properties Co	P.O. Box 150 Pacific Grove, Calif. 93950	do	Monterey.
Owens-Illinois Glass Co	P.O. Box 1035–1036 Toledo, Ohio 43601	do	Do.
Gold:			
Dickey Exploration Co	Alleghany, Calif. 95901	Underground mine	Sierra.
Heavy Metals Tech. Corp	406 Wilshire Blvd., Suite 204 Santa Monica, Calif. 90401	do	San Bernardino.
Fred Santoni	5078 W. Shields Ave. Fresno, Calif. 93705	Byproduct of sand and gravel operation.	Fresno, Merced, Sacramento, San Joaquin, Shasta, Stanislaus, Yuba.
West Hill Exploration, Inc., T. A. C. Darwin Mines Dept.	Lone Pine, Calif. 93545	Underground mine	Inyo.
Gypsum:			
C. L. Fannin Agricultural Gypsum.	Rte. 1, Box 7, Famosa Hwy. Wasco, Calif. 93280	Open pit mine	Kern.
H. M. Holloway, Inc	714 Sixth St. Wasco, Calif. 93280	do	Do.
Monolith Portland Cement Co.	Box 65677 Glassell Station Los Angeles, Calif. 90065	do	Ventura.
Superior Gypsum Co	2150 Franklin St. Oakland, Calif. 94612	do	Kern, San Luis Obispo.
Temblor Gypsum Co	Carrisa Plains, Star Rte. Box 80 Santa Margarita, Calif. 93453	do	Kern.
United States Gypsum Co	101 S. Wacker Drive Chicago, Ill. 60606	do	Imperial.
Iron Ore:			
American Exploration & Mining Co.	P.O. Box 129 Twentynine Palms, Calif. 92277	do	San Bernardino.
Kaiser Steel Corp	P.O. Box 158 Eagle Mtn., Calif. 92241	do	Riverside.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Lead:			
Bare & Sherrod	P.O. Box 538 Lone Pine, Calif. 93545	Underground mine	Inyo.
Monte Cristo Mining Corp.	P.O. Box 218 Las Vegas, Nev. 89101	do	Do.
West Hill Exploration Inc., T. A. C. Darwin Mines Dept.	Lone Pine, Calif. 93545	do	Do.
Lime:			
American Crystal Sugar Co.	Box 419 Denver, Colo. 80201	Shaft kiln	Yolo.
Diamond Springs Lime Co.	P.O. Box 407 Diamond Springs, Calif. 95619	Rotary kiln and continuous hydrator.	El Dorado.
The Flintkote Co.	P.O. Box 57367 Flint Station Los Angeles, Calif. 90057	Shaft and rotary kilns, continuous hydrator.	Contra Costa, Tuolumne.
Holly Sugar Corp.	Box 1052 Colorado Springs, Colo. 80901	Shaft kilns and continuous hydrator.	Glenn, Imperial, Orange, San Joaquin.
Kaiser Aluminum & Chem. Corp.	Moss Landing, Calif. 95039	Rotary kiln and continuous hydrator.	Monterey.
Chas. Pfizer & Co., Inc.	P.O. Drawer AD Victorville, Calif. 92392	Fluidized-bed kiln and continuous hydrator.	San Bernardino.
Spreckels Sugar Co.	2 Pine St. San Francisco, Calif. 94111	Shaft and rotary kilns.	Monterey, San Joaquin, Yolo.
Stauffer Chemical Co.	636 California St. San Francisco, Calif. 94119	Rotary kiln and continuous hydrator.	San Bernardino.
Union Sugar Division	230 California St. San Francisco, Calif. 94111	Shaft kiln	Santa Barbara.
Lithium minerals:			
American Potash & Chemical Corp.	OMB–508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines	San Bernardino.
Magnesium compounds:			
FMC Corp.	P.O. Box 344 Newark, Calif. 94560	Salt works bitterns	San Diego.
Kaiser Aluminum & Chem. Corp.	Moss Landing, Calif. 95039	Sea water processing	Monterey.
Merck & Co., Inc.	Rahway, N. J. 07065	do	San Mateo.
Mercury:			
Buena Vista Mines, Inc.	P.O. Box 753 Paso Robles, Calif. 93446	Underground mine	San Luis Obispo.
Buttes Gas & Oil Co.	2150 Franklin St. Oakland, Calif. 94612	Open pit mine	Marin.
Floyd Edwards	9516 Graton Road Sebastopol, Calif. 95472	Underground mine	Do.
Guadalupe Mining Co.	14900 Guadalupe Mine Road San Jose Calif. 95120	do	Santa Clara.
Hugh C. Ingle, Jr.	P.O. Box 553 Middletown, Calif. 95461	Open pit and underground mines.	Napa.
International Resources Inc.	2225 Hillside Drive Santa Rosa, Calif. 95404	do	Colusa, Lake, Sonoma.
Knoxville Exploration & Mining.	P.O. Box 2655 San Francisco, Calif. 94126	Open pit mine	Napa.
New Idria Mining & Chem. Co.	3457 So. Cedar Fresno, Calif. 93745	Open pit and underground mines.	San Benito, Santa Clara.
New Klau Mining & Construction Co.	Adelaide Road Paso Robles, Calif. 93446	Open pit mine	San Luis Obispo.
Quad Metals Corporation	827 Lincoln Building Spokane, Wash. 99201	Underground mine	Inyo.
Sonoma Mines, Inc.	P.O. Box 226 Guerneville, Calif. 95446	do	Sonoma.
Sulphur Creek Mining	201 Ridge Road Ukiah, Calif. 95482	do	Do.
Sunbird Mines, Ltd.	1018–A Anacapa St. Santa Barbara, Calif. 93101	Open pit mine	Santa Barbara.
Molybdenum:			
Union Carbide Corp., Mining & Metals Div.	270 Park Ave., 38th Floor New York, N. Y. 10017	Underground mine	Inyo.
Natural gas:			
Amerada Div. Amerada Hess Corp.	Box 417 Rio Vista, Calif. 94571	Gasfield	Contra Costa, Sacramento, San Joaquin, Solano.
Occidental Petroleum Corp.	10889 Wilshire Blvd. Los Angeles, Calif. 90024	do	Colusa, Contra Costa, Sacramento, San Joaquin, Solano, Sutter, Yolo.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas—Continued			
Shell Oil Co	1008 W. 6th St. Los Angeles, Calif. 90017	Gasfield	Contra Costa, Fresno, Kern, Kings, Madera, Santa Barbara, Solano, Tulare, Yolo.
Signal Oil and Gas Co	1010 Wilshire Blvd. Los Angeles, Calif. 90017	do	Contra Costa, Sacramento, San Joaquin, Solano, Yolo.
Standard Oil Co. of California.	225 Bush St. San Francisco, Calif. 94120	do	Butte, Contra Costa, Glenn, Kern, Kings, Los Angeles, Sacramento, San Joaquin, Santa Barbara, Solano, Sutter, Tulare, Ventura, Yolo.
Texaco, Inc	3350 Wilshire Blvd. Los Angeles, Calif. 90005	do	Fresno, Glenn, Humboldt, Kern, Madera, Sacramento, San Joaquin, Santa Barbara, Solano, Sutter, Tehama.
Union Oil Co. of California	461 S. Boylston Los Angeles, Calif. 90017	do	Contra Costa, Kern, Sacramento, San Joaquin, Solano.
Natural gas liquids:			
Atlantic Richfield Co	445 South Figueroa St. Los Angeles, Calif. 90054	Natural gasoline plants.	Kern, Santa Barbara, Ventura.
Getty Oil Company	P.O. Box 54050 Los Angeles, Calif. 90005	do	Kern, Ventura.
Mobil Oil Co	612 S. Flower St. Los Angeles, Calif. 90054	do	Los Angeles.
Shell Oil Co	1008 West 6th Street Los Angeles, Calif. 90054	do	Kern, Los Angeles, Santa Barbara, Ventura.
Standard Oil Co. of California.	225 Bush Street San Francisco, Calif. 94120	do	Fresno, Kern, Kings, Los Angeles, Orange, Santa Barbara, Ventura.
Texaco, Inc	3350 Wilshire Blvd. Los Angeles, Calif. 90005	do	Los Angeles, Santa Barbara, Ventura.
Union Oil Co. of California	P.O. Box 7600 Los Angeles, Calif. 90054	do	Fresno, Kern, Los Angeles, Orange, Santa Barbara, Ventura.
Peat:			
Peter J. Gambetta	Route 1, Box 78 Brentwood, Calif. 94513	Reed-sedge bog	Contra Costa.
R. W. McClellan, Jr	151 Commercial Way Costa Mesa, Calif. 92627	Humus bog	Orange.
Vita-Peat Co., Inc	P.O. Box 428 Bethel Island, Calif. 94511	Reed-sedge bog	Contra Costa.
Perlite:			
American Perlite Co	11831 Vose St. No. Hollywood, Calif. 91605	Open pit mine	Inyo.
Petroleum:			
Atlantic Richfield Co	5900 Cherry Ave. Long Beach, Calif. 90805	Oilfields	Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Belridge Oil Co	1300 West 4th St. Los Angeles, Calif. 90017	do	Kern, Santa Barbara.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum—Continued			
Chanslor-Western Oil & Development Co.	4549 Produce Plaza Los Angeles, Calif. 90058	Oilfields	Kern, Los Angeles, Orange, Ventura.
Getty Oil Co	3810 Wilshire Blvd. Los Angeles, Calif. 90005	----do	Fresno, Kern, Los Angeles, Monterey, Orange, Riverside, San Bernardino, Santa Barbara, Ventura.
Gulf Oil Corp	5400 Rosedale Hwy. Bakersfield, Calif. 93302	----do	Fresno, Kern, Los Angeles, Orange, Santa Barbara, Ventura.
Humble Oil & Refining Co.	1800 Avenue of the Stars Los Angeles, Calif. 90067	----do	Do.
Long Beach (City of) Dept. of Oil Properties.	925 Harbor Plaza Long Beach, Calif. 90801	----do	Los Angeles.
Mobil Oil Corp	612 S. Flower St. Los Angeles, Calif. 90017	----do	Fresno, Kern, Kings, Los Angeles, Monterey, Orange, San Benito, San Luis Obispo, Santa Barbara, Ventura.
Occidental Petroleum Corp.	10889 Wilshire Blvd. Los Angeles, Calif. 90024	----do	Contra Costa, Kern, Los Angeles, Orange.
Phillips Petroleum Co	1306 Santa Barbara St. Santa Barbara, Calif. 93104	----do	Santa Barbara.
Shell Oil Co	1008 West 6th St. Los Angeles, Calif. 90017	----do	Contra Costa, Fresno, Kern, Los Angeles, Orange, San Benito, Santa Barbara, Ventura.
Signal Oil and Gas Co	1010 Wilshire Blvd. Los Angeles, Calif. 90017	----do	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Standard Oil Co. of California.	225 Bush St. San Francisco, Calif. 94120	----do	Contra Costa, Fresno, Kern, Kings, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Texaco, Inc	3350 Wilshire Blvd. Los Angeles, Calif. 90005	----do	Fresno, Kern, Los Angeles, Monterey, Orange, Santa Barbara, Ventura.
Union Oil Co. of California.	461 South Boylston Los Angeles, Calif. 90017	----do	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.
Union Pacific Railroad Co.	5480 Ferguson Drive Los Angeles, Calif. 90022	----do	Los Angeles, Ventura.
Phosphate:			
Cuyama Phosphate Corp	401 Alameda De Las Pulgas San Mateo, Calif. 94402	Open pit mine	Santa Barbara.
Potassium salts:			
American Potash & Chem. Corp.	OMB-508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines	San Bernardino.
Pumice:			
Aiken Builders Products	P.O. Box 878 Las Vegas, Nev. 89101	Open pit mine	Do.
B.S.B. Cinder Company	Route 1, Box 562 Montague, Calif. 96404	----do	Siskiyou.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Pumice—Continued			
Cinder Products Company	3450 Lakeshore Avenue Oakland, Calif. 94610	Open pit mine	Lake.
Diamond International Corp.	P.O. Box D Red Bluff, Calif. 96080	do	Tehama.
Glass Mountain Block, Inc.	515 Kietzke Lane Reno, Nev. 89502	do	Siskiyou.
Alvin Lindgren	Redding Highway Alturas, Calif. 96101	do	Do.
Red Lava Products of California.	Star Route Clearlake, Calif. 95423	do	Lake.
Shastalite Cinder Co	P.O. Box 341 Weed, Calif. 96094	do	Siskiyou.
U.S. Pumice Supply Co., Inc.	6331 Hollywood Blvd. Los Angeles, Calif. 90028	do	Mono.
Rare-earth metals:			
Molybdenum Corp. of America.	Mountain Pass via Nipton, Calif. 92366	do	San Bernardino.
Salt:			
Leslie Salt Company	505 Beach St. San Francisco, Calif. 94111	Solar evaporation and open pit mine.	Alameda, Napa, San Bernardino, San Mateo.
Metropolitan Water Dist. of Southern California.	P.O. Box 54153 Los Angeles, Calif. 90054	Solar evaporation	San Bernardino.
Pacific Salt & Chemical Co.	4262 Wilshire Blvd. Los Angeles, Calif. 90021	do	Do.
Standard Salt Company	Suite 803 Wilflower Bldg. 615 S. Flower St. Los Angeles, Calif. 90017	do	Do.
Western Salt Company	P.O. Box 149 San Diego, Calif. 92112	do	Kern, Orange, San Diego.
Sand and gravel:			
Antelope Valley Aggregates	P.O. Box 187 Littlerock, Calif. 93543	Open pit mine	Los Angeles.
Azusa Western, Inc	P.O. Box 575 Azusa, Calif. 91702	do	Do.
Baldwin Contracting Co., Inc.	P.O. Box 311 Marysville, Calif. 95901	do	Butte, Yuba.
Basalt Rock Co., Inc	P.O. Box 2540 Napa, Calif. 94558	do	Sonoma.
Blue Diamond Concrete Materials Div., The Flintkote Co.	P.O. Box 2678 Los Angeles, Calif. 90054	do	Los Angeles, Orange.
California Materials Co	P.O. Box 845 Sun Valley, Calif. 91352	do	Los Angeles.
Chandler's Palos Verdes Sand & Gravel Co.	P.O. Box 295 Lomita, Calif. 90717	do	Do.
Joe Chevreaux	890 Grass Valley Hwy. Auburn, Calif. 95603	do	Placer.
Consolidated Rock Products Co.	Box 2950 Terminal Annex Los Angeles, Calif. 90054	do	Los Angeles, Orange, San Bernardino, Ventura.
Crystal Silica Co	Ottawa, Ill. 61350	do	San Diego.
Del Monte Properties Co	P.O. Box 150 Pacific Grove, Calif. 93950	do	Monterey.
H. G. Fenton Material Co	702 Washington St. San Diego, Calif. 92112	do	San Diego.
Granite Construction Co	7218 Perkins Branch Sacramento, Calif. 93940	do	Sacramento, Yolo.
Hartman Concrete Materials Co.	P.O. Box 1632 Bakersfield, Calif. 93302	do	Kern.
International Pipe & Ceramic Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	do	Amador.
Kaiser Industries Corp	300 Lakeside Dr. Oakland, Calif. 94612	do	Alameda, Contra Costa, Glenn, Santa Clara, Santa Cruz, Sonoma.
Kern Rock Co	P.O. Box 3329 Bakersfield, Calif. 93305	do	Kern.
Livingston-Graham, Inc	5500 N. Peck Road El Monte, Calif. 91731	do	Los Angeles, Orange, San Bernardino, Ventura.
Manning Bros. Rock & Sand Co.	P.O. Box 204 Irwindale, Calif. 91706	do	Los Angeles.
Massey Sand & Rock Co	P.O. Drawer P Indio, Calif. 92201	do	Riverside.
Nelson & Sloan	P.O. Box 488 Chula Vista, Calif. 92012	do	San Diego.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Niles Sand & Gravel Co., Inc.	P.O. Box 2248 Fremont, Calif. 94536	Open pit mine	Alameda.
Owens-Illinois Glass Co	P.O. Box 1035 Toledo, Ohio 43601	do	Amador, Monterey, Riverside.
Owl Rock Products Co	P.O. Box 47 Irwindale, Calif. 91707	do	Fresno.
Owl Service Rock Co	P.O. Box 309 Riverside, Calif. 92501	do	San Bernardino.
Pacific Cement & Aggregates, Div. of Lone Star Cement Corp.	400 Alabama St. San Francisco, Calif. 94110	do	Alameda, Fresno, Monterey, Sacramento, San Joaquin, San Mateo, Santa Cruz, Tulare, Yolo.
Pacific Rock & Gravel Co	P.O. Box 844 La Habra, Calif. 90631	do	San Bernardino.
A. J. Raisch Paving Co	99 Pullman Way San Jose, Calif. 95111	do	Santa Clara.
Rhodes & Jamieson Ltd	P.O. Box 118 Oakland, Calif. 94604	do	Alameda.
San Diego Consolidated Co	P.O. Box 3093 San Diego, Calif. 92103	do	San Diego.
Southern Pacific Milling Co	3555 Vineyard Avenue Oxnard, Calif. 93030	do	Santa Barbara, Ventura.
Standard Materials Co	P.O. Box 3171 Modesto, Calif. 95350	do	Merced, Stanislaus.
Sully-Miller Contracting Co	P.O. Box 432 Orange, Calif. 92669	do	Orange.
Teichert Aggregates	P.O. Box 15002 Sacramento, Calif. 95813	do	Butte, Nevada, Sacramento, San Joaquin, Yolo, Yuba.
Triangle Rock Products, Inc	P.O. Box 2083 San Bernardino, Calif. 92406	do	Los Angeles, Riverside, San Bernardino.
Silver:			
Bare & Sherrod	P.O. Box 538 Lone Pine, Calif. 93545	Underground mine	Inyo.
Claude B. Lovestedt	P.O. Box 1496 Carson City, Nev. 89701	do	Alpine.
Union Carbide Corp., Mining & Metals Division.	270 Park Ave., 38th Floor New York, N. Y. 10017	do	Inyo.
West Hill Exploration, Inc., T. A. C. Darwin Mines Dept.	Lone Pine, Calif. 93545	do	Do.
Sodium compounds:			
American Potash & Chem. Corp.	OMB-508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Dry lake brines	San Bernardino.
Stauffer Chemical Co	636 California St. San Francisco, Calif. 94119	do	Do.
United States Borax & Chemical Corp.	P.O. Box 75128 Sanford Station Los Angeles, Calif. 90005	Open pit mine	Kern.
Stone:			
American Cement Corp	P.O. Box 832 Riverside, Calif. 92501	Open quarry and underground mine.	Los Angeles, Riverside, San Bernardino.
Basalt Rock Co., Inc	P.O. Box 2540 Napa, Calif. 94558	Open quarry	Marin, Napa, Sonoma.
Calaveras Cement Div., The Flintkote Co.	San Andreas, Calif. 95249	do	Calaveras, Shasta.
California Portland Cement Co.	612 South Flower St. Los Angeles, Calif. 90017	do	Kern, San Bernardino.
Diamond Springs Lime Co	P.O. Box 407 Diamond Springs, Calif. 95619	Open quarry and underground mine.	El Dorado.
Dumbarton Quarry Associates.	P.O. Box 487 Fremont, Calif. 94537	Open quarry	Alameda.
East Bay Excavating Co	28814 Mission Blvd. Hayward, Calif. 94544	do	Do.
Eaton & Smith	1215 Michigan St. San Francisco, Calif. 94107	do	San Luis Obispo.
El Dorado Limestone Co	P.O. Box 8 Shingle Springs, Calif. 95682	Underground mine	El Dorado.
Felton Quarry	326 Fall Creek Drive Felton, Calif. 95018	Open quarry	Santa Cruz.
Gallagher & Burke	344 High St. Oakland, Calif. 94601	do	Alameda.
Granite Rock Co	P.O. Box 151 Watsonville, Calif. 95076	do	San Benito.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Hawley Rock, Inc	P.O. Box 7 Irwindle, Calif. 91706	Open quarry	Riverside.
Hein Bros. Basalt Rock Co	P.O. Box 162 Petaluma, Calif. 94952	----do	Sonoma.
Hillsdale Rock Co., Inc	500 Hillsdale Ave. San Jose, Calif. 95123	----do	Santa Clara.
Hutchinson Co	7360 Schmidt Lane El Cerrito, Calif. 94530	----do	Marin.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	Open quarry and dredge.	San Benito, San Mateo.
Kaiser Aluminum & Chem. Corp.	Moss Landing, Calif. 95039	Open quarry	Monterey.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, Calif. 95014	----do	San Bernardino, Santa Clara.
Kaiser Industries Corp	300 Lakeside Drive Oakland, Calif. 94612	----do	Contra Costa.
Minerals, Pigments & Metals Div., Chas. Pfizer & Co., Inc.	P.O. Drawer AD Victorville, Calif. 92394	----do	San Bernardino.
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, Minn. 55101	----do	Riverside.
Monolith Portland Cement Co.	Box 65677 Glassell Station Los Angeles, Calif. 90065	----do	Kern.
Neary Rock Quarry, Inc	11920 Stonebrook Ave. Los Altos, Calif. 94022	----do	Santa Clara.
Pacific Cement & Aggregates	400 Alabama St. San Francisco, Calif. 94110	----do	Contra Costa, San Mateo, Santa Cruz.
Pacific Western Industries, Inc.	3810 Wilshire Blvd. Los Angeles, Calif. 90005	----do	Kern.
Page Mill Quarry Corp	P.O. Box 11487 Palo Alto, Calif. 94306	----do	Santa Clara.
Quarry Products, Inc	P.O. Box 1147 Richmond, Calif. 94802	----do	Contra Costa.
Rhodes & Jamieson, Ltd	P.O. Box 118 Oakland, Calif. 94604	----do	San Mateo.
Schmidt Construction, Inc	P.O. Box 412 Camarillo, Calif. 93010	----do	Los Angeles, Santa Barbara.
South Coast Asphalt Co., Inc.	P.O. Box 218 Carlsbad, Calif. 92008	----do	San Diego.
Southwestern Portland Cement Co.	1034 Wilshire Blvd. Los Angeles, Calif. 90017	----do	San Bernardino.
Stauffer Chemical Co	636 California St. San Francisco, Calif. 94119	----do	Inyo.
Stringfellow Constructors, Inc.	P.O. Box 6 Riverside, Calif. 92502	----do	Riverside, Solano.
Syar & Harms Industries, Inc.	P.O. Box 1272 Vallejo, Calif. 94590	----do	Solano.
Tapo Minerals Corp	P.O. Box 1485 Studio City, Calif. 91604	----do	Ventura.
United States Lime Div. of The Flintkote Co.	P.O. Box 57367 Flint Station Los Angeles, Calif. 90057	Open quarry and underground mine.	Tuolumne.
Vinnell Mining & Materials Corp.	1145 Westminster Ave. Alhambra, Calif. 91802	Open quarry	San Bernardino.
Talc, pyrophyllite, and soapstone:			
L. Grantham Corp	1915 So. Coast Hwy. Laguna Beach, Calif. 92651	Underground mine	Inyo.
Minerals, Pigments & Metals Div., Chas. Pfizer & Co., Inc.	P.O. Drawer AD Victorville, Calif. 92394	Open pit and underground mines.	Inyo, San Bernardino.
Pomona Tile Manufacturing Co.	216 So. Reservoir St. Pomona, Calif. 91766	Underground mine	San Bernardino.
Bill Tonkin	Box 113 Lone Pine, Calif. 93545	Open pit mine	Inyo.
The United Sierra Div., Cyprus Mines Corp.	P.O. Box 1201 Trenton, N.J. 08606	Open pit and underground mines.	Inyo, San Bernardino.
Western Talc Co	Box 368 Yermo, Calif. 92398	Open pit and underground mine.	San Bernardino.
Tungsten:			
Mines Exploration, Inc	P.O. Box 27 Red Mountain, Calif. 92374	Underground mine	Do.
Union Carbide Corp., Mining & Metals Div.	270 Park Ave., 38th Floor New York, N. Y. 10017	----do	Inyo.
Wollastonite:			
Minerals, Pigments & Metals Div., Chas. Pfizer & Co., Inc.	P.O. Drawer AD Victorville, Calif. 92394	Open pit mine	Riverside.
Zinc:			
Bare & Sherrod	P.O. Box 538 Lone Pine, Calif. 93545	Underground mine	Inyo.
West Hill Exploration, Inc., T. A. C. Darwin Mines Dept.	Lone Pine, Calif. 93545	----do	Do.

The Mineral Industry of Colorado

By William C. Henkes [1]

Mineral production in Colorado in 1969 was valued at $368.5 million, 3 percent greater than in the previous year. Most notable was a $5 million increase in the value of molybdenum. Molybdenum shipments reached a record high for the second successive year. Increases in the values of lead, silver, vanadium, zinc, coal, and fluorspar more than offset appreciable losses in petroleum and uranium.

The State ranked first in the Nation in output of molybdenum, tin, and vanadium; matched South Dakota as top producer of beryllium concentrates; and was second in output of carbon dioxide and fluorspar.

[1] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in Colorado [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Beryllium concentrate—short tons	W	W	46	W
Carbon dioxide (natural)—thousand cubic feet	200,657	$34	175,787	$30
Clays—thousand short tons	616	1,222	732	1,619
Coal (bituminous)—do	5,558	26,785	5,530	29,121
Copper (recoverable content of ores, etc.)—short tons	3,451	2,888	3,598	3,421
Feldspar—long tons	W	W	358	3
Gem stones	NA	121	NA	122
Gold (recoverable content of ores, etc.)—troy ounces	22,638	[2] 889	25,777	[2] 1,070
Gypsum—thousand short tons	98	354	94	339
Lead (recoverable content of ores, etc.)—short tons	19,778	5,226	21,767	6,484
Lime—thousand short tons	125	2,375	127	2,449
Molybdenum (content of concentrate)—thousand pounds	61,684	100,296	62,411	105,346
Natural gas (marketed)—million cubic feet	121,424	16,392	118,754	17,219
Natural gas liquids:				
LP gases—thousand 42-gallon barrels	1,987	3,338	1,782	2,762
Natural gasoline and cycle products—do	1,289	3,248	1,076	2,798
Peat—short tons	28,457	250	26,103	160
Petroleum (crude)—thousand 42-gallon barrels	31,937	94,215	28,294	88,277
Pumice—thousand short tons	28	234	42	232
Pyrites—thousand long tons	23	97	24	120
Sand and gravel—thousand short tons	23,121	26,608	19,877	27,266
Silver (recoverable content of ores, etc.)—thousand troy ounces	1,646	3,531	2,599	4,653
Stone—thousand short tons	2,471	5,201	2,245	5,079
Tin (content of concentrate)—long tons	33	64	44	119
Tungsten concentrate (60-percent WO_3 basis)—short tons	1,893	4,413	1,941	4,440
Uranium (recoverable content U_3O_8)—thousand pounds	2,706	[3] 20,009	2,736	[3] 16,935
Vanadium (recoverable in ore and concentrate)—short tons	3,492	12,468	W	W
Zinc (recoverable content of ores, etc.)—do	50,258	13,570	53,715	15,685
Value of items that cannot be disclosed: Cement, fluorspar, iron ore, perlite, rare-earth metal concentrate, salt and values indicated by symbol W	XX	r 15,630	XX	32,745
Total	XX	359,458	XX	368,494
Total 1967 constant dollars	XX	354,146	XX	p 351,093

p Preliminary. 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.

[2] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

[3] Value estimated on $8.00 (1968) and $5.86 (1969) per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 (1968) and $6.10 (1969) per pound for commercial sales; includes value of U_3O_8 obtained from New Mexico ores processed at an out-of-State mill.

Table 2.—Value of mineral production in Colorado, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	$5,338	$5,309	Sand and gravel, petroleum, natural gas, lime, gold, stone, silver.
Alamosa	490	190	Sand and gravel, peat, stone.
Arapahoe	2,448	1,806	Sand and gravel, petroleum, stone.
Archuleta	342	606	Sand and gravel, petroleum, natural gas, stone.
Baca	1,065	1,260	Natural gas, petroleum, sand and gravel.
Bent	71	60	Sand and gravel, natural gas, petroleum, clays.
Boulder	2,381	3,635	Sand and gravel, fluorspar, lime, stone, clays, tungsten concentrate, lead, peat, gold, silver, petroleum, copper.
Chaffee	831	1,111	Stone, sand and gravel, gypsum, peat.
Cheyenne	36	1,389	Petroleum, sand and gravel, stone.
Clear Creek	14,701	12,657	Molybdenum, sand and gravel, silver, lead, gold, zinc, copper.
Conejos	111	99	Sand and gravel.
Costilla	170	W	Pumice, sand and gravel.
Crowley	3	80	Sand and gravel, stone.
Custer	99	228	Sand and gravel, perlite, stone, lead, silver, copper, gold.
Delta	2,649	3,170	Coal, sand and gravel, lime.
Dolores	W	W	Zinc, lead, silver, stone, copper, gold, iron ore.
Douglas	684	687	Sand and gravel, clays, stone.
Eagle	7,692	9,686	Zinc, lead, silver, sand and gravel, copper, gold, pumice.
Elbert	160	365	Sand and gravel, clays, petroleum, stone.
El Paso	2,753	2,071	Sand and gravel, stone, clays.
Fremont	10,699	11,379	Cement, stone, coal, gypsum, uranium, petroleum, sand and gravel, clays, fluorspar, feldspar, beryllium concentrate.
Garfield	3,202	3,395	Vanadium, sand and gravel, uranium, lime, stone, natural gas, coal, petroleum.
Gilpin	W	58	Sand and gravel, stone, peat, gold, lead, silver, copper.
Grand	77	58	Sand and gravel, stone.
Gunnison	3,839	4,885	Coal, sand and gravel, zinc, lead, silver, copper, stone, gold.
Hinsdale	24	W	Sand and gravel, silver, zinc, lead, copper, gold.
Huerfano	241	289	Coal, sand and gravel, stone, clays.
Jackson	620	1,976	Fluorspar, petroleum, natural gas, sand and gravel, stone.
Jefferson	W	W	Uranium, sand and gravel, clays, stone, gold, silver.
Kiowa	3,399	3,760	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kit Carson	498	870	Sand and gravel.
Lake	91,037	97,772	Molybdenum, tungsten concentrate, sand and gravel, pyrites, tin, rare-earth metal concentrate, peat.
La Plata	7,765	7,613	Natural gas, natural gas liquids, sand and gravel, coal, petroleum, peat, stone.
Larimer	9,864	8,128	Cement, stone, sand and gravel, petroleum, lime, natural gas liquids, natural gas, gypsum.
Las Animas	5,844	6,729	Coal, sand and gravel, clays, stone, gold.
Lincoln	360	255	Sand and gravel.
Logan	9,046	8,500	Petroleum, natural gas liquids, natural gas, sand and gravel, lime, stone.
Mesa	9,593	8,243	Uranium, vanadium, sand and gravel, natural gas, coal, natural gas liquids, stone.
Mineral	1,140	W	Silver, lead, zinc, copper, sand and gravel, gold.
Moffat	11,045	10,525	Petroleum, natural gas, coal, sand and gravel, stone, gold.
Montezuma	1,876	1,640	Petroleum, sand and gravel, natural gas, carbon dioxide.
Montrose	14,490	13,594	Uranium, vanadium, sand and gravel, coal, stone, salt.
Morgan	7,038	5,929	Petroleum, natural gas, natural gas liquids, sand and gravel, lime, stone.
Otero	712	W	Sand and gravel, lime, stone.
Ouray	2,267	1,925	Zinc, lead, copper, silver, gold, sand and gravel.
Park	117	164	Sand and gravel, peat, beryllium concentrate, zinc, gold, silver, stone, lead, copper.
Phillips	85	96	Sand and gravel, stone.
Pitkin	6,262	6,433	Coal, iron ore, sand and gravel, natural gas.
Prowers	179	248	Sand and gravel, petroleum, stone.
Pueblo	2,433	2,441	Sand and gravel, lime, clays.
Rio Blanco	56,642	50,686	Petroleum, natural gas, natural gas liquids, stone, coal, sand and gravel, vanadium, uranium.
Rio Grande	276	305	Sand and gravel, stone.
Routt	6,226	6,639	Coal, petroleum, pumice, sand and gravel.
Saguache	129	322	Sand and gravel, lead, silver, copper, zinc, pumice, clays, gold, stone.
San Juan	4,074	4,979	Zinc, lead, silver, copper, gold, tungsten concentrate.
San Miguel	17,016	18,225	Vanadium, uranium, zinc, lead, copper, silver, gold, natural gas, sand and gravel, iron ore, stone, petroleum.
Sedgwick	202	549	Sand and gravel, lime, natural gas, stone.
Summit	301	325	Sand and gravel, lead, zinc, stone, silver, gold, copper.
Teller	133	158	Sand and gravel, peat, stone.
Washington	12,458	13,976	Petroleum, natural gas, natural gas liquids, sand and gravel.
Weld	8,684	7,250	Petroleum, coal, sand and gravel, natural gas, lime.
Yuma	256	76	Sand and gravel.
Undistributed [2]	7,287	13,686	
Total [3]	359,458	368,494	

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

[1] Denver County not listed because no production was reported.

[2] Includes beryllium concentrate (1968) and gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

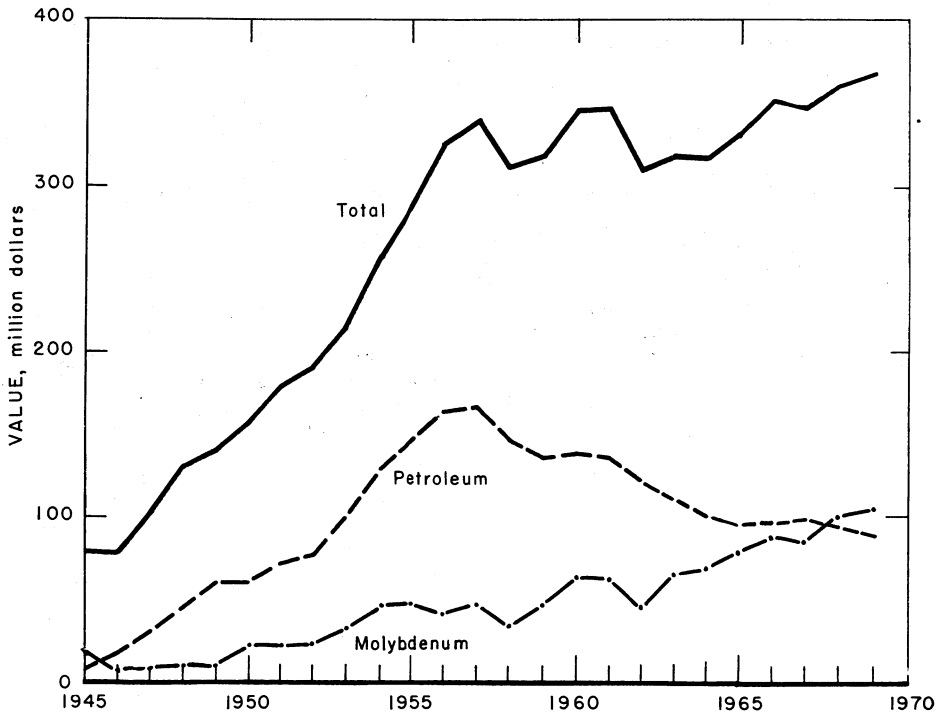

Figure 1.—Value of molybdenum, petroleum, and total value of mineral production in Colorado.

Table 3.—Indicators of business activity in Colorado

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	845.9	875.3	+3.5
Employment	do	820.7	849.4	+3.5
Unemployment	do	25.2	25.9	+2.8
Agricultural employment	do	53.8	51.8	−3.7
Nonagricultural employment	do	766.9	797.6	+4.0
Mining	do	13.1	13.3	+1.5
Construction	do	36.7	37.9	+3.3
Manufacturing	do	107.1	113.9	+6.3
Government	do	160.9	165.3	+2.7
All other	do	449.1	467.2	+4.0
Industrial sources of personal income:				
Agriculture	millions	$242	$274	+13.2
Mining	do	$127	$137	+7.9
Construction	do	$364	$411	+12.9
Manufacturing	do	$877	$928	+5.8
Government	do	$978	$1,115	+14.0
All other	do	$2,561	$2,820	+10.1
Personal income:				
Total	do	$6,824	$7,492	+9.8
Per capita		$3,301	$3,568	+8.1
Construction activity:				
Total value of new construction	millions	$286.1	$324.2	+13.3
Residential	do	$204.6	$200.6	−2.0
Nonresidential	do	$81.5	$123.6	+51.7
Highway construction contracts awarded	do	$45.2	$64.8	+43.4
Cement shipments to and within the State	thousand 376-pound barrels	5,083	5,009	−1.5
Business receipts:				
Retail sales	millions	$6,333.5	$7,132.3	+12.6
Farm marketing receipts	do	$903.6	$1,045.0	+15.6
Mineral production	do	$359.5	$368.5	+2.6
Utility production and consumption:				
Electric power consumption	million kilowatt-hours	6716.7	7349.0	+9.4
Natural gas consumption	billion cubic feet	205.4	223.6	+8.9

p Preliminary.

Sources: Business Research Division, University of Colorado; Engineering News-Record, v. 184, No. 16 Apr. 30, 1970, pp. 12–13; U.S. Bureau of Mines.

Thirty-two mineral commodities, the same number and group as in 1968, were produced during the year. Of these, 13 were classed as metals, 13 as nonmetals, and six as fuels. The metals comprised 48 percent of the total mineral value, fuels 38 percent, and nonmetals 14 percent. Based on value, the leading commodity in each group was molybdenum ($105.3 million), petroleum ($88.3 million), and sand and gravel ($27.3 million). These three commodities accounted for 60 percent of the total value.

Within the metals group, 10 commodities had gains in value and three declined compared with 1968. Four of fuels showed losses; two had increases. Eight of the nonmetals had increases in value and five had losses. Twenty of the 32 mineral commodities produced had output value of over $1 million; in fact, nine had values exceeding $10 million.

Employment and Injuries.—Preliminary data for 1969 and final data for 1968 for employment and injuries in the mineral industries, excluding mineral fuels except coal and peat, are shown in table 4.

Legislation and Government Programs.—The Colorado Land Board announced a new royalty schedule in February for uranium mining on State lands. The new sliding-scale replaces the previous 12.5-percent royalty. For surface operations the scale is 5 percent on ore with a gross purchase price of $4 or less per ton up to 23.5 percent on ore with a gross price of $32 or more per ton. On underground operations the rate ranges from 5 percent on ore with a price of $14 or less per ton up to 10 percent for ore with a price of $32 or more per ton.

The Colorado Open Cut Land Reclamation Act of 1969, effective July 1, 1969, requires the posting of bonds and payment of fees to insure restoration of land disturbed by strip mining. In addition, it provides for the preservation of natural resources and the protection and perpetuation of the value of strip-mined lands.

The Bureau of Mines released six publi-

Table 4.—Worktime 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
1968:								
Coal	1,325	231	306	2,416	6	85	37.67	16,559
Peat	35	159	6	29	------	1	35.03	245
Metal	4,532	268	1,216	9,921	3	370	37.60	3,794
Nonmetal	510	174	89	709	------	15	21.16	332
Sand and gravel	1,376	191	262	2,125	1	64	30.59	6,435
Stone	516	245	126	1,024	------	19	18.55	1,457
Total [1]	8,294	242	2,005	16,223	10	554	34.76	5,736
1969: [p]								
Coal	1,395	239	334	2,579	4	77	31.40	10,708
Peat	25	109	3	17	------	1	58.28	466
Metal	4,415	256	1,131	9,010	13	392	44.95	10,405
Nonmetal	500	215	107	859	------	22	25.60	1,356
Sand and gravel	1,495	207	310	2,530	1	49	19.76	2,835
Stone	525	226	119	973	------	9	9.25	282
Total [1]	8,355	240	2,004	15,970	18	550	35.57	8,140

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

cations and reprinted a bulletin dealing with minerals in Colorado; all seven publications concerned oil shale research.[2] The Geological Survey released 10 publications concerned with geology and minerals in the State.[3]

As in the past, heavy-construction projects such as highways and dams, financed by various governmental agencies, consumed much of the cement, sand and gravel, and stone produced in the State. Contracts totaling $64.8 million were awarded during the year for highway construction, an increase of 43.3 percent from the $45.2 million awarded in 1968; the largest portion of the contracts was for construction in the National System of Interstate and Defense Highways—$43.2 million, nearly double that of 1968.[4] The additional funds should result in higher levels of production of the construction minerals during 1970.

[2] Smith, John Ward. Theoretical Relationship Between Density and Oil Yield for Oil Shales. BuMines Rept. of Inv. 7248, April 1969, 14 pp.

Smith, John Ward, and Neil B. Young. Determination of Dawsonite and Nahcolite in Green River Formation Oil Shales. BuMines Rept. of Inv. 7286, August 1969, 20 pp.

Ruark, J. R., H. W. Sohns, and H. C. Carpenter. Gas Combustion Retorting of Oil Shale Under Anvil Points Lease Agreement: Stage I. BuMines Rept. of Inv. 7303, November 1969, 109 pp.

Rogers, Marianne P. List of Bureau of Mines Publications on Oil Shale and Shale Oil, 1917–68. BuMines Inf. Circ. 8429, 1969, 61 pp.

Dana, George F. Bureau of Mines-Atomic Energy Commission Colorado Corehole No. 3, Rio Blanco County, Colorado. BuMines Open-File Report, July 1968.

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East, J. H., Jr., and E. D. Gardner. Oil-Shale Mining, Rifle, Colorado, 1944–56. BuMines Bull. 611, 1964, 163 pp.

[3] Shawe, Daniel R., George C., Simmons, and Norbert L. Archbold. Stratigraphy of Slick Rock District and Vicinity, San Miguel and Dolores Counties, Colorado. U.S. Geol. Survey Prof. Paper 576–A, 1968, 108 pp.

Hawley, C. C. Geology and Beryllium Deposits of the Lake George (or Badger Flats) Beryllium Area, Park and Jefferson Counties, Colorado. U.S. Geol. Survey Prof. Paper 608–A, 1969, 44 pp.

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Steven, T. A., and L. J. Schmitt, Jr., U.S. Geological Survey, and M. J. Sheridan and F. E. Williams, U.S. Bureau of Mines. Mineral Resources of the Juan Primitive Area, Colorado. U.S. Geol. Survey Bull. 1261–F, 1969, 187 pp.

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Barker, Fred. Gold Investigations in Precambrian Clastic and Pelitic Rocks, Southwestern Colorado and Northern New Mexico. U.S. Geol. Survey Bull. 1272–F, 1969, 22 pp.

Donnell, John R. Paleocene and Lower Eocene Units in the Southern Part of the Piceance Creek Basin, Colorado. U.S. Geol. Survey Bull. 1274–M, 1969, 18 pp.

[4] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1970, 1969 and Budgets for Maintenance. V. 184, No. 16, Apr. 30, 1970, pp. 12–13; v. 182, No. 14, Apr. 3, 1969, pp. 52–53.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—Colorado produced 46 tons of beryllium concentrates, a 42 percent decrease from that of 1968. The State had two operating mines during the year. U.S. Beryllium Corp., at midyear, assumed operations of the froth flotation mill at the Boomer mine near Lake George; the mill, owned by Mineral Concentrates & Chemical Co., Inc., has processed ore from U.S. Beryllium's operations in the area. Beryl Ores Co., Arvada, continued to purchase and process beryl produced by small operators.

Cadmium, Indium, and Thallium.—American Smelting and Refining Company (Asarco) recovered cadmium, indium, and thallium metal and thallous sulfate at its Denver plant from flue dust, dross, and other byproduct material from out-of-State smelters and processing plants. The value of these products is not included in the State's mineral value because of their out-of-State origin.

Copper.—Output of copper was up 4.3 percent in quantity and 18.5 percent in value. The increase in value reflected the 25 percent increase in domestic refinery prices of the commodity; average price for the first week in 1969 was 41.726 cents per pound compared with 52.138 cents for the last week. During the year, 34 operations in 15 counties yielded copper, compared with 48 operations in 16 counties during 1968.

The Idarado mine of Idarado Mining Co., located in the Red Mountain and Upper San Miguel mining districts, accounted for 74 percent of the output. Although output of the Idarado mine was down slightly, 22 tons, increased yields from other mines more than offset this decrease. The Sunnyside and Belle Creole mines of Standard Metals Corp. produced 200 tons more than during 1968; yield of the Brenneman mine was down 110 tons.

Homestake Mining Co. produced byproduct copper from its Bulldog Mountain silver mine in Mineral Country. McFarland & Hullinger, lessee, at Asarco's Keystone mine, Gunnison County, produced 63 tons of copper, twice that of the previous year. The Oil Shale Corp. (TOSCO), Denver-based oil shale firm, is joint operator with McFarland & Hullinger.

Construction and development work continued at the Summitville mine, Rio Grande County. The new 300-ton-per-day mill reportedly was placed in operation near mid-year, but no production was reported for the year. On June 1 Union Pacific Railroad Co., Natural Resources Division, assumed management of the operation from Cleveland Cliffs Iron Co.; W. S. Moore Co. is third partner in the venture.

Gold.—Gold output increased 3,139 troy ounces above the 1968 production of 22,638 ounces. Value for the year was up 20.4 percent; 1969 was the first full year under the New York selling price.

Idarado Mining Co. operations accounted for 63.9 percent of the total output. Other principal gold production was from the Sunnyside mine of Standard Metals Corp. with 4,536 ounces (an increase of 3,222 ounces), the Belle Creole mine of Standard Metals with 848 ounces (up 600 ounces), and The New Jersey Zinc Co. Eagle mine in Eagle County.

Thirty-two lode mines and 10 placer operations yielded gold, compared with 49 and 15, respectively, in 1968. Of the placer operations, accounting for 4 percent (1,056 ounces) of the State production, only three were primarily for gold; the rest were sand and gravel pits. Eight lode mines yielded more than 100 ounces of gold.

Among the nineteen counties with gold production during the year, San Miguel, San Juan, and Ouray again were the leading sources; their output in 1969 was, respectively, 13,841, 6,090, and 2,665 ounces, totaling 88 percent of the output in the State.

Iron Ore.—Production of iron ore increased 16 percent; value increased 42 percent. The increase in output was the result of a 17-percent boost by Pitkin Iron Corp. at its Copper Basin mine in Pitkin County; the mine yielded 98 percent of the State's output of iron ore. The ore, magnetite with 67 percent iron, was shipped to the Pueblo smelter of CF&I Steel Corp.

Small quantities of brown iron ore produced in Dolores and San Miguel Counties were shipped to Chas. Pfizer & Co., Inc., East St. Louis, Ill., for use as paint pigment.

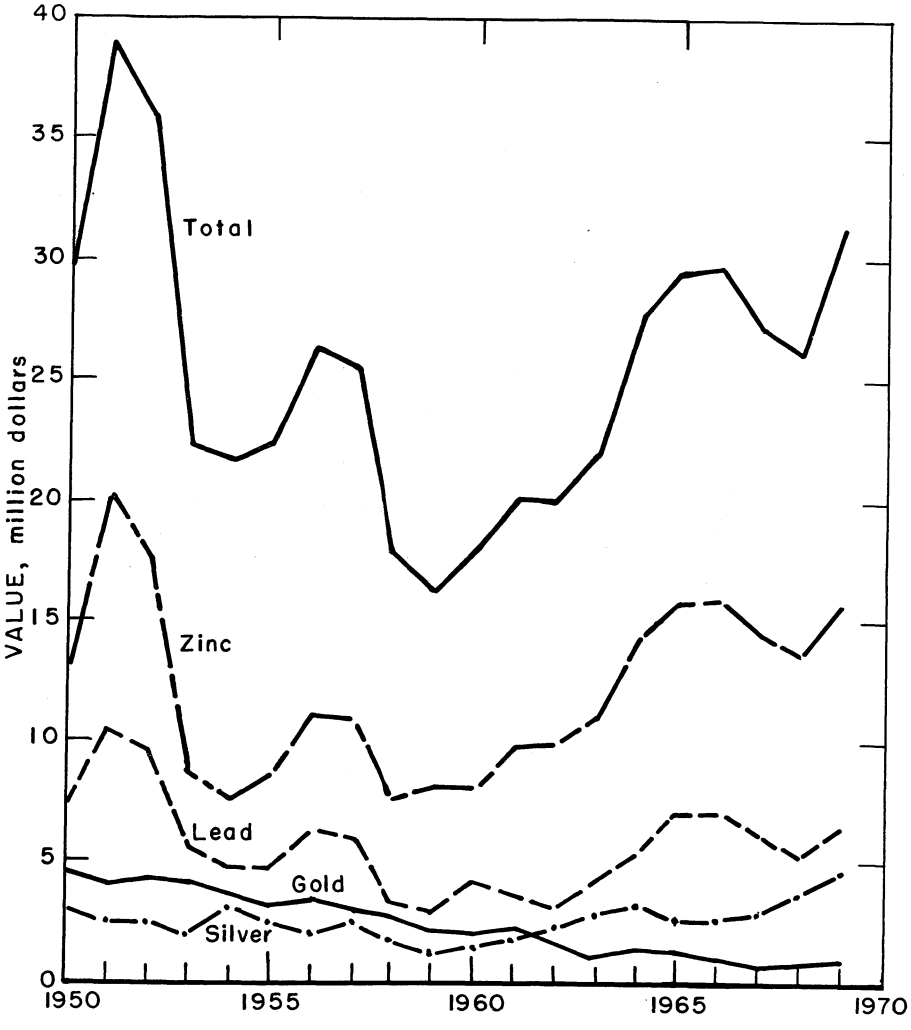

Figure 2.—Value of mine production of gold, silver, lead, and zinc, and total value of these minerals (including copper) in Colorado.

Table 5.—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)
1965	58	13	1,021	37,228	$1,303	2,051	$2,652
1966	62	14	1,225	31,915	1,117	2,086	2,697
1967	39	15	1,173	21,181	741	1,818	2,817
1968	56	15	1,056	22,638	889	1,646	3,531
1969	37	10	1,090	25,777	1,070	2,599	4,653
1858–1969	NA	NA	NA	40,877,434	924,851	785,687	626,998

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	3,828	$2,710	22,495	$7,018	53,870	$15,730	$29,413
1966	4,237	3,065	23,082	6,978	54,822	15,898	29,755
1967	3,993	3,053	21,923	6,138	52,442	14,519	27,268
1968	3,451	2,888	19,778	5,226	50,258	13,570	26,104
1969	3,598	3,421	21,767	6,484	53,715	15,685	31,313
1858–1969	335,635	120,106	2,946,015	375,685	2,377,752	478,973	2,526,613

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.

Lead.—Output of lead increased 10 percent; however, because of a price increase, the value of production was up 24 percent. The price increased from 13.0 cents per pound at the beginning of the year to 16.5 cents at yearend, averaging 14.895 cents per pound for the year. There were 36 producing mines in 15 counties; six mines with production in excess of 500 tons accounted for 92 percent of the State output.

The Idarado mine in Ouray and San Miguel Counties was the largest source with 9,089 tons of lead. Other principal mines, in order of output, were the Sunnyside mine (Standard Metals), Eagle (New Jersey Zinc), Emperius (Emperius Mining), Bulldog Mountain (Homestake), Rico Argentine (Rico Argentine), and Belle Creole (Standard Metals).

Six of the 15 counties with lead production had output of over 500 tons. Ranked according to output, the principal counties were San Miguel, San Juan, Mineral, Eagle, Ouray, and Dolores.

The sinking of a 1,700-foot shaft in Iowa Gulch, near Leadville, continued during the year. A joint venture of Resurrection Mining Co., a subsidiary of Newmont Mining Co., and Asarco, the project is to develop lead-zinc ore in the Irene-Sunday-Hellena area.

Leadville Lead Corp. continued its developments at the head of Iowa Gulch. A main building has been constructed at the portal of Sherman tunnel; shops and a general service area near the portal are under construction. The 9- by 10-foot Sherman tunnel was driven east for 3,500 feet, and a 450-foot raise begun. The mine and facilities, designed for a daily production of 5,000 tons, were to be fully operational in early 1970.

Molybdenum.—Molybdenum, the most valuable mineral produced in the State, exceeded petroleum, the second-ranked mineral, by $17.1 million. Output increased slightly in quantity and 5 percent in value; the increase in value resulted from a price rise between January 1969 and January 1970 of 10 cents per pound of contained molybdenum.

The two mines in Colorado—Climax in Lake County, and Urad in Clear Creek County—supplied 61 percent of the Nation's output of molybdenum and about 40 percent of free world production. Both mines are owned and operated by Climax Molybdenum Co., American Metal Climax, Inc. (AMAX).

Development work continued at the AMAX Henderson molybdenum project; the No. 1 shaft and mine site preparation were virtually completed. The company's annual report stated that proved and probable ore reserves total 303 million tons, with 0.49 percent molybdenum sulfide. The mine is expected to have an ultimate annual capacity of 50 million pounds of molybdenum, nearly doubling the company's capacity in this commodity. The

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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 (thousands)	Troy ounces	Value (thousands)
Adams	-------	4	---------	656	$27	93	[3]
Boulder	1	1	350	212	9	2,189	$4
Clear Creek	6	--------	1,488	45	2	6,402	11
Custer	1	--------	[4] 110,298	[4] 760	[4] 32	[4] 1,052,927	[4] 1,885
Dolores	2	--------	43,694	128	5	112,669	202
Eagle	1	--------	279,243	822	34	210,505	377
Gilpin	3	1	362	80	3	923	2
Gunnison	2	--------	21,941	27	1	51,365	92
Hinsdale	1	--------	[4]	[4]	[4]	[4]	[4]
Jefferson	-------	2	---------	255	11	37	[3]
Las Animas	-------	1	---------	10	[3]	--------	--------
Mineral	2	--------	[4]	[4]	[4]	[4]	[4]
Moffat	-------	1	---------	3	[3]	--------	--------
Ouray	2	--------	69,868	2,665	111	163,100	292
Park	2	--------	810	112	5	2,237	4
Saguache	1	--------	7,509	53	2	30,307	54
San Juan	5	--------	214,735	6,090	253	266,579	477
San Miguel	1	--------	339,142	13,841	575	698,060	1,250
Summit	7	--------	889	18	1	1,170	2
Total							
1969 [5]	37	10	1,090,329	25,777	1,070	2,598,563	4,653
1968 [5]	56	15	1,056,126	22,638	889	1,646,283	2,531

County	Copper		Lead		Zinc		Total value [5] (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Adams	-------	--------	---------	---------	---------	---------	$27
Boulder	2	$2	49	$15	---------	---------	29
Clear Creek	1	1	13	4	3	$1	19
Custer	[4] 187	[4] 178	[4] 2,747	[4] 818	[4] 2,468	[4] 721	[4] 3,634
Dolores	56	53	1,450	432	2,011	587	1,279
Eagle	127	120	2,277	678	28,425	8,300	9,510
Gilpin	1	1	8	3	---------	---------	8
Gunnison	63	60	465	138	627	183	475
Hinsdale	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Jefferson	-------	--------	---------	---------	---------	---------	11
Las Animas	-------	--------	---------	---------	---------	---------	[3]
Mineral	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Moffat	-------	--------	---------	---------	---------	---------	[3]
Ouray	445	423	1,560	465	2,032	593	1,884
Park	2	2	8	2	53	16	28
Saguache	35	34	222	66	86	25	181
San Juan	444	422	5,286	1,575	7,708	2,251	4,978
San Miguel	2,234	2,124	7,639	2,276	10,282	3,002	9,227
Summit	1	1	43	13	20	6	22
Total							
1969 [5]	3,598	3,421	21,767	6,484	53,715	15,685	31,313
1968 [5]	3,451	2,888	19,778	5,226	50,258	13,570	26,103

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines.
[2] Does not include gravel washed.
[3] Less than ½ unit.
[4] Custer, Hinsdale, and Mineral Counties combined to avoid disclosing individual company confidential data.
[5] Data may not add to totals shown because of independent rounding.

Henderson project received national acclaim for its efforts to preserve the environment while preparing to produce a commodity vital to present standards of living.

Rare-Earth Metals.—Shipments of monazite (a mixture of rare-earth phosphates) declined 54 percent. The mineral was recovered by AMAX from mill tailings at the Climax molybdenum mine.

Molybdenum Corporation of America (Molycorp) announced early in the year that it was producing seven more of the rare-earth elements at its Louviers plant, enabling the company to ship from stock, oxides of all 15 of the metals; purity of the oxides is 99.9 percent. Molycorp also announced 10- to 20-percent reductions in price of four of the more widely used rare-earth oxides.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1969, by class of ore or other source material, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Dry gold	2	100	70	129	---	1	[2]
Dry gold-silver	2	515	86	693	[2]	1	---
Dry silver	5	69,887	63	954,195	225	2,554	1,266
Total [3]	9	70,502	219	955,017	225	2,555	1,266
Copper-lead-zinc	4	411,175	16,525	862,294	5,390	18,632	24,547
Lead	10	990	97	4,767	5	99	8
Lead-zinc	16	330,309	6,990	587,775	1,446	17,608	24,652
Zinc	2	277,350	873	186,890	126	4,541	56,957
Total [3]	32	1,019,824	24,485	1,641,726	6,967	40,880	106,164
Other lode material:							
Lead cleanup	[4]	[5] 3	17	1,690	4	100	---
Total lode material [3]	37	1,090,329	24,721	2,598,433	7,196	43,534	107,430
Placer	10	---	1,056	130	---	---	---
Total all sources	47	1,090,329	25,777	2,598,563	7,196	43,534	107,430

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Less than ½ unit.
[3] Data may not add to totals shown because of independent rounding.
[4] From properties not classed as mines.
[5] Excludes tonnage of fluorspar ore.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1969, by method of recovery and type of material processed, in terms of recoverable metals

Method of recovery and type of material processed	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Amalgamation: Ore	4,014	1,317	---	---	---
Concentration and smelting of concentrates:					
Ore [1]	20,639	2,567,910	7,064	43,440	107,419
Total	24,653	2,569,227	7,064	43,440	107,419
Direct smelting:					
Ore	68	29,182	132	93	11
Cleanup	-------	24	[3]	2	---
Total [2]	68	29,206	132	94	11
Placer	1,056	130	---	---	---
Grand total [2]	25,777	2,598,563	7,196	43,534	107,430

[1] Includes concentrate from fluorspar ore.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than ½ unit.

Silver.—Output of silver from 47 operations in 17 counties increased 952,280 troy ounces (58 percent) above that of 1968; value increased 32 percent. The average price of silver dropped from $2.1446 per troy ounce in 1968 to $1.79067; the New York selling price, however, fluctuated between a low of $1.5620 (in June) and a high of $1.9990 (in January). All but 130 ounces were produced from lode mines; the six placer operations were byproduct enterprises at sand and gravel pits. Of the 37 lode mines yielding silver, 11 had production exceeding 20,000 ounces and each registered appreciable increases in output. The two principal mines—Bulldog Mountain and Idarado—accounted for 67 percent of the State output.

The Bulldog Mountain project, under lease to Homestake Mining Co., was the major source of silver during the year. Initial production from the mine exceeded

the output of the next largest producer, Idarado, by an appreciable amount. Homestake reported that reserves, as of January 1, 1970, were 409,480 tons with an average grade of 21.8 ounces of silver per ton and 2.7 percent lead, compared with 232,175 tons containing 21.4 ounces of silver and 3.2 percent lead per ton for the previous year.

Other mines having silver production in excess of 20,000 troy ounces were Eagle (New Jersey Zinc), Sunnyside (Standard Metals), Emperius (Emperius Mining), Rico Argentine (Rico Argentine Mining), Belle Creole (Standard Metals), Keystone (McFarland & Hullinger, lessee from Asarco), Rawley 200 (U.S. Silver Mining Co.) Silver Bell (Silver Bell Industries, Inc.), and Brenneman (Standard Metals).

Supplying 86 percent of the output, leading counties in silver output were, in order of production, Mineral, San Miguel, San Juan, and Eagle.

Tin.—Byproduct tin concentrate was produced at the Climax molybdenum mine of AMAX. Tin content of the concentrates was 44 long tons, 33 percent more than during the previous year. Colorado, again the leading tin-producing State with 66 percent of the Nation's output, was followed by South Dakota, Alaska, and New Mexico. The tin concentrates from Climax were shipped to England and Brazil for processing.

Tungsten.—Most of the output of tungsten concentrates, slightly higher than during 1968, came as a byproduct of the operations of the Climax molybdenum mine. Other operations were the Eureka mine of Canyon Mining Corp., Boulder County; and the Adams mine of Domain Minerals, Inc., San Juan County. The concentrates were sent to western Europe, New York, Ohio, and Pennsylvania for processing.

Uranium.—Output of uranium oxide (U_3O_8) increased slightly; however, value declined 15 percent because of generally lower prices. Colorado ranked third in the Nation in production of U_3O_8 with 11.5 percent of the total; it followed New Mexico and Wyoming.

The number of operations dropped sharply from the 278 in the previous year to 158 in 1969. These yielded 620,641 tons of uranium ore, compared with 654,917 tons recovered in 1968. Average grade of the ore was 0.24 percent U_3O_8, appreciably better than the average of 0.223 percent in 1968. Montrose County, with 98 of the operations and 41 percent of the output of ore, was the leading county, followed in order of production, by San Miguel, Mesa, and Jefferson Counties.

Thirteen of the 34 ore producers, seven less than in 1968, had outputs in excess of 1,000 tons of ore. Operators with more than 10,000 tons of ore production during the year, in order of output, were Mining and Metals Division, Union Carbide Corp.; Climax Uranium Co., American Metal Climax, Inc.; Cotter Corp.; Cleghorn & Washburn Mining Co.; and Shiprock, Ltd. These companies accounted for 94 percent of the ore and recoverable content of U_3O_8.

Four uranium mills were active during the year—the Uravan and Rifle mills of

Table 9.—Mine production of uranium (U_3O_8), by counties in terms of recoverable metal

County	1968			1969		
	Number of operations	Pounds	Value[1] (thousands)	Number of operations	Pounds	Value[2] (thousands)
Fremont	2	[3] 363,896	[3] $2,496	2	[3] 662,945	[3] $4,020
Garfield	2	(3)	(3)	2	(3)	(3)
Jefferson	3	(3)	(3)	1	(3)	(3)
Mesa	50	658,420	4,788	30	511,842	3,071
Montrose	170	1,166,797	8,860	98	1,026,181	6,668
Rio Blanco	3	(3)	(3)	2	(3)	(3)
San Miguel	48	516,444	3,866	23	535,515	3,176
Total[4]	278	2,705,557	20,009	158	2,736,483	16,935

[1] Value estimated, based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales; includes value of U_3O_8 obtained from Colorado ores processed at out-of-State mills.

[2] Value estimated, based on $5.86 per pound for sales to the Atomic Energy Commission and an assumed price of $6.10 per pound for commercial sales; includes value of U_3O_8 obtained from Colorado ores processed at an out-of-State mill.

[3] Fremont, Garfield, Jefferson, Rio Blanco, and Saguache Counties combined to avoid disclosing individual company confidential data.

[4] Data may not add to totals shown because of independent rounding.

Union Carbide Corp., the Climax Uranium Co. mill at Grand Junction, and the Canon City mill of Cotter Corp. Climax Uranium Co. announced that its 450-ton-per-day mill at Grand Junction would be shut down early in 1970 because of the nationwide slowdown in construction of nuclear powerplants. Of the total ore produced in the State, 660 tons were shipped to Moab, Utah, to be processed in the mill of Atlas Minerals Division, Atlas Corp.

Homestead Minerals Corp., Denver, reported plans for constructing a uranium mill at Maybell, west of Craig. Daily output capacity was to be 1,000 to 1,500 pounds of U_3O_8; completion was set for the spring of 1970.

Vanadium.—Colorado accounted for most of the Nation's production of vanadium; however, output declined from that of 1968. Production was in the form of fused vanadium oxide (V_2O_5) recovered from the processing of uranium-vanadium ores at the Rifle and Uravan mills of Union Carbide Corp. and the Grand Junction mill of Climax Uranium Co.

Montrose and San Miguel Counties were the leading sources of vanadium-bearing ores; other counties with production were Mesa, Garfield, and Rio Blanco.

Zinc.—Output of zinc was up 6.9 percent in quantity and 15.5 percent in value. Average price per pound in 1969 was 14.6 cents, 8.1 percent higher than the average for 1968. Prices during 1969 ranged from 13.5 cents per pound during the first week in January to 15.5 cents during the last 3 months of the year.

Twelve counties had 22 operating mines. Eagle County ranked first in production, followed, in order of output, by San Miguel, San Juan, and Mineral Counties. The four accounted for 91 percent of the State total.

Of the 22 producing mines, nine had output of over 500 tons. The three largest producers were the same and in the same order as in 1968—the Eagle mine in Eagle County, Idarado in Ouray and San Miguel Counties, and Sunnyside in San Juan County. Other mines having over 500 tons of output were Emperius and Bulldog Mountain in Mineral County, Rico Argentine in Dolores County, Belle Creole and Brenneman in San Juan County, and Keystone in Gunnison County.

The zinc-concentrate roasting plant of The New Jersey Zinc Co. at Canon City, shut down the previous year, was sold to the Canon Chemicals Co. The latter company planned to reclaim the large zinc plant dump to develop soil additives for manufacturing fertilizers.

MINERAL FUELS

Carbon Dioxide.—Production of carbon dioxide from the McElmo field, Montezuma County, declined sharply (12.4 percent). A reorganization of Colorado Carbonics, Inc., Cortez, resulted in reduced output of carbon dioxide and the transfer of most of its operations to Phoenix, Ariz., where it will function under the name Dye Carbonics, Inc.

The unmarketable, oil-contaminated carbon dioxide from the McCallum oil field, Jackson County, was vented to the air after removal of the petroleum. Output from the field was 3.2 billion cubic feet, compared with 4.3 billion in 1968.

Coal (Bituminous).—Although output of coal was virtually unchanged from that of 1968, value increased nearly 9 percent. Fifty-two producing mines were operated in 14 counties, two less than during the previous year. Nine were strip mines; the rest were underground. Routt County, with four mines, again had the highest production with 1.8 million tons, 32 percent of the State output; it also was the only county with output of more than a million tons. Seven other counties had production of over 100,000 tons of coal.

Of the 52 mines, 21 each had output between 1,000 and 10,000 tons, 19 between 10,000 and 100,000 tons, seven between 100,000 and 500,000 tons, and five between 500,000 and 1 million tons. The five largest mines, in order of production, were the Allen underground mine of CF&I, Las Animas County; Somerset underground mine of United States Steel Corp., Delta and Gunnison Counties; Edna Strip mine of The Pittsburg & Midway Coal Mining Co.; Energy strip mine of Energy Coal Co.; and Seneca strip mine of Peabody Coal Co. The three strip mines are in Routt County.

The average value of coal produced increased $0.45 per ton, from $4.82 to $5.27. Coal from strip mines averaged $3.59 per ton and from underground $6.15 per ton; comparable figures for 1968 were $3.43 and $5.48, respectively.

On June 30, Boulder Valley Coal Co.

Table 10.—Coal (bituminous) sold or used [1] by producers, by counties

Year and county	Number of mines operating			Sold or used (short tons)		
	Underground	Strip	Total	Underground	Strip	Total
1968:						
Delta	4		4	358,979		358,979
Fremont	13		13	232,343		232,343
Garfield	1		1	2,426		2,426
Gunnison	5		5	512,695		512,695
Huerfano	2		2	26,638		26,638
La Plata	4		4	22,526		22,526
Las Animas	4		4	771,280		771,280
Mesa	4	1	5	98,302	30,865	129,167
Moffat	2		2	347,713		347,713
Montrose		1	1		69,164	69,164
Pitkin	2		2	702,284		702,284
Rio Blanco	2		2	5,667		5,667
Routt	2	3	5	28,719	1,694,873	1,723,592
Weld	4		4	653,900		653,900
Total	49	5	54	3,763,472	1,794,902	5,558,374
1969:						
Delta	W		W	W		W
Fremont	11	3	14	198,489	21,356	219,845
Garfield	1		1	1,948		1,948
Gunnison	4		4	569,493		569,493
Huerfano	2		2	24,546		24,546
La Plata	W	W	W	W	W	18,664
Las Animas	W		W	W		W
Mesa	3	1	4	39,839	44,806	84,645
Moffat	W		W	W		W
Montrose		W	W		W	W
Pitkin	W		W	W		W
Rio Blanco	W		W	W		W
Routt	1	3	4	14,056	1,777,350	1,791,406
Weld	4		4	572,109		572,109
Other counties	17	2	19	2,194,437	71,889	2,247,662
Total	43	9	52	3,614,917	1,915,401	5,530,318

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Excludes mines producing less than 1,000 short tons.

closed its No. 3 mine in Weld County, last of its mines in Colorado. The mine had been operated since 1940, and cumulative production totaled over 2 million tons.

United States Steel Corp. and the Denver and Rio Grande Railway Co., on March 5, dedicated a unit train system serving three coal mines and the Geneva steel mill at Provo, Utah. Two of the coal mines are in Colorado—United States Steel's Somerset mine, Delta and Gunnison Counties, and Mid-Continent Coal and Coke Co. operations in Pitkin County; the third mine is United States Steel's Geneva mine near Sunnyside, Utah. Initial operation of the system, using 1,050 cars involved 24-hour cycles serving the Geneva mine, 48-hour cycles for the Somerset mine, and a weekly two-trip cycle for Mid-Continent's production, which was accumulated at Grand Junction. Cars and locomotives were serviced and coordinated at Helper, Utah. Later in the year, Mid-Continent completed storage and loading facilities at Carbondale, Colo. This eliminated the transhipment at Grand Junction and the need for 120 railway cars. Plans are for similar facilities at the Somerset mine, which would eliminate need for another 60 cars; the unloading facility at the steel plant is to be modified to accomodate 100-ton cars to replace the 70-ton cars now in use. Ultimately, it is expected that 230 100-ton cars will serve the system.

Natural Gas.—Marketed natural gas declined 2 percent in quantity but increased 5 percent in value. According to the Colorado Oil and Gas Conservation Commission production of natural gas during the year was 118.8 billion cubic feet, 8.3 billion less than in 1968.[5]

Marketed natural gas, by counties, was similar to that of the previous year; La Plata ranked first with 36.1 billion cubic feet, Rio Blanco second with 25.9 billion, and Moffat third with 21.6 billion. Morgan

[5] Colorado Department of Natural Resources. Oil and Gas Conservation Commission. Oil and Gas Statistics 1969. Production Review, p. 10. All field natural-gas and petroleum-production figures cited in the chapter are from this work.

County, with 8.5 billion cubic feet, continued to be active chiefly because of operation of the Fort Morgan gas storage field.

The principal source of dry gas was the Ignacio-Blanco field, La Plata County, with production of 29.7 billion cubic feet. The productive horizons were Cretaceous in age —the Dakota, Fruitlands-Pictured Cliffs, and Mesaverde formations. Second most productive field was Piceance Creek with output of 10.9 billion cubic feet of dry gas; West Hiawatha with 5.5 billion was third; and Divide Creek and Powder Wash ranked fourth and fifth, respectively, with 5.0 and 4.8 billion cubic feet.

The Rangely-Weber reservoir again yielded the largest quantity of wet-gas. All of the output, 4.7 billion cubic feet, was processed for removal of liquids; 127.5 million cubic feet were returned to the reservoir for pressure maintenance. Of the 3.8 billion cubic feet of gas produced at Wilson Creek field, Rio Blanco County, 2.9 billion were returned to the reservoir.

The American Gas Association, Inc. (AGA) and the American Petroleum Institute (API), in their annual reserves estimates, gave Colorado natural gas reserves of 1.6 trillion cubic feet as of Dec. 31, 1969, a decline of 63.8 billion cubic feet. New fields, revisions, and extensions added 44.5 billion cubic feet; however, this failed to offset the depletion caused by production.[6]

The State's five gas-storage projects—Asbury Creek, Fort Morgan, House Creek, Leyden mine, and Springdale—had 15.5 billion cubic feet of gas in storage at the beginning of 1969, 8.5 billion were injected, and 8.0 billion withdrawn during the year for a yearend balance of 16.0 billion cubic feet. Again the Fort Morgan field was the most active, 4.0 billion cubic feet injected and 3.9 billion withdrawn. Second most active was the Leyden mine, a converted coal mine north of Denver, with 3.3 billion cubic feet injected and 2.8 billion withdrawn.

In June the U.S. Supreme Court ruled, by a 4 to 2 decision, that the agreement between El Paso Natural Gas Co. and Colorado Interstate Corp., whereby the latter company would acquire the facilities of El Paso's Pacific Northwest Division, did not satisfy the terms of the original divestiture order. The 12-year-old controversy stems from an antitrust decision designed to encourage competition in supplying natural gas to California markets.

The State had 14 gas discoveries during the year. On the basis of initial potential, the most significant was the Weld County discovery of Davidor and Davidor, Inc.; the well, Government No. 1, SE¼ SE¼ sec 27 T8N, R58W, was completed flowing 6.4 million cubic feet per day from "D" Sand formation (Cretaceous) perforation from 6,288 to 6,296 feet. The Trail Canyon field in Rio Blanco County was discovered by Willard Pease Drilling Co. and others. The well, Government-Cascade No. 1, NW¼ SE¼ sec 16, T4S, R101W, was completed as a shut-in gas well without an initial potential gage; however, tests had had gages of 1.4 million cubic feet per day from the Dakota formation (Cretaceous).

Also on the Western Slope was the dual new pay discovery at Lay Creek. The field previously had produced from the Tertiary Fort Union and Lance formations; during the year Humble Oil and Refining Co. drilled a deep test well to 16,381 feet in the Cambrian. The well, Lay Creek Unit No. 1, NW¼ SE¼ sec 13, T8N, R93W, was tested at daily rates of 3.8 million cubic feet of gas from the Mesaverde formation (Cretaceous) and 1.6 million from the Lewis (Cretaceous).

At 3:00 P.M. (MST) September 10, the 40-kiloton nuclear device of Project Rulison was detonated as planned, without any apparent ill effects on the environment. The blast was the second experiment in the Nation to stimulate natural gas production by nuclear fracturing from low-permeability gas zones. The first was Project Gasbuggy, detonated in December 1967 in New Mexico. Project Rulison was jointly sponsored by Austral Oil Co., Inc., the AEC, the Bureau of Mines, and CER Geonuclear Corp. The shotpoint, in sec 25, T7S, R95W, Garfield County, was at the bottom of an 8,443-foot hole in the Mesaverde formation (Cretaceous). The formation, approximately 2,000 feet thick at the location, contains an estimated 110 billion cubic feet of gas per square mile; production after opening of the hole scheduled in mid-1970 could reach 20 million cubic feet per day. Anticipated cavity size after the

[6] American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada and United States Productive Capacity as of Dec. 31, 1969. V. 24, May 1970, p. 120.

Table 11.—Gas input and products at natural gas liquids extraction plants in 1969

Plant	County	Owner	Gas input (million cubic feet)	Products (thousand barrels)
Adena	Morgan	Union Oil Company of Calif	5,858	512
Fruita	Mesa	Continental Oil Co	5,446	108
Little Beaver	Washington	do	313	54
Loveland	Larimer	Associated Programs, Inc	143	14
McClave	Kiowa	Fleetwood Drilling Co	1,207	34
Minto	Logan	Sun Oil Co	19	2
Padroni	do	Associated Programs, Inc	12	2
Piceance Creek	Rio Blanco	Chadbourne Corp	5,901	72
Rangely	do	Chevron Oil Co	4,688	476
San Juan	La Plata	El Paso Natural Gas Co	60,109	1,024
Vallery	Morgan	Associated Programs, Inc	847	68
Wilson Creek	Rio Blanco	Texaco Inc	3,833	368
Yenter	Logan	Associated Programs, Inc	2,057	233

Source: Colorado Department of Natural Resources. Oil and Gas Conservation Commission. Oil and Gas Statistics 1969. Plant Intake and Products, pp. 102–105.

explosion was 160 feet in diameter and 370 feet high, with a surrounding fractured zone 740 feet in diameter.

Natural Gas Liquids.—Production of natural gas liquids decreased 12.8 percent. LP gases decreased 10 percent and natural gasoline 17 percent in quantity.

Natural gas throughput of the 13 gasoline plants, according to the Oil and Gas Conservation Commission, was 90.4 billion cubic feet for the year; output was 3.0 million barrels of products.[7] Gas input declined 5.3 percent; output was down 9.1 percent. Continental Oil Co.'s Little Beaver plant did not operate after August; the Minto plant of Sun Oil Co. did not operate after September; and the Padroni plant of Associated Programs, Inc., was not operative after May.

The Chadbourne Corp. of Midland, Tex., completed its Piceance Creek plant in Rio Blanco County in May. The refrigerated-absorption plant has a daily input capacity of 30 million cubic feet of gas; planned output was 9,000 gallons of propane and 11,000 gallons of combined liquids.

Oil Shale.—Atlantic Richfield Co. (ARCO) acquired early in the year, an undivided 30 percent interest in the assets of Colony Development Corp. The purchase includes interests in 16,138 acres of oil shale lands in Colorado, option on 8,562 acres in Utah, and in the technology and facilities of the Colony group. Other owners in the group and their interests are Sohio Petroleum Co., 30 percent; The Oil Shale Corp. (TOSCO), 20 percent; and Cleveland Cliffs Iron Co., 20 percent. ARCO will be operator for the group.

In an address to the American Petroleum Institute in Chicago, TOSCO revealed some shale oil extraction costs developed by the company. Costs are based on assumptions of 66,000 tons of oil shale mined per day, an average mining height of 59 feet, shale containing 35.8 gallons of oil per ton, and mining by conventional methods. Mining, crushing, and disposal of spent shale amounts to 50.7 cents per barrel of recovered oil, 34.0 cents per barrel for retorting, 35.3 cents per barrel for refining the oil, and 46.5 cents for depreciation—a total of $1.67 per barrel. These costs do not include payments of any kind for shale reserves, nor for royalties on the TOSCO process.[8]

Peat.—Production of peat was 2,354 tons (8.3 percent) less than in 1968. Fifteen operations were located in eight counties: three each were in Boulder, Park, and Teller Counties; two were in Gilpin; and one each were in Alamosa, Chaffee, Lake, and La Plata Counties. Park County was the leading source with 8,854 tons, followed by Teller with 7,256 tons. Sixty-two percent of the output was moss type, 37 percent was humus, and the rest was reed-sedge. The average value of $6.13 per ton for peat was $2.66 per ton less than in 1968 and $3.16 below the value for 1967.

Most of the output, 21,888 tons, was shipped in bulk; the rest was packaged. Of the total, 20,374 tons were not processed. Sixty percent of the production, 15,555 tons, was used for general soil improve-

[7] Pages 102–105 of work cited in footnote 4.
[8] Chemical and Engineering News. V. 47, No. 22, May 26, 1969, p. 34.

ment, 6,327 tons in mixed fertilizers, and 6 tons for mushroom beds.

Petroleum.—Output of petroleum was down 11 percent in quantity and 6 percent in value because discoveries of new reserves failed to keep pace with production and the older fields were further depleted.

Leading county in production was Rio Blanco, with 51 percent of the State total; the county has the two leading oilfields, Rangely and Wilson Creek. Washingon and Logan Counties again ranked second and third, with 15.5 and 8.5 percent of the output.

The Rangely-Weber reservoir continued to dominate the State oil yield. With a cumulative output at yearend of 427.7 million barrels of oil, it had produced 46.3 percent of Colorado's cumulative oil production. Output declined 3.0 million barrels in 1969.

Active fluid-injection projects during the year totaled 45 in 42 fields—42 were waterflood projects and three were combined gas- and water-injection. On July 15, authorization was given by the State for the waterflooding of the "J" Sand reservoir in the Northwest Graylin field, and injection began in November. The area covered 1,930 acres; cumulative production was about 600,000 barrels. At the time of the hearing only 27,000 barrels of primary oil were available. Waterflooding will recover an estimated additional 1.2 million barrels of oil. Water injected in all the projects amounted to 140.8 million barrels (18,151 acre-feet); of this, 82.7 million barrels (59 percent) were injected in the Rangely-Weber reservoir. Again, the State data do not differentiate between "new" water and water produced with the oil and reinjected.

The API and AGA estimated crude oil reserves for Colorado, as of Dec. 31, 1969, at 400.6 million barrels, a decline of 19.9 million barrels from the figure for 1968. An additional 49.3 million barrels are considered economically available by fluid injection. New fields and new pools added 5.6 million barrels; revisions and extensions added 2.5 million barrels.[9]

[9] Pages 26, 27 of work cited in footnote 5.

Table 12.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1968	1969	Principal fields in 1969, in order of production
Adams	443	553	Mocassin, Nile, Middlemist, Roman Nose,[1] Badger Creek.
Arapahoe	357	220	Black Jack, Roman Nose.[2]
Archuleta	55	51	Price Gramps.
Baca	71	75	Flank, Greenwood.
Bent	1	1	McClave, Lubers.
Boulder	1	1	Boulder.
Cheyenne	9	417	Golden Spike, Ladder Creek, Cheyenne Wells.
Elbert	------	7	Ironhorse.
Fremont	23	33	Florence-Canon City.
Garfield	(3)	(3)	Mam Creek.
Jackson	198	179	McCallum, Battleship.
Kiowa	1,015	1,101	Brandon.
La Plata	24	23	Red Mesa.
Larimer	329	261	Wellington, Loveland.
Logan	2,418	2,399	Saber, Northwest Graylin, West Padroni, Mount Hope, Ramrod, Yenter.
Moffat	2,200	1,636	Maudlin Gulch, Powder Wash, Iles.
Montezuma	436	317	Cache, Marble Wash, Flodine Park.
Morgan	1,345	947	Adena, Boxer, Peterson, Sand River, Roundup.
Prowers	1	1	Comanche.
Rio Blanco	17,231	14,428	Rangely, Wilson Creek, Nine Mile.
Routt	89	85	Grassy Creek, North Sage Creek, Tow Creek.
San Miguel	2	3	Andy's Mesa.
Washington	4,081	4,389	Westfork, Rush Willadel, Plum Bush Creek, Belle, Cimarron, Big Beaver, Bison.
Weld	1,608	1,167	Black Hollow, Pierce, Sleeper, Border.
Total	31,937	28,294	

[1] Partly in Arapahoe County.
[2] Partly in Adams County.
[3] Less than ½ unit.

Source: Colorado Department of Natural Resources. Oil and Gas Conservation Commission. Oil and Gas Statistics 1969. Oil and Gas Statistics by counties, pp. 11–86.

Drilling activity reached a total of 814 wells, the highest number since 1959 when 816 wells were drilled. The overall increase was 319 wells (64.4 percent). Major increase was in exploratory drilling, reflecting the widened interest in the Cretaceous formations in the eastern Rocky Mountain area. Total wildcat wells exactly doubled —from 269 wells in 1968 to 538 wells in 1969. Drilling accounted for much of the estimated total expenditures of the oil industry in Colorado (not including manufacturing and marketing). Of a total of $128.5 million, $58.5 million were for drilling expenses.[10] The success ratio for exploratory drilling was 11.2 percent, a definite improvement over the 7.4 percent for 1968, but considerably below the 16.2 percent achieved in 1967.

Based on initial potential, the most significant discovery was the Sleeper field, Weld County. The discovery well, Chancellor Exploration Co. and Exeter Drilling Co., Buczkowskyj No. 1-X, NW¼ SW¼ sec 23, T12N, R56W, was completed for an initial pumping gage of 287 barrels of oil daily from the "D" Sand (Cretaceous). Logan County had a good discovery at the Ramrod field; Petroleum, Inc., Nelson-O No. 1, NE¼ NW¼ sec 33, T12N, R55W1 was completed pumping 250 barrels of oil per day from the "J" Sand (Cretaceous). At yearend five wells were producing in the field.

The Belle field in Washington County, discovered by Tiger Oil Co., had 11 producing wells at yearend. The discovery well, Appenzeller No. 1-3, NW¼ NE¼ sec 3, T1S, R53W, was completed for a pump gage of 55 barrels per day from the "J" Sand; later wells were more successful.

Several new fields were discovered in southeastern Colorado, along the Las Animas Arch. Possibly the most significant was the Golden Spike field; the discovery well, International Nuclear Corp., Lowe No. 1, NE¼ NE¼ sec 12, T16S, R45W, Cheyenne County, was completed for a daily pumping gage of 180 barrels of oil. By yearend eight wells were producing. Other new fields along the Arch included Ladder Creek with seven producing wells at yearend, Smoky Creek with three wells, and Timber Creek with two wells.

One of the largest lease agreements on record included about 2.8 million acres in northeastern Colorado. The agreement, reached during the summer, was between Union Pacific Railroad Co. and Pan Amer-

[10] Petroleum Information Corp. 1969 Résumé, Oil and Gas Operations in the Rocky Mountain Region, p. A–11.

Table 13.—Principal oilfields in 1969

Field	County	Production		Cumulative production to Jan. 1, 1970	
		Oil (barrels)	Gas (thousand cubic feet)	Oil (barrels)	Gas (thousand cubic feet)
Rangely (Weber)	Rio Blanco	11,785,057	4,734,656	427,791,230	663,007,110
Wilson Creek	do	2,200,100	3,832,521	67,129,499	48,030,201
Brandon	Kiowa	977,072	1,236	3,014,378	1,236
Maudlin Gulch	Moffat	936,809	120,437	4,831,205	902,184
Westfork	Washington	382,932	----------	2,968,043	888,049
Rush Willadel	do	367,309	----------	2,838,165	12,464
Rangely-(Mancos)	Rio Blanco	313,994	530	11,576,878	646
Plum Bush Creek	Washington	292,562	33,920	17,474,322	1,985,212
Black Hollow	Weld	291,921	12,780	9,012,314	276,001
Adena	Morgan	321,553	2,748,204	59,231,746	78,071,655
Saber	Logan	275,883	1,398,441	1,416,870	7,835,631
Belle	Washington	266,552	55,720	266,552	55,720
Cimarron	do	265,293	----------	500,918	----------
Big Beaver	do	260,362	22,153	10,475,446	1,518,893
Golden Spike	Cheyenne	251,746	200	251,746	200
Pierce	Weld	243,993	28,450	6,733,187	242,448
Bison	Washington	241,618	----------	3,465,401	2,467
Powder Wash	Moffat	209,055	4,767,583	4,667,483	87,326,564
Boxer	Morgan	195,708	978,490	1,671,879	4,165,821
Lindon	Washington	177,277	----------	2,616,565	10,462
Redwing	do	171,286	147,847	281,840	258,079
Graylin, NW	Logan	156,753	24,660	11,685,717	11,084,806
Sleeper	Weld	153,216	122,706	153,216	122,706
Black Jack	Arapahoe	144,308	11,746	675,596	16,862
Padroni, W	Logan	141,092	----------	2,467,175	251,221

Source: Colorado Department of Natural Resources. Oil and Gas Conservation Commission. Oil and Gas Statistics, 1969. Production by Leases, pp. 12–86.

Table 14.—Oil and gas well drilling, by counties

County	Oil	Gas	Dry	Total	Footage
1968:					
Exploratory completions:					
Adams	1	--	15	16	94,977
Archuleta	--	--	1	1	1,565
Baca	--	--	9	9	41,277
Bent	--	--	1	1	5,600
Cheyenne	2	--	2	4	22,571
Delta	--	--	1	1	7,650
Dolores	--	--	2	2	12,007
Elbert	1	--	16	17	101,797
El Paso	--	--	2	2	3,075
Grand	--	--	1	1	6,811
Kiowa	3	--	12	15	80,203
Kit Carson	--	--	4	4	20,769
La Plata	--	1	2	3	8,465
Logan	1	--	27	28	144,485
Mesa	--	--	1	1	7,644
Moffat	--	1	11	12	71,074
Montezuma	--	--	13	13	50,100
Montrose	--	--	1	1	7,998
Morgan	1	1	15	17	98,097
Otero	--	--	2	2	8,105
Phillips	--	--	1	1	3,996
Prowers	--	--	5	5	27,512
Rio Blanco	--	--	13	13	74,004
Routt	--	--	3	3	10,099
San Miguel	--	1	1	2	18,285
Washington	5	--	69	74	338,316
Weld	2	--	15	17	110,436
Yuma	--	--	4	4	17,441
Total	16	4	249	269	1,394,359
Development completions:					
Adams	5	--	9	14	81,726
Elbert	3	--	1	4	22,687
Baca	--	4	3	7	23,932
Garfield	--	1	--	1	8,516
Kiowa	5	1	--	6	29,245
Kit Carson	--	--	2	2	10,220
La Plata	3	--	5	8	33,943
Larimer	2	--	--	2	10,935
Las Animas	--	--	1	1	2,220
Logan	1	1	8	10	50,413
Moffat	8	6	9	23	129,684
Montezuma	1	--	2	3	17,975
Montrose	--	--	1	1	9,150
Morgan	4	2	10	16	93,847
Rio Blanco	24	28	12	64	296,859
Routt	1	--	--	1	5,397
San Miguel	--	2	3	5	44,485
Washington	16	1	15	32	153,449
Weld	20	--	6	26	173,859
Total	93	46	87	226	1,198,542
Total all drilling	109	50	336	495	2,592,901

County	Oil	Gas	Dry	Total	Footage
1969:					
Exploratory completions:					
Adams	5	--	20	25	156,640
Arapahoe	1	--	10	11	62,696
Baca	--	--	3	3	16,679
Bent	--	--	3	3	16,269
Cheyenne	12	--	26	38	209,937
Conejos	--	--	1	1	235
Delta	--	--	1	1	2,015
Dolores	--	--	3	3	15,982
Elbert	1	--	30	31	201,459
El Paso	--	--	4	4	23,845
Garfield	--	--	3	3	5,050
Huerfano	--	--	2	2	4,368
Jackson	--	--	2	2	15,361
Kiowa	2	2	21	25	126,764
Kit Carson	--	1	13	14	81,109
La Plata	--	1	3	4	16,200
Lincoln	--	--	1	1	4,556
Logan	9	1	61	71	371,691
Mesa	--	1	--	1	4,375
Moffat	1	3	12	16	95,392
Montezuma	1	--	5	6	12,853
Montrose	--	--	1	1	8,639
Morgan	--	--	19	19	108,989
Otero	--	--	1	1	6,766
Prowers	--	--	6	6	33,927
Rio Blanco	1	3	2	6	34,605
Routt	--	--	5	5	20,057
San Miguel	--	--	2	2	19,401
Washington	6	--	164	170	779,643
Weld	7	2	41	50	328,803
Yuma	--	--	13	13	54,950
Total	46	14	478	538	2,839,256
Development completions:					
Adams	5	--	9	14	85,286
Arapahoe	1	--	--	1	5,770
Baca	2	--	--	2	8,168
Cheyenne	10	--	8	18	91,549
Fremont	--	--	3	3	8,910
Kiowa	5	1	1	7	33,848
La Plata	3	10	3	16	97,924
Larimer	--	--	1	1	5,481
Logan	12	--	13	25	129,521
Mesa	--	3	--	3	13,702
Moffat	10	2	7	19	110,238
Montezuma	--	--	4	4	9,005
Montrose	--	--	1	1	10,645
Morgan	3	1	3	7	42,564
Pitkin	--	--	1	1	5,300
Rio Blanco	33	15	38	86	305,442
Routt	--	--	2	2	8,622
San Miguel	--	1	--	1	8,637
Washington	22	--	29	51	240,394
Weld	6	--	7	13	85,052
Yuma	--	--	1	1	3,906
Total	112	33	131	276	1,309,964
Total all drilling	158	47	609	814	4,149,220

Source: Committee on Statistics of Drilling, American Association of Petroleum Geologists.

ican Petroleum Corp., whereby the latter would explore some 7 million acres of union Pacific land in Colorado, Wyoming, and Utah; 40 percent of the land is in Colorado. Under terms of the agreement, Union Pacific retains a 15-percent overriding royalty on 480 acres and a 100-percent interest in the remaining 160 acres of each section acquired by Pan American. Pan American agreed to pay a cash bonus of $9 million for the first 3 years and spend a minimum of $15 million in exploration during the same period. Anticipated exploration expenditures will be several times that amount.

The State's four operating refineries remained the same as in 1968—American Gilsonite Co. at Fruita, Continental Oil

Table 15.—Principal oil and gas discoveries in 1969

County and field	Well	Operator	Location			Producing formation	Total depth (feet)	Initial production		Remarks
			Section	Township	Range			Barrels of oil per day	Thousand cubic feet of gas per day	
Adams:										
Nile	No. 1 Double Bar-O-Double Bar.	Sundance Oil Co.-McCulloch Oil Corporation of Calif.	18	1 S	60 W	"D" Sandstone	6,625	234	-----	Pumping.
Gunsmoke	No. 1 Martyn	R. E. Hibbert Oil Properties-Exeter Drilling Co.	6	3 S	58 W	"J" Sandstone	6,185	101	-----	Do.
Cheyenne:										
Cheyenne Wells	No. 3 UPRR Roth	Mull Drilling Co	5	14 S	44 W	Topeka	5,482½	120	-----	Pumping. New pay.
Ladder Creek	No. 1 Miller	International Nuclear Corp.-Plains Exploration Co.	12	15 S	45 W	Spergen	5,412	161	-----	Pumping.
Golden Spike	No. 1 Lowe	International Nuclear Corp.	12	16 S	45 W	Mississippian	5,500	180	-----	Do.
Kiowa:										
Wildcat	No. 1 Merrick-E	Champlin Petroleum Co	33	18 S	47 W	Keyes Sandstone	5,475	---	3,520	Flowing.
Wildcat	No. 1 Twombly	Samedan Oil Corp	24	20 S	46 W	Marmaton	5,110	---	2,000	Do.
Logan:										
Cloverleaf	No. 1 Cloverleaf-State	K & M Associates-Toltek Drilling Co.	34	8 N	52 W	"J" Sandstone	4,485	103	-----	Pumping.
Pow Wow	No. 1 Herrman	R. D. Brew, Braden-Gear Drilling Co.	26	12 N	53 W	----do	5,405	150	-----	Do.
Ramrod	No. 1 Nelson-O	Petroleum, Inc	33	12 N	55 W	----do	5,903	250	-----	Do.
Moffat:										
Lay Creek	No. 1 Lay Creek	Humble Oil & Refining Co	13	8 N	93 W	Mesaverde	16,381	---	1,622	Flowing.
						Lewis	------	---	1,612	New pay.
Wildcat	No. 1-25-Government	Stauffer Chemical Co	25	9 N	91 W	----do	6,083	---	3,155	Flowing.
Washington:										
Dart	No. 1-23 Gebauer	Tiger Oil Co	23	1 N	53 W	"J" Sandstone	4,954	170	-----	Pumping.
Red Cloud	No. 1-29 Pieper	----do	29	1 N	53 W	----do	4,998	212	-----	Do.
Weld:										
Wildcat	No. 1 Government	Davidor & Davidor, Inc	27	8 N	58 W	"D" Sandstone	6,445	---	6,400	Flowing.
Sleeper	No. 1-X Buczkowskyj	Chancellor Exploration Co. -Exeter Drilling Co.	23	12 N	56 W	----do	6,387	287	-----	Pumping.
Crystal	No. 1 Holland	J. A. Terteling & Sons-South Texas Development Co.	34	12 N	57 W	----do	6,782	186	-----	Flowing.

Source: Petroleum Information Corp., 1969 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

Co. at Denver, King Resources Co. at Denver, and Morrison Refining Co. at Grand Junction. The Tenneco Oil Co. refinery at Denver was sold to General Real Estate & Resources Trust Co. for $6.8 million and leased to King Resources. Total refining capacity in the State was unchanged, 42,900 barrels of crude oil per day.

The refineries processed 13.7 million barrels of crude oil, of which 11.6 million were from other States. Wyoming continued as the principal supplier of the interstate receipts with 8.8 million barrels. Also supplying crude oil to Colorado were Montana, New Mexico, and Utah. Colorado producers shipped 28.6 million barrels of crude oil out of State. Utah received 16.8 million barrels, Ohio 6.3 million, Oklahoma 1.5 million barrels; other recipients were Indiana, Kansas, Illinois, Wyoming, California, and Pennsylvania.

NONMETALS

Cement.—Shipments of portland cement were 8 percent less than during the previous year, but shipments of masonry cement gained 9 percent. As in the past, production was at the Boettcher plant, Larimer County, and the Portland plant, Fremont County, of Ideal Cement Co., a division of Ideal Basic Industries, Inc. Of the output 93 percent of the portland and 95 percent of the masonry cement went to consumers in Colorado; the balance was shipped to nearby States. Seventy percent of the portland cement shipments went to ready-mixed concrete companies. Other users, in order of consumption, were concrete products manufacturers, highway contractors, and building material dealers.

The Lyons plant of Dewey Rocky Mountain Cement Co., subsidiary of Martin Marietta Corp., was completed in December.[11] The plant is equipped with a direct digital control computer, which enables process engineers to work out efficient control systems and make on-line changes. The plant also incorporates equipment for dust- and fume-control, equipment for treating oil-bearing shale, and a ferris wheel-type feeder for the kiln.

Clays.—Production of clay increased 19 percent in quantity and 32 percent in value. The increased output is partly attributable to new, automated equipment and other improvements in some of the plants. Ratios of clay varieties to total clay sold and used were virtually unchanged from those of 1968; 60.4 percent was miscellaneous clay and shale, 39.4 percent was fireclay, and 0.2 percent was bentonite. Clay used by producers for manufacturing clay products (captive production) amounted to 74 perent of the total; the balance was sold as raw clay.

The numbers of active companies and operations were unchanged from the previous year—24 companies, 53 operations. Fourteen companies produced fireclay, one produced fireclay and common clay, three produced bentonite, and six produced common and undifferentiated clay and shale. The largest producer, The Idealite Co., a division of Ideal Cement Co., mined shale for making lightweight aggregate. Other leading producers were Robinson Brick & Tile Co. and Denver Brick & Pipe Co. Jefferson County, with 64 percent of output, was the leader of the 11 clay-producing counties.

Fireclay was used in the manufacture of heavy clay products (building brick and sewer pipe) and refractories; common clay and shale were used for building brick, lightweight aggregate, and pottery; bentonite was used for reservoir-pond linings.

[11] Mineral Processing. V. 11, No. 4, April 1970, p. 12.

Table 16.—Clay sold or used by producers, by counties

County	1968		1969	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Bent	------	---	W	W
Boulder	11,178	$21	W	W
Douglas	67,526	127	63,893	$194
Elbert	W	W	W	W
El Paso	W	W	W	W
Fremont	23,018	68	28,573	85
Huerfano	W	W	W	W
Jefferson	404,429	566	468,646	658
Las Animas	W	W	W	W
Pueblo	55,925	343	95,226	W
Saguache	985	7	W	W
Undistributed	53,175	90	75,193	682
Total	616,236	1,222	731,531	1,619

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

Feldspar.—The only source of marketable feldspar in the State was the Mica Lode mine in Fremont County, operated by Lockhart & Sons. Production of feldspar was 18 percent more than during 1968 because of greater market outlets. The product was used for decorative aggregate.

Fluorspar.—Output of fluorspar increased almost fourfold as the reactivated Northgate mine of Ozark-Mahoning Co. at Cowdrey reached full-scale production. Three mines in three counties were productive: Burlington mine, Boulder County, operated by Allied Chemical Corp.; Chicken Claim, Fremont County, operated by Howard & H. D. Rusler; and the Northgate mine, Jackson County. The Chicken Claim output was fluxing gravel used in steelmaking; of the balance, most was acid-grade used for hydrofluoric acid.

Gypsum.—Output of gypsum declined 4 percent in quantity and value. Production was from five mines in three counties—three in Fremont County and one each in Chaffee and Larimer Counties. All mines were open pit operations. Uncalcined gypsum was used as portland-cement retarder and as a soil conditioner; calcined gypsum was used for manufacturing building products, principally wallboard.

Lime.—Prodution of lime increased moderately—2,000 tons for a 2-percent gain. The Colorado Lime Co., Inc. plant in El Paso County, the only producer of lime for soil stabilization, was not operated during the year; this reduced the number of operating plants to 12 and eliminated for a time that use category.

The great increase in use of lime in the basic-oxygen steel furnaces of CF&I more than offset the decrease in usage for soil stabilization. Ten of the 12 plants were at sugar beet refineries; eight were owned by The Great Western Sugar Co. and one each by American Crystal Sugar Co. and Holly Sugar Corp. The other two were the Glenwood Springs plant of Basic Chemical Corp. and the Pueblo plant of CF&I. Output of the Basic Chemical plant was sold for metallurgical and sewage and water treatment uses; that from CF&I was used for refractories, as well as in the company's basic-oxygen steel furnaces.

Perlite.—The only crude perlite produced in the State was mined at the Rosita mine of Persolite Products, Inc., in Custer County. Output was 13 percent higher than during 1968. Production from the mine was shipped to the company's expanding plant at Florence.

Perlite was expanded at three plants in the State—Persolite at Florence; Grefco, Inc., Dicalite Division, at Antonito; and W. R. Grace & Co., Zonolite Division, Western Region, at Denver. Source of the crude perlite for the Grefco and W. R. Grace plants was from deposits in New Mexico. Expanded perlite from the Grefco plant was used for filler and filter aid; that from W. R. Grace and Persolite was used for concrete and plaster aggregate, horticultural aggregates, masonry and cavity-fill insulation, and other miscellaneous uses.

Pumice.—Production of pumice, in the form of volcanic cinders and scoria, increased 14,000 tons (50 percent); value, however, declined 1 percent. Output was from five operations in four counties. Scoria was produced by Colorado Aggregate Co., Inc., at its Mesita Hill mine in Costilla County, and by McCoy Aggregate Co. at the McCoy pit in Routt County. Volcanic cinders were mined by Dotsero Block Co., Inc., and Roaring Fork Pumice Block Co. in Eagle County, and by Volcanic Materials, Inc., in Saguache County. Most of the production was used for railroad ballast and concrete aggregate; lesser amounts were used for roofing, landscaping, road construction, and absorbent (animal).

Volcanic Materials, Inc., was purchased late in the year by Ashley Valley Oil Co., Tulsa, Okla. The company will continue operations as a subsidiary of Ashley.

Pyrites.—Output of pyrites, a byproduct of molybdenum mining at the Climax mine, increased 1,000 tons (4 percent). The pyrite was shipped for subsequent use in manufacturing sulfuric acid; minor amounts were used for coloring in glass bottles.

Salt.—Salt, in the form of brine, was recovered from a well in Montrose County by Union Carbide Corp. for use in the company's uranium-vanadium mill at Uravan. Production was essentially unchanged from that of the previous year.

Sand and Gravel.—Output of sand and gravel decreased 14 percent from the record high of 23.1 million tons in 1968. The decline reflected the lower level of construction contracts awarded in the previous year. Again, sand and gravel was the most valuable nonmetallic mineral com-

modity in the State, comprising 52 percent of the value of the nonmetallics and 7 percent of the value of all mineral commodities. Sand and gravel ranked fourth in value after molybdenum, petroleum, and coal.

Of the total output, 81 percent was gravel and 19 percent was sand. Average value for gravel was $1.42 per ton; average for sand was $1.18; overall average was $1.37 per ton. Most of the sand and gravel, 18.8 million tons, was processed before use; that is, washed, screened, crushed, or a combination of these. The balance, 1.1 million tons, was pit run. Average value of the processed material was $1.42 per ton, compared with $0.54 for the pit-run sand and gravel.

Table 17.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Adams	3,401	$3,695	2,582	$3,263
Alamosa	664	489	151	189
Arapahoe	1,212	1,391	858	1,117
Archuleta	180	170	262	437
Baca	128	135	55	130
Bent	64	64	40	50
Boulder	1,244	1,314	1,770	2,469
Chaffee	307	325	151	201
Cheyenne	14	9	54	87
Clear Creek	W	W	W	W
Conejos	86	95	69	99
Costilla	W	W	1	1
Crowley	6	3	48	79
Custer	55	48	122	180
Delta	249	300	W	W
Dolores	120	120	-----	-----
Douglas	435	500	407	456
Eagle	31	37	90	163
Elbert	W	W	216	290
El Paso	1,550	2,114	1,285	1,512
Fremont	303	313	53	92
Garfield	178	247	358	627
Gilpin	-----	-----	20	24
Grand	69	76	37	54
Gunnison	373	359	187	359
Hinsdale	(1)	(1)	9	16
Huerfano	26	26	48	79
Jackson	-----	-----	11	19
Jefferson	2,407	3,588	2,191	3,122
Kiowa	136	134	37	61
Kit Carson	485	497	539	870
Lake	352	390	183	217
La Plata	181	251	126	257
Larimer	1,098	1,177	678	887
Las Animas	781	804	810	1,353
Lincoln	370	358	307	255
Logan	850	856	90	114
Mesa	722	834	721	1,164
Mineral	3	3	59	99
Moffat	264	259	355	562
Montezuma	291	350	425	449
Montrose	192	180	317	394
Morgan	301	337	260	356
Otero	W	W	483	697
Ouray	49	35	46	41
Park	-----	-----	42	70
Phillips	74	85	54	96
Pitkin	212	245	151	193
Prowers	144	176	W	W
Pueblo	1,032	1,646	943	1,352
Rio Blanco	174	179	5	12
Rio Grande	126	145	173	305
Routt	W	W	W	W
Saguache	W	W	72	121
San Juan	25	25	-----	-----
San Miguel	42	42	84	100
Sedgwick	74	66	461	372
Summit	147	164	185	300
Teller	27	23	106	78
Washington	106	105	58	61
Weld	699	699	545	635
Yuma	258	256	72	76
Undistributed	804	869	415	604
Total	23,121	26,608	19,877	27,266

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Less than ½ unit.

Table 18.—Sand and gravel sold or used by producers, by class of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	2,321	$2,605	2,184	$2,620
Paving	628	1,573	874	877
Railroad ballast	(1)	(1)	-----	-----
Fill	142	100	202	143
Other	[1] 100	[1] 162	[1] 117	[1] 201
Industrial:				
Blast	(1)	(1)	(1)	(1)
Fire or furnace	(1)	(1)	(1)	(1)
Engine	(1)	(1)	(1)	(1)
Filtration	(1)	(1)	(1)	(1)
Oil (hydrafrac)	-----	-----	(1)	(1)
Other	-----	-----	(1)	(1)
Total [2]	3,191	4,440	3,377	3,840
Gravel:				
Construction:				
Building	2,555	3,699	2,942	4,819
Paving	5,427	6,779	3,645	4,619
Railroad ballast	97	180	[2] 125	[2] 152
Fill	312	254	377	365
Other	290	346	(3)	(3)
Miscellaneous	95	112	215	303
Total [2]	8,776	11,370	7,305	10,257
Total sand and gravel [2]	11,967	15,810	10,682	14,098
Government-and-contractor operations:				
Sand:				
Building	1	1	5	16
Paving	1,365	1,373	434	650
Fill	101	101	30	37
Other	16	14	2	1
Total	1,483	1,489	471	704
Gravel:				
Building	-----	-----	28	75
Paving	8,677	8,632	7,883	11,742
Fill	985	671	813	647
Other	9	6	-----	-----
Total	9,671	9,309	8,724	12,464
Total sand and gravel	11,154	10,798	9,915	13,168
All operations:				
Sand	4,674	5,929	3,848	4,544
Gravel	18,447	20,679	16,029	22,721
Total [2]	23,121	26,608	19,877	27,266

[1] Railroad ballast (1968), other (construction), blast, fire or furnace, engine, filtration, oil (hydrafrac) (1969), and other (industrial) (1969) sand combined to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.
[3] Railroad ballast and other gravel combined to avoid disclosing individual company confidential data.

Output of commercial operators was 10.7 million tons, 54 percent of total production. Leading producers (those with output of more than 500,000 tons), in order of output, were Cooley Gravel Co., Asphalt Paving Co., The Brannan Sand & Gravel Co., Flatiron Sand and Gravel Co., Pre-Mix Concrete, Inc., and Broderick and Gibbons, Inc. These companies accounted for 4.4 million tons of sand and gravel, 22 percent of the State production. Noncommercial production—that produced for Governmental agencies, either by Government crews or by contractors—amounted to 9.2 million tons, 46 percent of total output. The number of sand and gravel operations decreased from 355 in 1968 to 304 in 1969. Of the operations, 164 were Government-and-contractor and 140 were classed as commercial.

Road construction and maintenance consumed 12.8 million tons of sand and gravel; and building construction used 5.2 million tons. The remaining 1.9 million tons were used for fill, railroad ballast, industrial sand (blast, engine, filtration, fire and furnace, and hydrafracing), and miscellaneous uses.

Among the 63 counties in the State, all except Denver, Dolores, and San Juan had sand and gravel production. Forty counties had commercial operations, and all but

Pitkin and Routt had Government-and-contractor operations. Adams County had the greatest production, 2.6 million tons; it was followed, in order of output, by Jefferson, Boulder, and El Paso Counties all of which had production of over 1 million tons. Output of the four counties was 39 percent of the State total. Thirty-one counties had yields between 100,000 and 1 million tons; 25 had less than 100,000 tons.

Stone.—Production of stone decreased 226,000 tons, 9 percent less than in the previous year. Forty counties had stone production from 130 quarries. The principal producer was again Fremont County. Five counties had output exceeding 100,000 tons of stone; in addition to Fremont, they were Chaffee, Dolores, El Paso, and Larimer.

Virtually all of the stone produced, 99 percent, was as crushed and broken stone; 13,373 tons were dimension stone. Principal uses of crushed and broken stone were for making cement, flux stone, making lime, surface-treatment aggregate, and concrete aggregate. Limestone, including dolomite, was the principal stone produced, followed by sandstone and quartzite, traprock, and granite. Other types were marble, quartz, and miscellaneous stone.

Table 19.—Stone sold or used by producers, by counties

County	1968		1969	
	Short tons	Value	Short tons	Value
Adams	497	$746	1,724	$2,591
Alamosa	-----	-----	73	112
Arapahoe	2,300	4,010	958	2,275
Archuleta	646	969	1,020	3,386
Baca	94	141	-----	-----
Boulder	97,225	190,468	11,854	75,906
Chaffee	W	W	W	W
Cheyenne	-----	-----	554	831
Conejos	W	W	-----	-----
Crowley	-----	-----	658	987
Custer	W	W	W	W
Dolores	23,151	46,326	113,790	56,895
Douglas	W	W	10,620	36,226
Eagle	23,638	25,017	-----	-----
Elbert	-----	-----	736	1,104
El Paso	W	W	W	W
Fremont	910,630	1,490,684	W	W
Garfield	61,682	203,907	W	W
Gilpin	-----	-----	W	W
Grand	420	630	2,472	4,335
Gunnison	203,952	407,828	6,512	28,548
Hinsdale	1,512	3,024	-----	-----
Huerfano	10	15	1,350	4,491
Jackson	-----	-----	1,051	4,180
Jefferson	23,552	99,091	88,663	244,981
Kit Carson	715	1,072	-----	-----
Lake	13,876	22,458	-----	-----
La Plata	-----	-----	4,278	11,422
Larimer	496,986	1,361,150	520,616	1,264,683
Las Animas	40,569	60,854	5,040	7,560
Lincoln	1,192	1,788	-----	-----
Logan	1,800	2,160	948	3,592
Mesa	W	W	244	8,480
Moffat	-----	-----	12,528	33,408
Montrose	23,965	113,834	15,611	90,916
Morgan	-----	-----	245	368
Otero	317	476	42	112
Park	W	W	W	W
Phillips	132	198	134	201
Pitkin	330	495	-----	-----
Prowers	-----	-----	620	930
Pueblo	W	W	-----	-----
Rio Blanco	1,782	2,673	68,300	137,500
Rio Grande	88,734	131,286	66	99
Routt	1,782	2,673	-----	-----
Saguache	-----	-----	248	1,240
San Miguel	-----	-----	5,994	W
Sedgwick	750	750	18	27
Summit	448	537	70	3,500
Teller	644	12,880	W	W
Washington	1,500	9,450	-----	-----
Weld	2,913	9,884	-----	-----
Undistributed	443,680	993,987	1,368,393	3,047,653
Total	2,471,424	5,201,461	2,245,430	5,078,539

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

Table 20.—Stone sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind of stone	1965		1966		1967		1968		1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dolomite and limestone	2,204	$4,067	2,191	$3,911	[1] 2,214	[1] $3,823	1,812	$3,694	1,847	$3,913
Granite	2,059	3,089	2,789	4,358	284	418	202	470	76	179
Marble	2	33	3	35	3	26	1	12	1	13
Quartz, quartzite, and sandstone	189	833	1,664	2,443	281	847	252	615	182	595
Quartz and quartzite	NA	NA	NA	NA	NA	NA	72	162	20	213
Sandstone	NA	NA	NA	NA	NA	NA	180	453	162	382
Traprock	W	W	45	48	W	W	-----	-----	83	228
Other stone	335	616	338	536	211	370	204	410	56	151
Total [2]	4,789	8,638	7,031	11,331	2,992	5,485	2,471	5,201	2,245	5,079

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Other stone."

[1] Excludes dimension limestone which is included with "Other stone."

[2] Data may not add to totals shown because of independent rounding.

Table 21.—Stone sold or used by producers, by uses

Use		1968		1969	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension stone:					
Rough:					
Irregular-shaped stone and rubble	short tons	1,743	$17	4,632	$81
Architectural	cubic feet	32,622	29	33,539	36
Monumental	do.	6,962	13	10,952	31
Other	do.	31,373	36	48,265	55
Dressed:					
Architectural	do.	43,792	96	2,349	16
Monumental	do.	5,000	100	-----	-----
Flagging	do.	8,451	10	[1] 15,418	[1] 33
Total (approximate)	short tons	12,200	301	13,400	252
Crushed and broken stone:					
Bituminous aggregate	short tons	W	W	W	W
Concrete aggregate	do.	204,012	447	W	W
Roadbase stone	do.	219,966	371	W	W
Surface treatment aggregates	do.	145,740	312	223,094	262
Lime	do.	174,873	423	234,183	557
Metallurgical	do.	W	W	W	W
Riprap and jetty stone	do.	258,963	469	126,402	353
Terrazzo	do.	W	W	13,564	164
Other	do.	[2] 1,455,670	[2] 2,878	[3] 1,634,814	[3] 3,491
Total	do.	2,459,224	4,900	2,232,057	4,827
Total stone (approximate)	do.	2,471,400	5,201	2,245,400	5,079

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

[1] Flagging and house stone veneer combined to avoid disclosing individual company confidential data.

[2] Includes stone used in asphalt fillers, cement, landscaping, manufactured fine aggregate, mine dusting, other soil conditioners and nutrients, railroad ballast, refractories, and terrazzo.

[3] Includes stone used in cement, macadam aggregates, manufactured fine aggregates, mine dusting, refractories, roofing aggregates, soil conditioners, unspecified aggregate, and other unspecified uses.

Leading stone producers, in order of output, were Ideal Cement Co. (limestone), CF&I (limestone and dolomite), Castle Concrete Co. (limestone), Frank H. Norberg Co. (limestone), and Dolores County Highway Department (sandstone). The five producers each had output of 100,000 tons or more.

Sulfur.—The first shipment of sulfur from the new recovery unit at the Continental Oil Co. refinery at Denver was made in July. A total of 1,003 long tons of sulfur was shipped during the year. This byproduct sulfur is not included as part of the mineral production of the State because it is considered a secondary product.

Vermiculite.—Crude vermiculite from Montana was exfoliated by W. R. Grace & Co. at its plant in Denver. The product was sold for use as loose-fill insulation, concrete and plaster aggregate, soil conditioning, and fire base.

Table 22.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium: U.S. Beryllium Corp	306 Bon Durant Bldg. Pueblo, Colo. 81003	Open pit mine and mill	Park.
Carbon Dioxide, natural: Tenneco Oil Co.	Box 2410 Denver, Colo. 80201	Well in McElmo field	Montezuma.
Cement: Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Wet process, 2-rotary-kiln plant.	Fremont.
		Dry process, 2-rotary-kiln plant.	Larimer.
Clays:			
The Idealite Co., a division of Ideal Basic Industries, Inc.	----do----	Open pit mine and expanding plant.	Jefferson.
Robinson Brick & Tile Co	500 South Santa Fe Drive Denver, Colo. 80223	Underground mine and 3 open pit mines.	Douglas.
		Open pit mine	Elbert.
		----do----	El Paso.
		Open pit mine and 2 underground mines.	Jefferson.
Coal, bituminous:			
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Underground mine	Las Animas.
Energy Coal Co	2850 North Meridian St. Indianapolis, Ind. 46208	Strip mine and crushing plant.	Routt.
Mid-Continent Coal and Coke Co.	Carbondale, Colo. 81623	3 underground mines; cleaning and thermal drying plant.	Pitkin.
Peabody Coal Co	301 N. Memorial Drive St. Louis, Mo. 63102	Strip mine and crushing plant.	Montrose.
		----do----	Routt.
The Pittsburg & Midway Coal Mining Co.	Ten Main Center Kansas City, Mo. 64105	Strip mine; crushing and oil treatment plant.	Do.
United States Steel Corp. Western District-Coal.	Box 807 Dragerton, Utah 84520	Underground mine; cleaning and crushing plant.	Delta and Gunnison.
Copper: Idarado Mining Co	Ouray, Colo. 81427	*See* Zinc	Ouray and San Miguel.
Fluorspar:			
Allied Chemical Corp., Industrial Chemicals Division.	Box 70 Morristown, N.J. 07960	Underground mine and plant.	Boulder.
Ozark-Mahoning Co., Mahoning Mining Division.	Box 57 Rosiclare, Ill. 62982	----do----	Jackson.
Gold:			
Idarado Mining Co	Ouray, Colo. 81427	*See* Zinc	Ouray and San Miguel.
Standard Metals Corp	415 Petroleum Club Bldg. 110 16th St. Denver, Colo. 80202	----do----	San Juan.
Gypsum: Johns-Manville Corp	215 Market St. Room 916 San Francisco, Calif. 94105	Open pit mine and wallboard plant.	Fremont.
Iron ore: Pitkin Iron Corp	105 West Adams St. Chicago, Ill. 60603	Open pit mine	Pitkin.
Lead:			
Emperius Mining Co	Creede, Colo. 81130	*See* Zinc	Mineral.
Homestake Mining Co	Box 98 Creede, Colo. 81130	*See* Silver	Do.
Idarado Mining Co	Ouray, Colo. 81427	*See* Zinc	Ouray and San Miguel.
The New Jersey Zinc Co	2045 City Line Road Bethlehem, Pa. 18017	----do----	Eagle.
Rico Argentine Mining Co	605 Kearns Bldg. Salt Lake City, Utah 84101	----do----	Dolores.
Standard Metals Corp	415 Petroleum Club Bldg. 110 16th St. Denver, Colo. 80202	----do----	San Juan.
Lime:			
The Great Western Sugar Co	Box 5308 Denver, Colo. 80217	Pot-kiln plant	Adams.
		2 pot-kiln plants	Boulder.
		----do----	Larimer.
		Pot-kiln plant	Logan.
		Shaft-kiln plant	Morgan.
		Pot-kiln plant	Sedgwick.
		2 pot-kiln plants	Weld.
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Natural-frequency-vibrating kiln plant.	Pueblo.
Molybdenum:			
American Metal Climax, Inc., Climax Molybdenum Co.	No. 1 Greenwich Plaza Greenwich, Conn. 06830	Underground mine and mill.	Clear Creek.
		Underground mine, mill, and byproducts plant.	Lake.

Table 22.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas and petroleum:			
Bright & Schiff	107 Mercantile Continental Bldg. Dallas, Tex. 75201	Crude oil and gas wells: Saber field.	Logan.
Champlin Petroleum Co	Box 9365 Fort Worth, Tex. 76107	Crude oil and gas wells: Boxer field.	Morgan.
		Crude oil and gas wells: Bison, Ramp, and Westfork fields.	Washington.
Chevron Oil Co., Western Division.	Box 599, 1700 Broadway Denver, Colo. 80201	Crude oil and gas wells: Black Hollow and Pierce fields.	Weld.
		Crude oil and gas wells, and gas processing plant: Rangely field.	Rio Blanco.
Clinton Oil Co	6810 West Hwy. 54 Wichita, Kans. 67209	Crude oil and gas wells: Belle field.	Washington.
Continental Oil Co	Box 2197 Houston, Tex. 77001	Crude oil and gas wells: McCallum field.	Jackson.
		Crude oil and gas wells: Big Beaver, Bobcat, Little Beaver, and Plum Bush Creek fields.	Washington.
		Refinery	Adams.
Don M. Rounds Co	925 Petroleum Club Bldg. Denver, Colo. 80202	Crude oil wells: Cimarron field.	Washington.
El Paso Natural Gas Co	Box 1492 El Paso, Tex. 79999	Gas processing plant	La Plata.
International Nuclear Corp	308 Lincoln Tower Bldg. Denver, Colo. 80203	Crude oil wells: Brandon field.	Kiowa.
Monsanto Co., Hydrocarbons & Polymers Division.	800 North Lindbergh Blvd. St. Louis, Mo. 63116	Crude oil wells: Battleship field.	Jackson.
		Crude oil and gas wells: Marble Wash field.	Montezuma.
		Crude oil and gas wells: Little East Beaver and Nugget fields.	Washington.
Pan American Petroleum	Box 591 Tulsa, Okla. 74102	Crude oil and gas wells: Black Jack field.	Arapahoe.
		Crude oil and gas wells: Cache field.	Montezuma.
		Crude oil and gas wells: Big Beaver field.	Washington.
King Resources Co	1616 Glenarm St. Denver, Colo. 80202	Refinery	Adams.
Texaco Inc	Box 2100 Denver, Colo. 80201	Crude oil and gas wells: Danforth Hills and Maudlin Gulch fields.	Moffat.
		Crude oil and gas wells and gas processing plant: Wilson Creek field.	Rio Blanco.
Union Oil Company of California, Northern Division.	1860 Lincoln St. Denver, Colo. 80203	Crude oil and gas wells and gas processing plant: Adena field.	Morgan.
Union Texas Petroleum	3000 Richmond Ave. Houston, Tex. 77001	Crude oil wells: Blade, Lindon, Ranger, Ring, and Rush Willadel fields.	Washington.
Peat:			
Alpen Meadows, Inc	Box 1074 Colorado Springs, Colo. 80901	Bog	Teller.
McCoy & Jensen, Inc	Rte 1, Box 252 Morrison, Colo. 80465	----do	Park.
Clarence C. Reiff	109 East Eagle Ave. Kremmling, Colo. 80459	----do	Lake.
Universal Peat Co	5926 West Arizona Ave. Denver, Colo. 80226	----do	Park.
Perlite: Persolite Products, Inc	635 Curtis St. Denver, Colo. 80204	Open pit mine	Custer.
		Expanding plant	Fremont.
Pumice:			
Colorado Aggregate Co., Inc.	Mesita, Colo. 81142	Open pit mine and plant.	Costilla.
Dotsero Block Co., Inc	Box 933 Glenwood Springs, Colo. 81601	----do	Eagle.
McCoy Aggregate Co	703 Lincoln Ave. Steamboat Springs, Colo. 80477	----do	Routt.
Pyrites: American Metal Climax Inc., Climax Molybdenum Co.	No. 1 Greenwich Plaza Greenwich, Conn. 06830	*See* Molybdenum	Lake.

Table 22.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Rare-earths, monazite: American Metal Climax, Inc., Climax Molybdenum Co.	No. 1 Greenwich Plaza Greenwich, Conn. 06830	*See* Molybdenum	Lake.
Sand and gravel (commercial):			
Asphalt Paving Co	14802 West 44th Ave. Golden, Colo. 80401	Pit and plant	Douglas.
		----do	Garfield.
		Pit and 2 plants	Jefferson.
		Pit and plant	Lincoln.
The Brannan Sand & Gravel Co.	4800 Brighton Blvd. Denver, Colo. 80216	Pit and 4 plants	Adams.
		Pit and plant	Arapahoe.
		----do	Jefferson.
Broderick & Gibbons, Inc	Box 313 Pueblo, Colo. 81002	4 pits and plant	El Paso.
		7 pits and plant	Pueblo.
Cooley Gravel Co	5631 Tennyson St. Arvada, Colo. 80002	Pit and plant	Adams.
		2 pits and plants	Arapahoe.
Flatiron Sand & Gravel Co	2344 Spruce St. Boulder, Colo. 80302	Pit and plant	Boulder.
Pre-Mix Concrete, Inc., Pre-Mix Sand & Gravel Division.	1500 West 12th Ave. Denver, Colo. 80204	----do	Adams.
		----do	Douglas.
Silver:			
American Smelting and Refining Co. (McFarland & Hullinger, lessee.)	120 Broadway New York, N.Y. 10005	*See* Zinc	Gunnison.
Emperius Mining Co	Creede, Colo. 81130	----do	Mineral.
Homestake Mining Co	Box 98 Creede, Colo. 81130	Underground mine and mill.	Do.
Idarado Mining Co	Ouray, Colo. 81427	*See* Zinc	Ouray and San Miguel.
The New Jersey Zinc Co	2045 City Lane Road Bethlehem, Pa. 18017	----do	Eagle.
Rico Argentine Mining Co	605 Kearns Bldg. Salt Lake City, Utah 84101	----do	Dolores.
Silver Bell Industries, Inc	222 Milwaukee St. Denver, Colo. 80206	Underground mine and mill.	Do.
Standard Metals Corp	415 Petroleum Club Bldg. 110 16th St. Denver, Colo. 80202	*See* Zinc	San Juan.
U.S. Silver Mining Co	Box 749 Salida, Colo. 81201	Underground mine and mill.	Saguache.
Stone:			
Castle Concrete Co	Box 2379 Colorado Springs, Colo. 80901	2 quarries and plants	El Paso.
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Quarry and plant	Chaffee.
		----do	Fremont.
Dolores County Highway Departments.	Dove Creek, Colo. 81324	----do	Dolores.
Frank H. Norberg Co	418 Guaranty Bank Bldg. Denver, Colo. 80202	----do	Garfield.
		2 quarries and plants	Larimer.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Quarry and plant	Fremont.
		----do	Larimer.
Tin: American Metal Climax, Inc., Climax Molybdenum Co.	No. 1 Greenwich Plaza Greenwich, Conn. 06830	*See* Molybdenum	Lake.
Tungsten: American Metal Climax, Inc., Climax Molybdenum Co.	----do	----do	Do.
Uranium:			
American Metal Climax, Inc., Climax Uranium Co.	Box 1629 Grand Junction, Colo. 81501	Underground mine	Garfield.
		6 underground mines and mill.	Mesa.
		16 underground mines	Montrose.
Cotter Corp	Box 468 Golden, Colo. 80401	5 underground mines	San Miguel.
		Underground mine	Jefferson.
		Underground mine and mill.	Fremont.
Union Carbide Corp	270 Park Avenue New York, N.Y. 10017	----do	Garfield.
		4 underground mines	Mesa.
		63 underground mines and mill.	Montrose.
		3 underground mines	San Miguel.
Vanadium:			
American Metal Climax, Inc., Climax Uranium Co.	Box 1629 Grand Junction, Colo. 81501	*See* Uranium	Garfield, Mesa, Montrose, San Miguel.
Union Carbide Corp	270 Park Ave. New York, N.Y. 10017	----do	Do.

Table 22.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Zinc:			
American Smelting and Refining Co. (McFarland & Hullinger, lessee.)	120 Broadway New York, N.Y. 10005	Underground mine and mill.	Gunnison.
Emperius Mining Co	Creede, Colo. 81130	----do	Mineral.
Homestake Mining Co	Box 98 Creede, Colo. 81130	*See* Silver	Do.
Idarado Mining Co	Ouray, Colo. 81427	Underground mine and mill.	Ouray and San Miguel.
The New Jersey Zinc Co	2045 City Line Road Bethlehem, Pa. 18017	----do	Eagle.
Rico Argentine Mining Co	605 Kearns Bldg. Salt Lake City, Utah 84101	----do	Dolores.
Standard Metals Corp	415 Petroleum Club Bldg. 110 16th St. Denver, Colo. 80202	3 underground mines and mill.	San Juan.

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 Eugene C. Baker [1]

Value of mineral production in Connecticut was $28 million, an increase of about 16 percent from 1968. Greater sales of sand and gravel, stone products, feldspar and lime accounted for the value increase.

Sand and gravel and stone continued to be the principal minerals produced in the State. Their sales accounted for about 92 percent of the value of all minerals produced. The combined production of these commodities was up about 8 percent.

The State Department of Highways and the Department of Public Works reported that there was an increase in the building of roads, bridges, buildings, dams, and recreation facilities. This activity was the prime contributor to the increased value of mineral production for 1969.

During 1969, the Geological and Natural History Survey published Bulletin 102, Thirty-third Biennial Report of the Commissioners, 1967–69. This report summarizes the progress of the Survey in its continued geologic mapping and natural history programs. It also summarizes the education program at Dinosaur State Park, which was started in 1968 in cooperation with the Park and Forest Commission.

The U.S. Geological Survey published one surficial map, GQ–782, New Preston quadrangle, and 14 aeromagnetic maps. Also, 10 surficial quadrangles and two bedrock maps were in printing.

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[1] Industry economist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Connecticut [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays----------thousand short tons--	195	$325	197	$341
Gem stones----------	NA	8	NA	8
Sand and gravel----------thousand short tons--	8,752	9,321	8,857	10,359
Stone----------do----	6,383	12,729	7,562	15,325
Value of items that cannot be disclosed: Feldspar, lime, and mica (scrap)----------	XX	1,493	XX	1,734
Total----------	XX	23,876	XX	27,767
Total 1967 constant dollars----------	XX	23,687	XX	p 27,013

p Preliminary. 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 Connecticut, by counties

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Fairfield	$976	$1,164	Sand and gravel.
Hartford	8,497	8,978	Stone, sand and gravel, clays.
Litchfield	2,781	3,195	Stone, sand and gravel, lime.
Middlesex	1,514	1,801	Feldspar, sand and gravel, stone, mica, clays.
New Haven	7,186	9,167	Stone, sand and gravel, clays.
New London	1,096	1,264	Stone, sand and gravel.
Tolland	W	W	Sand and gravel.
Windham	W	W	Sand and gravel, stone.
Undistributed [1]	1,825	2,200	
Total [2]	23,876	27,767	

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.
[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Connecticut business activity

	1968	1969 p	Change, percent
Employment, and labor force, annual average: [1]			
Total labor force—thousands	1,330	1,363	+2.5
Manufacturing—do	477	475	−0.4
Durable goods—do	356	353	−0.8
Nondurable goods—do	121	122	+0.8
Nonagricultural—do	1,150	1,195	+3.9
Unemployment—percent of work force	3.7	3.8	+2.7
Personal income: [2]			
Total—millions	r $12,611	$13,610	+7.9
Per capita	$4,259	$4,537	+6.5
Construction activity:			
New building permits [3]	2,060	1,978	−4.0
Cement shipments to and within Connecticut—thousand 376-pound barrels	4,313	4,390	+1.8
Business activity:			
New incorporations [3]	287	328	+14.3
Electric power sales [3]—million kilowatt-hours	417	447	+7.2
Mineral production value—thousands	$23,876	$27,767	+16.3

p Preliminary. r Revised.
[1] Connecticut Labor Department.
[2] Survey of Current Business.
[3] Connecticut Economic Indicators.

Table 4.—Worktime 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
1968:								
Nonmetal	138	283	39	314	---	10	31.86	335
Sand and gravel	456	212	97	785	---	11	14.02	516
Stone	384	275	106	888	---	20	22.53	550
Total [1]	978	247	241	1,986	---	41	20.64	502
1969: p								
Nonmetal	85	259	22	182	---	4	21.99	896
Sand and gravel	505	221	112	912	---	19	20.84	280
Stone	400	266	106	894	---	17	19.02	616
Total [1]	990	242	240	1,987	---	40	20.13	488

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Cement is not manufactured in the State. Shipments of portland cement into Connecticut from Pennsylvania, New York, Maryland, and Maine totaled about 4.4 million barrels; masonry cement receipts were 145 thousand barrels. Consumption of portland cement increased about 2 percent compared with that of 1968.

Clays.—Clay production and value was about the same as in 1968. Mining operations were located in Hartford, Middlesex, and New Haven Counties by four companies. Most of the clay was consumed in the manufacture of building brick; small quantities were utilized by the ceramic and specialty clay products industry. The State Division of Building Construction reported that there was an increase in the commercial use of brick and concrete construction in 1969.

Feldspar.—The production of crude feldspar from one mine in Middlesex County was slightly greater than that of 1968. The recovered product was subsequently concentrated by flotation. The concentrate was primarily used by manufacturers of glass and ceramic products in New Jersey, Pennsylvania, and Rhode Island. Limited quantities were exported.

Gem Stones.—Mineralogical societies dealers, and individuals collected specimens from dumps, quarries, and pegmatite deposits in the State. The value of the collectors' items was about $8,000, the same as it has been for the past several years.

Gypsum.—National Gypsum Co. imported crude gypsum for processing into finished building plaster products, and board and sheathing materials in its New Haven plant.

Lime.—Production and value of lime, quick and hydrated, increased 8 percent and 16 percent, respectively, compared with that of 1968. Most of the quicklime was used to manufacture calcium metal at a nearby plant and for use in paper manufacture. The hydrated lime was sold primarily to masonry contractors; some was used as agricultural lime.

Mica.—Scrap mica was produced as a byproduct from processing crude feldspar by the flotation process at a plant in Middlesex County. Mica production, the same as in 1968, was sold to processors of roofing materials.

Sand and Gravel.—Production of commercial and Government-and-contractor sand and gravel increased slightly. However, the unit selling price increased from $1.07 per ton to $1.17 per ton. This resulted in a value increase of about 11 percent compared with the value for 1968.

Of the 8.9 million tons produced, commerical operators sold about 88 percent and Government-and-contractor operations used about 12 percent. The 8.9 million tons produced by 77 commercial and 13 Government-and-contractor operations were used primarily as aggregate in concrete for structural and paving construction. Small amounts were used as fill and ballast.

Sand and gravel was produced in all of the State's eight counties; however, 54 percent was produced in Hartford and New Haven Counties.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	2,054	$2,306	2,001	$2,459
Paving	1,630	2,035	1,663	2,426
Fill	413	246	313	180
Other [1]	186	178	290	313
Total	4,283	4,765	[2] 4,266	5,378
Gravel:				
Structural	1,504	2,446	1,438	2,403
Paving	886	1,039	1,003	1,354
Fill	712	342	790	383
Other [3]	194	246	296	422
Total	3,296	4,073	[2] 3,526	4,562
Total sand and gravel	7,579	8,838	[2] 7,793	9,940
Government-and-contractor operations:				
Sand:				
Paving	183	72	153	62
Fill	30	20	15	10
Other	27	16	25	16
Total	240	108	193	88
Gravel:				
Paving	835	306	827	299
Fill	98	69	44	33
Total	933	375	871	332
Total sand and gravel	1,173	483	1,064	[2] 419
All operations:				
Sand	4,523	4,873	4,459	5,466
Gravel	4,229	4,448	4,397	4,894
Total	8,752	9,321	[2] 8,857	[2] 10,359

[1] Includes molding, filter, and other sand.
[2] Data does not add to totals shown because of independent rounding.
[3] Includes railroad ballast, miscellaneous, and other gravel.

Stone.—Production of stone increased about 18 percent, and its value increased about 20 percent compared with that of 1968.

Crushed basalt used chiefly as construction aggregate and railroad ballast constituted about 92 percent of the total stone production and 84 percent of total value. Its production came from 11 operations in Hartford, Litchfield, and New Haven Counties.

Crushed limestone and dolomite was produced in Litchfield County only, by four operators. It was marketed as metallurgical flux, soil neutralizer, lime manufacturing, and filler.

Crushed sandstone production in Middlesex and New London Counties was used in manufacturing fine aggregate and terrazzo. Quartz and quartzite was also produced for use in glass, asphalt filler, and abrasives. Dimension sandstone was produced in Windham County, and sold primarily for use as rubble and in rough construction work. The dressed stone was marketed as building stone veneer.

METALS

Charles Pfizer & Co., Inc., at Canaan, Litchfield County, produced metallic magnesium, barium, and calcium, and an iron copper powder registered under the trade name Prefiltron. This firm is the only known producer of calcium metal in the United States, which is used to remove impurities during steelmaking. Barium metal is used by the electronics, metals, and chemical industries. Prefiltron is used in the manufacture of electrodes.

The State has six steel mills that produce bars, rods, coils, strip, and wire rope. Approximately 75 foundries produced ferrous and nonferrous castings, and 11

foundries produced ferrous and nonferrous forgings and ingots.

About 25 scrap metal dealers collect and process ferrous metal for export and sale to area foundries.

The Nutmeg Mining Co., Falls Village, continued underground exploration in search of copper and silver in Litchfield County. An additional 300 feet were drilled in 1969. Total depth of drilling is currently 800 feet. No metal recovery was reported.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Michael Kane Brick Co	654 Newfield St. Middletown, Conn. 06475	Pit	Middlesex.
The Keller Pottery Co	North Wales, Pa. 19454	Pit	Hartford.
The Kelsey Ferguson Brick Co	East Windsor Hill, Conn. 06028	Pit	Do.
Plasticrete Corp., Stiles Brick Div	P.O. Box 248 North Haven, Conn. 06473	Pit	New Haven.
Feldspar:			
The Feldspar Corp.[1]	Spruce Pine, N.C. 28777	Pit	Middlesex.
Lime:			
Minerals, Pigments & Metals Div. Chas. Pfizer & Co., Inc.	Daisy Hill Road Canaan, Conn. 06018	Plant	Litchfield.
Gypsum (calcined):			
National Gypsum Company	325 Delaware Ave. Buffalo, N.Y. 14202	----do----	New Haven.
Sand and gravel:			
The Balf Co.[2]	190 Huyshope Ave. Hartford, Conn. 06106	Pit	Hartford.
Beard Sand & Gravel Co., Inc	127 Boston Post Road Milford, Conn. 06460	Pit	New Haven.
C. W. Blakeslee & Sons, Inc	58 Waverly St. New Haven, Conn. 06511	Pit	Middlesex.
The D. J. Carten Sand & Gravel Co	Naugatuck Ave. S. P.O. Box 155 Devon, Conn. 06460	Pit	New Haven.
Chapman Sand & Gravel	Box 442 Melrose, Conn. 06049	Pit	Hartford.
Connecticut Sand & Stone Corp	7 West Main St. Plainsville, Conn. 06062	Pit	Hartford and Litchfield.
John J. Doyle Sand & Gravel Co., Inc	P.O. Box 732 New London, Conn. 06321	Pit	New London.
Dunning Sand & Gravel Co., Inc	Brickyard Rd. Farmington, Conn. 06032	Pit	Hartford.
Hamden Sand & Gravel Co	P.O. Box 4312 Hamden, Conn 06514	Pit	New Haven.
Helming Brothers, Inc., c/o Tomasso, Inc.	Warren St. New Britain, Conn. 06050	Pit	Hartford.
John Lomazzo & Sons Corp	Route 57, Weston Rd. Weston, Conn. 06388	Pit	Fairfield.
Meriden-Wallingford Sand & Stone Co., Inc.	No. Colony Rd. Wallingford, Conn. 06492	Pit	New Haven.
The New Haven Trap Rock Co., Div. of Ashland Oil, Inc.	265 Church St. New Haven, Conn. 06510	Pit	Windham.
Newington Construction Co	187 Richard St. Newington, Conn. 06111	Pit	Hartford.
Oneglia & Gervasini Building Materials, Inc.[2]	P.O. Box 907 Torrington, Conn. 06790	Pit	Litchfield.
Roncari Industries, Inc	1776 South Main St. East Granby, Conn. 06026	Pit	Hartford.
Sega Sand & Gravel, Inc	271 Danbury Rd. New Milford, Conn. 06776	Pit	Litchfield.
Waterbury Sand & Gravel Co	551 So. Leonard St. Waterbury, Conn. 06708	Pit	New Haven.
Stone:			
Basalt, crushed and broken:			
The Balf Co	190 Huyshope Ave. Hartford, Conn. 06106	Quarry	Hartford.
Chas. W. Blakeslee & Sons, Inc	58 Waverly St. New Haven, Conn. 06510	----do----	New Haven.
A. N. Farnham, Inc	90 Pine Rock Ave. New Haven, Conn. 06514	----do----	Do.
The New Haven Trap Rock Co., Div. of Ashland Oil, Inc.	265 Church St. New Haven, Conn. 06510	----do----	Do.
Oneglia & Gervasini Building Materials, Inc.	P.O. Box 907 Torrington, Conn. 06790	----do----	Litchfield.
Roncari Industries, Inc	1776 South St. E. Granby, Conn. 06026	----do----	Hartford.
Angelo Tomasso, Inc	P.O. Box 76 New Britain, Conn. 06050	----do----	Do.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Basalt, crushed and broken—Continued			
Tomasso of Farmington, Inc	P.O. Box 76 New Britain, Conn. 06050	Quarry	Hartford.
The York Hill Trap Rock Quarry Co.	Westfield Rd. Meriden, Conn. 06450	----do----	New Haven.
Granite, dimension:			
Castellucci & Sons, Inc	West River St. Providence, R.I. 02904	----do----	Do.
R. B. Merriott & Sons	Oneco, Conn. 06373	----do----	Windham.
Tower Hill Granite Co	305 Manchester Rd. E. Glastonbury, Conn. 06025	----do----	Hartford.
Granite, crushed and broken:			
The New Haven Trap Rock Co	265 Church St. New Haven, Conn. 06510	----do----	Windham.
Limestone and dolomite, crushed:			
Allyndale Corp	East Canaan, Conn. 06024	----do----	Litchfield.
The Conklin Limestone Co., Inc	Canaan, Conn. 06018	----do----	Do.
Minerals, Pigments & Metals Div. Chas. Pfizer & Co., Inc.	Daisy Hill Road Canaan, Conn. 06018	----do----	Do.
United States Gypsum Co. (Falls Village).	101 So. Wacker Dr. Chicago, Ill. 60606	----do----	Do.
Quartzite, crushed:			
Ottawa Silica Co., Connecticut Silica Div.	P.O. Box 577 Ottawa, Ill. 61350	----do----	New London.
Sandstone and quartzite, dimension:			
Helene Stone Corp	Danielson, Conn. 06239	----do----	Windham.
Hughes Stone Co	R.D. Box 150 Dayville, Conn. 06241	----do----	Do.
Robert V. Olson	P.O. Box 684 Danielson, Conn. 06239	----do----	Do.

[1] Also quartzite and scrap mica.
[2] Two operations.

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 Paul H. Mutschler [1]

The value of mineral production in Delaware for 1969 was $2.1 million, a 4 percent increase over 1968. Minerals produced in the State included common or miscellaneous clay and sand and gravel. The State's only stone producer ceased operations at the end of 1968. The production of clay decreased from 12,000 to 11,000 tons; the production of sand and gravel increased from 1.6 to 2.3 millon tons.

[1]Industry economist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Delaware [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	12	$12	11	$11
Gem stones	NA	1	NA	1
Sand and gravel—thousand short tons	1,596	1,483	2,257	2,074
Stone—do	200	500	-----	-----
Total	XX	1,996	XX	2,086
Total 1967 constant dollars	XX	1,976	XX	p 2,031

p Preliminary. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Indicators of Delaware business activity

	1968	1969	Change, percent
Employment and labor force, annual average: [1]			
Civilian work force—thousands	236.2	241.6	+2.3
Unemployment—as percent of work force	3.1	3.1	-----
Manufacturing—thousands	72.6	73.1	+0.7
Durable goods—do	18.5	18.0	−2.7
Nondurable goods—do	54.1	55.1	+1.8
Nonmanufacturing—do	129.8	134.8	+3.9
Personal income: [2]			
Total—millions	$2,026	p $2,167	+7.0
Per capita	r 3,802	p 4,013	+5.5
Construction activity:			
Cement shipments to Delaware—thousand 376-pound barrels	1,011.4	913.4	−9.7
Mineral production value—thousands	$1,996	$2,086	+4.5

p Preliminary. r Revised.
[1] Bureau of Employment Security—Delaware.
[2] Survey of Current Business.

Table 3.—Worktime 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
1968:								
Nonmetal	12	243	3	23	---	1	42.93	730
Sand and gravel	66	212	14	112	---	1	8.91	71
Stone	10	218	2	20	---	--	-----	----
Total	88	217	19	155	---	2	12.89	161
1969: p								
Nonmetal	(1)	313	1	5	---	--	-----	----
Sand and gravel	45	233	10	87	---	1	11.53	427
Stone	---	---	---	---	---	--	-----	----
Total	45	236	11	92	---	1	10.90	403

p Preliminary.
1 Less than 3.

REVIEW OF MINERAL COMMODITIES

NONMETALS

Clays.—Delaware Brick Co. was again the only producer of clay in the State. The total annual output of clay was 11,000 tons, a decrease of approximately 8 percent from the previous year. Output from this operation in New Castle County, just south of New Castle, was used in the manufacture of common red brick.

A contract between the Federal Bureau of Mines and the State of Delaware to sample and evaluate clays, including greensand (glauconite), continued in force. During 1969 a total of 14 clay samples were tested. Three of these samples were subjected to additional rotary kiln tests. The Delaware Geological Survey plans to publish the results of these and other tests in July 1970.

Sand and Gravel.—Production was reported by 12 companies, one less than in the previous year. Sand and/or gravel pits were operated in all three counties. In addition, sand and gravel, chiefly the latter, was brought in from adjacent States. Reported production of sand was 878,000 tons valued at $1,037,000, a considerable increase over 1968 production of 641,000 tons valued at $688,000. Gravel production totaled 1,379,000 tons valued at $1,037,000, an increase from the 955,000 tons valued at $795,000 reported in 1968. An overall 41-percent increase in sand and gravel production was realized in 1969 over 1968. Of the total production, 782,000 tons was processed and the remainder was sold as bank run. Use of the material was as follows, in thousands of short tons: Building, 365 sand and 75 gravel; paving (or highway), 252 sand and 1,058 gravel; and other, including fill, 261 sand and 246 gravel. Nearly all material was hauled by truck to its destination. Prices for washed sand varied from a low of $0.97 to a high of $2 per ton, gravel from $1 per ton to $3, and pit run material, chiefly gravel, from $0.50 to $0.70 per ton.

Stone.—The State's only stone producer ceased operations at the end of 1968.

Table 4.–Principal producers

Commodity and company	Address	Type of activity	County
Clay: Delaware Brick Co	River Rd., New Castle, Del. 19720	Pit	New Castle.
Sand and gravel:			
Clough & Caulk Sand & Gravel	P.O. Box 129, Route 1, Wyoming, Del. 19934	Pit	Kent.
Delaware Sand & Gravel Co	R.D. No. 2 New Castle, Del. 19720	Pit	New Castle.
George Nashold, Inc	Box 286 Frederica, Del. 19946	Pit	Kent.
Parkway Gravel, Inc	4048 New Castle Ave., New Castle, Del. 19720	Pit	New Castle.
Petrillo Brothers, Inc	P.O. Box 710 Wilmington, Del. 19809	Pit	Do.
St. Jones River Gravel Co	Box 426 Dover, Del. 19901	Pit	Kent.
Whittington's Sand & Gravel Co	U.S. Route 40 Bear, Del. 19701	Pit	New Castle.
Woodlawn Gravel Co	P.O. Box 2501, Wilmington, Del. 19805	Pit	Do.

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 Florida Bureau of Geology for collecting information on all minerals except fuels.

By John W. Sweeney [1] and Earl L. Maxwell [2]

Mineral production in Florida totaled $295 million in 1969, $9.2 million or 3 percent less than that of 1968. This overall decline in mineral production value was attributable to a 17-percent decrease in the value of phosphate rock, the State's most valuable mineral commodity. In 1969, significant value increases were noted for most of the mineral commodities produced, especially those related to the building industry, which reached record levels.

For the 76th consecutive year, Florida led the Nation in phosphate rock output, even though total marketable production decreased 9 percent from that of 1968. Florida also ranked first in the production of fuller's earth and zircon, second in ilmenite, and was the only producer of staurolite.

Florida continued to be the major supplier of phosphate rock for domestic markets (71 percent) and the second leading exporter to world markets. In 1969, exports from Florida accounted for almost 92 percent of the total United States phosphate rock exports. However, exports from Florida ports decreased 6 percent in tonnage and 12 percent in value from that of 1968. These decreases in tonnage and value are in part due to increased foreign competition eroding Florida markets and to a general slump in export sales. Exports from Florida were moved through the ports of Tampa, Boca Grande, and Jacksonsville; shipments were made to 34 foreign countries with Japan, Canada, Italy, and West Germany each receiving more than 1 million short tons of phosphate rock. For the third consecutive year, domestic shipments declined due to another poor planting season in the Midwest.

[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.
[2] Minerals statistical analyst, Bureau of Geology, Department of Natural Resources, Tallahassee, Fla.

Table 1.—Mineral production in Florida [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Clays—thousand short tons	808	$11,699	907	$13,627
Lime—do.	125	2,059	182	2,712
Natural gas—million cubic feet	108	16	50	8
Peat—short tons	41,213	277	55,265	359
Petroleum (crude)—thousand 42-gallon barrels	1,474	W	1,731	W
Sand and gravel—thousand short tons	7,765	7,967	14,409	13,988
Stone [2]—do.	36,692	46,563	42,332	56,611
Value of items that cannot be disclosed: Cement, kyanite concentrates, magnesium compounds, natural gas liquids, phosphate rock, rare-earth metal concentrates (1968), staurolite, stone (dimension), titanium concentrates, zirconium concentrates, and values indicated by symbol W	XX	236,042	XX	208,071
Total	XX	304,623	XX	295,376
Total 1967 constant dollars	XX	278,411	XX	p 294,824

p Preliminary. 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 dimension limestone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Florida, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Alachua	$1,376	$1,299	Limestone.
Bay	W	W	Sand and gravel.
Brevard	W	898	Limestone, sand and gravel.
Broward	6,450	11,187	Do.
Calhoun	--------	4	Sand and gravel.
Charlotte	--------	W	Sand and gravel, limestone.
Citrus	1,889	1,673	Limestone, miscellaneous clay, phosphate rock.
Clay	W	W	Ilmenite, zircon, sand and gravel, staurolite, miscellaneous clay, peat, kyanite.
Collier	2,693	3,470	Petroleum, limestone.
Columbia	W	--------	
Dade	28,088	33,953	Cement, limestone, sand and gravel.
Duval	W	W	Oystershell.
Escambia	W	583	Sand and gravel, miscellaneous clay.
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	W	Phosphate rock.
Hendry	W	W	Petroleum, sand and gravel.
Hernando	W	W	Limestone, lime.
Hillsborough	25,127	22,555	Cement, phosphate rock, oystershell, sand and gravel, peat.
Jackson	157	W	Limestone, sand and gravel.
Lake	W	1,459	Sand and gravel.
Lee	W	W	Limestone, oystershell.
Leon	W	W	Sand and gravel.
Levy	1,149	1,046	Limestone.
Manatee	W	W	Limestone.
Marion	2,734	1,761	Limestone, fuller's earth, sand and gravel, phosphate rock.
Martin	W	--------	
Monroe	W	1,223	Limestone.
Okaloosa	--------	W	Sand and gravel, miscellaneous clay.
Orange	51	W	Sand and gravel, peat.
Palm Beach	661	1,113	Limestone, sand and gravel.
Pinellas	685	W	Oystershell, sand and gravel.
Polk	$165,743	$137,696	Phosphate rock, sand and gravel, peat.
Putnam	1,238	1,156	Sand and gravel, kaolin, peat.
St. Lucie	W	W	Sand and gravel, limestone, peat.
Sumter	2,366	3,741	Limestone, lime, peat.
Suwannee	W	W	Limestone.
Taylor	W	W	Do.
Volusia	W	W	Sand and gravel.
Walton	W	W	Oystershell, sand and gravel.
Washington	W	--------	
Undistributed [2]	64,216	70,560	
Total [3]	304,623	295,376	

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

[1] The following counties are not listed because no production was reported: Baker, Bradford, DeSoto, Dixie, Flagler, Hardee, Highlands, Holmes, Indian River, Jefferson, Lafayette, Liberty, Madison, Nassau, Okeechobee, Osceola, Pasco, St. Johns, Santa Rosa, Sarasota, Seminole, Union, and Wakulla.

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

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Florida business activity

		1968	1969	Change, percent
Employment and labor force, annual average:				
Total nonagricultural employment	thousands	r 2,383	2,533	+6.2
Manufacturing	do	308.2	310.4	+0.7
Mining	do	8.6	8.7	+1.1
Nonmetallic minerals, except fuels	do	7.7	7.8	+1.2
Phosphate rock	do	5.6	5.7	+1.7
Personal income:				
Total	millions	r $19,626	$21,777	+10.9
Per capita		r $3,160	$3,427	+8.4
Construction activity:				
Housing units authorized		107,042	127,376	+18.9
Value of construction	thousands	$1,367,314	$1,890,863	+38.2
New business incorporations		14,813	18,557	+25.2
Farm marketing receipts	millions	$1,218.3	$1,232.5	+1.1
Mineral production	do	$304.6	$295.3	−3.0
Utility sales or consumption: Sales of electrical energy	million kilowatt hours	38,638	43,135	+11.6
Export trade	millions	$866.3	$971.9	+12.1
Import trade	do	$766.5	$779.1	+1.6

r Revised.

Sources: Florida Industrial Commission; Survey of Current Business, U.S. Department of Commerce.

Table 4.—Worktime 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
1968:								
Peat	32	248	8	58	--	--	--	--
Metal	141	353	50	399	--	--	--	--
Nonmetal	3,298	299	987	7,904	--	81	10.25	290
Sand and gravel	314	254	80	690	1	18	27.52	9,521
Stone	2,301	297	685	6,125	2	95	15.84	2,821
Total [1]	6,086	297	1,809	15,176	3	194	12.98	1,722
1969: [p]								
Peat	45	240	11	85	--	1	11.82	496
Metal	150	354	53	422	--	--	--	--
Nonmetal	3,305	298	993	7,968	2	64	8.28	1,996
Sand and gravel	375	264	102	911	1	23	26.35	11,925
Stone	2,335	289	676	5,959	4	104	18.12	5,560
Total [1]	6,215	294	1,835	15,345	7	192	12.97	3,906

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

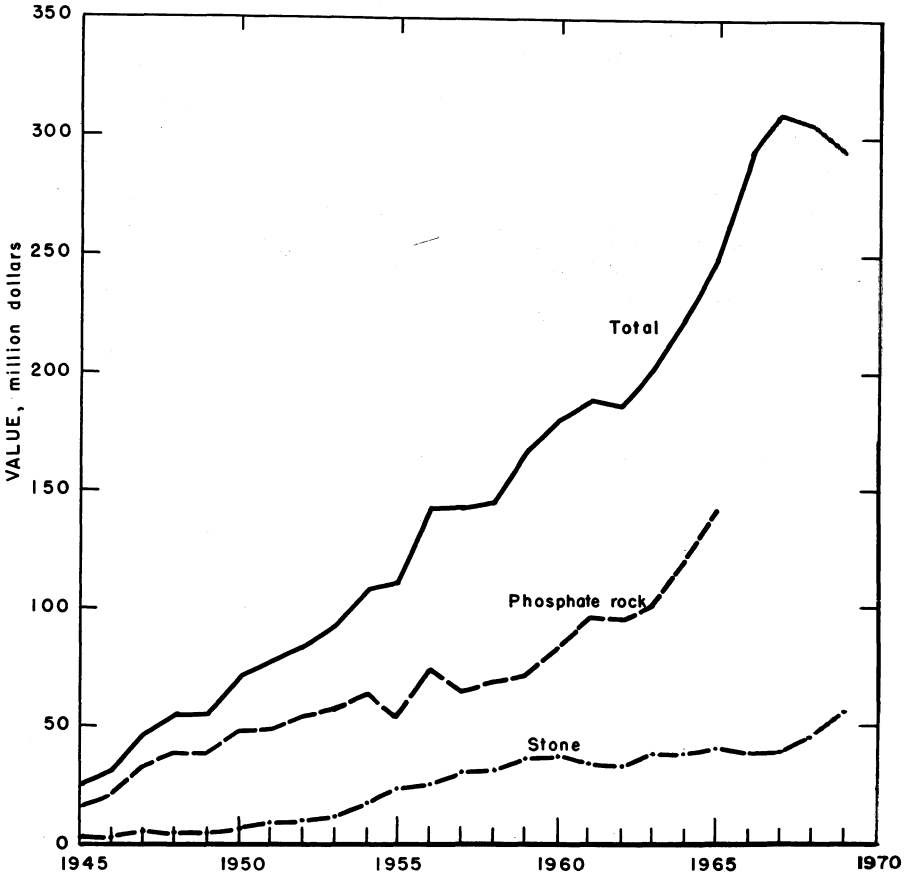

Figure 1.—Value of phosphate rock, stone, and total value of mineral production in Florida.

Electrical energy requirements continued to increase in the State with consumption increasing 12 percent. For the second consecutive year, the only decrease noted in industrial consumption was that by the phosphate industry as the companies continued to adjust to slow fertilizer sales.

Florida Power Corp.'s Crystal River 510,000-kilowatt generating unit No. 2 went on stream late in the year. The facility will be joined in 1972 by the company's first nuclear generator which will have a capability of 850,000 kilowatts. When all three units—at this site—are in production, the total capacity at the Crystal River plant will be 2,000,000 kilowatts. Construction continued at Tampa Electric Co.'s Big Bend Power Station near Tampa; the first 450,000-kilowatt unit is scheduled for completion in 1970. Tampa Electric Co. also instituted a program to study the effect of thermal pollution in a step to safeguard the polluting of Tampa Bay. Florida Power and Light Co. announced they will construct a 419,000-kilowatt generating plant at Sanford at a cost of $40 million. Gulf Power Corp. announced they will build a seventh generating unit at the Crist Steam Plant north of Pensacola; the new $60 million unit will have a capacity of 500,000 kilowatts. The sixth unit, presetly under construction, will have a capacity of 320,000 kilowatts and is scheduled to go on stream in May 1970.

Construction of the Seaboard Coastline Railroad's $8.5 million rail-ship phosphate handling terminal at Rockport (East Bay) continued and is scheduled for completion late in 1970. At Port Sutton, the Duval Corp. opened its sulfur storage terminal with a designed storage capacity of 120,000 long tons of liquid sulfur. River-Gulf Terminals, Inc., opened its million-dollar bulk-handling terminal, designed to accommodate the increasing quantities of incoming waterborne fertilizer materials, potash, nitrates, etc. The terminal is designed to store up to 50,000 tons of bulk fertilizer materials.

Jacksonville Bulk Terminals, Inc., modified its loading facilities so it will be able to handle all types of bulk dry products rather than phosphate rock, exclusively.

Construction of Port Manatee continued, and it is expected that limited operations will begin by mid-1970. The Levy County Port Authority purchased 50 acres of land fronting the Cross-Florida Barge Canal at Inglis. The port plan calls for a modern barge operation designed to haul phosphate rock from the north-Florida operations to the midwest via the Gulf of Mexico and the Mississippi River.

The second phase of a $72 million channel deepening plan approved by the U S. Army Corps of Engineers regional Atlanta office was submitted to the U.S. Rivers and Harbors Board for review. Under the plan, the main ship channels leading into Tampa Harbor from the Gulf of Mexico would be deepened from 34 to 42 feet and widened to 500 feet.

An informative article was presented discussing how new technology and cheaper power may change the transporation pattern in the phosphate industry.[3]

The use of Florida and North Carolina phosphate rock exported to Mexico for the manufacture of phosphoric acid and subsequent export was presented in a published article.[4]

Aluminum Company of America (Alcoa) announced plans to construct a $3 million plant near Ft. Meade, Fla., to produce 17,000 tons of aluminum fluoride and 3,000 tons of cryolite annually. Alcoa will use byproduct fluosilicic acid—generated in the manufacture of phosphate fertilizers—as feedstock for their plant.

Florida Steel Corp. began construction on its new $5 million electric furnace and rolling mill in Dade County. The operation is expected to go on stream in early 1970.

The Florida ecomony advanced as shown by the business activity indicators in table 3 with the exception of mineral production. This decrease in the value of mineral production is wholly attributable to depressed phosphate rock prices. Construction activity however increased considerably, increasing the demand for mineral construction materials. Housing construction increased almost 19 percent with the value of construction over 38 percent higher than in 1968. This construction recorded its greatest growth in the Miami area where large apartments and condominiums were being constructed at a rapid pace. The Tampa-St. Petersburg area showed the second highest construction growth rate in the State.

[3] Florida Journal of Commerce. New Technology and Cheaper Power Will Change Pattern of Phosphate Industry Transportation Needs. V. 11, No. 1, January 1969, pp. 2–3.

[4] Florida Journal of Commerce. Phosphate by Tanker. V. 11, No. 4, April 1969, pp. 4–5.

Legislation and Government Programs.—The Bureau of Mines Knoxville Mineral Supply Field Office, Knoxville, Tenn., conducted a study of the phosphate industry in the southeastern United States and its relationship to world mineral fertilizer demand. Publication is scheduled for mid-1970. The office also started a cost study on the economic availability of byproduct fluorine. Two other studies were conducted at the Bureau of Mines Tuscaloosa Metallurgy Research Laboratory, Tuscaloosa, Ala. The first investigated methods of beneficiating Florida land-pebble phosphate. The objective was to develop new processes for increasing recovery of the phosphate fines and thus decrease the formation of washer slime. The second study was to devise methods for recovering heavy mineral concentrates from phosphate washer plant tailings. Another objective was to develop new or improved methods for recovering high-grade rutile concentrates from the mixed heavy mineral concentrate.

The Inglis Lock on the western end of the Cross-Florida Barge Canal was completed. The other completed locks are the St. Johns Lock in Putnam County and the Eureka Lock in Marion County. New contract letting was slowed as Federal funds were not appropriated to meet construction schedules.

Several bills relating to the minerals industry were introduced in the State legislature in 1969. One bill proposed banning offshore drilling for oil; another proposed giving the State tighter control over oil and gas exploration on State-owned lands, these bills were both shelved. In another State action a legislative investigating committee drafted a series of bills designed to give the State better control of leased mineral lands.

The Legislature passed the Florida Air and Water Pollution Control Act giving the Department of Air and Water Pollution Control authority to enforce the State's air and water pollution regulations. The Departmet of Air and Water Pollution Control adopted construction standards for phosphate waste (slime) retaining dams.

The Bureau of Geology, Department of Natural Resources, continued studies of mineral resources throughout the State. A comprehensive report describing the mineral resources in Holmes, Walton, and Washington Counties was published.[5]

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for 95 percent of the State's total mineral production value in 1969. Principal nonmetals produced, listed in order of value, were phosphate rock, stone, cement, sand and gravel, and clays.

Cement.—Shipments of masonry cement increased 18 percent in quanity and value. Shipments of portland cement increased 2 percent in quanity and 7 percent in value. These increased shipments are directly related to the increased construction activity in the State.

Types I and II (general-use and moderate-heat), Type III (high-early strenth), and white cements were produced. Most of the shipments were made within the State, but shipments were also made to Georgia, Tennessee, North Carolina, and other States. Masonry cement shipments were principally within the State, but shipments were also made to North Carolina and Georgia. Shipments, mainly in bulk form were made by truck (78 percent) and by rail (22 percent). Principal consumers were ready-mixed concrete companies, concrete products manufacturers, and building materials dealers.

Raw materials used in the manufacture of cement were mined principally within the State, and included limestone, clay, sand, and staurolite. Small amounts of blast furnace slag and gypsum were used but obtained from out-of-State sources. Ten rotary kilns were operated at the three plants which had a total capacity of over 12 million barrels per year. All plants used the wet process. Over 400 million kilowatt-hours of electrical energy were consumed in the manufacture of cement; 54 percent of the power was purchased, and the remainder was home-generated.

[5] Yon, J. William, Jr., and C. W. Hendry, Jr. Mineral Resources Study of Holmes, Walton and Washington Counties. Dept. of Natural Resources, Bureau of Geology. Geol. Bull. No. 50, 1969, 161 pp.

Maule Industries, Inc., completed its new 2.4 million barrel-per-year cement plant at Pensuco, near Miami, in December 1969. The company plans to begin producing cement in January 1970.

Clays.—Total clay output increased 13 percent, and the value increased 16 percent, establishing a new record in 1969.

Florida led the Nation for the 12th consecutive year in fuller's earth production. Fuller's earth output increased 15 percent and value 18 percent, setting a record high for the State. Three producers were active in Gadsden County and one producer in Marion County. The clay was used for absorbents (41 percent), insecticides and fungicides (33 percent), drilling mud (17 percent), mineral oils (6 percent), and other uses (3 percent).

Kaolin output decreased 18 percent and the value decreased 16 percent from that of 1968. Kaolin was produced by one company in Putnam County; principal uses were in whiteware, pottery, and wall tile. Part of this large decline in output is due to Cyprus Mines Corp. closing its Putnam County facilities.

Miscellaneous clay output increased 12 percent and value 18 percent, setting a record high for the State. These increases were due to increased consumption of clays in the manufacture of cement and lightweight aggregate.

Gypsum.—Crude imported gypsum was calcined by three companies for use in the manufacture of gypsum building products. Two companies operated plants near Jacksonville, Duval County; and the third operated a plant near Tampa, Hillsborough County. The three plants used nine calcining kettles, one rotary kiln, one holoflite, and four board machines in the processing of gypsum and manufacture of gypsum products; total capacity of the plants was about 1.5 million tons of calcined products. Crude ore for all operations was transported by ship from company owned deposits in Nova Scotia.

Kyanite.—A small amount of kyanite-sillimanite mixture was recovered from tailings of a heavy minerals operation. The mixture was marketed for refractory uses.

Lime.—Primary lime sold or used totaled 182,000 tons and was valued at $2.7 million, representing increases of 45 percent and 32 percent, respectively, over 1968 production. One company manufactured quicklime for use in recovery of magnesia from sea water. Two other companies produced quicklime and hydrated lime for various chemical uses. Florida was the major marketing area, with a small amount shipped to Georgia.

Magnesia.—Basic Magnesia, Inc., produced magnesium compounds at its plant near Port St. Joe. The plant has an annual capacity of 60,000 tons of refractory periclase and chemical magnesia derived from sea water. Principal uses of the magnesium compounds were for refractories and chemicals. The company announced it will install an electrostatic precipitator to reduce dust emissions.

Perlite.—Three companies expanded perlite in three counties from ore mined in Colorado and New Mexico; total output was more than 9,400 tons valued at $676,000, representing increases of 11 and 13 percent, repectively, in tonnage and value over 1968 levels. The expanded perlite was used for plaster and concrete aggregate, soil conditioning, and insulation.

Phosphate Rock.—Marketable production of phosphate rock showed a decline for the first time in 13 years, reflecting the prevailing overcapacity situation in the industry. Phosphate rock, however, still accounted for the major portion of the State's total mineral production value. For the 76th consecutive year, Florida led the Nation in output and value of this commodity.

Florida's 1969 production data is combined with that of North Carolina to conceal the latter's output, because there is only one producing company in North Carolina. Combined marketable production from both States in 1969 was 29.9 million short tons, valued at $160.8 million and representing 79 percent of the total national output. This was a 9-percent decrease from the 33-million-ton output, and a 17-percent decrease from the $193.3 million value in 1968. Marketable production sold or used totaled 28.8 million tons valued at $155 million—a 2-percent decrease from the 29.6 million tons sold or used and a 10-percent decrease in value from that of 1968. Agricultural uses accounted for 17.5 million tons, or 60 percent; industrial uses 553,000 tons, or 2 percent; and exports 10.8 million tons, or 38 percent. Exports from the two States were valued at $55.2 million. Agricultural uses were for ordinary superphosphate, triple superphosphate, wet process phosporic

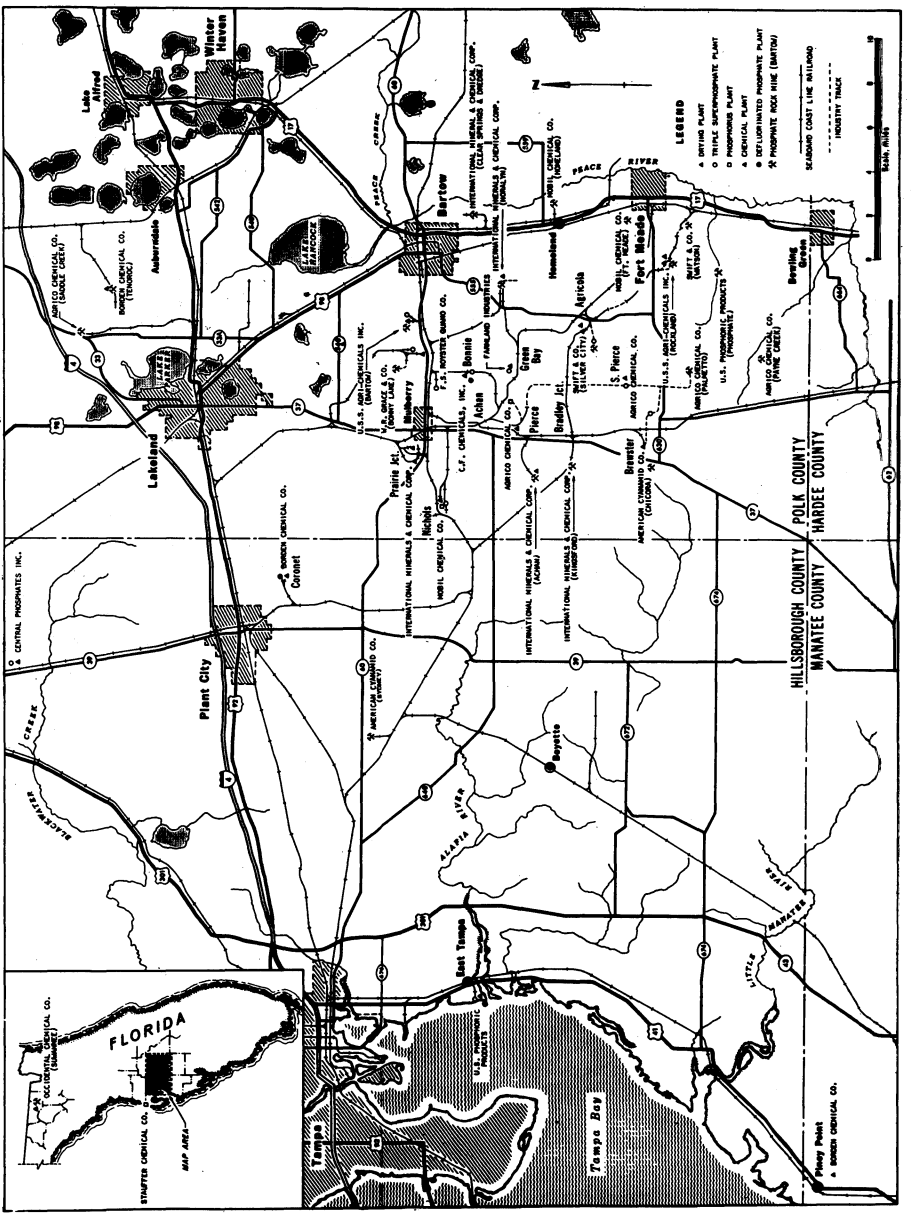

Figure 2.—Location of phosphate mines and plants in the Florida land-pebble areas, 1969.

acid, nitrophosphate, direct application to the soil, stock and poultry feed, and fertilizer filler. Industrial uses included the manufacture of elemental phosphorus.

Mine production of crude dry ore in Florida and North Carolina was 111.2 million short tons with a P_2O_5 content of 15.7 million tons.

Land-pebble phosphate rock was produced at 18 mines by 10 companies in three counties. One company processed tailings from an abandoned mine.

Hard-rock phosphate rock was not produced in the State during the year.

Soft-rock phosphate was produced by five companies at six mines in three counties. Total mine production was 30,000 tons with a P_2O_5 content of 6,000 tons, valued at $221,000. The soft rock was used for direct application to the soil, in stock and poultry feed, and as fertilizer filler.

Phillips Petroleum Corp. acquired 3,500 acres of phosphate reserve lands in DeSoto County during the year.

The Tennessee Valley Authority (TVA) offered at public auction 4,400 acres in Citrus and Marion Counties, Fla., which were originally acquired as phosphate reserves.

Agrico Chemical Co. operated its Payne Creek and Saddle Creek mines and plants in Polk County during the entire year; the Palmetto mine was shut down in mid-September, but plans were to reopen it in January 1970.

American Cyanamid Co. announced plans to double the capacity of its Chicora mine. New facilities will include a washer and flotation plant and a second 45-cubic-yard dragline. Chicora expansion, expected to be completed early in 1971, will replace production from its Sydney operation, which is expected to close in mid-1970. During the year, the company deeded 1,160 acres of land to the Alafia River Basin Board of the Southwest Florida Water Management District. About 770 acres of this area will be a lake which will serve as a water reservoir for the Alafia River Basin. The lake will be surrounded by 390 acres of reclaimed mined out land which will be used for recreation. The company announced a new procedure for using phosphate slimes in land reclamation. It is anticipated that this procedure will permit the phosphate industry to use these waste products to reconstruct mined out land and recover large volumes of water that would normally be bound to the slimes.[6]

Borden Chemical Co. operated its Tenoroc mine in Polk County, its defluorination plant near Plant City, and its phosphoric acid plant at Piney Point, Manatee County.

W.R. Grace & Co.'s mining and fertilizer manufacturing operations were hampered by a strike from May 21 to October 13, 1969. The company's Bonny Lake mine did not operate during this period; however, chemical facilities were operated from July 5 to October 13, using phosphate rock from stockpiles. The company purchased additional phosphate lands in Manatee County during the year. Grace also added 400 acres to their water recirculation system and spent $1.4 million in water pollution abatement equipment to improve waste water quality to alleviate pollution problems.

International Minerals & Chemical Corp. (IMC) sold its Bonnie phosphate chemicals complex to C. F. Chemicals, Inc. The sale included phosphate fertilizer plants and sulfuric acid plants on a 2,800-acre site west of Bartow, Fla.; the plants have an annual production capacity of approximately 1 million tons of concentrated phosphate fertilizers. IMC will supply phosphate rock to C. F. Chemicals, Inc., Bartow Phosphate Works (formely IMC's Bonnie complex) and purchase chemicals from them. IMC will also continue to own and sell the products from their phosphate feed ingredients plant there. IMC exchanged certain Florida phosphate properties with Mobil Chemical Co. and purchased Mobil's Clear Springs processing facility. The company also made capital improvements at its Noralyn and Kingsford phosphate rock plants. These improvements are expected to increase IMC's basic phosphate rock production capacity by approximately 25 percent, improve quality control, and increase its mineral reserve position in the Florida phosphate fields.

Minerals Recovery Corp. processed tailings from previous mining operations at its Boyette recovery plant.

Mobil Chemical Co. exchanged certain properties with IMC near its Ft. Meade mine, which will extend the life of this fa-

[6] Timberlake, Richcard C. Building Land With Phosphate Waste. Min. Eng., v. 21, No. 12, December 1969, pp. 38–40.

cility and justify capital improvements. The company also studied the feasibility of adding an additional electric furnace at its Nichols plant.

Ocidental Chemical Co. (Oxychem) announced plans to build a defluorinated phosphate plant adjacent to its Suwannee River phosphate mine and chemicals complex near White Springs, Fla. The plant will cost approximately $6 million. Completion is scheduled for late 1970, and the facility will produce at an initial rate of 100,000 tons of defluorinated phosphate per year. This facility will consume an estimated 135,000 tons of phosphate rock annually.

Swift & Co. operated both its Watson and Silver City mines on a 7-day schedule in 1969, which was anomalous to the rest of the industry. The company also operated an additional dragline at the Watson mine and installed additional wet rock storage facilities. These improvements increased the company's Florida capacity by about 50 percent.

U. S. Phosphoric Products, Division Tennessee Corp., operated its phosphate mine and beneficiation plant near Ft. Meade during the year. Output was used at the company's East Tampa chemical complex in the manufacture of ordinary superphosphate, triple superphosphate, and phosphoric acid.

U.S.S. Agri-Chemicals, Inc., added a fluosilicic acid recovery system to its fertilizer manufacturing facilities. The fluosilicic acid product will be used in Alcoa's aluminum fluoride plant near Ft. Meade, which is scheduled for construction early in 1970.

The Bureau of Mines developed cost estimates for the disposal of phosphate rock washer slimes by pond settling from a study of the method used at International Minerals & Chemical Corp. (IMC), Noralyn Phosphate Operations, Polk County, Fla. Data were obtained by basing phosphate production and slime generation statistics on plant capacity rather than on actual company records. Cost estimates, prepared as a guide in evaluating alternative disposal methods and in identifying needed areas of research, could be applicable to any Florida plant using the same disposal method. To conserve mineral resources and to improve enviromental conditions, the Bureau recommended further research directed toward developing alternative methods of disposal, including the recovery of water and P_2O_5 values from the slimes.[7]

Sand and Gravel.—Sand and gravel output was 14.4 million tons valued at $13.9 million in 1969, setting a new record in production and value for the State. This increased production paralleled the increased demand for construction materials in the State during the year. Much of this increased production, however, was due to large tonnages of fill sand produced and was used by several of the large land development companies in the State. Polk County was the leading producer of sand used for building purposes, and accounted for 20 percent of the output and 22 percent of the value. Nearly all of the sand was produced by commerical operators. There were 52 commerical sand and gravel operations during the year; of these, 21 produced between 200,000 and 1 million tons; 15 produced between 50,000 and 200,000 tons; and 16 produced less than 50,000 tons. Eighty percent of the commerical output was transported by truck, 18 percent by rail, and 2 percent by water. The sand and gravel was mainly used for construction purposes with a small amount going into industrial uses. Descriptive articles on two Florida sand operations were published.[8]

Staurolite.—Staurolite was recovered as a byproduct of ilmenite production at the Highland and Trail Ridge plants of E. I. du Pont de Nemours & Co., Inc., in Clay County. Both output and value increased over 1968 levels. Florida is the only State with a recorded production of staurolite.

Stone.—Florida stone (all limestone) is divided into two types—hard-rock and soft-rock. Each type has a different end use and value. Hard-rock is used as concrete and bituminous aggregates and ranges in value from $1.25 to $2.50 per ton. Soft-rock limestone is used for dense-graded roadbase material, surface treatment aggregate, and in the manufacture of lime; it ranges in value from $0.60 to $1.90 per ton.

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[7] Boyle, J. R. Waste Disposal Costs of a Florida Phosphate Operation. BuMines Inf. Circ. 8404, 1969, 24 pp.

[8] McDonough, E. W. Dream Comes True for Polk City Sand & Silica Co. Dixie Contractor, v. 4, No. 44, July 1969, pp. 29 and 31.
Trauffer, Walter E. New 400-tph Sand Plant in Central Florida Built to Serve Growing Area. Pit and Quarry, v. 62, No. 1, July 1969, pp. 163–165.

Table 5.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Broward	3	W	W	3	744	$615
Calhoun	1	-----	-----	1	4	4
Dade	4	W	$160	3	W	W
Escambia	5	371	379	5	510	W
Gadsden	2	288	W	2	W	W
Jackson	1	W	W	1	17	17
Lake	5	W	W	5	1,893	1,459
Marion	2	55	66	2	W	W
Orange	--	-----	-----	1	243	243
Palm Beach	1	81	50	1	421	281
Pinellas	1	11	9	1	W	10
Polk	7	2,365	2,613	8	2,861	W
Putnam	5	490	W	4	W	W
St. Lucie	3	245	W	4	779	673
Undistributed [1]	11	3,859	4,690	14	6,937	10,688
Total [2]	51	7,765	7,967	55	14,409	13,988

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

[1] Includes Bay, Brevard, Charlotte (1969), Clay, Franklin, Glades, Hendry, Hillsborough, Leon, Okaloosa (1969), Volusia and Walton Counties, and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 6.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968			1969		
		Value			Value	
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Sand:						
Structural	6,267	$5,263	$0.84	8,024	$7,311	$0.91
Paving	254	227	.89	W	W	W
Total sand and gravel [1]	7,765	7,967	1.03	14,409	13,988	.97

[1] Includes blast, chemical, engine, fill, filler, filtration, glass, molding, and other sands and use indicated by symbol W; paving, structural, fill, and other gravel.

Hard-rock limestone was produced in Broward, Collier, Dade, Hernando, Lee, Monroe, and Suwanee Counties.

Soft-rock limestone was produced in all of the counties listed in table 7. Soft-rock limestone accounted for approximately 62 percent of the output and 53 percent of the value of the crushed limestone produced in 1969.

Total stone output, crushed limestone and oystershell, but excluding dimension limestone, was 42.3 million tons valued at $56.6 million, setting a record for stone output and value.

Crushed limestone output was 40.7 million tons valued at $53.6 million, increases of 15 percent in tonnage and 20 percent in value over the 1968 level. The value increase is attributed to higher costs of doing business and the continued heavy demand for building construction materials. Output came from 91 quarries in 23 counties, compared with 85 quarries in 18 counties in 1968. The three leading producing counties were Dade, Broward, and Hernando, which supplied 60 percent of the State's total tonnage and value. Thirteen companies operated 33 quarries accounting for 64 percent of the crushed stone output and 65 percent of the value. Of the total crushed limestone sold or used, agricultural stone accounted for 1 percent of the output and 4 percent of the value; concrete aggregate, 27 percent and 31 percent, respectively; bituminous aggregate, 7 percent and 7 percent, respectively; dense graded road base stone, 49 percent and 44 percent, respectively; and other stone use, 16 percent and 14 percent, respectively. Crushed limestone was transported 77 percent by truck, 21 percent by rail, and 2 percent by water.

Maule Industries, Inc., announced plans for a $5 million expansion at its Pennsuco Quarry. The expansion will double its production capacity to about 8 million tons per year.

Table 7.—Crushed limestone sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Alachua	6	2,047	$1,376	6	1,818	$1,299
Broward	12	5,041	W	16	6,907	10,572
Collier	6	1,129	W	6	1,374	W
Dade	14	10,162	W	14	11,720	W
Hernando	8	6,492	9,991	6	6,735	10,804
Levy	3	472	1,149	3	494	1,046
Marion	7	1,579	W	10	801	W
Monroe	2	1,313	W	2	1,367	1,223
Palm Beach	5	598	611	6	706	832
Sumter	3	1,875	W	3	W	W
Undistributed [1]	19	4,839	31,486	19	8,807	27,848
Total [2]	85	35,548	44,612	91	40,730	53,626

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Brevard, Charlotte (1969), Citrus, Columbia (1968), Jackson, Lee, Manatee, St. Lucie (1969), Suwannee, and Taylor Counties, and counties indicated by symbol W.
[2] Data may not add to total shown because of independent rounding.

Table 8.—Crushed limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968			1969		
		Value			Value	
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Agricultural stone	929	$2,966	$3.19	[1] 820	$3,066	$3.74
Concrete aggregate	10,560	14,827	1.40	11,346	17,682	1.56
Bituminous aggregate	497	880	1.77	2,836	4,148	1.46
Dense graded base stone	15,877	18,090	1.14	19,028	22,149	1.16
Fill	W	W	W	1,683	1,157	.69
Surface treatment aggregate	1,138	928	.82	------	------	-----
Other uses [2]	6,547	6,921	1.06	5,016	5,424	1.08
Total [3]	35,548	44,612	1.25	40,730	53,626	1.32

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes poultry grit.
[2] Includes asphalt filler, cement, chemical stone, lightweight aggregate (1969), lime, manufactured fine aggregate, poultry grit (1968), railroad ballast, unspecified aggregate (1969), and other uses.
[3] Data may not add to total shown because of independent rounding.

Oystershell was dredged and crushed by five companies in five counties on State leases. Total output was 1.6 million tons valued at almost $3 million, increases of 40 percent in tonnage and 53 percent in value above 1968 levels. Most of the oystershell was used as dense road base material, and a smaller tonnage was used for poultry grit.

Dimension limestone was produced by one company, in Manatee County, for decorative uses.

Vermiculite.—Exfoliated vermiculite was produced at five plants in Duval, Hillsborough, and Palm Beach Counties from crude material shipped into the State.

METALS

Metals accounted for only 3 percent of the State's total mineral production value.

Ferroalloys.—Three companies produced ferrophosphorus as a byproduct of elemental phosphorus manufacture. The value of ferroalloys is not included in the total State mineral production value.

Rare-Earth Minerals.—No rare-earth minerals were produced in the State during the year.

Titanium Concentrates.—Shipments of ilmenite concentrate increased 6 percent in tonnage and value over 1968 shipments, reflecting an increase in national demand for titanium metals and minerals.

American Cyanamid Co. and Union Camp Corp. announced plans for the formation of Titanium Enterprises, which would develop a major titanium-bearing heavy minerals deposit in Clay County. The deposit is owned by Union Camp Corp. and extends across 5,000 acres. Feasi-

bility studies have been completed and pilot plant operations are scheduled for 1970. If the results are favorable, mining operations are scheduled to start by mid-1972.

The Bureau of Mines continued a research program on the recovery of heavy mineral concentrates from Florida phosphate washer tailings. A second part of this research was to develop new or improved methods to recover high-grade concentrates of rutile, ilmenite, zircon, and monazite from mixed heavy mineral concentrates.

Zirconium Concentrates.—Shipments of zirconium concentrates recovered from ilmenite mining remained at the 1968 level. Zirconium concentrates were recovered from ilmenite mining by one company.

MINERAL FUELS

Mineral fuels production consisted of natural gas, crude petroleum, their coproducts, and peat. Fuels accounted for only 2 percent of the State's total mineral production value.

Natural Gas.—Natural gas production in Florida came from the two Sunoco-Fields fields and the Sunniland field, both in Collier County. Most of the production is used in operating heater treaters, since it has not been commerically feasible to market the small quanity of gas available. Production reports indicate a decrease in output from 1968 levels.

Peat.—Peat production increased 34 percent in tonnage and 29 percent in value over that of 1968. Eleven companies in seven counties produced 55,300 tons of humus, moss, and reed-sedge peat valued at $359,000. About half of the peat sold was unprepared and the other half was only shredded; it was sold in bulk for soil improvement purposes.

Petroleum.—Crude petroleum production from the State increased 17 percent in quanity and 25 percent in value over that of 1968. A total of 1,733,485 barrels of oil were produced from the four oilfields of (southern) Florida from 46 pumping wells. Cumulative production in Florida, 1943–69, was 16.4 million barrels. During the year, Mobil Oil Corp.'s well, No. 1 Barron Collier, Jr., was completed as the discovery well for a new field. The stabilized production was about 100 to 115 barrels of oil per day with 0.2 percent salt water. Humble Oil and Refining Co.'s No. 1 Lehigh Acres Incorporated well in Lee County was bottomed at 15,710 feet after reportedly reaching "basement rock"; this is the deepest well drilled in Florida.

Oil and gas regulatory orders adopted and promulgated in 1969 were as follows: Order No. 8—recognized that there is no connection between the oil accumulation in the original Sunoco-fielda field and that in the West Sunoco-Felda field; Order No. 9—permitted the Humble Oil and Refining Co. to utilize the "Boulder Zone" in an abandoned oil producer for the disposal of salt water produced from the Sunniland field.

Table 9.—Oil and gas well drilling in 1969, by counties

County	Oil	Dry	Total [1]	Footage
Exploratory completions:				
Collier	1	--	1	11,987
Duval	--	3	3	11,892
Franklin	--	1	1	14,369
Lee	--	1	1	11,960
Polk	--	1	1	9,670
Santa Rosa	--	1	1	6,871
Total	1	7	8	66,749
Development completions:				
Collier	2	--	2	23,410
Hendry	3	--	3	34,961
Total	5	--	5	58,371
Total all drilling	6	7	13	125,120

[1] No gas wells.

Source: American Association of Petroleum Geologists.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement, portland and masonry:			
General Portland Cement Co.	Box 1528 Tampa, Fla. 33601	2 plants	Dale and Hillsborough.
Lehigh Portland Cement Co.	718 Hamilton St. Allentown, Pa. 18105	Plant	Dade.
Clays:			
Fuller's earth:			
Dresser Industries, Inc.	Box 6504 Houston, Tex. 77005	Open pit mine	Gadsden.
Engelhard Minerals & Chemicals Corp.	Menlo Park Edison, N. J. 08817	2 open pit mines	Do.
Floridin Co	Berkeley Springs, W. Va. 25411	Open pit mine	Do.
Mid-Florida Mining	Box 68–F Lowell, Fla. 32663	----do	Marion.
Kaolin:			
Edgar Plastic Kaolin Co	Edgar, Fla. 32049	----do	Putnam.
Miscellaneous:			
Appalachee Correctional Institute	Box 127 Chattahoochee, Fla. 32324	----do	Gadsden.
Bickerstaff Clay Products Co., Inc.	Box 1178 Columbus, Ga. 31902	Open pit mine and plant.	Escambia.
Coastal Asphalt Co	Box 637 Ft. Walton Beach, Fla. 32548	Open pit mine	Okaloosa.
Florida Solite Co	Box 297 Green Cove Springs, Fla. 32043	Open pit mine and plant.	Clay.
General Portland Cement Co.	Box 1528 Tampa, Fla. 33601	Open pit mine	Citrus.
Gypsum, calcined:			
Kaiser Gypsum Co., Inc	300 Lakeside Drive Oakland, Calif. 94612	Plant	Duval.
National Gypsum Co	325 Delaware Ave. Buffalo, N. Y. 14202	----do	Hillsborough.
U.S. Gypsum Co	101 S. Wacker Drive Chicago, Ill. 60606	----do	Duval.
Lime:			
Primary:			
Basic Magnesia, Inc	Box 160 Port St. Joe, Fla. 32456	Plant	Gulf.
Chemical Lime, Inc	Box 250 Ocala, Fla. 32670	----do	Hernando.
Dixie Lime & Stone Co.	Box 910 Ocala, Fla. 32670	Plant	Sumter.
Magnesium compounds:			
Basic Magnesia, Inc	Box 160 Port St. Joe, Fla. 32456	----do	Gulf.
Peat:			
M.L.S. Industries	Drawer 567 Stuart, Fla. 33494	Mine	St. Lucie.
McCranie Wholesale Peat	Rt. 1 Box 272–V Seffner, Fla. 33584	----do	Hillsborough.
F. E. Stearns Peat	Rt. 1 Box 347–I Valrico, Fla. 33594	----do	Do.
Traxler Peat Co	Box 86 Florahome, Fla. 32635	----do	Putnam.
Zellwood Peat Co	Box 555 Zellwood, Fla. 32798	----do	Orange.
Perlite, expanded:			
Airlite Processing Corp	Rt. 3 Box 417 Vero Beach, Fla. 32960	Plant	Indian River.
Chemrock Corp	End of Osage St. Nashville, Tenn. 37208	----do	Duval.
W. R. Grace & Co	62 Whittmore Ave. Cambridge, Mass. 02140	----do	Dade.
Petroleum:			
Humble Oil & Refining Co	Box 2024 Houston, Tex. 77001	Sunniland field	Collier.
Sun Oil Company	Box 2880 Dallas, Tex. 75221	Sunoco-Felda field	Collier and Hendry.
Phosphate rock:			
Land-pebble:			
Agrico Chemical Co	5050 Poplar Ave. Memphis, Tenn. 38117	3 open pit mines	Polk.
American Cyanamid Co.	Berdan Ave. Wayne, N. J. 07472	2 open pit mines	Hillsborough and Polk.
International Minerals & Chemicals Corp.	Old Orchard Road Skokie, Ill. 60079	3 open pit mines	Polk.
Mobil Chemical Co	Box 31 Nichols, Fla. 33863	2 open pit mines	Do.
U.S.S. Agri-Chemicals, Inc.	Box 867 Ft. Meade, Fla. 33841	----do	Do.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Phosphate rock—Continued			
Soft-rock:			
Howard Phosphate Co.	Box 13800 Orlando, Fla. 32809	Open pit mine	Citrus.
Kellogg Co	Box 218 Hernando, Fla. 32642	----do	Do.
Loncala Phosphate Co.	Box 766 High Springs, Fla. 32643	2 open pit mines	Marion and Gilchrist.
Soil Builders, Inc	Box 368 Dunnellon, Fla. 32630	Open pit mine	Citrus.
Sun Phosphate Co	Box 523 Ocala, Fla. 32670	----do	Do.
Phosphorus, elemental:			
Agrico Chemical Co	5050 Poplar Ave. Memphis, Tenn. 38117	3 electric furnaces	Polk.
Mobil Chemical Co	Box 311 Nichols, Fla. 33863	Electric furnace	Do.
Stauffer Chemical Co	299 Park Ave. New York, N. Y. 10017	----do	Pinellas.
Sand and gravel:			
General Development Corp.	1111 South Bayshore Drive Miami, Fla. 33131	3 open pit mines	Brevard, Charlotte, St. Lucie.
E. R. Jahna Industries, Inc.	First & East Tillman Lake Wales, Fla. 33853	Open pit mine	Lake and Polk.
Orange Sand Company	Box 4667 Jacksonville, Fla. 32204	Open pit mine	Lake.
Seminole Rock Products, Inc.	8100 N.W. 74th St. Miami, Fla. 33166	----do	Dade.
Standard Sand & Silica Company	Box 35 Davenport, Fla. 33837	----do	Polk.
Staurolite:			
E. I. du Pont de Nemours & Co., Inc.	Du Pont Building, D–10084 Wilmington, Del. 19898	Plant	Clay.
Stone:			
Limestone, crushed:			
Dixie Lime & Stone Company	Box 910 Ocala, Fla. 32670	8 quarries	Alachua, Citrus, Jackson, Levy, Marion, Sumter.
Florida Rock Products Corp.	Box 4667 Jacksonville, Fla. 32201	2 quarries	Hernando and Suwannee.
General Development Corp.	1111 South Bayshore Drive Miami, Fla. 33166	3 quarries	Brevard, Charlotte, St. Lucie.
Houdaille-Duval-Wright Co.	Box 8068 Seminole Annex Ft. Lauderdale, Fla. 33310	5 quarries	Alachua, Broward, Dade.
Maule Industries, Inc.	Box 2601 Hialeah, Fla. 33012	2 quarries	Broward and Dade.
Limestone, dimension:			
Bradenton Stone Company	Box 1220 Bradenton, Fla. 33506	Quarry	Manatee.
Oystershell:			
Bay Dredging & Construction Co.	Box 1484 Tampa, Fla. 33601	Dredge	Hillsborough.
Benton & Company, Inc	Box 1347 St. Petersburg, Fla. 33731	----do	Pinellas.
Ft. Myers Shell & Dredging Co., Inc.	Box 973 Ft. Myers, Fla. 33902	----do	Lee.
Houdaille-Duval-Wright Co.	Box 1588 Jacksonville, Fla. 32201	----do	Duval.
Radcliff Materials, Inc	Box 1288 Mobile, Ala. 36601	----do	Walton.
Titanium concentrates:			
E. I. du Pont de Nemours & Co., Inc.	Du Pont Building D–10084 Wilmington, Del. 19898	2 dredges and plants	Clay.
Vermiculite, exfoliated:			
W. R. Grace & Company	62 Whittmore Ave. Cambridge, Mass. 01109	3 plants	Duval, Hillsborough, Palm Beach.
Verlite Company	Box 11385 Tampa, Fla. 33610	Plant	Hillsborough.
Schmelzer Sales Association, Inc.	3519 Cantrell Road Little Rock, Ark. 72207	----do	Do.
Zirconium concentrates:			
E. I. du Pont de Nemours & Co., Inc.	Du Pont Building D–10084 Wilmington, Del. 19898	----do	Clay.

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, U.S. Department of the Interior, and the Geological Survey of Georgia.

By F. Vernon Tompkins [1] and J. H. Auvil, Jr.[2]

Total value of Georgia mineral production in 1969 was $191 million, an increase of 10 percent over that of 1968, setting a new record for the State. This gain in value was attributable to increases in both quantity and higher unit values of the commodities produced. The major contributors were clay and stone, which accounted for 52 percent and 31 percent of the total production value, respectively. Nonmetallic minerals comprised nearly 98 percent of the total value; metals and peat were credited with the remaining value. The increase in quantity and value of nonmetallic minerals for industrial use was greater than that for construction materials, cement excepted. Commodities contributing most to the increase in value were kaolin, cement, and crushed marble.

Georgia led the Nation in the production of kaolin; it was second in fuller's earth, kyanite, rare-earth metals concentrates, and zirconium (zircon) concentrates; third in scrap mica and bauxite; and fourth in barite and titanium (ilmenite) concentrates.

Most sectors of the Georgia economy continued to improve as indicated in table 3, with the exception of agricultural employment. The number and value of private housing units and value of other private construction each increased, but the 4 percent increase in value of all private construction was below the 1967–68 rate. The relatively low level of construction activity was indicated by an increase of only about 2 percent in the quantity of the major minerals produced for construction, cement excepted. Total income and per capita income were greater than in 1968, but no adjustment was made for inflation-

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[2] Director, Georgia Department of Mines, Mining and Geology, Atlanta, Ga.

Table 1.—Mineral production in Georgia [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite—thousand short tons	140	$2,874	124	$3,116
Clays—do	5,111	88,632	5,670	98,462
Iron ore (usable)—thousand long tons, gross weight	192	1,119	241	1,338
Sand and gravel—thousand short tons	3,803	4,314	3,824	4,709
Stone—do	26,903	56,177	27,755	59,451
Talc—short tons	45,600	288	47,790	301
Value of items that cannot be disclosed: Bauxite, cement, feldspar, kyanite, mica, peat, rare-earth metals concentrates, titanium concentrates, and zirconium concentrates	XX	19,686	XX	23,525
Total	XX	173,090	XX	190,902
Total 1967 constant dollars	XX	174,420	XX	p184,622

p Preliminary. 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 Georgia, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Baldwin	W	W	Kaolin.
Bartow	$4,022	$4,418	Barite, limestone, slate, iron oxide pigments, miscellaneous clay.
Bibb	602	1,138	Miscellaneous clay, sand and gravel.
Charlton	W	W	Ilmenite, zircon, monazite.
Chatham	W	W	Sand and gravel.
Chattooga	W	W	Marble.
Cherokee	W	W	Mica.
Clarke	W	W	Granite.
Clayton	W	W	Do.
Cobb	W	W	Do.
Columbia	W	W	Miscellaneous clay.
Cook	102	86	Sand and gravel.
Crawford	W	W	Do.
Decatur	W	W	Fuller's earth.
De Kalb	4,658	4,960	Granite.
Dougherty	W	W	Sand and gravel.
Douglas	W	W	Granite.
Early	W	W	Limestone.
Effingham	W	W	Sand and gravel.
Elbert	W	W	Granite.
Evans	32	W	Sand and gravel.
Fannin	81	W	Limestone.
Fayette	W	W	Granite.
Floyd	W	W	Limestone, miscellaneous clay.
Fulton	9,936	12,790	Cement, granite, miscellaneous clay, sand and gravel.
Gilmer	W	W	Marble.
Glynn	W	W	Sand and gravel.
Gordon	24	W	Miscellaneous clay.
Greene	W	W	Sand and gravel.
Gwinnett	W	W	Granite.
Hall	W	W	Granite, limestone.
Hancock	9	W	Granite.
Hart	W	W	Mica.
Henry	W	W	Granite.
Houston	W	W	Cement, limestone, miscellaneous clay.
Jasper	W	W	Feldspar, quartz.
Jefferson	855	W	Fuller's earth.
Jones	5,930	W	Granite.
Lamar	W	W	Do.
Lincoln	W	W	Kyanite.
Long	W	W	Sand and gravel.
Lowndes	W	W	Peat.
Madison	W	W	Granite.
Mitchell	W	W	Limestone.
Monroe	W	W	Granite.
Montgomery	20	20	Sand and gravel.
Murray	288	301	Talc.
Muscogee	W	W	Granite, sand and gravel.
Oglethorpe	2,018	1,616	Granite.
Pickens	W	W	Marble, sandstone.
Polk	W	W	Cement, slate, miscellaneous clay, sandstone.
Rabun	W	W	Granite.
Richmond	4,517	4,830	Quartzite, kaolin, miscellaneous clay, sand and gravel.
Rockdale	W	731	Sand and gravel.
Spalding	W	W	Granite.
Stephens	W	W	Do.
Stewart	1,033	W	Iron ore.
Sumter	W	W	Kaolin, bauxite.
Talbot	526	W	Sand and gravel.
Taylor	W	W	Do.
Thomas	3,387	3,750	Fuller's earth, sand and gravel.
Twiggs	W	W	Kaolin, fuller's earth.
Walker	780	W	Limestone, miscellaneous clay.
Ware	18	W	Sand and gravel.
Warren	W	W	Granite, kaolin.
Washington	34,314	36,043	Kaolin.
Whitfield	1,358	W	Limestone.
Wilkinson	W	W	Kaolin.
Undistributed	98,580	120,218	
Total [2]	173,090	190,902	

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, Brooks, Bryan, Bulloch, Burke, Butts, Calhoun, Camden, Candler, Carroll, Catoosa, Chattahoochee, Clay, Clinch, Coffee, Colquitt, Coweta, Crisp, Dade, Dawson, Dodge, Dooly, Echols, Emanuel, Forsyth, Franklin, Glascock, Grady, Habersham, Haralson, Harris, Heard, Irwin, Jackson, Jeff Davis, Jenkins, Johnson, Lanier, Laurens, Lee, Liberty, Lumpkin, Macon, Marion, McDuffie, McIntosh, Meriwether, Miller, Morgan, Newton, Oconee, Paulding, Peach, Pierce, Pike, Pulaski, Putnam, Quitman, Randolph, Schley, Screven, Seminole, Taliaferro, Tattnall, Telfair, Terrell, Tift, Toombs, Towns, Treutlen Troup, Turner, Union, Upson, Walton, Wayne, Webster, Wheeler, White, Wilcox, Wilkes, and Worth.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Selected economic indicators of Georgia business activity

		1968	1969	Change, percent
Employment and labor force, annual average:				
Total work force available	thousands	1,811.2	1,862.5	+2.8
Total unemployed	do	60.6	55.0	−9.2
Employment:				
Agricultural	thousands	88.1	88.1	0.0
Nonagricultural	do	1,427.0	1,488.4	+4.3
Mining	do	6.7	6.8	+1.5
Contract construction	do	77.8	79.9	+2.7
Service (excludes gas and sanitary)	do	167.0	170.8	+2.3
Government (all)	do	269.4	278.4	+3.3
Total manufacturing	do	449.2	465.9	+3.7
Personal income:				
Total	millions	$12,705	$14,108	+11.0
Per capita		$2,775	$3,040	+9.5
Construction activity:				
House units—private:				
Number		38,128	39,296	+3.1
Value	millions	$442.8	$454.6	+2.7
Total private construction (excluding private housing)	do	$254.9	$271.4	+6.5
Cement shipments to and within Georgia:				
Portland	thousand 376-pound barrels	8,602	10,880	+26.5
Masonry	thousand 280-pound barrels	2,505	1,366	−45.5
Farm marketing receipts	millions	r $1,038.7	$1,123.4	+8.2
Mineral production	millions	$173.1	$190.9	+10.3
Electrical energy-sales	million kilowatt-hours	26,291.3	29,384.7	+11.8
Export trading	millions	$229.6	$249.2	+8.5
Import trading	do	$259.8	$271.4	+4.5

r Revised.

Sources: U.S. Department of Commerce; Georgia Department of Labor; University of Georgia; Bureau of Mines.

Table 4.—Worktime 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
1968:								
Metal	119	306	36	303	--	7	23.10	548
Nonmetal and peat	3,480	302	1,052	8,454	--	215	25.43	693
Sand and gravel	241	250	60	546	--	10	18.32	771
Stone	3,086	265	819	7,062	2	121	17.42	2,259
Total	6,926	284	1,967	16,365	2	353	21.69	1,369
1969: p								
Metal	125	308	39	330	--	1	3.03	27
Nonmetal and peat	3,305	304	1,004	8,076	1	212	26.38	1,776
Sand and gravel	230	266	61	551	--	11	19.95	437
Stone	2,855	261	746	6,614	3	125	19.35	4,400
Total [1]	6,515	284	1,850	15,572	4	349	22.67	2,806

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

ary trend. The State ranked 39th Nationally in per capita income.

Legislation and Government Programs.—The Georgia Department of Mines, Mining and Geology continued its Mineral Exploration Program for phosphate and other minerals. A project report with the results of the exploration of South Georgia phosphate was published.[3] A potentially economic phosphate deposit in eastern Chatham County was indicated from exploration by this Department during the last few years. Their estimate, published in 1969, was 7.2 billion tons averaging 22.5 percent bone phosphate of lime.[4] Investigation of metallic sulfides, limestone, and talc in northwestern Georgia continued as a part of a cooperative project between the U.S. Department of Commerce and the Coosa Valley Area Planning and Development Commission, Rome, Ga.

[3] Georgia Department of Mines, Mining and Geology. South Georgia Minerals Program—Phosphate. Project Report No. 11, 1969, 165 pp.

[4] Furlow, James W. Stratigraphy and Economic Geology of the Eastern Chatham County Phosphate Deposit. Georgia Geol. Survey Bull. 82, 1969, 40 pp.

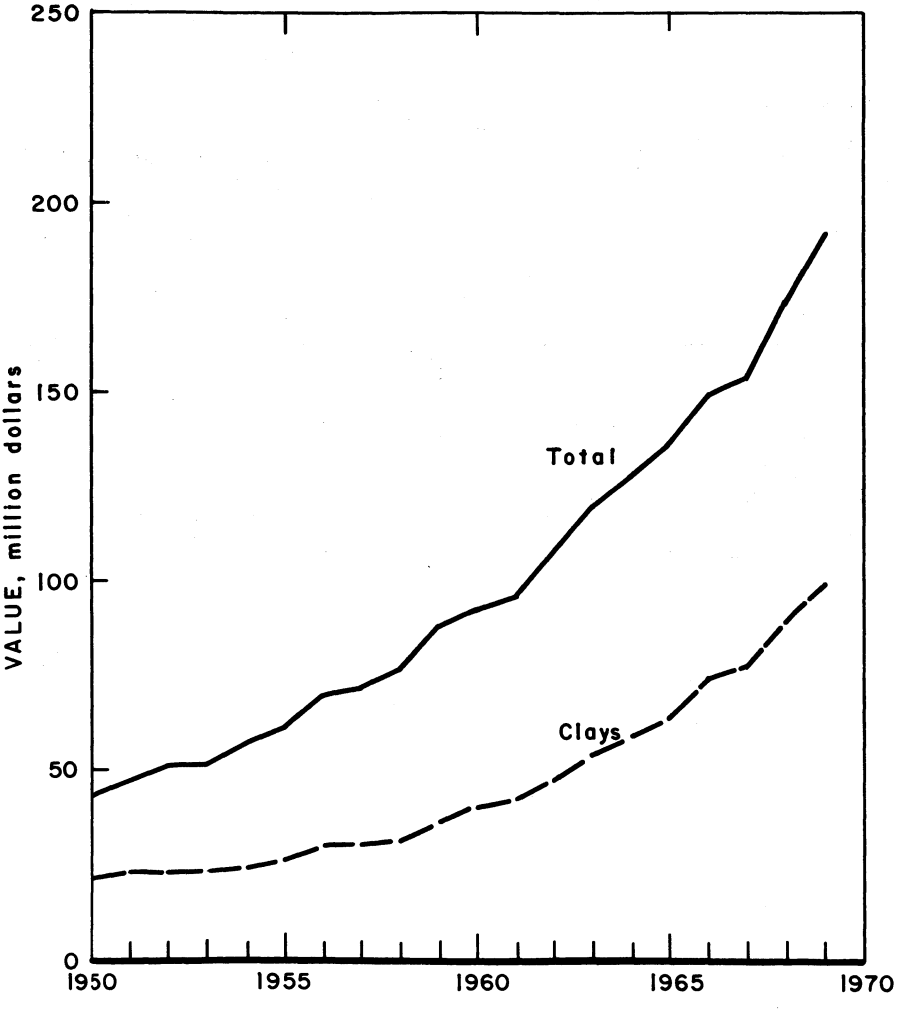

Figure 1.—Value of clays, and total value of mineral production in Georgia.

The Surface Mining Act to regulate reclamation of surface-mined land became effective on January 1, 1969. Leveling and reseeding was started on land previously mined in lieu of land now being mined.

Construction of highways is a significant market for mineral construction materials. At the close of 1969, a total of 721.6 miles (62.8 percent) of the planned Interstate System in Georgia was completed, 133.0 miles (11.6 percent) was under construction, and 295.0 miles (25.6 percent) was yet to be built.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Barite.—Primary barite was produced by four companies in the Carterville district, Bartow County. Output decreased 11 percent, but the value increased production of chemical-grade barite. The major uses were in barium chemicals, fillers (paint and rubber); a component of drilling mud; and in the manufacture of glass.

Cement.—Cement continued to rank third in the value of the State's mineral production in 1969. Portland and masonry cements were manufactured. Principal uses of portland cement were for ready-mix concrete, concrete products, and highway construction. Seventy-three percent of both types of cement were shipped to bordering States, and Mississippi. Transportation to markets was 70 percent by truck and 30 percent by rail. About 93 percent was shipped in bulk and 7 percent in containers.

Principal raw materials used in the manufacture of cement were mined within the State, and included limestone, miscellaneous clay, sand, and sandstone.

Clays.—Clays ranked first in the State in terms of value and accounted for 52 percent of the total value of mineral production in 1969. Fuller's earth, kaolin, and miscellaneous clay were mined by 35 companies from 53 pits in 19 counties.

Fuller's earth was produced by seven companies from seven mines in four counties. Production increased 5 percent in quantity and 7 percent in value, setting a new record for the State. Major uses were for absorbents, fillers (mostly for insecticides), for filtering oil or grease, and as a component of drilling muds.

Kaolin ranked first in the value among the State's mineral commodities, accounting for 46 percent of the total value of minerals produced. Output increased 16 percent and the value 11 percent, setting a new record for the State. Production was by 17 companies at 29 mines in seven counties. Kaolin was marketed nationally, and a small quantity was marketed internationally. The principal product was of premium grade of micron-sized hexagonal plates used for high-gloss coating of paper. Other kaolin products of premium price were used for fillers for paper, and extenders for paint. Kaolin of lower unit value was used for refactories (firebrick, etc.), other industrial fillers, and pottery. Continuing research in the industry has resulted in obtaining a premium product from kaolin formerly considered as uneconomical to mine and process. Increasing quantities of kaolin, which are currently unusable, were segregated and stockpiled when removed to facilitate mining.

Table 5.—Kaolin sold or used by producers, by counties

County	1968		1969	
	Number of mines	Thousand short tons	Number of mines	Thousand short tons
Twiggs	5	1,017	5	1,307
Washington	10	1,361	14	1,632
Wilkinson	5	W	5	392
Other counties [1]	7	787	5	344
Total [2]	27	3,165	29	3,676

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Baldwin, Jones (1968), Richmond, Sumter, Warren, and counties indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Table 6.—Kaolin sold or used by producers, by uses

(Thousand short tons)

Use	1968	1969
Pottery and stoneware: Whiteware	W	103
Refractories: Firebrick and block	209	289
Fillers:		
Paper filling	1,977	2,357
Rubber	94	103
Paint	120	116
Chemicals, other	32	30
Other uses [1]	732	678
Total [2]	3,165	3,676

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

[1] Includes stoneware; enameling (1968); floor and wall tile; glass refractories (1968); mortar, foundries and steelwork (bulk); kiln furniture; high alumina brick; other refractories; linoleum and oilcloth (1968); insecticides and fungicides; fertilizer filler; plastics filler; other fillers; portland and other cements; catalysts (oil refining); exports (1968); other uses; and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 7.—Miscellaneous clay sold or used by producers, by counties

County	1968		1969	
	Number of mines	Thousand short tons	Number of mines	Thousand short tons
Bartow	1	2	1	2
Fulton	4	W	4	475
Gordon	1	W	1	12
Richmond	2	W	3	500
Other counties [1]	9	1,629	8	674
Total [2]	17	1,631	17	1,663

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

[1] Includes Bibb, Columbia, Floyd, Houston, Polk, and Walker Counties, and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Miscellaneous clay was produced by 14 companies from 17 mines in 10 counties. Output of miscellaneous clay increased 2 percent, and value increased 24 percent over that of 1968. Miscellaneous clay was mainly used in brick manufacture with lesser quantities in the manufacture of cement and tile.

Feldspar.—One company mined feldspathic rock in Jasper County and recovered a feldspar concentrate by flotation. Most of the feldspar was used in pottery with lesser amounts in the manufacture of glass.

Gypsum.—Gypsum from out-of-State sources was calcined at three plants in Chatham and Glynn Counties. It was used in the manufacture of wallboard and similar building materials.

Kyanite.—Kyanite mined in Lincoln County was used principally in refractories. Production increased both in quantity and value.

Mica.—Scrap mica was produced by two companies from two mines in Hart and Cherokee Counties. The principal product was ground mica used as a filler in joint cement, rubber, and paint. A small quantity of flake mica was used to coat asphalt roofing.

Perlite.—Crude perlite, shipped into Georgia, was expanded at a plant in Fulton County. Its uses were as lightweight aggregate, in building plaster, in concrete blocks, and for horticultural applications.

Sand and Gravel.—Sand and gravel continued to rank fourth in value of minerals produced in the State. The quantity produced was only slightly greater than in 1968, but the value increased 9 percent. Sand and gravel was produced in 19 counties by 20 companies from 25 pits; one plant produced more than 500,000 tons, one plant between 400,000 and 500,000 tons, six plants between 200,000 and 300,000 tons, five plants between 100,000 and 200,000 tons, and 12 plants less than 100,000 tons. The construction industry was the major market for sand and gravel, used mostly for building purposes with a lesser amount for paving. A small quantity of sand was sold for industrial use, primarily for the manufacture of glass, as molding sand, and for sand blasting. Some ground sand was sold for foundry or other use.

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

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Cook	1	135	$102	1	115	$86
Evans	1	21	32	1	W	W
Montgomery	1	27	20	1	20	20
Muscogee	1	174	335	2	W	W
Rockdale	1	W	W	1	452	731
Talbot	2	655	526	2	W	W
Ware	1	27	18	1	W	W
Undistributed [1]	16	2,764	3,281	16	3,237	3,872
Total	24	3,803	4,314	25	3,824	4,709

W Witheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Bibb, Chatham, Crawford, Dougherty, Effingham, Fulton, Glynn, Greene, Long, Richmond, Taylor, Thomas, and counties indicated by symbol W.

Table 9.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,989	$2,785	$0.93	3,016	$2,997	$0.99
Paving	439	331	.75	384	305	.79
Fill	36	31	.86	22	18	.82
Foundry	10	10	1.00	W	W	W
Other uses [1]	329	1,157	3.52	402	1,389	3.46
Total sand and gravel	3,803	4,314	1.13	3,824	4,709	1.23

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes glass, molding, blast, engine, filtration, and other sands; structural, paving, fill gravel, and uses indicated by symbol W.

Stone.—Stone ranked second in value of production and accounted for 31 percent of the State's total mineral value. The quantity of stone produced increased 3 percent, and the value increased 6 percent. Stone was produced by 48 companies and three governmental agencies from 82 quarries in 36 counties. Thirteen quarries produced more than 900,000 tons, nine quarries between 500,000 and 900,000 tons, 15 quarries between 100,000 and 500,000 tons, and 45 quarries less than 100,000 tons. Leading counties in the quantity of stone produced were DeKalb, Fulton, Clayton, and Jones. Three-fourths of the crushed stone was hauled by truck and one-fourth by rail.

Crushed granite was produced by nine companies from 25 quarries in 19 counties. Quantity and value increased 4 percent and 5 percent, respectively, over that of 1968, setting a new record for the State. Principal uses were for roads and concrete aggregate with lesser quantities for railroad ballast. Dimension granite was quarried by 25 companies from 29 quarries in five counties. The major use was for monumental purposes, but some was also sold for curbing and rubble. Much of the monumental granite was marketed outside of the State.

Crushed limestone was produced by nine companies and three governmental agencies from 12 quarries in nine counties. The quantity decreased 5 percent, and the value decreased 4 percent from the record year of 1968. Uses were for roads, concrete aggregate, and the manufacture of cement. A small quantity was sold as agricultural limestone.

Crushed marble was produced by two companies from eight quarries in three counties. Both tonnage and value increased considerably over that of 1968. It was marketed mostly as agricultural limestone, terrazzo, industrial fillers, and whiting. One company produced micron-sized marble for a filler and coater of paper. Dimension marble, quarried by one company in Pickens County, was used mainly for cut stone, veneer, and rough stone.

Table 10.—Crushed granite sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Dense graded road base stone	17,690	$25,285	$1.43	9,769	$14,255	$1.46
Concrete aggregate	(1)	(1)	(1)	4,465	6,738	1.51
Railroad ballast	976	1,279	1.31	1,423	1,934	1.36
Surface treatment aggregate	(1)	(1)	(1)	1,156	1,784	1.54
Asphalt fill	----	----	----	250	W	W
Other uses [2]	758	1,530	2.02	3,186	4,766	1.50
Total [3]	19,423	28,095	1.45	20,249	29,476	1.46

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Included with dense graded road base stone.
[2] Includes poultry grit, bituminous aggregate, macadam aggregate, roofing aggregate, other aggregate, riprap, filter stone, blasting sand (1968), and uses indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Table 11.—Dimension granite sold or used by producers, by counties

County	1968				1969			
	Number of quarries	Thousand cubic feet	Short tons (equivalent)	Value (thousands)	Number of quarries	Thousand cubic feet	Short tons (equivalent)	Value (thousands)
De Kalb	4	W	W	W	4	458	80,878	$1,441
Elbert	13	408	36,062	$1,433	12	328	44,227	1,969
Hancock	1	4	374	9	1	W	W	W
Oglethorpe	10	423	39,777	2,018	10	475	41,854	1,616
Other counties [1]	2	1,039	86,891	2,570	2	353	33,069	1,073
Total [2]	30	1,873	163,104	6,029	29	1,614	200,028	6,100

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Madison County and counties indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Table 12.—Dimension granite sold or used by producers, by uses

(Thousand cubic feet and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per cubic foot		Total	Average per cubic foot
Rough monumental	1,057	$3,067	$2.90	1,082	$3,926	$3.63
Dressed monumental	137	1,609	11.75	72	W	W
Rubble	404	139	.34	298	W	W
Other uses [1]	275	1,215	4.42	163	2,174	13.34
Total [2]	1,873	6,029	3.22	1,614	6,100	3.78

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes rough construction, architectural stone, curbing, and flagging.
[2] Data may not add to totals shown because of independent rounding.

Table 13.—Crushed limestone sold or used by producers, by uses
(Thousand short tons and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Dense graded road base stone	3,022	$4,576	$1.51	1,435	$2,030	$1.41
Cement	W	W	W	1,400	1,914	1.37
Concrete aggregate	(1)	(1)	(1)	742	1,282	1.73
Aglime	212	403	1.90	170	336	1.97
Other uses [2]	1,354	1,903	1.41	586	1,036	1.77
Total [3]	4,587	6,882	1.50	4,334	6,599	1.52

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Included in dense graded road base stone.
[2] Includes bituminous aggregate, macadam aggregate, surface treatment aggregate, other aggregate, fluxing stone (1968), and uses indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Crushed sandstone (including quartzite) was produced by three companies from three quarries in three counties. Major uses were for concrete and asphalt aggregate, railroad ballast, road construction, and in the manufacture of cement. Dimension sandstone was quarried by two operators in Pickens County and used mostly as rough blocks, flagging, and irregular-shaped stone.

Crushed slate was produced by two companies. Both tonnage and value increased considerably, setting a record for the State. The principal product of an operation in Bartow County was roofing granules, and the byproduct was slate fines for industrial fillers. Crushed slate produced in Polk County was expanded into lightweight aggregate.

Talc.—Talc was produced by one company from five mines in Murray County. Both output and value increased. Major uses were for roofing and as a filler for asphalt and insecticides. Other uses were fillers for rubber and textiles and for ceramics. A small quantity of crayon-grade talc was produced.

Vermiculite.—W. R. Grace & Co. expanded exfoliated vermiculite, shipped into the State, at its Atlanta plant. Production and value were higher than in 1968.

METALS

Bauxite.—Bauxite of chemical grade was produced by one company from a mine in Sumter County and shipped to a plant in Bartow County for drying.

Iron Ore.—Limonitic iron ore was mined by three companies from three open pit mines in Stewart County. It was shipped to steel plants in both Birmingham and Gadsden, Ala. The quantity and value of limonitic ore increased over that of 1968. One company produced natural iron-oxide pigments of ochre and umber from open pit mines in Bartow County. The ochre was used mainly in chemical process or in concrete capping; umber was used mostly as coloring for brick facing.

Rare-Earth Minerals.—Monazite concentrate was obtained as a coproduct from an ilmenite dredging operation and plant in Charlton County.

Titanium.—Humphreys Mining Co. continued to produce ilmenite concentrate at its dredge and plant in south Georgia in Charlton County. Output and value decreased slightly from that of 1968.

Zirconium.—Zircon was concentrated as a coproduct at Humphreys Mining Co.'s plant in Charlton County. Both output and value decreased.

FUELS

Peat.—Peat was produced by two companies in Lowndes County for use as soil conditioner and flower packing.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
Barite, primary:			
Cain Mining Co	Box 304 Cartersville, Ga. 30120	Open pit mine	Bartow.
Milchem, Inc	3920 Essex Lane Houston, Tex. 77027	do	Do.
New Riverside Ochre Co	Box 387 Cartersville, Ga. 30120	do	Do.
Paga Mining Co	Cartersville, Ga. 30120	Open pit mine and grinding mill.	Do.
Bauxite: American Cyanamid Co	Berdan Ave. Wayne, N.J. 07472	Open pit mine and drying plant.	Sumter.
Cement, portland:			
Marquette Cement Manufacturing Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Plant	Polk.
Penn-Dixie Cement Corp	Box 152 Nazareth, Pa. 18064	do	Houston.
Southern Cement Co	16th Floor Bank for Savings Bldg. Birmingham, Ala. 35203	do	Fulton.
Clay:			
Fuller's earth:			
Cairo Production Co., Inc.	Box 358 Cairo, Ga. 31728	Open pit mine	Thomas.
Englehard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	do	Decatur.
General Reduction Corp	212 W. Monroe Chicago, Ill. 60606	do	Twiggs.
Georgia-Tennessee Mining & Chemical Co.	Box 307 Wrens, Ga. 30833	do	Jefferson.
Waverly Mineral Products Co.	Meigs, Ga. 31765	do	Thomas.
Kaolin:			
American Industrial Clay Co. of Sandersville.	Sandersville, Ga. 31082	2 open pit mines	Warren and Washington.
Engelhard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	do	Washington and Wilkinson.
Freeport Kaolin Co	405 Lexington Ave. New York, N.Y. 10017	Open pit mine	Twiggs.
Georgia Kaolin Co	433 North Broad St. Elizabeth, N.J. 07208	do	Do.
J. M. Huber Corp	630 3rd Ave. New York, N.Y. 10017	2 open pit mines	Twiggs and Warren.
Miscellaneous:			
Burns Brick Co	Box 4787 Macon, Ga. 31208	Open pit mine	Bibb.
Chattahoochee Brick Co	3195 Brick Plant Rd. Atlanta, Ga. 30321	3 open pit mines	Floyd (1) and Fulton (2).
Cherokee Brick & Tile Co.	Box 4567 Macon, Ga. 31208	Open pit mine	Bibb.
Merry Brothers Brick & Tile Co.	415 Masonic Bldg. Augusta, Ga. 30902	do	Richmond.
Southern Cement Co	16th Floor Bank for Savings Bldg. Birmingham, Ala. 35203	do	Fulton.
Feldspar: The Feldspar Corp	Spruce Pine, N.C. 28777	Open pit mine and flotation plant.	Jasper.
Gypsum, calcined:			
The Flintkote Co	480 Central Ave. East Rutherford, N.J. 07073	Plant	Chatham.
Georgia-Pacific Corp	Commonwealth Bldg. Portland, Ore. 97207	do	Glynn.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	do	Chatham.
Iron ore:			
Davis Bros	Brantley, Ala. 36009	Open pit mine	Stewart.
Lumpkin Mining Co	Box 234 Greenville, Ala. 36037	do	Do.
Pigeon Creek Mining Co	Lumpkin, Ga. 31815	do	Do.
Iron oxide pigment materials: New Riverside Ochre Co.	Box 387 Cartersville, Ga. 31020	do	Bartow.
Kyanite: Aluminum Silicates, Inc	Box 649 Washington, Ga. 30673	Open pit mine and mill.	Lincoln.
Mica, scrap:			
Franklin Mineral Products Co.	Box 0 Wilmington, Mass. 01887	Open pit mine and grinding mill.	Hart.
Thompson-Weinman & Co	Cartersville, Ga. 30120	Underground mine and grinding mill.	Cherokee and Bartow.
Peat:			
Georgia Peat Moss Co	Route 2 Lake Park, Ga. 31636	Open pit mine	Lowndes.
Lake Park Peat Moss Co	Lake Park, Ga. 31636	do	Do.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Perlite, expanded: W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Fulton.
Rare-earth metals: Humphreys Mining Co.	Box 8 Folkston, Ga. 31537	Dredge and plant	Charlton.
Sand and gravel:			
Atlanta Sand & Supply Co	605 Forsyth Bldg. Atlanta, Ga. 30303	Open pit mine	Crawford.
Dawes Silica Mining Co., Inc.	Drawer 920 Thomasville, Ga. 31792	4 open pit mines	Dougherty, Effingham, Long, and Thomas.
Drake Eye Mining Co	Box 236 Lithonia, Ga. 30058	Open pit mine and dredge.	Rockdale.
Howard Sand Co	Howard, Ga. 31039	Open pit mine	Taylor.
Taylor County Sand Co	Junction City, Ga. 31812	----do	Talbot.
Stone:			
Granite, crushed:			
Dixie Lime & Stone Co	Box 910 Ocala, Fla. 32670	5 quarries	Clayton, Fayette, Lamar, Monroe, and Spalding.
Hitchcock Corp	Box 35 Murphy, N.C. 28906	3 quarries	Clayton, Fulton, and Jones.
Stone Mountain Grit Co., Inc.	Box 458 Lithonia, Ga. 30058	2 quarries	De Kalb and Fulton.
Vulcan Materials Co	Box 12078 N. Side Station Atlanta, Ga. 30305	6 quarries	Cobb, Douglas, Fulton, Gwinnett, Henry and Muscogee.
Weston & Brooker Co	Box 335 Gray, Ga. 31032	Quarry	Jones.
	Box 180 Thomas, Ga. 30824	----do	Warren.
Granite, dimension:			
Bennie & Harvey	Box 958 Elberton, Ga. 30635	----do	Oglethorpe.
Coggins Granite Industries, Inc.	Box 250 Elberton, Ga. 30635	2 quarries	Elbert and Madison.
Davidson Granite Co., Inc.	Lithonia, Ga. 30058	Quarry	De Kalb.
Georgia Marble Co	Elberton, Ga. 30635	----do	Madison.
Stone Mountain Granite Co.	Stone Mountain, Ga. 30083	----do	De Kalb.
Limestone, crushed:			
Dalton Rock Products Co.	Box 1608 Dalton, Ga. 30720	----do	Whitfield.
Georgia Rock Products Co.	Arlington, Ga. 31713	----do	Early.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	----do	Houston.
Ready-Mix Concrete Co., Inc.	401 E. 1st Ave. Rome, Ga. 30161	----do	Floyd.
The Stone Man, Inc	3814 Tennessee Ave. Chattanooga, Tenn. 37409	----do	Walker.
Marble, crushed:			
Georgia Marble Co	Tate, Ga. 30177	4 quarries	Gilmer and Pickens.
Marble Products Co	67 Peachtree Park Drive Atlanta, Ga. 30309	2 quarries	Chattooga and Pickens.
Marble, dimension: Georgia Marble Co.	Tate, Ga. 30177	Quarry and finishing plant.	Pickens.
Sandstone, crushed:			
Marquette Cement Manufacturing Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Quarry	Polk.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	Quartzite quarry	Richmond.
Sandstone, dimension:			
Carl S. Johnson	Route 1 Talking Rock, Ga. 30175	Quarry	Pickens.
North Georgia Stone Co.	Whitestone, Ga. 30186	2 quarries	Do.
Slate, crushed:			
General Aniline & Film Corp.	Fairmont, Ga. 30139	Underground quarry	Bartow.
Georgia Lightweight Aggregate Co.	Box 19781, Station N Atlanta, Ga. 30325	Quarry and expanding plant.	Polk.
Talc: Georgia Talc Co	Box 278 Chatsworth, Ga. 30705	5 underground mines and 1 open pit.	Murray.
Titanium concentrates: Humphreys Mining Co.	Box 8 Folkston, Ga. 31537	Dredge and plant	Charlton.
Vermiculite, exfoliated: W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Fulton.
Zirconium concentrates: Humphreys Mining Co.	Box 8 Folkston, Ga. 31537	Dredge and plant	Charlton.

The Mineral Industry of Hawaii

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Hawaii Department of Land and Natural Resources for the collection of mineral data.

By Roy Y. Ashizawa [1]

The value of Hawaii's mineral output in 1969 reached an alltime high of $29.5 million, reflecting the unprecedented volume of construction. The ongoing construction boom was further augmented in 1969 by startups of new building projects that were authorized on Oahu Island before adoption of a more restrictive zoning ordinance. As a result, demand for sand and gravel and stone reached a record 7.1 million tons, and nearly 2.6 million barrels of locally produced and imported portland cement was consumed. Production of pumice and volcanic cinders for use as lightweight concrete aggregate and lime for masonry and sugar refining also increased appreciably. Output of black coral, clay, and solar-evaporated salt declined.

[1] Mineral specialist, Bureau of Mines, San Francisco, Calif.

Table 1.—Mineral production in Hawaii [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement—thousand 376-pound barrels	1,841	$ 9,254	2,075	$10,544
Clay—thousand short tons	3	4	2	9
Lime—do	8	268	9	287
Pumice, pumicite, and volcanic cinder—do	408	724	403	783
Sand and gravel—do	546	1,653	552	1,816
Stone—do	5,211	11,273	6,534	16,059
Value of items that cannot be disclosed:				
Gem stones and salt	XX	49	XX	41
Total	XX	23,225	XX	29,539
Total 1967 constant dollars	XX	r 22,996	XX	p 28,761

p Preliminary. r Revised. 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 Hawaii, by counties
(Thousands)

County	1968	1969	Minerals produced in 1969, in order of value
Hawaii	$ 2,089	$ 2,039	Stone, pumice and volcanic cinder.
Honolulu	18,481	24,337	Stone, cement, lime, sand and gravel, clays, salt.
Kauai	419	839	Stone, sand and gravel, volcanic cinder.
Maui	2,236	2,324	Sand and gravel, stone, volcanic cinder, lime, gem stones.
Total	23,225	29,539	

Table 3.—Economic indicators

		1968 r	1969 p
Employment	thousands	296.6	310.0
Personal income:			
Total	millions	$2,705.0	$3,024.0
Per capita		$3,513.0	$3,882.0
Construction:			
Completed	millions	$463.2	$625.6
Building permits on Oahu	do	$345.6	$412.6
Manufacturing	do	$344.0	$400.0
Sugar	do	$200.0	$195.0
Pineapple	do	$127.6	$120.0
Mineral production value	do	$23.2	$29.5
Defense expenditures	do	$606.0	$660.2
Visitors:			
Arrivals	thousands	1,209.4	1,364.2
Expenditures	millions	$460.0	$580.0

p Preliminary. r Revised.
Sources: Survey of Current Business, Hawaii Department of Labor and Industrial Relations, Hawaii Visitors Bureau, Hawaii Department of Taxation, Honolulu Building Department, Bank of Hawaii, and First Hawaiian Bank.

Table 4.—Worktime 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
1968:								
Nonmetal	102	88	9	71	---	1	14.17	213
Sand and gravel	31	90	3	22	---	--	-----	-----
Stone	493	234	115	939	---	40	42.58	1,604
Total	626	203	127	1,032	---	41	39.72	1,475
1969: p								
Nonmetal	95	112	12	91	---	4	43.94	538
Sand and gravel	35	97	3	26	---	--	-----	-----
Stone	585	266	156	1,310	---	44	33.58	869
Total	715	238	171	1,427	---	48	33.64	833

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—After nearly 10 years of continuous operation the two cement plants on Oahu Island were faced with operating problems. The kiln section of one was inadequate to meet cement clinker demand, and the other plant was in need of repairs. As a result, cement clinker from Japan and finished portland cement from the U.S. mainland were imported to help fill Hawaii's record requirement of 2,583,000 barrels of portland cement.

The two plants produced 2,102,000 barrels of cement and shipped 2,075,000 barrels—1,846,000 barrels in bulk and 229,000 barrels in paper bags. Of the total, 2,066,000 barrels were shipped for use in Hawaii and 9,000 barrels were exported. Shipments went to ready-mixed concrete companies (78 percent), concrete product manufacturers (15 percent), building material dealers (4 percent), and contractors, government agencies, and miscellaneous customers (3 percent).

Raw materials used in cement production included 326,000 tons of coral limestone and 74,000 tons of basalt from quarries on Oahu. Silica sand, gypsum, and grinding aids were imported.

The two plants used 50.2 million kilowatt-hours of electrical energy.

By yearend, Hawaiian Cement Corp. had begun a $6-million expansion to increase the annual capacity of its Barbers Point facility to 2.5 million barrels of cement. As part of the expansion, a second kiln, capable of producing 1.5 million barrels of cement clinker, was scheduled for installation by late 1971.

Clays.—Clays were mined on Oahu near Waimanalo and hauled to the Barbers Point facility of Pacific Clay Corp., Hawaii's sole manufacturer of clay products. The clays were ground, pugged, and extruded into brick and block and fired in a kiln at 2,150° F. The company also constructed a tumbler in which new brick were chipped and coated with cement to simulate used brick, for which demand in decorative uses, was growing.

Gem Stones.—Black coral gem material was collected by scuba divers from the deep channel waters between the islands of Maui, Lanai, and Molokai. The tree-like coral was cut and polished by lapidaries and jewelers and mounted in rings, brooches, and other free form jewelry items.

Lime.—Production of lime at two plants, one on Oahu and one on Maui, increased to nearly 8,600 tons. Sugar mills used 82 percent of the output for clarifying cane juice. Most of the remainder was sold for use in masonry, sewage treatment, water purification, and as a flux in melting scrap iron. Purchased limestone was calcined at the Oahu plant and coral beach sand at the Maui plant. Each plant operated one rotary kiln and one continuous hydrator.

Pumice and Volcanic Cinder.—Production of pumice and volcanic cinders at 22 open pit operations totaled nearly 403,000 tons, of which 41 percent was used as lightweight concrete aggregate, 31 percent for construction of secondary and tertiary roads, and 28 percent for landscaping, filtration, and horticultural uses. Output was less than in 1968, but the value was greater owing to increased sales of higher unit-value pumice and cinder products prepared for use as lightweight aggregate. Principal production for this use occurred at the Puuwaawaa pumice quarry on Hawaii Island and the Waieli cinder pit on Molokai Island, mainly for shipment by barge to Oahu.

Salt.—Crude salt was produced by solar evaporation of seawater in a series of concentrating and crystallizing ponds near the Barbers Point barge harbor on Oahu. The coarse, crystalline salt was washed, bagged, and sold through grocery stores for use in curing fish and seasoning meats.

Hawaii's additional requirements of salt for food and chemical processing, table salt, and livestock feed were supplied by mainland producers.

Sand and Gravel.—Nearly 552,000 tons of coral sand and basaltic gravel was mined at 17 locations on the islands of Kauai, Lanai, Maui, Molokai, and Oahu. Most of the sand produced on Molokai was barged to Oahu.

A trend toward greater use of manufactured sand was initiated by producers who informally agreed among themselves to remove less sand from the beaches. The largest sand-manufacturing plant was operated at the Waimanalo quarry on Oahu, where coral limestone was crushed, ground, washed, and classified to specified sand gradations.

Stone.—A record 6.5 million tons of stone was quarried, primarily for use as concrete aggregate and base material. Nearly 85 percent was produced on Oahu, 10 percent on Hawaii, and 5 percent on Kauai, Maui, and Molokai. The stone producers quarried 4,920,000 tons of basalt, 1,184,000 tons of coral limestone, and 430,000 tons of aa rock, moss rock, and lava slabs. Output of basalt at Halawa, Kapaa, Palailai, and Kaena on Oahu totaled 4,439,000 tons, an alltime high. Basalt rock was quarried also at Hilo and Kona on Hawaii, near Puhi on Kauai, at Camp 10 on Maui, and at Manawainui on Molokai. Coral limestone was produced at Barbers Point, Waianae, Lualualei, Waimanalo, and Laie on Oahu, at Koloa on Kauai, and from the dredged stockpile at Kawaihae on Hawaii. On Molokai, a 12-inch cutter-head suction dredge was being utilized to dredge coral offshore of the Puuahala district to fill the shore area for a resort.

Output of miscellaneous stone consisted mainly of aa rock and decorative lava slabs on Hawaii, moss rock near Waianae on Oahu, and decomposed volcanic rock on Kauai. Several new aa deposits were being developed on the island of Hawaii. The largest, in the Honokohau district, will be the principal source of concrete aggregate,

base material, and stone sand for use in construction of the new Keahole airport.

Vermiculite.—Crude vermiculite from mines in Montana was exfoliated in a vertical furnace on Oahu. The volume of sales of expanded vermiculite for lightweight aggregate, heat and sound insulation, and agricultural uses was double that of 1968.

MINERAL FUELS

Standard Oil Co. of California operated its 35,000-barrel-per-day oil refinery at Barbers Point on Oahu, utilizing crude oil from foreign oilfields. Principal products were jet fuel, fuel oil, gasoline, liquefied gas, and asphalt. Local demand for all of the products increased appreciably. The largest gains were for jet fuel, distillate fuel oil, and liquefied gas.

Dillingham Petroleum Corp. proceeded with engineering, design, and construction for a 50,000-barrel-per-day oil refinery at Barbers Point. The $60 million refinery, scheduled for completion in 1972 as an all hydrogen facility with hydrodesulfurization and hydrocracking, was planned to produce a full range of products including gasoline, commercial and military jet fuels, diesel fuels, and fuel oils.

Hawaiian Independent Refinery, Inc., organized principally by Honolulu Gas Co., Ltd., awaited approval for creation of a foreign trade subzone at the Barbers Point site of its planned 29,500-barrel-per-day oil refinery. Approval of the subzone would permit the company to import foreign crude oil and sell the planned principal products, aviation fuel and bunker fuel, to international carriers without being subject to import duties.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	Island
Cement:			
Hawaiian Cement Corp	1600 Kapiolani Blvd., Suite 1200 Honolulu, Hawaii 96814	Dry process portland cement plant.	Oahu.
Kaiser Cement & Gypsum Corp.	Permanente Rd. Permanente, Calif. 95014	Wet process portland cement plant.	Do.
Clays: Pacific Clay Corp	547 Halekauwila St. Honolulu, Hawaii 96813	Open pit mine	Do.
Lime:			
GasprO, Ltd	P.O. Box 2454 Honolulu, Hawaii 96804	Rotary kiln and continuous hydrator.	Do.
Hawaiian Commercial & Sugar Co.	Puunene, Hawaii 96784	----do	Maui.
Pumice and volcanic cinder:			
Concrete Industries, Inc	P.O. Box 86 Puunene, Hawaii 96784	Open pit mine	Do.
Fong Construction Co., Ltd.	237 Dairy Rd. Kahului, Hawaii 96732	----do	Do.
James W. Glover, Ltd	P.O. Box 275 Hilo, Hawaii 96720	----do	Hawaii.
Grove Farm Co., Ltd	Puhi Rural Station Lihue, Hawaii 96766	----do	Kauai.
Haleakala Ranch Company	Makawao, Hawaii 96768	----do	Maui.
Hawaiian Agricultural Co., Ltd.	Pahala, Hawaii 96777	----do	Hawaii.
HC&D, Ltd	P.O. Box 190 Honolulu, Hawaii, 96810	----do	Molokai.
Hutchinson Sugar Co., Ltd.	Naalehu, Hawaii 96772	----do	Hawaii.
James Kuwana	P.O. Box 406 Pahoa, Hawaii 96778	----do	Do.
Maui Land & Pineapple Co., Inc.	R.R. 1, Box 445-C Lahaina, Hawaii 96761	----do	Maui.
McBryde Sugar Co., Ltd	Eleele, Hawaii 96705	----do	Kauai.
Olokele Sugar Company, Ltd.	Kaumakani, Hawaii 96747	----do	Do.
Pacific Concrete & Rock Co., Ltd.	2344 Pahounui Dr. Honolulu, Hawaii 96819	----do	Molokai.
Pepeekeo Sugar Co	Pepeekeo, Hawaii 96783	----do	Hawaii.
Puna Sugar Co. Ltd	Keaau, Hawaii 96749	----do	Do.
M. Shimizu, Contractor	P.O. Box 396 Kahului, Hawaii 96732	----do	Maui.
J. A. Thompson, Contractor.	C/O Postmaster Kaunakakai, Hawaii 96748	----do	Molokai.
Volcanite, Ltd	828 Fort St. Honolulu, Hawaii 96813	----do	Hawaii.
Salt:			
Tanaka Hawaiian Salt	968 D Akepo Lane Honolulu, Hawaii 96817	Solar evaporation	Oahu.

Table 5.—Principal producers—Continued

Commodity and company	Address	Type of activity	Island
Sand and gravel:			
Concrete Industries, Inc.	P.O. Box 86 Puunene, Hawaii 96784	Open pit mine	Maui.
Dole Corp.	Lanai City, Hawaii 96763	do	Lanai.
Hale Kauai, Ltd.	Nawiliwili, Hawaii 96766	do	Kauai.
Hawaiian Commercial & Sugar Co., Ltd.	Puunene, Hawaii 96784	do	Maui.
HC&D, Ltd.	P.O. Box 190 Honolulu, Hawaii 96810	do	Molokai.
Kekaha Sugar Co., Ltd.	Kekaha, Hawaii 96752	do	Kauai.
Lihue Plantation Co., Ltd.	P.O. Box 751 Lihue, Hawaii 96766	do	Do.
Maui Concrete & Aggregates, Inc.	8 Central Ave. Wailuku, Hawaii 96793	do	Maui.
McBryde Sugar Co., Ltd.	Eleele, Hawaii 96705	do	Kauai.
Molokai Rock & Equipment.	Manawainui, Hawaii	do	Molokai.
Pacific Concrete & Rock Co., Ltd.	2344 Pahounui Dr. Honolulu, Hawaii 96819	do	Molokai, Oahu.
Pioneer Mill Co., Ltd.	Lahaina, Hawaii 96761	do	Maui.
Louis K. Rego Trucking	Lihue, Hawaii 96766	do	Kauai.
Wailuku Sugar Co.	Wailuku, Hawaii 96793	do	Maui.
Stone:			
Concrete Industries, Inc.	P.O. Box 86 Puunene, Hawaii 96784	Open quarry	Maui.
Ewa Sugar Co., Inc.	Ewa Beach, Hawaii 96706	do	Oahu.
James W. Glover, Ltd.	P.O. Box 275 Hilo, Hawaii 96720	do	Hawaii.
Grove Farm Co., Inc.	Puhi Rural Station Puhi, Hawaii 96766	do	Kauai.
Hawaiian Agricultural Co., Ltd.	Pahala, Hawaii 96777	do	Hawaii.
Hawaiian Bitumuls & Paving Co., Ltd.	P.O. Box 2240 Honolulu, Hawaii 96804	do	Oahu.
Hawaiian Cement Corp.	1600 Kapiolani Blvd., Suite 1200 Honolulu, Hawaii 96814	do	Do.
HC&D, Ltd.	P.O. Box 190 Honolulu, Hawaii 96810	do	Do.
Honokaa Sugar Co.	Haina, Hawaii 96709	do	Hawaii.
Joe's Moss Rock Co.	1446 Meyers St. Honolulu, Hawaii 96819	do	Oahu.
Kahuku Plantation Co.	Kahuku, Hawaii 96731	do	Oahu.
Kaiser Cement & Gypsum Corp.	Permanente Rd. Permanente, Calif. 95014	do	Do.
Kohala Sugar Co.	Hawi, Hawaii 96719	do	Hawaii.
James Kuwana	P.O. Box 406 Pahoa, Hawaii 96778	do	Do.
Kuwaye Brothers, Inc.	P.O. Box 707 Hilo, Hawaii 96720	do	Do.
Laie Concrete & Aggregate, Inc.	Laie, Hawaii 96762	do	Oahu.
Laupahoehoe Sugar Co.	Papaaloa, Hawaii 96780	do	Hawaii.
Lihue Plantation Co., Ltd.	P.O. Box 751 Lihue, Hawaii 96766	Open quarry	Kauai.
Moss Rock Hawaii.	6154-A Kalanianaole Hwy. Honolulu, Hawaii 96821	do	Oahu.
Paauhau Sugar Co., Ltd.	Paauhau, Hawaii 96775	do	Hawaii.
Pacific Cement & Aggregates Co.	400 Alabama St. San Francisco, Calif. 94110	do	Oahu.
Pacific Concrete & Rock Co., Ltd.	2344 Pahounui Dr. Honolulu, Hawaii 96819	do	Molokai, Oahu.
Puna Sugar Co., Ltd.	Keaau, Hawaii 96749	do	Hawaii.
R & R Moss Rock	87-1430-A Akowai Rd. Waianae, Hawaii 96792	do	Oahu.
J. M. Tanaka Construction, Inc.	P.O. Box 67 Kailua-Kona, Hawaii 96740	do	Hawaii.
Ultramar Chemical Co.	P.O. Box 395 Hilo, Hawaii 96720	do	Do.
Yamada Sons, Inc.	P.O. Box 577 Hilo, Hawaii 96720	do	Do.
Vermiculite (exfoliated):			
Vermiculite of Hawaii, Inc.	842-A Mapunapuna St. Honolulu, Hawaii 96819	Exfoliating plant	Oahu.

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 Fred V. Carrillo,[1] Mary Anne McComb,[2] and Norman S. Petersen [3]

Idaho's mineral production value rose $4 million (3 percent) in 1969 to a new high of $118.3 million. The previous record high was $114.9 million in 1966. As in the past, silver was the leading value product, accounting for 29 percent of the State's production value. However, the value of silver production dropped 1 percent compared with 1968, owing to a 17-percent fall in the average annual price; the total quantity of silver produced rose 19 percent. The value of lead production posted a gain of 35 percent, which was partially attributed to a 13-percent rise in the average annual price. The value of zinc production rose 6 percent, in spite of a 2-percent decline in volume; the annual average price of zinc increased 8 percent.

Construction material trends were mixed. Sand and gravel was down 17 percent in production value, but total volume was up 4 percent; this indicated a decline in the average price of sand and gravel. Stone also experienced a decrease in average unit price; this was more than offset by an increase in tonnage. Cement shipments fell, but the value rose, owing to an increase in average unit price. Clay rose in both categories with the greater rise being in value. Construction employment rose slightly over that of 1968. Toward the end of the year, activity was concentrated in the area of heavy construction; this was because of a greater emphasis on road and dam building.

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Table 1.—Mineral production in Idaho [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Antimony ore and concentrate, short tons, antimony content	853	W	922	W
Clays [2] thousand short tons	12	$14	23	$51
Copper (recoverable content of ores, etc.) short tons	3,525	2,950	3,332	3,168
Gem stones	NA	200	NA	90
Gold (recoverable content of ores, etc.) troy ounces	3,227	[3] 127	3,403	[3] 141
Gypsum thousand short tons	3	13	------	------
Lead (recoverable content of ores, etc.) short tons	54,790	14,478	65,597	19,541
Mercury 76-pound flasks	W	W	1,012	511
Peat short tons	W	W	1,000	W
Phosphate rock thousand short tons	3,879	22,721	W	W
Pumice do	135	259	21	62
Sand and gravel do	8,224	9,133	8,555	7,583
Silver (recoverable content of ores, etc.) thousand troy ounces	15,959	34,225	18,930	33,897
Stone thousand short tons	2,195	5,209	3,750	6,426
Tungsten ore and concentrate (60 percent WO$_3$ basis) short tons	W	W	27	63
Zinc (recoverable content of ores, etc.) do	57,248	15,457	55,900	16,323
Value of items that cannot be disclosed: Cement, fire clay, garnet, iron ore, kaolin, lime, perlite, vanadium, and values indicated by symbol W	XX	9,467	XX	30,453
Total	XX	114,253	XX	118,309
Total 1967 constant dollars	XX	r 104,569	XX	p 106,300

p Preliminary. r Revised. 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 fire clay and kaolin; included with "Value of items that cannot be disclosed."

[3] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

Table 2.—Value of mineral production in Idaho, by counties

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Ada	$436	W	Sand and gravel, clays.
Adams	42	$22	Sand and gravel.
Bannock	W	2,867	Cement, sand and gravel, stone, peat, copper, silver.
Bear Lake	267	83	Sand and gravel.
Benewah	W	W	Garnet, stone.
Bingham	W	W	Phosphate rock, vanadium, sand and gravel, pumice, clays.
Blaine	1,137	1,279	Lead, silver, zinc, sand and gravel, gold, copper.
Boise	118	W	Gold, silver, zinc, lead.
Bonner	84	166	Stone, sand and gravel, lead, silver, zinc, copper, gold.
Bonneville	734	619	Lime, sand and gravel, stone, pumice, clays.
Boundary	31	W	Stone, sand and gravel, lead, silver, zinc.
Butte	108	W	Silver, lead, copper, zinc.
Camas	104	W	Silver, lead, sand and gravel, zinc, gold, copper.
Canyon	1,031	727	Sand and gravel, lime, pumice.
Caribou	W	W	Phosphate rock, vanadium, stone, sand and gravel.
Cassia	107	W	Sand and gravel, clays.
Clark	94	58	Sand and gravel, lead, silver, zinc, copper, gold.
Clearwater	1,889	W	Stone, sand and gravel.
Custer	1,506	1,331	Silver, lead, zinc, tungsten, copper, sand and gravel, gold.
Elmore	34	W	Clays, sand and gravel.
Franklin	208	83	Sand and gravel.
Fremont	17	------	----------
Gem	220	276	Sand and gravel.
Gooding	226	10	Do.
Idaho	111	473	Sand and gravel, silver, gold, zinc.
Jefferson	1,020	W	Sand and gravel, clays.
Jerome	(1)	18	Sand and gravel.
Kootenai	412	355	Sand and gravel, stone.
Latah	W	821	Clays, stone, sand and gravel.
Lemhi	W	88	Sand and gravel, copper, lead, silver, zinc, gold.
Lewis	------	W	Stone.
Lincoln	W	W	Sand and gravel.
Madison	------	19	Do.
Minidoka	237	238	Lime, sand and gravel, clays.
Nez Perce	403	440	Sand and gravel, stone, copper, silver.
Oneida	128	182	Sand and gravel, perlite, pumice.
Owyhee	73	14	Sand and gravel, silver, gold.
Payette	355	23	Sand and gravel.
Power	16	W	Sand and gravel, stone.
Shoshone	65,081	71,701	Silver, lead, zinc, copper, antimony, stone, gold, sand and gravel.
Teton	92	255	Sand and gravel.
Twin Falls	1,049	968	Sand and gravel, lime, clays.
Valley	35	39	Sand and gravel, iron ore.
Washington	689	547	Mercury, iron ore, stone.
Undistributed [2]	36,159	34,607	
Total	114,253	118,309	

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

[1] Less than ½ unit.

[2] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

Table 3.—Indicators of Idaho business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	[1] 287.6	293.6	+2.1
Unemployment	do	12.3	11.7	−4.9
Employment:				
Construction	do	9.6	9.7	+1.0
Lumber and wood products	do	12.7	13.1	+3.1
Food products	do	14.1	14.5	+2.8
All manufacturing	do	37.8	39.5	+4.5
All industries	do	275.1	281.9	+2.5
Payrolls, factory	millions	$237.6	$265.2	+11.6
Personal income:				
Total	do	$1,876.0	$2,051.0	+9.3
Per capita		$2,646.0	$2,857.0	+8.0
Construction activity:				
Heavy engineering awards	millions	$45.5	$61.3	+34.7
State Highway Commission:				
Value of contracts awarded	do	$28.3	$33.3	+17.7
Value of contract work performed	do	$40.3	$46.0	+14.1
Cement shipments to and within Idaho	thousand 376-pound barrels	1,730.0	2,539.0	+46.8
Farm marketing receipts	millions	$546.1	$620.3	+13.6
Mineral production value	do	$114.3	$118.3	+3.5

p Preliminary.
[1] Includes 200 workers involved in labor disputes.

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.

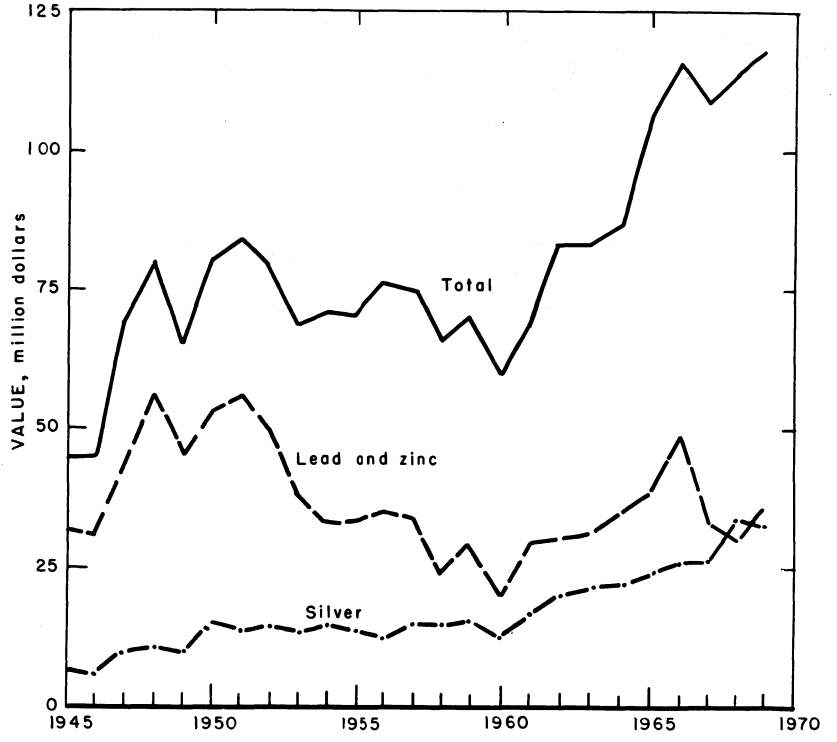

Figure 1.—Value of silver, lead and zinc, and total value of mineral production in Idaho.

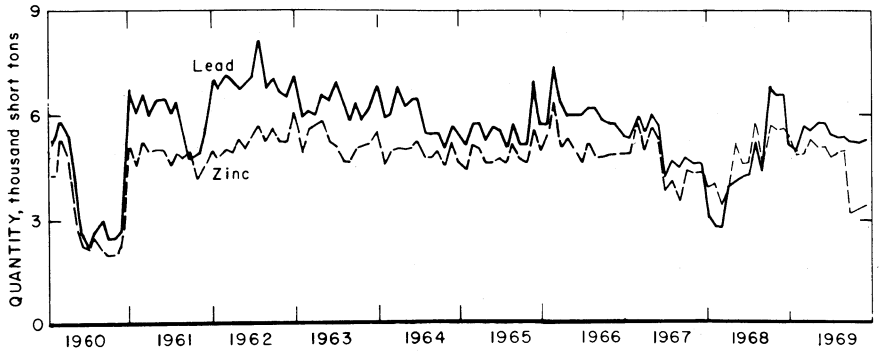

Figure 2.—Mine production of lead and zinc in Idaho, by months, in terms of recoverable metals.

Last spring, mineral exploration in the White Cloud area, Custer County, aroused the interests of recreation and wildlife enthusiasts. As of August 1969, American Smelting and Refining Co. (Asarco) and others had filed 150 claims in the Frog Lake vicinity, near Baker Lake.

A report on the Idaho economy for 1968 with projections for 1969 was published.[4]

Employment, Trade, and Markets.—All key indicators of Idaho business activity rose in 1969, with the exception of the unemployment rate which fell from 4.3 to 4.1 percent. Idaho experienced a decade of record growth. Average total employment was 13 percent higher than that recorded for 1960, yet the population for the State was estimated to have increased less than 6 percent in the last decade. Since the mid-1960's, employment had increased about 2 percent per year. Mining employment rose 10 percent over that of last year, but was only slightly above the figure reached in 1966 before the nationwide copper strike. The number of miners employed in 1969 (3,628) was a record high for the decade, but it was far below the totals reached in the 1940's and 1950's. By the end of the year, there was a shortage of experienced workers needed in the mines in Shoshone County, which yielded about 90 percent of the State's silver, zinc, copper, and gold.

[4] Mountsanides, Demetrius T. Idaho Economic Activity in 1968 and Prospects for 1969. Univ. of Washington Business Rev., Winter 1969, pp. 23–32.

Table 4.—Annual employment and wages paid in the mineral industries

Year	Mining							
	Metals		Nonmetals		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)
1965	2,935	$18,563	540	$3,431	3	$11	3,478	$22,005
1966	2,915	19,758	704	5,059	3	9	3,622	24,826
1967	2,718	20,089	637	4,432	3	8	3,358	24,530
1968	2,692	21,431	617	4,936	1	5	3,310	26,373
1969	2,965	24,121	662	5,405	1	5	3,628	29,531

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)
1965	854	$5,210	1,296	$8,234	1,245	$9,042	3,395	$22,486
1966	955	5,899	1,316	8,951	1,443	11,563	3,714	26,413
1967	930	5,959	1,302	9,850	1,490	12,613	3,722	28,422
1968	940	6,436	1,333	10,374	1,405	12,460	3,678	29,270
1969	1,003	7,148	1,323	11,066	1,378	12,858	3,704	31,072

Source: Idaho Employment Security Agency; employment covered by unemployment insurance. Industry groups may not correspond with those in the Bureau of Mines canvass.

Table 5.—Worktime 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
1968:								
Metal	2,456	243	598	4,778	4	261	55.46	8,928
Nonmetal and peat	515	236	122	1,032	---	25	24.23	1,571
Sand and gravel	352	180	63	505	---	11	21.79	1,085
Stone	202	176	36	298	---	6	20.12	902
Total [1]	3,525	232	818	6,613	4	303	46.42	6,820
1969: [p]								
Metal	2,315	247	572	4,576	5	347	76.92	12,561
Nonmetal and peat	485	223	108	903	1	15	17.72	6,856
Sand and gravel	815	163	133	1,066	---	19	17.82	356
Stone	310	203	63	513	---	6	11.69	479
Total [1]	3,925	223	877	7,059	6	387	55.68	9,110

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 6.—Hours and earnings of production workers in mining

	1965	1966	1967	1968	1969
Annual average:					
Weekly earnings	$116.22	$122.99	$136.52	$141.72	$154.62
Hourly earnings	$3.00	$3.18	$3.48	$3.58	$3.85
Weekly hours	38.8	38.7	39.2	39.5	40.2

Source: Idaho Employment Security Agency.

Table 7.—Office of Minerals Exploration contracts active during 1969

County and contractor	Commodity	Contract		
		Date	Total amount	Government participation, percent
Lemhi:				
Pope-Shenon mine	Copper	April 8, 1969	$85,700	50

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METALS

Antimony.—Output of antimony increased to 922 short tons, an 8-percent gain for the year. The State's only production continued to be from the Sunshine mine, near Kellogg, Shoshone County. Antimony was leached from silver concentrates and recovered at the Sunshine Mining Co. electrolytic plant as cathode metal. Production was derived entirely as a byproduct from silver ore. The value of the antimony produced increased 11.4 percent because of increased production and a higher average price.

Cadmium.—Recovery of electrolytic cadmium at The Bunker Hill Co. zinc plant increased 5 percent above the 1968 total.

Copper.—Production of copper declined slightly below the 1968 total to 3,332 tons. Despite smaller copper output, total value increased 7.4 percent to $3,168,000 as the average price rose from 42 cents per pound in 1968 to 47.5 cents per pound in 1969.

Cessation of production at the Blackbird mine in Lemhi County was a large factor in the decrease. Shoshone County was the leading copper-producing area with the greater part of the 3,251 tons derived from byproduct silver and lead-zinc production. Small amounts of copper were reported from Bannock, Blaine, Bonner, Butte, Camas, Clark, Custer, Lemhi, and Nez Perce Counties.

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)
1965	70	5	1,783	5,078	$178	18,457	$23,865
1966	52	6	1,995	5,056	177	19,777	25,571
1967	52	2	1,773	4,838	169	17,033	26,402
1968	65	3	1,710	3,227	127	15,959	34,225
1969	53	2	1,801	3,403	141	18,930	33,897
1863–1969 [3]	--	--	155,151	8,339,514	195,058	875,913	759,261

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	5,140	$3,639	66,606	$20,781	58,034	$16,946	$65,409
1966	4,961	3,589	72,334	21,867	60,997	17,689	68,893
1967	4,210	3,219	61,387	17,188	56,528	15,650	62,628
1968	3,525	2,950	54,790	14,478	57,248	15,457	67,237
1969	3,332	3,168	65,597	19,541	55,900	16,323	73,070
1863–1969 [3]	209,081	98,037	7,563,885	1,107,028	2,748,935	594,393	2,753,777

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings retreated, and ore and old slag shipped to smelters during the calendar year indicated. Data may not add to totals shown because of independent rounding.
[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)
1965	--	--	--	5	3	31	5	3	31
1966	1	(3)	6	5	2	61	6	3	67
1967	--	--	--	2	1	26	2	1	26
1968	--	--	--	3	(3)	6	3	(3)	6
1969	--	--	--	2	(3)	3	2	(3)	3

[1] Combined to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than ½ unit.

Table 10.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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)
Blaine	4	--	120	$5	244,138	$437
Boise	3	--	81	3	848	2
Bonner	2	--	W	W	1,798	3
Boundary	1	--	-----	---	20	(1)
Butte	2	--	-----	---	W	W
Clark	1	--	1	(1)	1,119	2
Custer	5	--	99	4	266,728	478
Idaho	1	1	1	(1)	W	W
Lemhi	5	--	5	(1)	921	2
Nez Perce	1	--	-----	---	120	(1)
Shoshone	23	--	3,046	126	18,405,398	32,958
Undistributed [2]	5	1	50	2	8,607	15
Total [3]	53	2	3,403	141	18,929,697	33,897

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Blaine	(1)	(1)	1,726	$514	1,082	$316	$1,273
Boise	-----	-----	W	W	W	W	5
Bonner	(1)	(1)	20	6	2	1	10
Boundary	-----	-----	1	(1)	(1)	(1)	(1)
Butte	W	W	W	W	(1)	(1)	W
Clark	(1)	(1)	90	27	2	1	30
Custer	38	$36	1,232	367	1,223	357	1,242
Idaho	-----	-----	------	------	W	W	W
Lemhi	29	28	12	3	2	1	34
Nez Perce	11	10	------	------	------	------	10
Shoshone	3,251	3,091	62,497	18,618	53,584	15,647	70,439
Undistributed [2]	3	3	19	6	4	1	27
Total [3]	3,332	3,168	65,597	19,541	55,900	16,323	73,070

W Withheld to avoid disclosing company confidential data; included with "Undistributed."
[1] Less than ½ unit.
[2] Includes values and quantities that cannot be shown separately for Bannock, Camas, Owyhee, and unassigned counties and items indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1969, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines	Material sold or treated (thousand short tons)	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Ore:							
Dry gold, gold-silver, and silver [1]	12	531	962	13,165	5,362	3,331	2,868
Copper and zinc [1]	11	20	13	24	90	1,126	4,253
Lead	16	246	1,547	3,587	507	49,457	5,683
Lead-zinc	11	716	875	1,922	606	69,250	87,084
Total [2]	38	983	2,435	5,533	1,203	119,834	97,020
Other lode material:							
Silver old tailings, zinc old tailings [1]	2	237	3	199	3	5,342	2,061
Zinc slag	1	50	-----	33	96	2,688	9,851
Total [2]	3	287	3	232	99	8,030	11,912
Total lode [2]	53	1,801	3,400	18,930	6,664	131,194	111,800
Placer	2	([3])	3				
Total all sources [2]	55	1,801	3,403	18,930	6,664	131,194	111,800

[1] Combined to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.
[3] 15 cubic yards.

Table 12.—Mine production of gold, silver, copper, lead, and zinc in 1969 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 (thousand troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Amalgamation, concentration, and smelting of concentrates [1]	3,275	18,823	6,468	127,728	101,742
Direct smelting:					
Ore, old tailings [1]	125	74	100	779	208
Old slag	-----	33	96	2,688	9,851
Total [2]	125	107	196	3,466	10,058
Placer	3	------	-----	-------	-------
Grand total	3,403	18,930	6,664	131,194	111,800

[1] Combined to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.

Table 13.—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							
1965	21	--	1,592	2,713	17,918	3,540	63,474	56,443	$62,054
1966	21	--	1,786	2,775	19,092	3,454	67,891	58,877	64,880
1967	26	--	1,595	2,444	16,483	2,714	57,587	54,807	59,008
1968	21	--	1,557	2,017	15,429	2,797	51,468	55,914	64,206
1969	23	--	1,690	3,046	18,405	3,251	62,497	53,584	70,439
1884–1969	XX	XX	[2]119,216	454,605	772,750	128,232	7,072,948	2,608,491	2,348,163

XX Not applicable.
[1] Does not include gravel washed.
[2] Complete data not available 1884–1904.

Desert Peak Mines, Ltd., of Vancouver, British Columbia, Canada, announced that it had obtained an Office of Minerals Exploration loan for exploration at the Pope-Shenon copper mine near Salmon, Lemhi County.

Gold.—State output of 3,403 ounces of gold increased annual production 5 percent from the record low in 1968. An increase in the average annual price of gold to $41.51 also increased the total value for the year to over $141,000. Production was obtained from 32 lode mines and two placer operations throughout the State, but 90 percent of the production was from mines in Shoshone County where 3,046 ounces was recovered as byproduct gold from 15 mines. The Lucky Friday mine, Shoshone County, with 1,430 ounces, or 42 percent of the State's total, was the leading source. Reported recovery of 120 ounces came from Blaine County, 99 ounces from Custer County, and 81 ounces from Boise County. Smaller amounts were also reported from Bonner, Camas, Clark, Idaho, Lemhi, and Owyhee Counties.

Placer miners operating in the State recovered only 3 ounces of gold. Stream gravels were worked at the Night Hawk placer in Idaho County and the Blue Gravel group in Owyhee County.

Bonanza Gold, Inc., explored its property in Prospect Gulch north of Osborn with trenching and three diamond-drill holes.

Iron Ore.—The Iron Mountain magnetite deposit near Weiser, operated by Rock Island Gypsum Co., and magnetite from the Porter Bros. Corp. stockpile at Lowman accounted for all the iron ore shipped in the State. Production, measured as shipments, declined 33 percent from the 1968 total as iron "mill scale" was substituted for iron ore in the cement-making process.

Lead.—A 1.7-cent-per-pound increase in the average annual price of lead helped raise the total value of lead produced during the year 35 percent to $19,541,000. The quantity of lead produced also increased 20 percent over that of 1968 to a total of 65,597 tons.

Advancing prices and firm demand encouraged exploration and development programs in the Coeur d'Alene region. The Bunker Hill Co. began construction on a $3.5 million acid plant to operate in conjunction with the new updraft sintering machine that was installed at the lead smelter. Scheduled to be operational late in 1970, the acid unit was to boost Bunker Hill's sulfuric acid production potential from an existing 650 tons per day from two acid recovery units in operation at the zinc plant to an overall potential of 950 tons per day from three units. A ventilation system, baghouse, and Venturi scrubber were also added to the lead smelter to improve pollution control.

Cardinal Silver, Inc., overhauled an old mill near Hailey to recover lead and zinc concentrates from its Silver Star, West Fork, and Silver King mine properties. Atlas Mining Co. shipped lead-silver ore from a new discovery in the Boulder Creek area, east of Mullan, to the Bunker Hill concentrator at Kellogg. Silver Crystal Mines, Inc., reported an ore strike at the Bear Top property near Murray.

Lead production from 16 lead mines and 11 lead-zinc mines comprised 90 percent of the total lead production. The remainder was derived chiefly as a byproduct from silver ore and zinc slag production. Significant developments included the following:

Mineral Hills District (Blaine County).—The Federal Resources Corp. Silver Star-Queens mine at Bellevue was the leading lead source in Blaine County, yielding 1,585 tons of lead and 1,025 tons of zinc from 21,609 tons of ore. Smaller amounts of lead were also mined at the Eureka mine and the Dennison silver mine.

Hunter District (Shoshone County).—According to Hecla Mining Co.'s annual report, the continuing emphasis of the No. 4 shaft project throughout the year at the Star-Morning Unit area mines, owned 70 percent by The Bunker Hill Co. and 30 percent by Hecla Mining Co., caused the lower than normal production of 157,335 tons of ore containing 7,358 tons of lead, 12,067 tons of zinc, and 351,468 ounces of silver. Work neared completion on equipping the ore and waste handling facilities and installation of the compressor at the No. 4 shaft. A new hoisting plant, on the 2,000-level Star tunnel, capable of hoisting 7,100 feet in a single vertical lift, was also readied. Development of the Star-Morning veins on the 7300 level continued throughout the year.

Periodic manpower shortages hampered production and development at the Lucky

Friday mine, according to the Hecla Mining Co.'s 1969 annual report. Although output was 92 percent greater than 1968 production, which was affected by a strike during that year, production of 183,785 tons of ore assaying 16.35 ounces of silver per ton, 10.65 percent lead, and 0.99 percent zinc was less than planned. The main production shaft was extended to a point just below the 4050 level; a portion of the vein on the 3650 level was developed during the year.

Lelande District (Shoshone County).—Development work at the Canyon lead-silver mine north of Wallace continued as a vertical production shaft neared the sixth level. Shipment of 6,224 tons of ore containing 563 tons of lead, 211 tons of zinc, and 34,536 ounces of silver was made to the Bunker Hill smelter.

Placer Center District (Shoshone County).—Day Mines, Inc., reported to its stockholders that production from the Dayrock mine totaled 30,478 tons of ore containing 11.9 percent lead and 1.0 percent zinc. Rehabilitation and modernization of surface and underground facilities were accomplished during 1969, and 292 feet of the main shaft was completely retimbered. Development work for the year was 335 feet of drifting, 212 feet of crosscutting, 832 feet of raising, and 13,891 feet of percussion test-drilling.

Yreka District (Shoshone County).—Asarco closed the Page mine, east of Kellogg, on October 1. The mine had been in operation since 1904.

Mercury.—The Idaho-Almaden mine near Weiser accounted for all the mercury production in the State. A small decrease in production resulted in a total of 1,012 flasks (76 pounds) being produced in 1969. Total value of the mercury produced was placed at $511,100; the average market price declined to $505 per flask from $536 per flask in 1968.

Molybdenum.—Exploration for molybdenum deposits was encouraged by an Asarco announcement of a major discovery in the White Cloud area of central Idaho. The company announced that an ore body valued at more than $100 million was located near Baker Lake in the Little Boulder Basin near Castle Peak, Custer County.

Idaho Molybdenum, Inc., explored claims by drilling at Big Pine Creek on the South Fork of the Payette River. Williams Mining Co. of Boise explored along the Roaring River near Atlanta. Vernon Taylor & Associates of Denver also conducted exploration for molybdenum near the Asarco discovery. Molybdenite exploration also was reported in Blaine County.

Silver.—Exploration activity remained high in the Coeur d'Alene region, despite a drop in the average annual price of silver to $1.79 per ounce. Asarco, Hecla Mining Co., Sunshine Mining Co., and The Bunker Hill Co. continued active exploration programs in the region.

Asarco explored a block of claims comprising the Coeur Project, a large area adjoining the Galena mine on the west, owned by Coeur d'Alene Mines Corp. and Rainbow Mining & Milling Co., Ltd. Exploration on the 3400 level disclosed new discoveries of silver ore along a crosscut driven southerly to prospect for extensions of the 356 vein.

Callahan Mining Corp., Day Mines, Inc., and Asarco consolidated properties just east of the Galena mine for the newly designated Caladay Project. The new company, Caladay Silver Mining Corp., began a projected $8 million exploration project to evaluate a 7,000-foot-long zone thought to be favorable for new silver ore bodies. During 1969, surface facilities were established, and an adit to a proposed shaft site was driven 3,277 feet into the mountainside.

Hecla Mining Co. joined several other companies in exploration projects in the district. In the Lucky Friday area near Mullan, preparations progressed for the DIA, North Abot, and West Independence exploration projects which used deep levels of the Lucky Friday and Star-Morning mines. Deepening of the Silver Summit shaft from the 3000 level to the 4000 level was undertaken. Two holes were drilled to test extensions of vein zones in the Nine Corp. property in the Dobson Pass region.

Sunshine Mining Co. conducted diamond drilling at the Coeur d'Alene-Crescent Evolution property, west of Osborn. Exploration along the Silver Syndicate fault in the Rambo area of the Sunshine mine was also undertaken.

The Bunker Hill Co. explored the Princeton-Magna property east of Mullan with trenching and geochemical soil sampling and began rehabilitating the Magna shaft.

Diamond-drilling operations were discontinued at the Silver Star-Queens mine near Bellevue, and cutbacks were initiated in the number of miners employed at the mine. Mining continued at the 900 level.

Additional exploration work in Shoshone County included rehabilitation of 4,500 feet of adit at the Golden Chest mine north of Wallace; diamond drilling at the Silver Seal property 2 miles south of the Sunshine mine; rehabilitation of the tunnel at the R-G mine on Beaver Creek; and drifting into a vein outcrop at the St. Elmo claim. Silver Crystal Mines, Inc., rehabilitated the Bear Top mine in the North Fork area north of Wallace, drilled nine long holes for exploration in the No. 1 Bear Top tunnel, and shipped 52 tons of development ore from the vein intercepted in the drilling.

Duval Corp. of Houston, Tex., conducted a diamond-drill exploration program at the Conjecture Mines, Inc., property near Lakeview. Russco Silver, Inc., explored for silver-lead in a crosscut at the Buttercup mine in Camas County.

Total silver production in the State increased 19 percent from the previous year as higher grade ores were mined from most Coeur d'Alene region mines. However, because of dipping silver prices, the total value of the ore produced decreased nearly 1 percent to $33,896,841.

Sunshine Mining Co. was the leading silver producer, reporting production of over 8,391,000 ounces from the Sunshine mine in the Coeur d'Alene mining region. Additional mines in the Coeur d'Alene area yielding substantial quantities of silver included the Bunker Hill, Crescent, Dayrock, Galena, Lucky Friday, Page, Star-Morning, and Silver Summit.

Significant developments occurred in the following districts:

Evolution District (Shoshone County).—Production of silver from the Sunshine mine was 6.6 percent higher than in 1968. In addition to 8,391,000 ounces of silver, the 271,515 tons of ore produced yielded 208 ounces of gold, 1,496 tons of copper, 398 tons of lead, and 230 tons of zinc. Construction began on Sunshine Mining Co.'s projected $2 million silver refinery on a 7-acre site ¾ mile north of the Sunshine mine.

Development of the Chester vein system in the Sunshine Unit area of the Sunshine mine was continued on the 5000 and 5200 levels during the year. The No. 10 production shaft was extended below the 5800 level, and a new service hoist was installed at the Jewell shaft, which relieved the load on the main production hoist.

The Silver Summit mine of Hecla Mining Co. was consolidated (effective Feb. 1, 1969) with seven other adjacent properties to form the Consolidation Silver Corp. Production ceased at the mine, and thereafter efforts were concentrated on a deep level development program. Before the shutdown, 4,175 tons of ore was mined, which yielded 98,390 ounces of silver and small amounts of gold, copper, and lead.

Placer Center District (Shoshone County).—Asarco announced completion of the mill expansion program at the Galena property near Wallace. The mill capacity was increased from 500 to 750 tons per day, but, because of a shortage of miners, full capacity could not be utilized. The No. 3 main hoisting shaft at the Galena mine was deepened 600 feet from the 3700 level. Production for the year yielded 3,765 tons of concentrates containing 2,958,707 ounces of silver and 1,064 tons of copper.

Operations, balanced between development work, stope production, and plant rehabilitation, continued at the Dayrock mine, 3 miles north of Wallace. According to the Day Mines, Inc., annual report, production in 1969 was 30,478 tons of ore milled, averaging 12.6 ounces of silver per ton, 11.9 percent lead, and 1.0 percent zinc.

Yreka District (Shoshone County).—Six mines in the Yreka district had reported production of 3,198,595 ounces of silver valued at $5,727,628. The largest production came from the Crescent and Bunker Hill mines of The Bunker Hill Co., a subsidiary of Gulf Resources and Chemical Corp. of Houston, Tex.

Work began in January on the No. 2 shaft at the Crescent mine. The three-compartment shaft was sunk from the 3100 level to the 3700 level where a crosscut was started to reach the Alhambra intersection on the 3700 level. A new hoist room was completed and the hoist installed in August.

Bayshore District (Custer County).—Clayton Silver Mines continued to be the leading producer of silver in Custer County. Total production for the county was 266,728 ounces of silver, all of which

came from five mines in the Bayhorse district. The Clayton mine yielded 81,455 tons of ore from which 228,824 ounces of silver was recovered. According to the annual report to the stockholders, production continued at near capacity during 1969, and the mill operated 357 days at a rate of 228 tons per day, with only 4 days lost for repairs and power failure. A major portion of the ore was mined from the 800 level North Stope.

Tungsten.—The Tungsten Jim mine of Salmon River Scheelite Corp. was the only reported tungsten producer in the State during the year. Total output increased to 27 tons of tungsten concentrate valued at $63,000.

Vanadium.—Output of vanadium remained similar to that of 1968. The vanadium was recovered from byproduct ferrophosphorus by the Kerr-McGee Corp. plant at Soda Springs, and Union Carbide Corp. plants at Hot Springs, Ark., and Rifle, Colo.

Zinc.—Total State production of zinc was 55,900 tons, down 2 percent from that of 1968. The Star-Morning Unit area, Bunker Hill, and Lucky Friday mines in the Coeur d'Alene area continued to supply the major portion of the State's zinc production, accounting for 93 percent of the total. The Page mine, which formerly was an important zinc producer in the area, was considered depleted and closed in October. Despite the lower production, value of the total zinc produced increased 5.6 percent to $16,323,000, as a 1-cent increase raised the average annual price to 14.6 cents per pound.

Clayton Silver Mines in Custer County recovered 1,154 tons of zinc from 81,455 tons of ore mined from the Clayton mine. Production at the mine continued at near capacity, although it was slightly lower than the 83,049 tons mined in 1968. Improvements made during the year increased mill capacity from 230 to 250 tons per day.

The Bunker Hill Co. was the only supplier of metallic zinc, derived from both company-owned and custom ores processed at the expanded and modernized Bunker Hill zinc smelter. Nearly 80 percent of the zinc mined in the State was treated at this facility.

Production was reported from three zinc mines in the State. The Monitor and Mountain Goat mines in the Beaver district of Shoshone County were among the leading zinc sources in the State. Production at the Monitor mine was reported in the Day Mines, Inc., annual report to the stockholders to be 10,324 tons of ore averaging 1.2 ounces of silver per ton, 3.1 percent lead, and 13.4 percent zinc. Also, according to the report, the Mountain Goat lease adjoining the Monitor mine was credited with shipments of 8,618 tons of ore averaging 3.4 percent lead and 10.2 percent zinc to the Dayrock mill.

NONMETALS

Cement.—Portland and masonry cements were produced and shipped from the Inkom, Bannock County, operation of Idaho Portland Cement Co. Production of portland cement increased slightly; however, shipments were 3 percent lower than those for the previous year. Masonry cement shipments were moderately greater. Shipments of portland cement went mainly to destinations within the State; significant quantities also were shipped to markets in other Rocky Mountain States. Limestone for cement manufacture continued to be supplied from the company-operated Inkom quarry.

In August, Idaho Portland Cement Co. was acquired by Oregon Portland Cement Co., Portland (Multnomah County), Oreg. The local identity of the Idaho Portland Cement Co. was to be maintained as an operating division of the Oregon firm.

Clays.—The quantity of clays sold or used by producers declined 11 percent compared with the total of the previous year. Sharply increased output of miscellaneous clay was more than offset by declines in kaolin and fire clay output. Miscellaneous clay was mined at operations in Ada, Bingham, Bonneville, Cassia, Elmore, Jefferson, Latah, Minidoka, and Twin Falls Counties. Output went mainly for use in making heavy-clay construction products; a small tonnage was mined, prepared, and packaged for use by hobbyists and at schools for making earthenware items. Fire clay for manufacturing refractories continued to be mined near Helmer, Latah County, by A. P. Green Refractories Co. J. R. Simplot Co. produced kaolin from an operation in Latah County for use as filler clay by the paper industry.

Garnet.—Production and shipments of abrasive garnet by Idaho producers were 17 and 18 percent lower than respective totals for 1968. As in the previous year, output was from two operations near Fernwood, Benewah County. The processed garnet was marketed mainly as an airblast abrasive.

Gem Stones.—Value of gem materials collected in the State was estimated at $90,000, a sharp drop from the total estimated for 1968. Restriction of digging areas available to the public reduced activity by collectors in the garnet digging area of Benewah County and accounted for the major share of the drop in estimated value of gem materials collected. Star garnet from an area near Fernwood, Benewah County, and precious opal from a digging site northeast of Spencer in Clark County were the principal gem materials sought by the public. Approximately 10,000 pounds of opal-bearing material and 3,600 pounds of garnet specimens were collected during the year. Several thousand visitors dug and collected the materials for eventual sale, trade, or fashioning into jewelry and mineral specimen displays.

Gypsum.—Rock Island Gypsum Co. continued to supply agricultural gypsum (land plaster) for local markets. Shipments were made during the year from stocks at the firm's Rock Creek mine near Weiser.

Kyanite.—There was no production of kyanite, but consolidation of certain leases was accomplished. Ashley Valley Oil Co. of Tulsa, Okla., leased 3,000 acres of kyanite-bearing land in the Woodrat Mountain area, Idaho County. Development of the properties was to depend on results of additional beneficiation work and on economic and market studies.

Lime.—Production of primary lime, all captive for use in sugar refining, increased 14 percent over the 1968 total. Limestone was calcined to quicklime at sugar refineries in Bonneville, Canyon, Minidoka, and Twin Falls Counties.

Perlite.—Production of perlite by Oneida Perlite Corp. increased more than threefold compared with the 1968 total. Crude perlite, mined at an openpit operation north of Malad, Oneida County, was screened, sized, and shipped to the firm's storage and expanding plant at Malad. Shipments of perlite to other firms for expanding were up sharply from the total of the previous year. Production and shipments of expanded perlite also were increased. The expanded product was sold for use as loose-fill insulation, concrete aggregate, and for soil conditioning.

Phosphate Rock.—Production of both crude and marketable phosphate rock declined moderately compared with respective totals for 1968. Output was continued from four operations in two counties. Monsanto Co. continued mining the Ballard property in Caribou County, and J. R. Simplot Co. produced from the Gay and Conda mines in Bingham and Caribou Counties, respectively. Stauffer Chemical Co. obtained phosphate rock from the Wooley Valley deposit in Caribou County for shipment to the firm's elemental phosphorus plant at Silver Bow, Mont.

The quantity of phosphate rock sold or used by producers increased 8 percent over the total for the previous year. Reduced requirements of phosphate rock for fertilizer manufacture, including wet-process phosphoric acid, were more than offset by increased quantities going to elemental phosphorus manufacture and to export markets. Elemental phosphorus production was the major use of phosphate rock produced in the State.

Elemental phosphorus production was continued by FMC Corp., Mineral Products Division, Pocatello, Power County, and by Monsanto Co., Soda Springs, Caribou County. Output was shipped to phosphorus conversion plants of the respective firms in the Western and Midwestern States for manufacturing industrial phosphate products.

J. R. Simplot Co. manufactured phosphate fertilizer products at the firm's Pocatello works. Phosphate rock from company mines in Bingham and Caribou Counties supplied the raw material requirements. During the first half of the year, Mountain Fuel Supply Co. utilized purchased phosphate rock at its beneficiating plant near Conda, Caribou County. The processed material went to fertilizer manufacturers in the Western States and Canada. In July, the Mountain Fuel firm announced that operation of its beneficiating facility at Conda would be suspended for an indefinite period.

The Bunker Hill Co. continued producing phosphate fertilizer products at Kellogg, Shoshone County. Purchased cal-

cined phosphate rock from western sources and sulfuric acid manufactured from waste gases at the Kellogg smelter complex were the principal raw materials used in manufacturing the fertilizer products.

Pozzolan.—El Paso Natural Gas Co. continued producing pozzolan from calcined opalite, a waste product from the firm's mercury furnacing operation near Weiser, Washington County. Completion of dam projects was the principal reason for the sharp decline in shipments—1,100 tons compared with 5,000 tons shipped in 1968.

Pumice.—Pumiceous materials sold or used by producers registered a sharp decline (114,000 tons) from the 1968 total. Reduced requirements for these materials at State highway department projects accounted for most of the decline; reduced production by commercial firms also contributed. Pumice production was from operations in Bingham, Bonneville, and Oneida Counties; scoria was mined by one firm in Canyon County. Output by commercial firms was used largely as an aggregate and admixture for lightweight concrete. Smaller quantities of scoria went for ballast and for decorative landscaping. A small tonnage of pumice was mined in Bingham County for use by the State highway department.

Sand and Gravel.—Sand and gravel production increased 4 percent over the 8.2-million-ton total for 1968. Greater demand for these materials at State highway department projects (4.1 million tons compared with 3.8 million tons in 1968) was the reason for the increase. Government-and-contractor tonnage (largely production by contractors for Federal, State, county, and municipal agencies) was 6 percent greater despite decreased use of these materials by the Bureau of Public Roads and U.S. Forest Service. Production by commercial firms remained substantially the same as for the previous year.

Del Monte Sand Co. continued producing quality sand for plaster, glass, abrasive, filler, and other specialty uses from operations in Gem County. A small quantity of industrial sand was produced by J. R. Simplot Co. as a byproduct of its clay beneficiation operations at Bovill, Latah County.

Ada County was the principal producing area with output exceeding 1.7 million tons. Production exceeded 500,000 tons each in Bannock, Canyon, Jefferson, Teton, and Twin Falls Counties. Sand and gravel production was reported from operations in 38 of the 44 counties in the State; however, significant tonnages also were produced that could not be assigned to a specific county of origin.

Table 14.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	788	$1,242	644	$932
Road material	1,153	1,254	1,152	1,272
Fill	137	150	191	130
Other [1]	84	193	133	364
Total	2,162	2,839	2,120	2,698
Government-and-contractor operations:				
Building	4	7	1	5
Road material	5,517	5,931	5,877	4,590
Fill	288	170	547	281
Other [1]	253	186	10	9
Total	6,062	6,294	6,435	4,885
All operations:				
Building	792	1,249	645	937
Road material	6,670	7,185	7,029	5,862
Fill	425	320	738	411
Other [1]	337	379	143	373
Grand total	8,224	9,133	8,555	7,583

[1] Includes special sands, railroad ballast, and sand and gravel used for miscellaneous purposes.

Stone.—Production of stone for all purposes increased 71 percent (1.6 million tons) over the 2.2-million-ton total for 1968. Greater demand for crushed stone at Federal dam and State highway department projects accounted for the sharp rise in output.

Granite was the principal stone quarried. Output, which was more than double that of 1968, went mainly for use at a U.S. Army Corps of Engineers dam project in Clearwater County. Significant tonnages also were used for roadbase and riprap. Basalt production ranked second in terms of tonnage, and major uses were roadbase, surfacing, and aggregate; smaller tonnages were used as riprap. Limestone output was moderately increased owing mainly to greater use in cement manufacture. Output was from quarries in Bannock, Bonneville, and Nez Perce Counties. Quartzite was produced in Benewah, Caribou, Power, and Shoshone Counties, for use principally as a flux at elemental phosphorus plants and roadstone by the State highway department. A quantity of marble was quarried and sawed by Idaho Travertine Corp. for use as decorative building stone. Stone was quarried in 14 counties; however, significant tonnages were produced which could not be assigned to a specific county of origin.

MINERAL FUELS

Peat.—Idaho Peat, Inc., continued production of reed-sedge peat from an operation near Downey, Bannock County. Shipments, mainly in bulk form, went for horticultural and general soil improvement uses.

Petroleum and Natural Gas.—In July, Signal Drilling Co., under contract to States Oil Co., Denver, Colo., began drilling a test hole near Arbon in Power County, reportedly seeking petroleum and/or natural gas. The drilling site was on 55,000 acres under lease to the Intermountain Gas Co. of Boise. In August, Intermountain Gas announced that exploratory drilling was suspended after reaching a depth of 3,677 feet.

Table 15.—Principal producers

Commodity and company	Address	Type of activity	County
METALS			
Antimony:			
Sunshine Mining Co	Kellogg, Idaho 83837	Mine and plant	Shoshone.
Copper:			
Copper Springs Mining Co., Inc	206 Wood St. Waitsburg, Washington 99361	Mine	Nez Perce.
Howard Sims	Salmon, Idaho 83467	do	Lemhi.
Gold:			
Charles Andrus	Marsing, Idaho 83639	Placer	Owyhee.
Come Back Mining Co	Idaho City, Idaho 83631	Mine	Boise.
A. W. Josue	Garden Valley, Idaho 83622	do	Do.
Earl Rice	Elk City, Idaho 83525	Placer	Idaho.
Iron Ore:			
Porter Bros. Corp	Boise, Idaho 83701	Plant	Valley.
Rock Island Gypsum Co	Weiser, Idaho 83672	Mine	Washington.
Lead:			
American Smelting & Refining Co	Wallace, Idaho 83873	Mine and mill	Shoshone.
Beardsley Gulch Mining Co	Room 206, 1355 Foothill Dr. Salt Lake City, Utah 84108	Mine	Custer.
The Bunker Hill Co	Kellogg, Idaho 83837	Mine, mill, smelter	Shoshone.
Canyon Silver Mines, Inc	Wallace, Idaho 83873	Mine	Do.
Clayton Silver Mines	Wallace, Idaho 83873	Mine and mill	Custer.
Day Mines, Inc	Wallace, Idaho 83873	do	Shoshone.
Federal Resources Corp	Mine—Hailey, Idaho 83333	Mine	Blaine.
	Mill—Bellevue, Idaho 83313	Mill	Do.
Hecla Mining Co	Wallace, Idaho 83873	Mine and mill	Shoshone.
Mitchell Bros	Dubois, Idaho 83423	Mine	Clark.
Mercury:			
El Paso Natural Gas Co	P.O. Box 1492 El Paso, Texas 79999 (Weiser, Idaho 83673)	Mine and plant	Washington.
Silver:			
American Smelting & Refining Co.	Wallace, Idaho 83873	Mine and mill	Shoshone.
The Bunker Hill Co	Kellogg, Idaho 83837	do	Do.
Canyon Silver Mines, Inc	Wallace, Idaho 83873	Mine	Do.
Clayton Silver Mine	Wallace, Idaho 83873	Mine and mill	Custer.
Hecla Mining Co	Wallace, Idaho 83873	do	Shoshone.
Sunshine Mining Co	Kellogg, Idaho 83837	do	Do.
Tungsten:			
Salmon River Scheelite Corp	Clayton, Idaho 83227	Mine and plant	Custer.

See footnotes at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Vanadium:			
Kerr-McGee Corp.[1]	Soda Springs, Idaho 83276	Plant	Caribou.
Zinc:			
American Smelting & Refining Co	Wallace, Idaho 83873	Mine and mill	Shoshone.
The Bunker Hill Co	Kellogg, Idaho 83837	Mine, mill, smelter	Do.
Day Mines, Inc	Wallace, Idaho 83873	Mine and mill	Do.
Hecla Mining Co	Wallace, Idaho 83873	do	Do.
Kennedy and Zanetti	Wallace, Idaho 83873	do	Do.
Sidney Mining Co	Kellogg, Idaho 83837	Mine	Do.
NONMETALS			
Cement:			
Idaho Portland Cement Co	Inkom, Idaho 83245	Plant	Bannock.
Clays:			
Burley Brick & Sand Co	P.O. Box 497 Burley, Idaho 83318	Pit and plant	Cassia, Minidoka.
A. P. Green Refractories Co	Troy, Idaho 83871	do	Latah.
Idaho Falls Brick & Tile Co., Inc.	Rt. 3, Box 53 Idaho Falls, Idaho 83401	do	Bingham, Bonneville, Jefferson.
Pullman Brick Co., Inc	7901 Warm Springs Ave. Boise, Idaho 83706	do	Ada, Elmore.
J. R. Simplot Co	P.O. Box 647 Bovill, Idaho 83806	do	Latah.
Snake River Pottery	Bliss, Idaho 83314	do	Twin Falls.
Garnet:			
Emerald Creek Garnet Milling Co	Box 192 Kellogg, Idaho 83837	Mine and plant	Benewah.
Idaho Garnet Abrasive Co	P.O. Box 1080 Kellogg, Idaho 83837	do	Do.
Peat:			
Idaho Peat, Inc	Downey, Idaho 83234	Bog	Bannock.
Perlite (crude and expanded):			
Oneida Perlite Corp	P.O. Box 162 Malad City, Idaho 83252	Pit and plant	Oneida.
Phosphate Rock:			
FMC Corp., Mineral Products Division.	Pocatello, Idaho 83201	Plant	Power.
Monsanto Co	Soda Springs, Idaho 83276	Mine and plant	Caribou.
Mountain Fuel Supply Co	Soda Springs, Idaho 83276	do	Do.
J. R. Simplot Co	Pocatello, Idaho 83201	Mine	Bingham.
	Conda, Idaho 83230	Mine and plant	Caribou.
Stauffer Chemical Co	Montpelier, Idaho 83254	Mine	Do.
Pumice:			
Hess Pumice Products	P.O. Box 209 Malad City, Idaho 83252	Mine and plant	Oneida.
Idaho Concrete Products, Inc	Box 1141 Idaho Falls, Idaho 83401	do	Bonneville.
Producer's Pumice	2743 E. Lincoln Idaho Falls, Idaho 83401	Mine	Do.
Western Block, Inc	224 First St. S. Nampa, Idaho 83651	do	Canyon.
Sand and Gravel:			
Bannock Paving Co	Box 4002 Pocatello, Idaho 83201	Pit and plant	Bannock.
DeAtley Corp	Box 648 Lewiston, Idaho 83501	do	Nez Perce.
Idaho Concrete Pipe Co	Box 972 Nampa, Idaho 83651	do	Ada, Canyon.
LeGrand Johnson Constr	Box 248 Logan, Utah 84321	do	Oneida.
Quinn Robbins Co., Inc	703 S. 16th Boise, Idaho 83707	do	Ada.
Bryon C. Rambo Crushing Co	Nampa, Idaho 83651	do	Canyon.
Twin Falls Constr. Co	Box 325 Twin Falls, Idaho 83301	do	Twin Falls.
Stone:			
DeAtley Corp	Box 648 Lewiston, Idaho 83501	Quarry and plant	Clearwater, Nez Perce, Various.
N. A. Degerstrom	E15 32d St. Spokane, Washington 99203	do	Benewah, Shoshone.
Dworshak Dam Constr	Box 1422 Orofino, Idaho 83544	do	Clearwater.
Grant Constr. Co	Hayden Lake, Idaho 83835	Quarry and plant	Boundary.
Idaho Portland Cement Co	Inkom, Idaho 83245	do	Bannock.
Materne Bros	Box O—Rosewood Station Spokane, Washington 99208	do	Various.
Monsanto Chemical Co	800 N. Lindberg Ave. St. Louis, Missouri 63166	do	Caribou.
Sather & Sons	Box 326 Parkwater Station Spokane, Washington 99211	do	Clearwater.

[1] Processed ferrophosphorus from Idaho.

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 Thomas O. Glover [1] and Theodore A. Myren [2]

Illinois mineral production in 1969 was valued at $659.8 million, nearly 2 percent more than in 1968. Increases in total value of masonry cement, coal, lime, natural gasoline and cycle products, peat, sand and gravel, stone, and tripoli offset decreases in portland cement, clays, fluorspar, lead, liquefied petroleum (LP) gases, natural gas, petroleum, and zinc. Mineral fuels comprised almost 70 percent of the State total value, nonmetals nearly 30 percent, and metals less than one percent.

In 1969, Illinois ranked first in the production of fluorspar, furnishing 48 percent of the Nation's total. The State ranked second in the Nation in stone production, fifth in sand and gravel, and fourth in coal output. Illinois also ranked high in the processing of mineral raw materials.

[1] Mining engineer, Bureau of Mines, Minneapolis, Minn.

[2] Statistical assistant, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Illinois [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	9,372	$32,475	8,720	$29,996
Masonry—thousand 280-pound barrels	602	2,097	603	2,137
Clays [2]—thousand short tons	2,327	4,813	1,863	4,321
Coal (bituminous)—do	62,441	250,685	64,722	279,712
Fluorspar—short tons	188,325	9,134	88,480	4,676
Lead (recoverable content of ores, etc.)—do	1,467	388	791	236
Natural gas—million cubic feet	4,380	552	3,800	536
Peat—short tons	61,520	867	67,330	958
Petroleum (crude)—thousand 42-gallon barrels	56,391	173,120	50,724	161,302
Sand and gravel—thousand short tons	45,609	52,943	44,138	56,688
Stone—do	55,858	80,188	54,857	81,318
Zinc (recoverable content of ores, etc.)—short tons	18,182	4,909	13,765	4,019
Value of items that cannot be disclosed: Fuller's earth, gem stones, lime, natural gas liquids, and tripoli	XX	35,372	XX	33,916
Total	XX	647,543	XX	659,815
Total 1967 constant dollars	XX	642,381	XX	p 623,635

p Preliminary. 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."

Table 2.—Value of mineral production in Illinois, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	$3,056	$2,639	Stone, lime, sand and gravel, coal, petroleum.
Alexander	276	278	Tripoli, sand and gravel, stone.
Bond	854	583	Sand and gravel, petroleum, clays.
Boone	W	458	Stone, sand and gravel.
Brown	50	23	Clays, stone, petroleum, sand and gravel.
Bureau	2,238	682	Sand and gravel.
Calhoun	W	W	Stone.
Carroll	399	365	Stone, sand and gravel.
Cass	-------	26	Sand and gravel.
Champaign	607	789	Sand and gravel, petroleum.
Christian	W	W	Coal, petroleum, stone.
Clark [2]	3,142	2,988	Petroleum, stone, sand and gravel.
Clay	W	W	Petroleum, stone.
Clinton	W	3,126	Petroleum, stone, sand and gravel.
Coles	W	W	Do.
Cook	42,365	42,348	Stone, lime, sand and gravel, clays, peat.
Crawford	W	W	Petroleum, sand and gravel.
Cumberland [2]	435	W	Sand and gravel, stone.
De Kalb	654	721	Stone, sand and gravel.
De Witt	W	989	Petroleum, sand and gravel.
Douglas	W	W	Coal, petroleum.
Du Page	W	W	Stone, sand and gravel.
Edgar	312	316	Petroleum.
Edwards	2,368	2,549	Petroleum, sand and gravel.
Effingham	2,086	2,057	Do.
Fayette	W	18,586	Petroleum, stone, sand and gravel, clays.
Ford	393	277	Sand and gravel.
Franklin	W	W	Coal, petroleum.
Fulton	28,960	29,886	Coal, sand and gravel.
Gallatin	W	W	Coal, petroleum, sand and gravel.
Greene	W	653	Stone.
Grundy	5,405	4,929	Sand and gravel, coal, clays.
Hamilton	11,647	6,908	Petroleum.
Hancock [2]	721	785	Stone, petroleum.
Hardin	15,018	8,894	Fluorspar, stone, zinc, lead.
Henderson	462	564	Stone.
Henry	W	W	Stone, sand and gravel.
Iroquois	8	19	Sand and gravel.
Jackson	W	804	Stone, coal, sand and gravel.
Jasper	4,048	4,237	Petroleum.
Jefferson	W	W	Coal, petroleum.
Jersey	W	169	Stone.
Jo Daviess	2,144	3,039	Zinc, stone, lead, sand and gravel.
Johnson	W	W	Stone, coal.
Kane	5,152	7,213	Sand and gravel, stone, peat.
Kankakee	W	3,393	Stone, coal, clays, sand and gravel.
Kendall	545	W	Stone, sand and gravel.
Knox	W	W	Coal, stone, clays.
Lake	1,144	1,000	Sand and gravel, peat.
La Salle	31,774	29,959	Sand and gravel, cement, clays, stone.
Lawrence	18,572	18,445	Petroleum, sand and gravel.
Lee	W	W	Cement, stone, sand and gravel.
Livingston	3,332	3,280	Stone, clays, sand and gravel.
Logan	736	676	Stone, sand and gravel.
McDonough [2]	W	W	Stone, clays.
McHenry	6,092	6,656	Sand and gravel, stone, peat.
McLean	956	804	Sand and gravel.
Macon	474	415	Sand and gravel, petroleum.
Macoupin	W	253	Stone, petroleum.
Madison	2,411	2,749	Stone, sand and gravel, petroleum.
Marion	W	W	Petroleum, stone.
Marshall	425	W	Sand and gravel.
Mason	W	W	Do.
Massac	W	W	Cement, sand and gravel, stone.
Menard	W	W	Stone, sand and gravel.
Mercer	321	300	Stone, coal.
Monroe	W	W	Stone.
Montgomery	12,853	14,760	Coal, stone, petroleum.
Morgan	-------	W	Sand and gravel.
Moultrie	W	W	Sand and gravel, petroleum.
Ogle	2,241	2,503	Sand and gravel, stone.
Peoria	10,614	13,513	Coal, sand and gravel, stone.
Perry	35,596	38,349	Coal, petroleum.
Piatt	33	-------	
Pike	881	1,387	Stone, sand and gravel.
Pope	2	4	Sand and gravel.
Pulaski	W	W	Clays, stone, sand and gravel.
Putnam	W	W	Sand and gravel.
Randolph	12,197	12,296	Coal, stone, petroleum, sand and gravel.
Richland	6,359	6,850	Petroleum.
Rock Island	2,946	2,574	Stone, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Illinois, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
St. Clair	$31,854	$29,371	Coal, stone, petroleum, sand and gravel, clays.
Saline	W	W	Coal, petroleum.
Sangamon	1,742	1,658	Sand and gravel, petroleum, clays.
Schuyler	W	W	Sand and gravel, stone.
Scott	316	309	Stone, clays, sand and gravel.
Shelby	390	464	Petroleum, sand and gravel, stone.
Stark	W	W	Coal, sand and gravel.
Stephenson	686	803	Stone, sand and gravel.
Tazewell	1,343	1,396	Sand and gravel, clays.
Union	W	W	Stone, sand and gravel.
Vermilion	6,235	6,179	Coal, stone, clays, sand and gravel.
Wabash	7,490	W	Petroleum, sand and gravel.
Warren	W	W	Stone.
Washington	2,796	W	Petroleum, stone, coal.
Wayne	18,841	18,003	Petroleum.
White	22,175	23,266	Petroleum, sand and gravel.
Whiteside	1,470	1,363	Peat, stone, sand and gravel.
Will	10,553	11,843	Stone, coal, sand and gravel.
Williamson	20,770	21,573	Coal, petroleum.
Winnebago	2,813	2,677	Sand and gravel, stone.
Woodford	W	548	Sand and gravel.
Undistributed [3]	234,767	232,301	
Total [4]	647,543	659,815	

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, value for these commodities are included with "Undistributed."

[2] 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.

[3] Includes value for natural gas, natural gas liquids, and sand and gravel (1968) that cannot be assigned to specific counties, and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Illinois business activity

	1968	1969 p	Change, percent
Labor force and employment, annual average: [1]			
Total labor force—thousands	r 4,949.7	5,039.8	+1.8
Agricultural employment—do	r 137.7	135.5	−1.6
Nonagricultural employment [2]—do	r 4,649.6	4,749.2	+2.1
Manufacturing—do	r 1,386.9	1,403.8	+1.2
Construction—do	r 188.0	195.6	+4.0
Mining, quarrying, and petroleum production—do	r 28.6	28.3	−1.3
Bituminous coal mining—do	r 8.9	9.3	+4.5
Crude petroleum and natural gas—do	r 7.2	6.8	−5.6
Other mining and quarrying—do	r 7.5	7.2	−4.0
Stone, clay, and glass products—do	r 37.9	39.8	+5.0
Primary metal industries—do	r 109.3	114.1	+4.4
All other—do	r 3,051.1	3,126.5	+2.5
Payrolls, manufacturing [3]—millions	$10,674	$11,501	+7.7
Personal income:			
Total—do	$43,760	$47,609	+8.8
Per capita	$3,993	$4,310	+7.9
Construction activity:			
Building permits: [4]			
Valuation of authorized residential and nonresidential private construction—millions	r $1,157.4	$1,038.3	−10.3
Number of private and public residential permits issued	r 79,227	67,364	−15.0
State highway division:			
Contracts awarded—millions	$215.7	$332.0	+53.9
Construction contract expenditures—do	$254.3	$216.9	−14.7
Portland cement shipments to and within Illinois—thousand 376-pound barrels	20,885	19,580	−6.2
Farm marketing receipts—millions	$2,591	$2,760	+6.5
Mineral production—do	$647.5	$659.8	+1.9
Raw steel production—thousand tons	10,510	11,873	+13.0
Utility production and consumption:			
Production of electric energy by electric utilities—million kilowatt hours	68,017	69,357	+2.0
Natural gas consumption—million cubic feet	1,008,061	1,098,817	+9.0

p Preliminary. r Revised.

[1] Adjusted to March 1969 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Includes workers covered under the Illinois Employment Security Act.

[4] Based on a Nationwide universe of 13,000 permit issuing places.

Sources: Illinois Department of Labor in cooperation with the U.S. Department of Labor, Survey of Current Business, Construction Reports, Illinois Department of Public Works and Buildings, Farm Income Situation, and the Federal Power Commission.

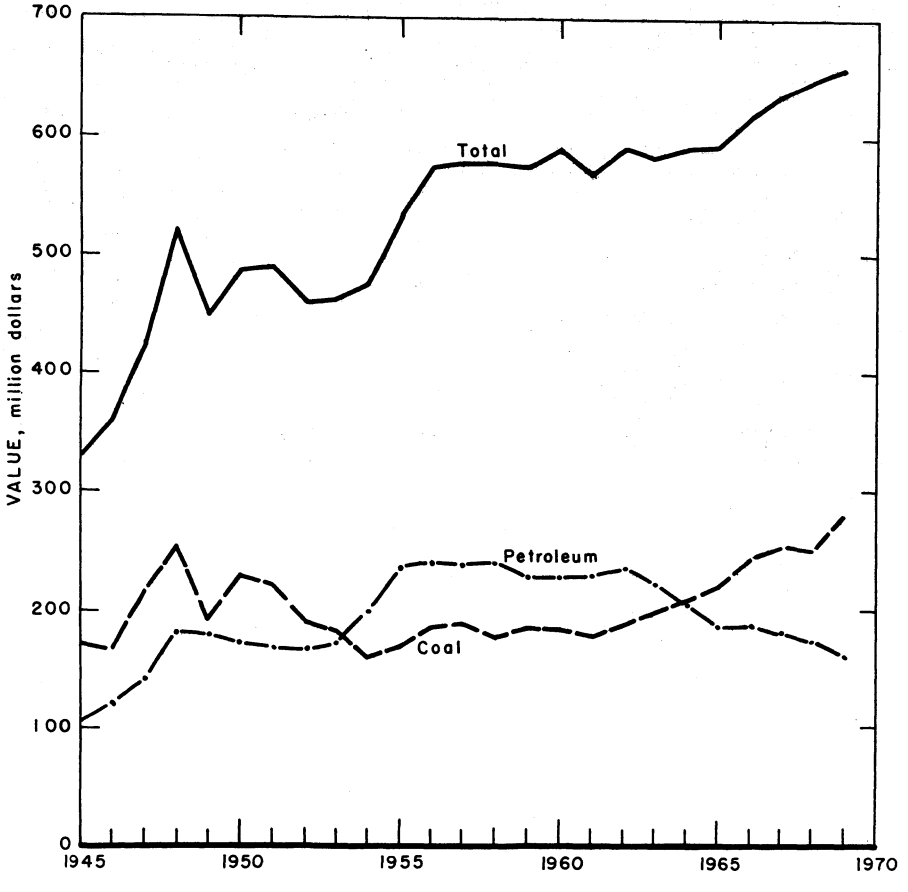

Figure 1.—Value of coal, petroleum, and total value of mineral production in Illinois.

Table 4.—Worktime 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
1968:								
Coal	8,461	251	2,123	16,605	15	712	43.78	8,211
Peat	25	208	5	48	------	------	------	------
Metal	48	271	13	104	------	8	76.90	1,365
Nonmetal	1,160	280	328	2,666	2	80	30.75	5,593
Sand and gravel	1,693	231	391	3,303	1	53	16.35	2,408
Stone	3,667	268	984	8,167	1	130	16.04	1,405
Total [1]	15,054	255	3,844	30,894	19	983	32.43	5,530
1969: [p]								
Coal	8,600	264	2,268	17,360	12	745	43.49	6,116
Peat	41	62	3	23	------	------	------	------
Metal	50	277	14	115	------	7	60.85	1,852
Nonmetal	1,065	240	256	2,072	------	45	21.71	961
Sand and gravel	1,675	227	380	3,257	------	50	15.35	1,013
Stone	3,530	272	961	7,966	2	170	21.59	2,507
Total [1]	14,965	259	3,881	30,795	14	1,017	33.41	4,275

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Illinois ranked fourth in the Nation in bituminous coal production with an output of 64.7 million tons valued at $279.7 million. The totals represented a 4-percent increase in tonnage and a 12-percent increase in value over the 1968 figures. The value of bituminous coal production accounted for 42 percent of the State's total mineral production value.

About 54 percent of the State's coal production was utilized in Illinois; shipments to Iowa, Indiana, Kentucky, Minnesota, Missouri, and Wisconsin consumers accounted for 40 percent. Electric utilities consumed over 73 percent of the total output, general manufacturing and processing 19 percent, coke and gas plants 5 percent, and retail dealers 2 percent. The increase in coal consumption by electric utilities was over 3.5 million tons. Sales to coke and gas plants increased 1.1 million tons, while sales to general manufacturing and retail dealers declined 1.1 and .3 million tons, respectively. Total coal consumption in Illinois was 45.2 million tons, 80 percent of which came from within the State.

Production was reported from 65 mines in 24 counties, excluding mines with less than 1,000 tons of annual production. Over 94 percent of the total output came from 13 counties, each of which had production exceeding 1 million tons. Those counties, in order of rank, were Perry, Franklin, Fulton, St. Clair, Christian, Jefferson, Williamson, Montgomery, Saline, Gallatin, Peoria, Randolph, and Knox.

Nine companies and their subsidiaries each produced over 1 million tons of coal to account for nearly 97 percent of the State total. Those companies were Ayrshire Coal Co., Bell & Zoller Coal Co., Freeman Coal Mining Corp., Old Ben Coal Corp., Peabody Coal Co., Sahara Coal Co., Inc., Southwestern Illinois Coal Corp., Truax-Traer Coal Co. (Division Consolidation Coal Co., Inc.), and The United Electric Coal Cos. The Peabody Coal Co. No. 10 underground mine in Christian County was the second largest bituminous coal mine in the Nation in production. The Southwestern Illinois Coal Corp. Captain mine in Perry County ranked third in the Nation in coal production and was the largest strip mine.

Strip mines supplied nearly 54 percent of the total production, and underground mines, the remainder. Production from strip mines decreased 4 percent from that of 1968, while underground production increased nearly 14 percent. Average mine value was $4.32 per ton, up from $4.01 in 1968.

Table 5.—Coal (bituminous) production in 1969, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (thousand short tons)			Value (thousands)
	Underground	Strip	Underground	Strip	Total [1]	
Adams	—	1	------	4	4	$30
Christian	1	—	5,403	------	5,403	W
Douglas	1	—	913	------	913	W
Franklin	4	—	8,558	------	8,558	W
Fulton	—	6	------	6,510	6,510	29,065
Gallatin	2	1	1,417	1,129	2,546	W
Grundy	—	1	------	240	240	W
Jackson	—	2	------	101	101	W
Jefferson	3	—	4,654	------	4,654	W
Johnson	—	2	------	29	29	W
Kankakee	—	1	------	115	115	W
Knox	—	1	------	1,773	1,773	W
Mercer	1	1	15	6	21	W
Montgomery	2	—	3,264	------	3,264	W
Peoria	—	4	------	2,352	2,352	W
Perry	—	4	------	10,428	10,428	38,284
Randolph	1	1	974	1,351	2,325	W
St. Clair	2	2	519	5,256	5,776	W
Saline	2	3	1,842	1,099	2,941	W
Stark	—	1	------	877	877	W
Vermilion	2	1	57	630	687	W
Washington	1	—	14	------	14	W
Will	—	1	------	673	673	W
Williamson	6	4	2,451	2,066	4,517	21,144
Total [1]	28	37	30,082	34,640	64,722	279,712

W Withheld to avoid disclosing individual company confidential data; included in total.
[1] Data may not add to totals shown because of independent rounding.

Table 6.—Shipments of bituminous coal for consumption in Illinois, by district of origin and consumer use

(Thousand short tons)

	District of origin [1]								Total
	1	3 and 6	4	7 and 8	9	10	11	19	
1965:									
Electric utilities	--	---	---	-----	2,670	22,115	395	--	25,180
Coke and gas plants	--	19	---	2,419	-----	1,170	-----	--	3,608
Retail dealers	--	34	15	1,305	1,116	1,959	129	--	4,558
All others	--	101	---	695	420	8,903	891	--	11,010
Total	--	154	15	4,419	4,206	34,147	1,415	--	44,356
1966:									
Electric utilities	--	---	---	-----	2,198	25,058	552	--	27,808
Coke and gas plants	--	---	---	2,113	-----	1,513	-----	--	3,626
Retail dealers	--	8	13	1,364	930	1,889	59	--	4,263
All others	--	55	---	740	256	9,113	521	--	10,685
Total	--	63	13	4,217	3,384	37,573	1,132	--	46,382
1967:									
Electric utilities	--	---	---	17	2,121	26,825	534	--	29,497
Coke and gas plants	--	110	---	1,871	-----	1,468	-----	--	3,449
Retail dealers	--	5	12	1,342	847	1,831	37	--	4,074
All others	--	52	---	553	182	8,386	517	--	9,690
Total	--	167	12	3,783	3,150	38,510	1,088	--	46,710
1968:									
Electric utilities	--	12	127	12	1,885	25,539	646	--	28,221
Coke and gas plants	--	196	---	1,673	-----	1,200	-----	--	3,069
Retail dealers	--	---	11	1,231	665	1,362	43	--	3,312
All others	--	41	---	484	258	7,618	462	--	8,863
Total	--	249	138	3,400	2,808	35,719	1,151	--	43,465
1969:									
Electric utilities	--	4	---	-----	3,063	26,622	656	48	30,393
Coke and gas plants	--	99	---	2,076	-----	1,538	-----	--	3,713
Retail dealers	--	---	14	1,287	587	1,141	48	--	3,077
All others	22	45	---	356	254	7,102	282	--	8,061
Total	22	148	14	3,719	3,904	36,403	986	48	45,244

[1] States or portion of States represented by each district are as follows: District 1—Maryland, Eastern Pennsylvania, and Eastern West Virginia; 3 and 6—Northern West Virginia; 4—Ohio; 7 and 8—Eastern Kentucky, Virginia, Southern West Virginia, and North-central Tennessee; 9—Western Kentucky; 10—Illinois; 11—Indiana; 19—Idaho and Wyoming.

About 77 percent of the coal was shipped by rail, 9 percent by truck, 8 percent by water, and 6 percent by other means including transportation from mine to point of use by conveyor or tram. Of the rail shipments, 36 percent was by unit train, an increase of over 4 million tons over that of 1968.

All but a minor part of the coal produced underground was loaded by machines, including 69 mobile loaders and 85 continuous miners. Equipment used at strip mines included 114 power shovels, draglines, and wheel excavators; 149 bulldozers; and 41 power drills. Eighty-five percent of the total production was cleaned by the 43 cleaning plants that operated during the year.

New coal mines with initial production in 1969 included Peabody Coal Co.'s Eagle No. 2 underground mine in Gallatin County and Truax-Traer Coal Co.'s Norris strip mine in Fulton County. Monterey Coal Co., a newly formed subsidiary of Carter Oil Co., announced plans for an underground coal mine near Carlinsville, Macoupin County. Mine and plant facilities were scheduled to be completed by the fall of 1970. Sahara Coal Co., Inc., has contracted for a new coal preparation plant in Saline County. The plant was scheduled for completion the latter part of 1970. The company also planned to open a new slope mine in Saline County. Ayrshire Collieries Corp. merged with American Metal Climax, Inc., (AMAX) on October 31. The company has started construction of a new 3-million-tons-per-year strip mine in Perry County which is scheduled to be completed in 1971. They have also contracted for a new coal preparation plant.

Mines that closed or were abandoned in 1969 included the Parton Coal Co., Inc., underground mine in Williamson County, Sherwood-Templeton Coal Co. Pioneer strip mine in Peoria County, Triple S Mines, Inc., strip mine in Adams County, and Venedy Coal Co. underground mine in Washington County. The latter two mines were the last mines operating in Adams and Washington Counties.

Coke.—Over 2.3 million tons of coke was produced in 1969, an increase of 13 percent from that of 1968. There were five plants operating at yearend. The majority of the coke was consumed by the producing companies. About 96 percent of the total production was used in blast furnaces. Nearly 3.7 million tons of coal was carbonized at Illinois coke plants, of which 46 percent came from Illinois; 53 percent from Kentucky and West Virginia; and the remainder from Pennsylvania and Virginia.

About 199,000 tons of coke breeze was recovered at the producing plants, an increase of 27 percent over 1968. Other products of coke-oven plants included coke-oven gas, tar, ammonia, crude light oil, and light-oil derivatives.

Peat.—Peat sales increased 9 percent in quantity and 10 percent in value over that of 1968. Production was reported by eight companies from Cook, Kane, Lake, McHenry, and Whiteside Counties. Reed-sedge peat was sold in bulk and packaged form, while humus and moss peat were sold in bulk only. Eighty-five percent of the sales were in packaged form. The majority of the peat was used for general soil improvement, with only a small amount being used as an ingredient for potting soils.

Petroleum, Natural Gas, and Natural Gas Liquids.—For the seventh consecutive year crude petroleum production declined. Output decreased 10 percent in quantity and 7 percent in value. The value of crude petroleum provided over 24 percent of the total State mineral output value. Waterflood oil production accounted for 73 percent of the total petroleum output.

Total wells completed in 1969 were 848, of which 393 were producing oil wells, 7 gas wells, 259 dry holes in pools, and 189 unsuccessful wildcats, according to the Illinois State Geological Survey. Total footage drilled was 2,072,541, of which 48 percent was in producing wells. Data do not include service wells, structure tests, and natural gas storage wells.

According to the American Petroleum Institute, proved crude oil reserves on December 31 were 272 million barrels, a 42-million barrel decrease since 1968. Proved reserves of natural gas on December 31 were 338 billion cubic feet, according to the American Gas Association (AGA), an increase of 40 billion cubic feet over 1968 estimates. Proved recoverable reserves of natural gas liquids totaled nearly 1.5 million barrels on Decembr 31, according to the AGA.

Table 7.—Crude petroleum production, by counties

(Thousand 42-gallon barrels and thousand dollars)

County	1968		1969	
	Quantity [1]	Value [2]	Quantity [1]	Value [2]
Adams	4	$12	4	$13
Bond	82	251	66	209
Brown	4	12	2	5
Champaign	1	2	(3)	(3)
Christian	446	1,370	364	1,158
Clark [4]	611	1,877	525	1,670
Clay	2,866	8,799	2,808	8,931
Clinton	932	2,862	908	2,888
Coles	583	1,790	455	1,447
Crawford	2,599	7,979	2,271	7,223
Cumberland	(4)	(4)	(4)	(4)
De Witt	236	724	214	679
Douglas	65	199	45	142
Edgar	102	312	99	316
Edwards	771	2,368	785	2,496
Effingham	676	2,075	645	2,051
Fayette	6,732	20,667	5,645	17,951
Franklin	1,560	4,790	1,244	3,956
Gallatin	1,178	3,617	1,036	3,296
Hamilton	3,794	11,647	2,172	6,908
Hancock [4]	38	115	37	116
Jasper	1,319	4,048	1,332	4,237
Jefferson	1,442	4,425	1,293	4,113
Lawrence	5,952	18,272	5,714	18,170
McDonough	(4)	(4)	(4)	(4)
Macon	13	40	10	33
Macoupin	6	17	8	26
Madison	180	553	150	476
Marion	4,231	12,989	3,777	12,012
Montgomery	1	3	2	5
Moultrie	3	11	4	12
Perry	19	60	21	66
Randolph	121	372	133	421
Richland	2,071	6,359	2,154	6,850
St. Clair	----	----	110	351
Saline	1,083	3,324	694	2,207
Sangamon	225	691	220	699
Shelby	48	147	58	185
Wabash	2,381	7,311	2,064	6,562
Washington	615	1,889	756	2,405
Wayne	6,137	18,841	5,661	18,003
White	7,138	21,913	7,102	22,585
Williamson	126	386	135	429
Total [5]	56,391	173,120	50,724	161,302

[1] Source: Illinois Geological Survey.
[2] County values calculated by using State average value per barrel; $3.07 for 1968 and $3.18 for 1969.
[3] Less than ½ unit.
[4] Production of Cumberland County included with Clark County, and McDonough County with Hancock County because actual source of production cannot be identified.
[5] Data may not add to totals shown because of independent rounding.

NONMETALS

Cement.—Portland and masonry cements were produced by four companies with plants in La Salle, Lee, and Massac Counties. Portland cement shipments decreased 7 percent in quantity and 8 percent in value. Shipments of masonry cement remained about the same in quantity but increased 2 percent in value.

Over 96 percent of the portland cement shipments consisted of types I and II (general use and moderate heat). The remainder was high-early-strength and special-use types. Nearly 95 percent of the portland cement was shipped in bulk, the remainder in bags. Nearly 81 percent of the shipments were made by truck; the remainder by rail and water. About 74 percent of the portland cement shipments were to ready-mixed concrete companies, 9 percent to concrete product manufacturers, 9 percent to dealers in building materials, 6 percent to highway contractors, and the remainder to other contractors and various governmental agencies.

Over 63 percent of the portland cement shipments were to consumers in Illinois. Most of the remainder went to consumers in neighboring States. Of the masonry cement shipped, 35 percent went to consum-

ers in Illinois. About 33 percent was shipped to Wisconsin, 21 percent to Tennessee, and the remainder to consumers in 16 other States. Approximately 14 million barrels of portland cement were shipped into Illinois from plants outside the State, mostly from Indiana, Michigan, and Missouri. In addition 593,000 barrels of masonry cement were imported from out-of-State plants, principally from Indiana.

Table 8.—Finished portland cement produced and shipped

(Thousand barrels and thousand dollars)

Year	Active plants	Production	Shipped from mills	
			Quantity	Value
1965	4	9,235	9,358	$30,622
1966	4	9,108	9,203	28,617
1967	4	9,608	9,069	30,186
1968	4	9,719	9,372	32,475
1969	4	8,872	8,720	29,996

Almost 2.8 million tons of limestone and 251,000 tons of other raw materials, including clay and shale, gypsum, iron ore, sand, slag, air-entraining compounds, and grinding aids were used in manufacturing portland cement. About 239.1 million kilowatt-hours of electricity was used in the manufacturing process; over 66 percent was purchased, while the remainder was home-generated.

Clays.—Total production of fire clay and miscellaneous clay and shale decreased 19 percent in quantity and 10 percent in value. Principal reason for the large decrease was a 4-month strike at the Marblehead Lime Co., General Dynamics Corp.'s lightweight aggregate operation near Ottawa. Lesser production of material for manufacturing cement and heavy clay products also contributed to the decrease. A decrease in output of fire clay was also recorded, but production of fuller's earth for absorbent uses increased markedly.

Production of clay and shale was reported from 16 counties, five fewer than in 1968. Fire clay was produced by eight companies in Grundy, La Salle, McDonough, and Scott Counties.

Fluorspar.—Although Illinois continued to be the Nation's leading producer of fluorspar, supplying 48 percent of the National total, shipments were about half of the 1968 output. Total Illinois shipments decreased 53 percent in quantity and 49 percent in value. A 6-month labor strike at the principal fluorspar operations, beginning in January, was the chief reason for the substantial drop. Acid-grade fluorspar accounted for 54 percent of the sales; ceramic grade, 45 percent; and metallurgical grade, 1 percent. Sales of all grades decreased—ceramic grade 60 percent, acid grade 45 percent, and metallurgical grade 44 percent.

About 321,000 tons of crude ore was milled to produce 85,000 tons of finished fluorspar as well as byproduct lead and zinc concentrates. Crude ore came from Hardin and Pope Counties in Illinois and from Kentucky. A small amount of Illinois crude ore was processed in Kentucky. Crude ore was mined by Cullum Mining Co., Minerva Oil Co., and Ozark-Mahoning Co. Several small producers removed crude ore from stockpiles.

Lime.—Quicklime and hydrated lime were produced at six plants in Adams and Cook Counties. Total production and value increased 3 and 7 percent respectively. The major reason for increased output was increased use by the steelmaking industry. Almost 69 percent was used for chemical and industrial purposes, 26 percent for refractory purposes, and the remainder in construction. Of that portion used for chemical and industrial purposes, 83 percent was used in metallurgical processes and 12 percent in water purification. About 34 percent of the lime was shipped to consumers in Illinois, while 56 percent went to Indiana. Menke Stone & Lime Co. sold their underground limestone mine and lime manufacturing facilities at Quincy in May. Calcium Carbonate Co., the new owner, plans to operate the mine but dismantled the lime plant.

Perlite.—Crude perlite mined outside the State was expanded by seven companies with plants in Champaign, Cook, De Kalb, Kankakee, Lake, and Will Counties. Production of the expanded product increased nearly 4 percent in quantity and 7 percent in value. Principal uses included roof insulation, over 72 percent; concrete aggregate, 13 percent; filter aid, 6 percent; building plaster, 2 percent; and other uses, 7 percent.

Sand and Gravel.—Illinois ranked fifth in the Nation in quantity and fourth in value of sand and gravel produced. Total production decreased 3 percent but increased 7 percent in value. Principal reason for the decrease in production was a 2.6-million-ton decrease in output for

building purposes. Production of paving sand and gravel increased over 1.5 million tons. Production was reported from 72 counties in which there were 280 commercial and 53 Government-and-contractor operations. About 89 percent of the commercial sand and gravel output was shipped by truck, and the remainder by rail or water.

Of the total sand and gravel produced, over 47 percent was used as paving material, 33 percent as building material, and the remainder as industrial sands, railroad ballast, and fill. The average value of the total sand and gravel produced was $1.28 per ton. Eleven counties (Cook, Grundy, Kane, Lake, La Salle, McHenry, Peoria, Rock Island, Tazewell, Will, and Winnebago) had an output of over 1 million tons each. Combined, these counties accounted for 67 percent of the State total production.

Stone.—Illinois ranked second in the Nation in stone production and third in value. Nearly all the production was limestone and dolomite, with only a small amount of sandstone (ganister) being mined in Alexander County. Total production decreased 2 percent in quantity, but increased 1 percent in value. Almost 80 percent of the production was used in con-

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	8,191	$7,993	6,363	$6,611
Paving	7,130	6,288	8,821	8,910
Blast	W	W	150	795
Foundry (ground sand)	W	W	58	W
Glass (ground sand)	W	W	64	176
Glass (unground sand)	2,059	4,618	2,137	5,102
Molding (ground sand)	1,088	3,749	1,159	4,305
Other [1]	4,088	7,078	3,256	7,189
Total [2]	22,506	29,726	22,010	33,089
Gravel:				
Building	9,113	9,022	8,384	8,409
Paving	10,993	12,256	11,321	13,307
Railroad ballast	152	157	W	W
Fill	1,357	934	1,503	1,273
Other	11	11	59	65
Total [2]	21,626	22,380	21,267	23,054
Total sand and gravel [2]	44,132	52,106	43,278	56,144
Government-and-contractor operations:				
Sand:				
Paving	448	249	113	68
Fill	343	163	230	138
Total [2]	791	412	342	206
Gravel:				
Building	11	6	4	2
Paving	674	418	514	337
Fill	1	1	------	------
Total	686	425	518	339
Total sand and gravel [2]	1,477	835	860	544
All operations:				
Sand	23,297	30,138	22,352	33,295
Gravel [2]	22,312	22,805	21,786	23,393
Total [1]	45,609	52,943	44,138	56,688

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

[1] Includes railroad ballast (1968), abrasives, chemical, enamel, engine, fill, filler, filtration, grinding and polishing, oil (hydrafrac), pottery, porcelain, tile, other construction and industrial sand, and items indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 10.—Production of sand and gravel and stone in 1969, by counties [1]

(Thousand short tons and thousand dollars)

County	Sand and gravel		Stone		County	Sand and gravel		Stone	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Adams	50	$71	854	W	Logan	266	W	W	W
Alexander	108	W	(2)	$3	McDonough	------	------	W	W
Bond	271	279	------	------	McHenry	6,858	$6,642	7	$9
Boone	110	95	347	363	McLean	758	804	------	------
Brown	3	W	W	W	Macon	463	382	------	------
Bureau	806	682	------	------	Macoupin	------	------	129	227
Calhoun	------	------	31	W	Madison	564	W	W	W
Carroll	W	W	308	W	Marion	------	------	W	W
Cass	44	26	------	------	Marshall	405	W	------	------
Champaign	761	789	------	------	Mason	23	W	------	------
Christian	------	------	W	W	Massac	W	W	W	W
Clark	400	W	W	W	Menard	1	1	498	W
Clay	------	------	154	W	Mercer	------	------	W	W
Clinton	74	W	W	W	Monroe	------	------	W	W
Coles	182	174	W	W	Montgomery	------	------	1,134	W
Cook	1,169	1,350	W	W	Morgan	W	W	------	------
Crawford	W	W	------	------	Moultrie	19	W	------	------
Cumberland	136	154	W	W	Ogle	856	1,925	464	578
De Kalb	341	W	W	W	Peoria	1,701	W	587	950
De Witt	229	310	------	------	Pike	W	W	753	W
Du Page	W	W	W	W	Pope	7	4	------	------
Edwards	60	53	------	------	Pulaski	41	36	W	W
Effingham	8	6	------	------	Putnam	W	W	------	------
Fayette	W	W	292	518	Randolph	W	W	1,522	2,009
Ford	206	277	------	------	Rock Island	1,089	W	W	W
Fulton	663	821	------	------	St. Clair	W	W	2,946	4,941
Gallatin	252	265	------	------	Sangamon	768	W	------	------
Greene	------	------	391	653	Schuyler	W	W	W	W
Grundy	W	W	------	------	Scott	W	W	140	W
Hancock	------	------	450	669	Shelby	167	W	W	W
Hardin	------	------	2,116	2,891	Stark	W	W	------	------
Henderson	------	------	354	564	Stephenson	153	109	675	694
Henry	W	W	W	W	Tazewell	1,032	W	------	------
Iroquois	20	19	------	------	Union	24	19	392	1,394
Jackson	W	W	W	W	Vermilion	245	210	W	W
Jersey	------	------	108	169	Wabash	141	W	------	------
Jo Daviess	146	101	490	510	Warren	------	------	W	W
Johnson	------	------	W	W	Washington	------	------	392	804
Kane	5,404	5,853	773	1,359	White	820	681	------	------
Kankakee	18	17	W	W	Whiteside	97	163	W	W
Kendall	W	W	W	W	Will	2,914	W	3,426	4,664
Knox	------	------	W	W	Winnebago	1,558	1,438	944	1,239
Lake	1,267	990	------	------	Woodford	367	548	------	------
La Salle	4,601	14,972	1,472	1,281	Undistributed [3]	4,964	15,925	29,001	50,939
Lawrence	302	275	------	------					
Lee	209	220	1,429	1,517					
Livingston	W	W	1,776	2,875	Total [4]	44,138	56,688	54,857	81,318

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

[1] All stone production consisted of limestone and dolomite, except Alexander County in which stone production consisted entirely of sandstone. No sand and gravel or stone production reported from the following counties: Douglas, Edgar, Franklin, Hamilton, Jasper, Jefferson, Perry, Piatt, Richland, Saline, Wayne, and Williamson.

[2] Less than ½ unit.

[3] Includes data indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

crete aggregate and roadstone; other major uses were for agricultural purposes and cement. Output for agricultural purposes decreased nearly 12 percent, and for concrete aggregate and roadstone 1 percent. The quantity used in manufacturing cement increased slightly. More than 91 percent of the crushed and broken stone was shipped by truck, 7 percent by rail, and the remainder by water.

Production of crushed and broken limestone was reported from 60 counties. Each of the following 14 counties had production exceeding 1 million tons: Cook, Du Page, Hardin, Johnson, Kankakee, La Salle, Lee, Livingston, Montgomery, Randolph, Rock Island, St. Clair, Vermilion, and Will. Together they produced almost 72 percent of the State total crushed and broken stone. Cook County alone contributed about one-third of the total. Dimension stone was produced in Kane, McHenry, and Union Counties.

Sulfur.—Shipments of elemental sulfur decreased over 3 percent in quantity and over 24 percent in value. The Anlin Com-

Table 11.—Limestone and dolomite sold or used by producers, by uses

Use		1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Dimension:					
Rough construction:					
Irregular-shaped stone	thousand short tons	(1)	$7	2	$46
Rubble	do	5	6	4	5
Dressed architectural:					
Cut	thousand cubic feet	(1)	11	(1)	12
House stone veneer	do	7	22	3	12
Sawed	do	1	4	2	13
Flagging	do	38	52	70	53
Total dimension	approximate thousand short tons	9	102	12	141
Crushed and broken:					
Concrete aggregate and roadstone:					
Concrete aggregate	thousand short tons	9,743	14,340	9,487	14,578
Bituminous aggregate	do	8,168	11,350	8,781	13,117
Macadam aggregate	do	6,757	10,020	4,982	7,712
Dense graded road base stone	do	13,368	18,586	12,920	18,320
Surface treatment aggregate	do	6,201	8,682	6,057	8,947
Unspecified aggregate and roadstone	do	NA	NA	1,387	1,995
Total aggregate and roadstone [2]	do	44,236	62,980	43,614	64,670
Agricultural limestone	do	4,799	7,623	4,245	6,561
Asphalt filler	do	119	551	217	1,024
Cement	do	2,711	2,318	2,730	2,279
Flux	do	936	1,320	980	1,420
Railroad ballast	do	204	255	197	289
Riprap and jetty stone	do	673	1,090	777	1,070
Other [3]	do	2,168	3,946	2,085	3,862
Total crushed and broken [2]	do	55,848	80,083	54,844	81,174
Grand total [2]	do	55,857	80,186	54,856	81,315

NA Not available.
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes limestone for filter uses (1968); chemical uses; dead-burned dolomite; lime; mine dusting; poultry grit and mineral food; stone sand; terrazzo and exposed aggregate; whiting or whiting substitute and other fillers or extenders; other and unspecified uses.

pany of Illinois recovered sulfur by the Amine-Gas-Purification and Modified-Claus processes at its Hartford plant in Madison County. The Union 76 Division, Union Oil Co. of California (formerly The Pure Oil Co.) recovered sulfur by the Modified-Claus process at its Lemont plant in Will County. The recovery of elemental sulfur was discontinued at the Lemont plant in October, 1969.

Tripoli (Amorphous Silica).—Crude material was recovered from underground mines in Alexander County by Illinois Minerals Co. near Elco, and Tammsco Div. (Lowe's, Inc.) near Tamms. The latter company, formerly Tamms Industries Co., changed hands December 1969. Production of crude material increased 9 percent in quantity and over 8 percent in value. Output of prepared material increased 6 percent in quantity and value. Prepared material was used for abrasives, filler, and other purposes. A $1.5-million expansion program at the Illinois Minerals Co. operation was completed in 1969.

Vermiculite.—Crude vermiculite mined outside the State was processed at plants operated by three companies in Cook, De Kalb, and Macoupin Counties. Output of exfoliated vermiculite which was used for insulation, concrete and plaster aggregate, masonry fill, and agricultural purposes, decreased almost 3 percent in quantity, but increased 3 percent in value.

METALS

Lead and Zinc.—Production of recoverable lead metal decreased 46 percent, and output of zinc metal decreased 24 percent. The substantial decrease in lead and zinc metal output was due primarily to the decreased production of fluorspar. Southern Illinois producers recovered lead and zinc as byproducts from their fluorspar operations. The total value of lead produced declined over 39 percent, while the value of

zinc declined a little more than 18 percent. Average weighted yearly prices were 14.90 cents per pound for lead and 14.60 cents per pound for zinc, compared with 13.21 cents for lead and 13.50 cents for zinc in 1968. Principal producers were Eagle-Picher Industries, Inc., in northern Illinois, and Minerva Oil Co., and Ozark-Mahoning Co. in southern Illinois. Eagle-Picher Industries, Inc., operated the Bautsch, Blackjack, and Rehm-Bauer mines. The company started an incline shaft into the Gray orebody, Jo Daviess County, late in the year.

Pig Iron and Steel.—About 7.3 million tons of pig iron, valued at $414.9 million, was shipped from Illinois blast furnaces or was consumed by the producing companies. This output represented an increase of about 16 percent from 1968 production. Pig iron was produced by five companies operating blast furnaces in Granite City and South Chicago. Fifteen blast furnaces were operated in 1969, seven of which were operated throughout the year.

About 4.3 million short tons of domestic iron and manganiferous ores (excluding agglomerates), 3.0 million tons of sinter, and 6.7 million tons of pellets were consumed in Illinois blast furnaces. Iron-ore pellet consumption increased over 54 percent.

The iron and steel industry consumed about 2.2 million short tons of limestone and dolomite—about 54 percent in blast furnaces, 31 percent in agglomerating plants, and 15 percent in steel furnaces. Nearly 4.4 million short tons of coke was consumed by blast furnaces. Illinois agglomerating plants consumed 2.4 million short tons of iron ore. Data for nonintegrated steel plants are not included.

According to the American Iron & Steel Institute, steel production in Illinois was 11.9 million tons, an increase of 13 percent over the 1968 quantity.

Other Metals.—American Zinc Co. recovered byproduct cadmium at its Monsanto plant, in St. Clair County, and The New Jersey Zinc Co. recovered cadmium as a byproduct of domestic zinc ore at its Depue plant, in Bureau County. United Refining & Smelting Co. produced bismuth and cadmium and some low-melting alloys at its Franklin Park plant, in Cook County. American Potash & Chemical Corp. processed concentrates bearing thorium, rare-earth elements, and yttrium at its West Chicago plant, in Du Page County.

Table 12.—Mine production of lead and zinc, in terms of recoverable metals

Year	Mines producing	Crude ore sold or treated			Lead		Zinc		Total value [1] (thousands)
		Fluorspar-lead-zinc	Lead and/or zinc	Total	Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	8	495,686	185,444	681,130	3,005	$938	18,314	$5,348	$6,285
1966	8	520,891	128,088	648,979	2,285	691	15,192	4,406	5,096
1967	7	508,835	195,712	704,547	2,384	668	20,416	5,652	6,320
1968	7	440,265	204,687	644,952	1,467	388	r 18,182	4,909	5,297
1969	5	220,987	261,103	482,090	791	236	13,765	4,019	4,255

r Revised.
[1] Data may not add to totals shown because of independent rounding.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Alpha Portland Cement Co	15 South Third St. Easton, Pa. 18043	Portland, dry process	La Salle.
Marquette Cement Mfg. Co	20 North Wacker Dr. Chicago, Ill. 60606	Portland and masonry, dry process.	Do.
Medusa Portland Cement Co	Box 5668 Cleveland, Ohio 44101	----do----	Lee.
Missouri Portland Cement Co	7751 Carondelet Ave. St. Louis, Mo. 63105	----do----	Massac.
Clays and shale:			
American Brick Co	6558 West Fullerton Ave. Chicago, Ill. 60635	Pit and plant	Cook.
Hydraulic-Press Brick Co. (Illinois Streator Div.)	705 Olive St. St. Louis, Mo. 63101	Pit	La Salle.
		Pit	Livingston.
		Pit and plant	St. Clair.
Illinois Brick Co	228 North La Salle St. Chicago, Ill. 60601	----do----	Cook.
Illinois Clay Products Co. (Div. A.P. Green Refractories Co.)	Box 64, Morris, Ill. 60450	----do----	Grundy.
Marblehead Lime Co. (General Dynamics Corp.)	300 West Washington St. Chicago, Ill. 60606	----do----	La Salle.
Marquette Cement Mfg. Co	20 North Wacker Dr. Chicago, Ill. 60606	Pit	Do.
Richards Brick Co	234 Springer Ave. Edwardsville, Ill. 62025	Pit	Bond.
Southern Clay Co., Inc. (Lowe's, Inc.)	North Edward St. Cassopolis, Mich. 49031	Pit and plant	Pulaski.
Western Brick Co. (Div. of Illinois Brick Co.)	Box 591 Danville, Ill. 61832	----do----	Vermilion.
Coal (bituminous):			
Ayrshire Coal Co., Div. of American Metal Climax, Inc.:	430 Big Four Bldg. 105 South Meridian St.		
Sun Spot	Indianapolis, Ind. 46225	Strip mine, cleaning plant.	Fulton.
Harmattan	----------	----do----	Vermilion.
Delta	----------	----do----	Williamson.
Barbara Kay Coal, Inc	Box 397 Marion, Ill. 62959	----do----	Do.
Bell & Zoller Coal Co	Box 100 Johnston City, Ill. 62951	Underground, mine cleaning plant.	Do.
Belle Valley Coal Co., Inc	Route 1 Belleville, Ill. 62220	----do----	St. Clair.
Forsyth-Energy, Inc	20 South Central Clayton, Mo. 63105	Strip mine, cleaning plant.	Williamson.
Freeman Coal Mining Corp.:	307 North Michigan Ave.		
Orient No. 5	Chicago, Ill. 60601	Underground mine, cleaning plant.	Franklin.
Orient No. 3	----------	----do----	Jefferson.
Orient No. 6	----------	----do----	Do.
Crown	----------	----do----	Montgomery.
Orient No. 4	----------	----do----	Williamson.
Inland Steel Co	30 West Monroe St. Chicago, Ill. 60603	----do----	Jefferson.
Moffat Coal Co	Box 74 Murdock, Ill. 62941	----do----	Douglas.
Old Ben Coal Corp.:	10 South Riverside Plaza		
Old Ben No. 21	Chicago, Ill. 60606	----do----	Franklin.
Old Ben No. 24	----------	Underground mine	Do.
Old Ben No. 26	----------	Underground mine, cleaning plant.	Do.
Peabody Coal Co.:	301 North Memorial Dr.		
No. 10	St. Louis, Mo. 63102	----do----	Christian.
Eagle	----------	Strip and underground mines, cleaning plant.	Gallatin.
Northern Illinois	----------	Strip mine	Grundy, Will
		Cleaning plant	Kankakee.
Mecco	----------	Strip mine, cleaning plant.	Knox.
Edwards	----------	----do----	Peoria.
Elm	----------	----do----	Do.
Midwest	----------	Strip and underground mines, cleaning plant.	St. Clair.
River King	----------	Strip mine, cleaning plant.	Do.
Will Scarlet	----------	----do----	Saline, Williamson.
Allendale	----------	----do----	Stark.
Sahara Coal Co., Inc.:	59 East Van Buren St.		
No. 5	Chicago, Ill. 60605	Underground mine	Saline.
No. 6	----------	Strip mine, cleaning plant.	Do.
No. 16	----------	Underground mine	Do.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous)—Continued			
Southwestern Illinois Coal Corp.:	1514 Merchants Bank Bldg.		
Captain	Indianapolis, Ind. 46204	Strip mine, cleaning plant.	Perry.
Streamline	----------	Strip mine	Do.
		Cleaning plant	Randolph.
Truax-Traer Coal Co., Div. Consolidation Coal Co., Inc.:	Box 218 Pinckneyville, Ill. 62674		
Hillsboro	----------	Underground mine	Montgomery.
Norris	----------	Strip mine, cleaning plant.	Fulton.
Burning Star No. 2	----------	----do	Perry.
Burning Star No. 3	----------	----do	Randolph.
The United Electric Coal Cos.:	307 North Michigan Ave.		
Cuba No. 9	Chicago, Ill. 60601	----do	Fulton.
Buckheart No. 17	----------	----do	Do.
Banner No. 27	----------	Strip mine	Fulton, Peoria.
		Cleaning plant	Peoria.
Fidelity No. 11	----------	Strip mine, cleaning plant.	Perry.
Zeigler Coal & Coke Co.: Spartan	208 South La Salle St. Chicago, Ill. 60604	Underground mine, cleaning plant.	Randolph.
Coke:			
General Motors Corp	7-210 General Motors Bldg. Detroit, Mich. 48202	Coke ovens	Lake.
Granite City Steel Co	Box 367 Granite City, Ill. 62041	----do	Madison.
Interlake Steel Corp	135th St. and Perry Ave. Chicago, Ill. 60627	----do	Cook.
International Harvester Co	401 North Michigan Ave. Chicago, Ill. 60611	----do	Do.
Republic Steel Corp	1629 Republic Bldg. Cleveland, Ohio 44101	----do	Do.
Fluorspar:			
Minerva Company, Mining Div. Minerva Oil Co.:	Eldorado, Ill. 62930		
Crystal Group	----------	Underground mines	Hardin, Pope.
		Mill	Hardin.
Minerva No. 1	----------	Underground mine, mill.	Do.
Ozark-Mahoning Co	Box 57 Rosiclare, Ill. 62982	Underground mines	Hardin, Pope.
		Mill	Hardin.
Iron and steel:			
Granite City Steel Co	Box 365 Granite City, Ill. 62040	Iron and steel furnaces	Madison.
Interlake Steel Corp	310 South Michigan Ave. Chicago, Ill. 60604	Iron furnaces	Cook.
Republic Steel Corp	1629 Republic Bldg. Cleveland, Ohio 44101	Iron furnace and steel furnaces.	Do.
United States Steel Corp	3426 East 89th St. Chicago, Ill. 60617	Iron and steel furnaces.	Do.
Wisconsin Steel Division International Harvester Co.	410 North Michigan Ave. Chicago, Ill. 60611	----do	Do.
Lead and zinc:			
Eagle-Picher Industries, Inc.:	Box 1040	Underground mines, ore	Jo Daviess.
Bautsch, Blackjack, and Rehm-Bauer.	Galena, Ill. 61036	processed at Graham mill.	
Graham mill	----------	----------	Do.
Minerva Company, Mining Div. Minerva Oil Co.:	Eldorado, Ill. 62930		
Minerva No. 1	----------	Underground mine, mill	Hardin.
Ozark-Mahoning Co	Box 57 Rosiclare, Ill. 62982	Underground mines	Hardin, Pope.
		Mill	Hardin.
Lime:			
Marblehead Lime Co.:	300 West Washington St.		
Marblehead Limekiln	Chicago, Ill. 60606	Quicklime and hydrated lime, 3 shaft kilns.	Adams.
Quincy Limekiln	----------	Quicklime, 1 calcimatic kiln.	Do.
South Chicago Limekiln	----------	Quicklime and hydrated lime, 4 rotary kilns.	Cook.
Thornton Limekiln	----------	----do	Do.
Standard Lime & Refractories Co. (Div. Martin Marietta Corp.)	2000 First National Bank Bldg. Baltimore, Md. 21203	Quicklime, 3 rotary kilns.	Do.
Natural gas processing: U.S. Industrial Chemicals Co., Div. of National Distillers & Chemical Corp.	99 Park Ave. New York, N.Y. 10016	----------	Douglas.
Peat:			
Anderson Peat Co. (Old Fort Industries, Inc.)	Morrison, Ill. 61270	Bog, processing plant	Whiteside.
Markman Peat Co	Route 3 Morrison, Ill. 61270	----do	Do.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Expanded perlite:			
Filter Materials Corp	124 North Buesching Rd. Lake Zurich, Ill. 60047	Processing plant	Lake.
Johns-Manville Perlite Corp., Building Products Div.	22 East 40th St. New York, N.Y. 10016	do	Will.
Mica Pellets, Inc	1008 Oak St. De Kalb, Ill. 60115	do	De Kalb.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	do	Lake.
Ryolex Corp	310 East Bradley Ave. Champaign, Ill. 61820	do	Champaign.
Silbrico Corp	6300 River Rd. La Grange, Ill. 60525	do	Cook.
U.S. Perlite Corp	Box 320 Momence, Ill. 60954	do	Kankakee.
Petroleum refineries:			
American Oil Co	910 South Michigan Ave. Chicago, Ill. 60680		Madison.
Clark Oil & Refining Co	8530 West National Ave. Milwaukee, Wis. 53227		Cook, Madison.
Marathon Oil Co	539 South Main Findlay, Ohio 45840		Crawford.
Mobil Oil Corp	150 East 42nd New York, N.Y. 10017		St. Clair.
Shell Oil Co	50 West 50th New York, N.Y. 10020		Madison.
Texaco Inc	135 East 42nd New York, N.Y. 10017		Lawrence, Will.
Union Oil Co. of California	Union Oil Center Los Angeles, Calif. 90054		Cook.
Sand and gravel:			
Arrowhead Silica Corp	Troy Grove, Ill. 61372	Pit; stationary plant	La Salle.
Bellrose Silica Co	307 Central Life Bldg. Ottawa, Ill. 61350	do	Do.
Beverly Gravel Co. (Plote, Inc.)	2400 South Roselle Rd. Palatine, Ill. 60067	Pit; portable and stationary plants.	Kane.
Chain O Lakes Sand & Gravel Co., Evanston Fuel & Material Co.	Fox Lake, Ill. 60020	Pit; stationary plant	McHenry.
Chicago Gravel Co	343 South Dearborn St. Chicago, Ill. 60604	Pits; stationary plants	Cook, Will.
Concrete Materials Division, Martin Marietta Corp.	4096 1st Ave. NE Cedar Rapids, Iowa 52406	Pits; portable and stationary plants.	Ogle, Peoria, Tazewell, Woodford.
Elmhurst-Chicago Stone Co	400 West 1st St. Elmhurst, Ill. 60126	Pits; stationary plants	Du Page, Will.
Illinois-Wisconsin Sand & Gravel Co.	Eastern Ave. South Beloit, Ill. 61080	Pit; dredge; stationary plant.	Winnebago.
McHenry Sand & Gravel Co., Inc.	920 North Front St. McHenry, Ill. 60050	Pits; portable plants	McHenry.
Manley Sand Division Martin Marietta Corp.	Rockton, Ill. 61072	Pit, stationary plant	Ogle.
Material Service Division General Dynamics Corp.	300 West Washington St. Chicago, Ill. 60606	Pits; stationary plants	Cook, Grundy, Kane, McHenry, Will.
Meyer Aggregate	Box 56, Route 2 Algonquin, Ill. 60102	Pits; portable and stationary plants.	McHenry.
Meyer Aggregate West Division		do	Kane, Kendall, Will.
Moline Consumers Co	313 16th St. Moline, Ill. 61265	do	Bureau, La Salle, Pike, Rock Island.
Ottawa Silica Co	Box 577, Ottawa, Ill. 61350	Pit; stationary plant	La Salle.
Road Materials Corp., E. M. Melahn Construction Co., Inc.	Box 205 East Dundee, Ill. 60118	Pits; stationary plants	Kane, McHenry.
Rowe Construction Co. R. A. Cullinan & Son.	1523 West Market St. Bloomington, Ill. 61701	Pits; portable and stationary plants.	Livingston, McLean.
Edward Schneider	Route 3, Box 72 Elgin, Ill. 60120	do	Kane.
Thelen Sand & Gravel	Route 3, Box 330 Antioch, Ill. 60002	Pit; portable and stationary plants.	Lake.
Urban Sand & Gravel Co	Route 1 Champaign, Ill. 61820	Pits; dredges; portable plants.	Champaign, Cumberland, McLean.
Vulcan Materials Co. Midwest Division.	29 North Wacker Dr. Chicago, Ill. 60606	Pits; stationary plants	Kane, Lake, McHenry.
Wedron Silica Co., Del Monte Properties Co.	135 South La Salle St. Chicago, Ill. 60603	Pit; stationary plant	La Salle.
White County Sand & Gravel	Maunie, Ill. 62861	do	White.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Smelters and refineries:			
American Smelting & Refining Co.	120 Broadway New York, N.Y. 10005	Zinc secondary plant	Clinton.
American Zinc Co.	20 South Fourth St. St. Louis, Mo. 63101	do.	Montgomery.
		Zinc primary plants	St. Clair.
Apex Smelting Co.	2537 Taylor St. Chicago, Ill. 60612	Zinc secondary plant	Cook.
Continental Smelting & Refining Co.	7751 West 47th Lyons, Ill. 60534	Lead secondary plant	Do.
Goldsmith Div. of National Lead Co.	900 West 18th St. Chicago, Ill. 60608	do.	Do.
Imperial Type Metal Co.	3400 Aramingo Ave. Philadelphia, Pa. 19134	do.	Do.
National Lead Co.	111 Broadway New York, N.Y. 10006	do.	Madison.
The New Jersey Zinc Co.	160 Front St. New York, N.Y. 10038	Zinc primary plant	Bureau.
Sandoval Zinc Co.	3649 South Albany Ave. Chicago, Ill. 60632	Zinc secondary plant	Marion.
Stone:			
Limestone and dolomite:			
Charleston Stone Co.	Box 280 Charleston, Ill. 61920	Quarries; stationary plant.	Coles.
Columbia Quarry Co.	1007 Washington Ave. St. Louis, Mo. 63101	Quarries; stationary plants.	Massac, Pulaski, St. Clair.
		Underground mine; stationary plant.	Monroe.
Conco-Western Stone Co.	111 North Spaulding St. Spring Valley, Ill. 61362	Quarry; portable plant	Kane.
East St. Louis Stone Co.	528 Murphy Bldg. East St. Louis, Ill. 62201	Quarry; stationary plant.	St. Clair.
Elmhurst-Chicago Stone Co.	400 West 1st St. Elmhurst, Ill. 60126	do.	Du Page.
D–P Indian Point Limestone Products, Inc.	Box 126 Mason City, Ill. 62664	do.	Menard.
Industrial Chemicals Div. Allied Chemicals Corp.	Box 70 Morristown, N.J. 07960	do.	Randolph.
General Dynamics Corp.: Marblehead Lime Co.	4226 Lawndale Ave. Lyons, Ill. 60534	Underground mine; stationary plant.	Adams.
Material Service Division.		Quarries; stationary plants.	Cook, Vermilion, Will.
Lincoln Stone Quarry, Inc.	Box 69 Hillside, Ill. 60162	Quarry; stationary plant.	Will.
Manteno Limestone Co.	Box 509 Manteno, Ill. 60950	do.	Kankakee.
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606	do.	La Salle.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	do.	Lee.
Lehigh Stone Corp. Div.	Box 669 Kankakee, Ill. 60901	Quarries; stationary plants.	Clark, Kankakee.
Midwest Stone Co.	Box 180, Anna, Ill. 62906	Quarry; portable plant	Union.
Mississippi Lime Co.	7 Alby St., Box 247 Alton, Ill. 62002	Underground mine; stationary plant.	Madison.
Missouri Portland Cement Co.	7751 Carondelet Ave. St. Louis, Mo. 63105	Quarry; stationary plant.	Hardin.
Moline Consumers Co.	313 16th St. Moline, Ill. 61265	Quarries; stationary and portable plants.	Adams, Brown, Henry, Pike, Rock Island, Warren.
Pontiac Stone Co.	Route 3, Box 412 Pontiac, Ill. 61764	Quarry; stationary plant.	Livingston.
Rein, Schultz & Dahl, Inc.	6217 Nesbitt Rd. Madison, Wis. 53711	Quarries; portable plants.	Carroll, Jo Daviess, Stephenson, Whiteside.
River Sand & Stone Co., Inc. (Ryan Contracting Co., Inc.).	Box 5271, Lawndale Branch 5416 Boonville Hwy. Evansville, Ind. 47715	Quarry; underground mine; stationary plant.	Hardin.
Rockford Blacktop Construction Co.	600 Boylston St. Loves Park, Ill. 61111	Quarries; portable plants.	Boone, Winnebago.
Southern Illinois Stone Co.	Box 38 Buncombe, Ill. 62912	Quarry; stationary plant.	Johnson.
Vulcan Materials Co., Midwest Division.	29 North Wacker Dr. Chicago, Ill. 60606	Quarries; stationary plants.	Cook, Will.
Sandstone: Virgil Bridges	Elco, Ill. 62929	Underground mine	Alexander.
Recovered sulfur:			
The Anlin Company of Illinois	Box 6554 Houston, Tex. 77005	Byproduct sulfur recovery.	Madison.
The Union 76 Division Union Oil Co. of California.	Box 239 Lemont, Ill. 60439	do.	Will.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Tripoli (amorphous silica):			
Illinois Minerals Co	218 10th St. Cairo, Ill. 62914	Underground mine	Alexander.
Tammsco Division (Lowe's, Inc.)	North Edward St. Cassopolis, Mich. 49031	----do	Do.
Exfoliated vermiculite:			
International Vermiculite Co	1st and Mound Sts. Girard, Ill. 62640	Processing plant	Macoupin.
Mica Pellets, Inc	1008 Oak St. De Kalb, Ill. 60115	----do	De Kalb.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	----do	Cook.

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] Mary B. Fox,[2] and Don N. West [3]

In 1969, the value of mineral production in Indiana totaled $241.9 million, nearly 3 percent more than in 1968, and the second highest on record. Increased output of coal, sand and gravel, and lime offset losses reported in the production of cement, clay, gypsum, natural gas, peat, petroleum, and stone. Nonmetals accounted for 55 percent of the State mineral production value and mineral fuels the remainder, as no metallic ores were mined in Indiana in 1969.

Mineral production was reported from 87 of the 92 counties in the State. The value of mineral production increased in 46 counties and declined in 41. No mineral production was reported from Benton, Brown, Ohio, Tipton, and Vanderburgh Counties. More than half (54 percent) the value of Indiana mineral production came from seven counties—Clark, Lake, Lawrence, Pike, Putnam, Sullivan, and Warrick. From these counties came all of the lime, most of the cement, more than three-quarters of the coal, and large quantities of building and crushed stone, sand and gravel, and clay were produced in the State. Thirty-one counties had mineral production valued at $1 million or more and accounted for 81 percent of the value of State mineral production. Data on the value of petroleum and natural gas are not available at the county level, but an estimated two-thirds of the State's petroleum output came from Gibson and Posey Counties.

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Table 1.—Mineral production in Indiana [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Abrasives (whetstones)—short tons	5	$16	5	$17
Cement, portland—thousand 376-pound barrels	14,774	48,096	14,497	45,264
Clays—thousand short tons	1,550	2,355	1,483	2,264
Coal (bituminous)—do	18,486	71,680	20,086	82,902
Natural gas—million cubic feet	234	55	171	40
Peat—short tons	38,763	557	38,214	515
Petroleum (crude)—thousand 42-gallon barrels	8,692	26,511	7,841	25,013
Sand and gravel—thousand short tons	25,774	26,160	26,218	27,438
Stone—do	26,307	46,790	25,559	45,400
Value of items that cannot be disclosed: Masonry cement, gypsum, and lime	XX	13,166	XX	13,018
Total	XX	235,386	XX	241,871
Total 1967 constant dollars	XX	233,282	XX	p230,475

p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

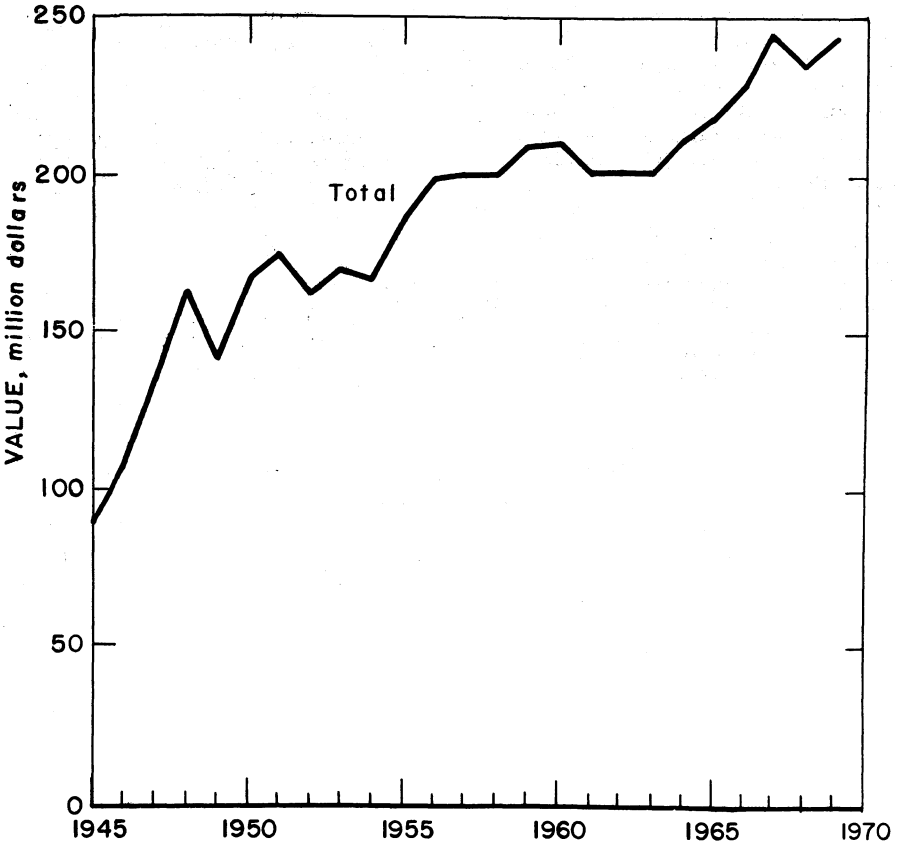

Figure 1.—Total value of mineral production in Indiana.

Table 2.—Value of mineral production in Indiana, by counties [1]

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	$721	$719	Stone, sand and gravel, clays.
Allen	3,117	3,504	Stone, sand and gravel.
Bartholomew	W	671	Do.
Blackford	W	W	Stone, clays.
Boone	145	177	Sand and gravel.
Carroll	W	W	Stone, sand and gravel.
Cass	W	W	Cement, stone, sand and gravel, clays.
Clark	W	W	Do.
Clay	W	W	Coal, clays.
Clinton	21	10	Sand and gravel.
Crawford	W	W	Stone.
Daviess	W	W	Coal, sand and gravel.
Dearborn	240	372	Sand and gravel.
Decatur	399	374	Stone.
De Kalb	381	295	Sand and gravel.
Delaware	1,270	1,333	Stone, sand and gravel, peat.
Dubois	12	W	Clays.
Elkhart	537	612	Sand and gravel, stone.
Fayette	307	369	Sand and gravel.
Floyd	W	W	Stone.
Fountain	W	W	Sand and gravel, coal, clays.
Franklin	60	156	Sand and gravel, stone, clays.
Fulton	215	197	Sand and gravel.
Gibson	W	W	Coal, sand and gravel.
Grant	W	W	Stone, sand and gravel, peat.
Greene	W	W	Coal, sand and gravel, clays.
Hamilton	3,985	3,601	Sand and gravel, stone.
Hancock	75	W	Sand and gravel.
Harrison	1,340	1,504	Sand and gravel, stone.
Hendricks	W	1	Sand and gravel.
Henry	397	379	Do.
Howard	W	W	Stone, sand and gravel.
Huntington	W	W	Stone, sand and gravel, clays.
Jackson	411	568	Sand and gravel, clays.
Jasper	875	W	Stone, sand and gravel.
Jay	W	W	Do.
Jefferson	-------	11	Sand and gravel.
Jennings	380	W	Stone.
Johnson	W	W	Sand and gravel.
Knox	507	560	Do.
Kosciusko	614	879	Sand and gravel, stone.
Lagrange	277	246	Do.
Lake	W	W	Cement, lime, sand and gravel, clays.
La Porte	W	1,206	Sand and gravel.
Lawrence	16,993	15,821	Cement, stone, sand and gravel.
Madison	2,071	1,984	Stone, sand and gravel.
Marion	W	W	Sand and gravel, peat.
Marshall	246	541	Sand and gravel, stone, peat.
Martin	W	W	Gypsum.
Miami	W	W	Sand and gravel, stone.
Monroe	6,811	7,078	Stone, sand and gravel.
Montgomery	192	W	Clays, sand and gravel.
Morgan	1,005	1,186	Clays, sand and gravel, stone.
Newton	W	W	Stone.
Noble	294	387	Sand and gravel, stone.
Orange	750	773	Stone, abrasives.
Owen	977	918	Stone, sand and gravel, clays, coal.
Parke	336	481	Sand and gravel, clays, coal.
Perry	W	W	Stone, sand and gravel.
Pike	W	W	Coal, stone.
Porter	W	W	Sand and gravel, clays.
Posey	W	W	Sand and gravel.
Pulaski	W	W	Stone, clays, sand and gravel.
Putnam	12,061	13,033	Cement, stone, sand and gravel.
Randolph	W	W	Stone, sand and gravel.
Ripley	443	W	Stone.
Rush	409	292	Stone, sand and gravel.
St. Joseph	W	818	Sand and gravel, stone.
Scott	409	W	Stone.
Shelby	1,280	1,336	Stone, sand and gravel.
Spencer	W	W	Coal.
Starke	37	32	Sand and gravel.
Steuben	573	230	Sand and gravel, stone.
Sullivan	W	W	Coal, sand and gravel, stone.
Switzerland	W	W	Sand and gravel, stone.
Tippecanoe	W	1,264	Sand and gravel.
Union	18	13	Do.
Vermillion	459	513	Sand and gravel, clays.

See footnotes at end of table.

Table 2.—Value of mineral production in Indiana, by counties [1]—Continued

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Vigo	$2,360	$1,528	Sand and gravel, coal.
Wabash	462	291	Stone, sand and gravel.
Warren	W	W	Sand and gravel, peat.
Warrick	W	W	Coal, stone.
Washington	W	W	Stone, sand and gravel.
Wayne	W	869	Sand and gravel, stone.
Wells	W	W	Stone, peat.
White	W	W	Stone.
Whitley	W	83	Sand and gravel.
Undistributed [2]	170,911	174,658	
Total [3]	235,386	241,871	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Data for petroleum and natural gas are not available on a county basis; however, value for these commodities are included with "Undistributed." Benton, Brown, Ohio, Tipton, and Vanderburgh Counties are not listed because no production was reported.
[2] Includes value for petroleum, natural gas, and values indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Indiana business activity

	1968	1969	Change, percent
Employment and labor force, annual average: [1]			
Total labor force—thousands	r 2,110.2	2,149.7	+1.9
Agricultural employment—do	58.2	54.1	−7.0
Nonagricultural employment [2]—do	r 1,978.9	2,032.9	+2.7
Manufacturing—do	r 722.9	746.5	+3.3
Construction—do	r 81.8	88.8	+8.6
Mining and quarrying—do	r 7.5	7.4	−1.3
Primary metal industries—do	r 110.3	113.0	+2.4
Steel mills—do	67.3	69.5	+3.3
Stone, clay, and glass products—do	r 24.5	24.9	+1.6
All other—do	r 1,166.7	1,190.2	+2.0
Payrolls, manufacturing [3]—millions	$5,512.6	$6,041.3	+9.6
Personal income:			
Total—do	$17,270	$18,891	+9.4
Per capita	$3,410	p $3,691	+8.2
Construction activity:			
Building permits: [4]			
Valuation of authorized residential construction—millions	r $372.4	$365.4	−1.9
Number of private and public residential units authorized	r 28,915	28,575	−1.2
Total contract construction work performed—millions	$1,505	$1,700	+13.0
State highway commission contracts awarded [5]—do	r $132.8	$94.4	−28.9
Portland cement shipments to and within Indiana, thousand 376-pound barrels	10,213	9,510	−6.9
Retail sales—millions	$8,810	$9,283	+5.4
Farm marketing receipts—do	$1,352.5	$1,499.7	+10.9
Mineral production—do	$235.4	$241.9	+2.8
Raw steel production—thousand tons	17,911	19,386	+8.2
Utility production and consumption:			
Production of electric energy by electric utilities, million kilowatt hours	48,024	52,400	+9.1
Natural gas consumption—million cubic feet	454,013	530,981	+17.0

p Preliminary. r Revised.
[1] Adjusted to March 1969 benchmark levels.
[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.
[3] Includes workers covered under the Indiana Employment Security Law.
[4] Based on a nationwide universe of 13,000 permit issuing places.
[5] Fiscal year ending June 30.
Sources: Indiana Employment Security Division in cooperation with the United States Department of Labor, Construction Reports, Statistical Abstract of the United States, Indiana State Highway Commission, Sales Management, Farm Income Situation, and Federal Power Commission.

Table 4.—Worktime 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
1968:								
Coal	2,269	257	583	4,521	4	186	42.03	7,240
Peat	30	186	6	45	---	1	22.38	2,126
Nonmetal	790	268	212	1,672	1	22	13.76	3,821
Sand and gravel	1,010	241	243	2,112	1	38	18.47	3,215
Stone	2,767	270	747	6,176	2	125	20.56	2,597
Total [1]	6,866	261	1,790	14,525	8	372	26.16	4,271
1969: [p]								
Coal	2,310	262	605	4,660	---	186	39.92	918
Peat	26	210	5	44	---	1	22.91	641
Nonmetal	665	262	177	1,412	---	20	14.17	789
Sand and gravel	930	246	230	2,009	1	37	18.91	4,460
Stone	3,040	273	830	6,644	2	102	15.65	2,392
Total [1]	6,975	265	1,847	14,768	3	346	23.63	2,050

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive stone.—Whetstones were fabricated from sandstone quarried in Orange County at a mill that has been in operation for more than 150 years near Orleans. This is probably the oldest mineral processing activity in the State.

Cement.—Shipments of portland cement decreased 2 percent in 1969, while masonry cement output was 9 percent lower than in 1968. Portland cement was produced at five plants, of which four also produced masonry cement. The average mill value of portland cement was $3.12 per barrel compared with $3.26 in 1968. Average value of masonry cement was $2.57 per barrel, down from $2.58 in the previous year. Yearend stocks of portland cement were 1.9 million barrels compared with nearly 2.1 million (adjusted) in 1968. Ninety percent of the portland cement shipped was types I and II (general use and moderate heat); the remainder was type III (high-early-strength), white, and portland slag and block. More than 40 percent of the portland cement shipped was used within the State. Out-of-State shipments went principally to Illinois, Kentucky, and Wisconsin. Nearly 3.7 million barrels of portland cement were shipped into Indiana from plants in other States, principally Michigan and Ohio.

Nearly 63 percent of the shipments was purchased by ready-mixed concrete companies with the remainder going to highway contractors (16 percent), concrete product manufacturers (14 percent), and to building material dealers and other users (7 percent). Eighty-two percent of the portland cement was shipped by truck and the remainder by rail.

About 3.2 million tons of limestone and 1.0 million tons of slag, clays and shale, gypsum, sand, air-entraining compounds, and grinding aids were used in manufacturing portland cement. The plants used 323 million kilowatt-hours of electrical energy. The dry process of manufacture was used at three plants and the wet process at two.

Annual finished portland cement capacity of Indiana plants increased to 20.3 million barrels from 18.7 million barrels in 1968. Lone Star Cement Corp. opened its 4 million-barrel cement plant at Greencastle in June, replacing its 2.7 million-barrel plant at the same location.

Clays.—Clay production was reported from 36 clay and shale pits operated by 28 companies in 19 counties. Ouput declined generally with an overall drop of more than 4 percent. Smaller demand for fire clay and miscellaneous clay and shale for cement and heavy clay products accounted for much of the loss. The only notable increase was in the demand for clay for use in lightweight aggregate (25 percent).

Gypsum.—Demand for crude gypsum, produced from two underground mines in Martin County, was about 6 percent less

Table 5.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Fire clay		Miscellaneous clay		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	329	$526	1,130	$1,634	1,459	$2,160
1966	314	511	1,177	1,685	1,491	2,196
1967	247	420	1,242	1,706	1,489	2,126
1968	182	340	1,369	2,015	1,550	2,355
1969	166	314	1,317	1,950	1,483	2,264

[1] Data may not add to totals shown because of independent rounding.

than in 1968. Lath, plaster, and wallboard were manufactured at plants adjacent to the mines. A wallboard plant was also operated at East Chicago in Lake County. The Indiana Geological Survey reported discovery of a gypsum deposit, overlain by dolomitic limestone and shale, in La Porte County. Subsequently, Republic Gypsum Co. announced it had leased 4,000 acres in that area and that studies indicated a deposit of 20 million tons of recoverable gypsum.

Lime.—A lime plant, in Lake County, was the only lime-making facility in the State. Output was up sharply from 1968 levels, and nearly all the shipments were

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,588	$4,058	4,809	$4,520
Paving	4,422	3,974	4,587	4,243
Fill	1,880	1,201	1,528	976
Railroad ballast	1	W	W	W
Industrial [1]	655	2,070	574	1,992
Other	99	83	91	70
Total [2]	11,645	11,386	11,588	11,800
Gravel:				
Building	3,369	4,253	3,493	4,528
Paving	7,770	8,628	7,793	8,934
Fill	2,062	1,359	2,471	1,680
Other [3]	10	10	8	9
Total [2]	13,211	14,250	13,764	15,150
Total sand and gravel	24,856	25,636	25,352	26,950
Government-and-contractor operations:				
Sand:				
Paving	58	31	11	5
Fill	4	2	------	------
Other	------	------	14	9
Total [2]	62	33	24	15
Gravel:				
Paving	849	487	833	469
Fill	7	4	9	4
Total [2]	856	491	841	473
Total sand and gravel [2]	918	524	866	488
All operations:				
Sand	11,707	11,419	11,612	11,815
Gravel [2]	14,067	14,741	14,606	15,623
Total	25,774	26,160	26,218	27,438

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

[1] Includes pottery, porcelain, and tile (1968), engine, fire or furnace, glass, molding, and other industrial sand.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes railroad ballast and other construction gravel.

Table 7.—Production of sand and gravel, by counties [1]

(Thousand short tons and thousand dollars)

County	1968		1969		County	1968		1969	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Adams	65	W	61	$85	Madison	910	W	822	W
Allen	1,095	W	1,148	W	Marion	3,862	W	W	W
Bartholomew	-----	-----	34	17	Marshall	279	$239	505	$534
Boone	138	$145	174	177	Miami	W	W	314	391
Carroll	W	W	W	W	Monroe	-----	-----	1	(2)
Cass	143	130	108	97	Montgomery	68	W	33	33
Clark	540	476	W	W	Morgan	W	W	W	W
Clinton	22	21	10	10	Noble	431	289	439	385
Daviess	56	57	75	82	Owen	W	W	W	W
Dearborn	207	240	289	372	Parke	W	W	396	379
De Kalb	411	381	355	295	Perry	-----	-----	24	17
Delaware	376	375	386	409	Porter	W	W	W	W
Elkhart	665	W	625	601	Posey	(2)	(2)	W	W
Fayette	277	307	307	369	Pulaski	W	W	W	W
Fountain	504	W	442	W	Putnam	W	W	W	W
Franklin	69	48	136	W	Randolph	27	26	20	19
Fulton	271	215	238	197	Rush	19	14	14	13
Gibson	W	W	W	W	St. Joseph	909	773	850	817
Grant	W	W	W	W	Shelby	350	390	317	380
Greene	187	W	205	W	Starke	47	37	44	32
Hamilton	2,434	W	1,847	W	Steuben	443	570	220	227
Hancock	102	75	79	W	Sullivan	W	W	184	119
Harrison	W	W	W	W	Switzerland	W	W	W	W
Hendricks	W	W	1	1	Tippecanoe	W	W	1,131	1,264
Henry	378	397	333	379	Union	33	18	24	13
Howard	140	107	366	389	Vermillion	265	W	W	W
Huntington	95	94	95	W	Vigo	1,044	W	1,108	W
Jackson	235	259	W	412	Wabash	150	148	65	W
Jasper	W	W	W	W	Warren	501	W	574	614
Jay	16	18	31	34	Warrick	21	W	-----	-----
Jefferson	-----	-----	15	11	Washington	-----	-----	5	2
Johnson	W	W	W	W	Wayne	365	W	504	597
Knox	584	W	613	560	Whitley	W	W	74	83
Kosciusko	734	W	1,026	878	Undistributed [3]	6,005	20,042	8,427	14,701
Lagrange	301	269	268	239					
Lake	W	W	W	W	Total [4]	25,774	26,160	26,218	27,438
La Porte	W	W	857	1,206					
Lawrence	-----	-----	1	(2)					

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

[1] No sand and gravel production reported from the following counties: Benton, Blackford, Brown, Clay, Crawford, Decatur, Dubois, Floyd, Jennings, Martin, Newton, Ohio, Orange, Pike, Ripley, Scott, Spencer, Tipton, Vanderburgh, Wells, and White.

[2] Less than ½ unit.

[3] Includes data indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

to steel plants in Indiana and Illinois. Indiana demand for lime reached nearly 1.3 million tons. Large quantitites were shipped into the State from Illinois, Ohio, and Missouri.

Perlite.—Crude perlite, mined in western states, was expanded at plants in Lake, Martin, and Scott Counties. The product was used chiefly for building plaster, concrete aggregate, and loose fill insulation.

Sand and Gravel.—Sand and gravel output was nearly 2 percent greater than in 1968, with increases reported for building and paving materials, and fill. Industrial sand production was off about 12 percent, with a substantial decline in the demand for molding sand. Sand and gravel for construction use accounted for 98 percent of the total production. Average value per ton increased 4 cents to $1.05 in 1969. Production was reported in 70 counties from 196 commercial and 28 government-and-contractor operations, including 129 stationary plants, 60 portable plants, and 26 dredges.

More than half (51 percent) of the output came from 10 counties, with Marion County leading in production. Nearly 92 percent of the sand and gravel was moved by truck, the remainder by rail and water transport.

Slag (Iron-Blast Furnace).—Slag was produced as a byproduct of pig iron in Lake County blast furnaces. The slag was used in manufacturing cement, mineral wool, and roofing granules; crushed for use as aggregate; and expanded for lightweight aggregate.

Table 8.—Limestone and dolomite sold or used by producers, by uses

Use	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural thousand cubic feet	2,607	$3,753	2,439	$3,989
Irregular-shaped stone thousand short tons	3	77	4	88
Rubble do	4	6	8	29
Dressed architectural:				
Cut thousand cubic feet	376	2,698	419	3,386
House stone veneer do	646	1,332	540	1,179
Sawed do	903	2,553	763	2,602
Flagging do	90	19	60	11
Total dimension approximate thousand short tons	388	10,438	357	[1] 11,285
Crushed and broken:				
Concrete aggregate and roadstone:				
Concrete aggregate thousand short tons	4,206	5,631	3,439	4,614
Bituminous aggregate do	2,767	4,129	2,357	3,154
Macadam aggregate do	2,864	4,014	1,962	2,841
Dense graded road base stone do	7,046	9,396	7,208	9,550
Surface treatment aggregate do	2,378	3,338	2,718	3,920
Unspecified aggregate and roadstone do	NA	NA	2,295	3,029
Total aggregate and roadstone [1] do	19,261	26,508	19,979	27,109
Agricultural limestone do	2,098	3,220	1,389	2,065
Cement do	2,771	2,595	2,644	2,570
Flux do	35	51	41	60
Railroad ballast do	440	584	452	590
Riprap and jetty stone do	937	2,203	242	476
Other [2] do	326	870	409	1,016
Total crushed and broken [1] do	25,867	36,031	25,157	33,885
Grand total [1] do	26,255	46,469	25,514	45,170

NA Not available.
[1] Data may not add to totals shown because of independent rounding.
[2] Includes stone used for asphalt filler; filter stone; mine dusting; other and unspecified uses (1968–69); and stone sand (1969).

Stone.—Total stone output declined about 3 percent from the 1968 level. Crushed stone, accounting for nearly 99 percent of the stone production, was in greater demand for use as aggregate, roadstone, and railroad ballast, while demand for riprap, agricultural limestone, and stone for cement was lower than in 1968.

Dimension limestone production was down 8 percent from 1968. Lesser demand for nearly all types of building stone was reported with the exception of rough construction stone and dressed cut stone. Most of the dimension stone (97 percent) was produced in Lawrence and Monroe Counties.

Crushed and broken limestone was quarried and processed in 43 counties. In five counties—Allen, Clark, Crawford, Lawrence, and Putnam—production of more than 1 million tons was reported. A large dolomite reef was discovered in southern Lake County by the Indiana Geological Survey in late 1969.

Calcareous marl, used for soil conditioning, was produced in seven counties with the largest production reported in Elkhart, Lagrange, Marshall, and Noble Counties. Output was 12 percent less than in 1968.

Sandstone was quarried for building use in Lawrence and Orange Counties and for rubble in Morgan County. Pike County sandstone was removed from old coal mine spoilbanks and used as surface treatment aggregate. Output was 16 percent lower than in 1968. General Refractories Co. closed their quarry near Shoals, Martin County, in 1969. Springs Valley Sandstone Co., opened a new quarry in Orange County and abandoned the Knight's quarry in Orange County and the Westall quarry in Crawford County. St. Meinrads Sandstone did not operate their quarry in Spencer County during 1969.

Sulfur.—Byproduct sulfur was recovered from crude petroleum by the American Oil Co. at Whiting, in Lake County. The Mathieson-Fluor process was used.

Table 9.—Production of limestone,[1] by counties

(Thousand short tons and thousand dollars)

County	1968		1969		Type of stone produced in 1969
	Quantity	Value	Quantity	Value	
Adams	W	W	W	W	Crushed and dimension.
Allen	W	W	W	W	Crushed.
Bartholomew	W	W	432	$654	Do.
Blackford	W	W	W	W	Do.
Carroll	W	W	W	W	Do.
Cass	676	$804	709	849	Crushed and dimension.
Clark	2,659	3,351	2,496	3,145	Crushed.
Crawford	W	W	W	W	Do.
Decatur	267	399	232	374	Do.
Delaware	653	895	646	911	Do.
Floyd	W	W	W	W	Do.
Franklin	1	10	2	32	Dimension.
Grant	W	W	W	W	Crushed and dimension.
Hamilton	837	W	W	W	Crushed.
Harrison	246	W	237	W	Do.
Howard	W	W	W	W	Do.
Huntington	W	W	W	W	Do.
Jasper	W	W	W	W	Do.
Jay	114	W	106	W	Do.
Jennings	253	380	W	W	Do.
Lawrence	2,502	W	2,410	7,665	Crushed and dimension.
Madison	W	W	W	W	Crushed.
Miami	------	------	35	W	Do.
Monroe	1,132	6,811	1,036	7,078	Crushed and dimension.
Morgan	W	W	W	W	Crushed.
Newton	W	W	W	W	Do.
Orange	595	W	569	W	Do.
Owen	W	W	W	W	Do.
Perry	W	W	W	W	Do.
Pulaski	W	W	W	W	Do.
Putnam	2,798	W	2,810	3,608	Do.
Randolph	191	W	206	W	Do.
Ripley	302	443	W	W	Do.
Rush	W	395	W	279	Crushed and dimension.
Scott	290	409	W	W	Crushed.
Shelby	595	890	623	956	Crushed and dimension.
Sullivan	15	38	16	37	Crushed.
Switzerland	80	W	60	W	Do.
Wabash	188	314	149	W	Do.
Warrick	W	W	W	W	Do.
Washington	W	W	W	W	Do.
Wayne	142	228	172	272	Crushed and dimension.
Wells	W	W	W	W	Crushed.
White	W	W	W	W	Do.
Total	26,255	46,469	25,514	45,170	

W Withheld to avoid disclosing individual company confidential data; included in "Total."
[1] "Limestone" used generally to include dolomite.

Table 10.—Calcareous marl production

Year	Number of producers	Short tons	Value
1965	21	64,493	$40,260
1966	21	61,532	38,778
1967	18	51,890	33,553
1968	13	35,828	28,311
1969	12	31,671	30,190

MINERAL FUELS

Coal (Bituminous).—Coal was produced from 38 mines (six underground and 32 strip) in 12 counties. Ninety-five percent of the coal was mined in five counties, with Warrick County accounting for about two-fifths of the State total. Nearly 16.6 million tons of coal was mechanically cleaned at 11 plants. About 66 percent of the coal was transported by rail (of which 10 percent was by unit train), 14 percent by truck, 7 percent by water, and the remainder by conveyor, tram, and other methods. Electric utility companies used 68 percent of the coal mined for power generation. More than 41 million tons of coal was consumed in Indiana, of which 17.2 million tons was mined in the State.

During 1969, the C. & H. Coal Co. underground mine in Warrick County, Harris Mining Co., Inc., and Peabody Coal Co.'s Old Glory strip mines in Greene County, and the P & D Coal Co. strip mine in Pike County were abandoned. The underground mine of Somerville Coal Co. in

Table 11.—Coal (bituminous) production in 1969, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (thousand short tons)			Value (thousands)
	Underground	Strip	Underground	Strip	Total	
Clay	--	5	-----	1,176	1,176	$5,195
Daviess	--	1	-----	21	21	W
Fountain	--	1	-----	W	W	W
Gibson	1	--	766	-----	766	W
Greene	--	6	-----	2,035	2,035	W
Owen	--	1	-----	W	W	W
Parke	--	1	-----	2	2	8
Pike	1	5	62	3,318	3,380	W
Spencer	--	1	-----	W	W	W
Sullivan	2	4	1,180	3,124	4,304	W
Vigo	1	--	87	-----	87	W
Warrick	1	7	15	8,201	8,216	32,532
Undistributed	--	--	-----	98	98	45,167
Total [1]	6	32	2,110	17,976	20,086	82,902

W Withheld to avoid disclosing individual company confidential data; included in "Undistributed."
[1] Data may not add to totals shown because of independent rounding.

Table 12.—Shipments of bituminous coal for consumption in Indiana, by district of origin and consumer use

(Thousand short tons)

Use	District of origin [1]							Total
	2	3 and 6	4	7 and 8	9	10	11	
1965:								
Electric utilities	---	---	---	556	6,290	2,674	8,433	17,953
Coke and gas plants	---	407	---	11,141	-----	376	-----	11,924
Retail dealers	---	16	---	762	17	12	441	1,248
All others	---	4	---	435	343	1,113	3,865	5,760
Total	---	427	---	12,894	6,650	4,175	12,739	36,885
1966:								
Electric utilities	---	---	---	450	5,591	2,861	9,698	18,600
Coke and gas plants	---	622	---	11,083	-----	541	-----	12,246
Retail dealers	---	8	---	695	17	24	419	1,163
All others	10	---	---	422	306	1,197	4,480	6,415
Total	10	630	---	12,650	5,914	4,623	14,597	38,424
1967:								
Electric utilities	---	---	---	650	5,408	3,767	10,799	20,624
Coke and gas plants	---	393	---	11,288	-----	640	-----	12,321
Retail dealers	---	5	---	632	8	19	406	1,070
All others	---	4	---	432	263	1,090	4,637	6,426
Total	---	402	---	13,002	5,679	5,516	15,842	40,441
1968:								
Electric utilities	---	---	---	1,254	5,601	3,125	11,526	21,506
Coke and gas plants	---	253	---	10,182	-----	1,103	-----	11,538
Retail dealers	---	4	10	602	2	51	329	998
All others	---	---	---	388	230	1,133	4,452	6,203
Total	---	257	10	12,426	5,833	5,412	16,307	40,245
1969:								
Electric utilities	---	---	---	1,209	6,331	2,623	12,226	22,389
Coke and gas plants	---	380	---	9,380	-----	1,806	-----	11,566
Retail dealers	---	2	---	457	1	14	182	656
All others	---	---	---	551	367	938	4,832	6,688
Total	---	382	---	11,597	6,699	5,381	17,240	41,299

[1] States or portion of States represented by each district are as follows: District 2—Western Pennsylvania; 3 and 6—Northern West Virginia; 4—Ohio; 7 and 8—Eastern Kentucky, Virginia, Southern West Virginia, and North Central Tennessee; 9—Western Kentucky; 10—Illinois; 11—Indiana.

Gibson County was idle. One new coal mine—the Blanton Coal Co. strip mine in Greene County—was opened during the year.

Public Service Co. of Indiana, Inc., contracted with Peabody Coal Co. for the purchase of 70 million tons of coal over a 30-year period, for its 1-million KW Cayuga plant under construction on the Wabash River.

Ayrshire Collieries Corp. merged with American Metal Climax, Inc. (AMAX), effective October 31, 1969; the latter was the surviving corporation.

According to the Indiana Geological Survey, several large coal companies leased deep coal reserves for underground mining in Gibson, Posey, and Sullivan Counties.

A project underway at the Indiana Geological Survey is designed to assess the distribution of the different forms of sulfur in various screen sizes of coal and in six specific gravity ranges. The project will provide data for cleaning a larger percentage of sulfur from coal at the preparation plant.

Coke.—Coke was produced at six plants, with output of 8.1 million tons, about the same amount as in 1968. More than 11.7 million tons of coal was carbonized at Indiana coke plants. None of the coking coal was mined in Indiana. Most of it was shipped from mines in Illinois, Kentucky, Virginia, and West Virginia. State coke output was used principally in northern Indiana blast furnaces. Indiana remained in third place in the Nation in coke production, after Pennsylvania and Ohio.

Peat.—Moss and humus peat was produced from bogs in six counties. Nearly all of the peat was sold for soil improvement. None was sold for use as fuel.

Petroleum and Natural Gas.—During 1969, a total of 496 wells were drilled, of which 174 were exploratory, 158 for primary development, 132 for secondary development, and 32 in connection with gas storage. Although the total number of wells drilled declined 5.5 percent from the previous year, the percentage of successful exploratory wells increased 2.4 percent.

The exploratory drilling resulted in 26 oil wells, five gas wells, and 143 dry holes. Drilling for primary development resulted in 76 oil wells, two gas wells, and 70 dry holes; 10 were for saltwater disposal. The secondary development wells were completed as 33 oil producers; 83 input, water supply, and saltwater disposal wells; and 16 dry holes.

Discoveries included five new fields (four producing from Mississippian and one from Pennsylvanian rocks), 10 extensions to existing fields (three producing from the Trenton Limestone and seven from Mississippian rocks), and 16 new pools (one in Pennsylvanian and the remainder in Mississippian rocks).

Oil production credited to secondary recovery methods was 5,021,900 barrels in 1968 and 4,478,700 barrels in 1969, a decline of nearly 11 percent. Primary oil pro-

Table 13.—Crude petroleum production in 1969, by major fields

Name of field	Year discovered	Area (acres)	Location, county	Number of wells		Production (barrels)
				Producing	Completed	
Black River Consolidated	1950	680	Posey	NA	---	135,884
Caborn Consolidated	1940	1,870	Posey	NA	---	145,254
Coe South	1961	440	Pike	NA	---	138,204
College Consolidated	1941	770	Posey	NA	---	131,040
Evansville	1947	400	Vanderburgh	NA	---	126,381
Griffin Consolidated	1938	7,370	Gibson & Posey	NA	1	1,684,026
Heusler Consolidated	1938	2,210	Posey & Vanderburgh	NA	5	385,488
Mount Carmel Consolidated	1941	2,070	Gibson & Knox	NA	1	122,678
Mount Vernon Consolidated	1941	2,330	Posey	NA	1	305,379
Oliver South	1950	300	Posey	NA	4	144,294
Princeton North Consolidated	1943	1,050	Gibson	NA	1	114,864
Springfield Consolidated	1946	2,640	Posey	NA	8	623,700
Union-Bowman (New) Consolidated	1941	15,550	Gibson, Knox & Pike	NA	18	399,209
Welborn Consolidated	1941	1,810	Posey	NA	2	224,349
Welborn North Consolidated	1953	380	Posey	NA	---	123,161
Wheatonville Consolidated	1949	1,660	Gibson	NA	2	178,072
Undistributed	XX	XX			92	2,859,485
Total	XX	XX		[e] 3,646	[1] 135	7,841,468

[e] Estimate. NA Not available. XX Not applicable.
[1] Includes workovers without newly drilled footages.

Source: Petroleum Section, Indiana Geological Survey.

Table 14.—Oil and gas wells drilled in 1969

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Allen	---	---	---	---	---	2	2
Cass	---	---	---	---	---	3	3
Clay	---	---	---	---	---	1	1
Crawford	---	---	1	---	---	3	4
Daviess	1	---	1	---	---	5	7
Dubois	5	---	1	1	1	9	17
Fulton	---	---	---	---	---	1	1
Gibson	31	---	25	12	---	28	96
Grant	---	---	1	---	---	---	1
Greene	11	---	---	3	---	8	22
Hamilton	---	---	1	---	---	---	1
Harrison	---	---	---	---	---	1	1
Huntington	2	---	1	---	---	---	3
Jay	---	1	---	---	---	1	2
Knox	3	---	4	5	---	7	19
La Porte	---	---	4	---	---	2	6
Marshall	---	---	---	---	---	1	1
Martin	---	---	---	---	---	1	1
Miami	3	---	2	---	---	---	5
Noble	---	---	---	---	---	2	2
Owen	---	---	---	---	---	1	1
Perry	---	---	---	---	---	3	3
Pike	11	---	11	---	---	8	30
Porter	---	---	---	---	---	1	1
Posey	28	---	14	3	---	12	57
Randolph	---	---	---	---	3	1	4
Rush	---	1	---	---	---	---	1
Spencer	7	---	11	---	---	23	41
Steuben	---	---	---	---	---	1	1
Sullivan	3	---	2	---	---	4	9
Tippecanoe	---	---	---	---	---	1	1
Vanderburgh	3	---	1	2	---	1	7
Vigo	1	---	---	---	---	---	1
Wabash	---	---	1	---	---	7	8
Warrick	---	---	2	---	1	---	3
Wayne	---	---	---	---	---	1	1
Wells	---	---	3	---	---	2	5
White	---	---	---	---	---	2	2
Total	[1] 109	2	[2] 86	26	5	143	[3] 371

[1] Includes oil wells completed in secondary recovery projects.
[2] Includes dry holes completed in secondary recovery projects.
[3] Includes workovers without newly drilled footages.

Source: Petroleum Section, Indiana Geological Survey.

duction amounted to 3,669,849 barrels in 1968 and 3,362,768 barrels in 1969, a decline of 8 percent. Total production showed a decrease of 10 percent from the previous year.

The discovery, by Citizens Gas and Coke Utility, of the Plummer Field in Greene County was the most significant exploratory success of the year. By the end of the year, 20 wells had been completed with a total daily output of approximately 2,000 barrels. Production is from the Salem Limestone (Mississippian). Oil accumulation is controlled by structural closure believed to be caused by deformation of sediments above a Silurian reef.

After a very substantial increase in 1968 to 234 million cubic feet, gas production declined to 171 million cubic feet in 1969, although this difference probably resulted more from the timing of company reports than an actual decline in the amount of gas produced.

The proved oil reserve at the end of 1969 was 41,307,000 barrels; and the total liquid hydrocarbon reserve was 41,347,000 barrels.[4]

Ten petroleum refineries had a total operating capacity of 616,000 barrels per stream day.[5]

METALS

Aluminum.—Aluminum Company of America operated a smelter at Newburgh

[4] American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. "Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada, and United States Productive Capacity as of December 31, 1969." V. 24, May 1970.

[5] Oil and Gas Journal. U.S. Refineries: Where, Capacities, Types of Processing. V. 68, No. 12, Apr. 6, 1970, pp. 124–126.

that produced aluminum ingots and thin-gauge aluminum sheet.

Pig Iron and Steel.—Two plants in East Chicago and one in Gary, all in Lake County, produced pig iron and steel. Bethlehem Steel Corp. started producing pig iron from its new plant at Chesterton, in Porter County, in December. Pig iron shipped or used by producers totaled 12.7 million tons in 1969 compared with 12.5 million in 1968.

The American Iron & Steel Institute reported that steel production in Indiana totaled nearly 19.4 million tons in 1969, compared with 17.9 million in 1968.

Inland Steel Co. reported plans to expand facilities at its Indiana Harbor operation. A 12-inch bar mill was completed in July. Projects now under construction include an electric furnace and billet casting installation and an 80-inch cold rolling mill complex, scheduled for completion in 1971.

Other Metals.—Antimonial lead, bismuth, gold, lead, silver, and tellurium were recovered by United States Smelting Lead Refinery, Inc., at its East Chicago plant.

Table 15.—Principal producers [1]

Commodity and company	Address	Type of activity	County
Abrasive Stone: Hindostan Whetstone Co.	Box 501 Bedford, Ind. 47421	Quarry; stationary plant	Orange.
Cement:			
Lehigh Portland Cement Co.	Young Bldg. 718 Hamilton St. Allentown, Pa. 18105	Portland, dry process	Lawrence.
Lone Star Cement Corp.	2511 East 46th St., Suite K Indianapolis, Ind. 46205	Portland and masonry, wet process.	Putnam.
Louisville Cement Co.	501 South 2nd St. Louisville, Ky. 40202	Portland and masonry, wet and dry process.	Cass, Clark.
Universal Atlas Cement Div., United States Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	Portland and masonry, dry process.	Lake.
Clays and Shale:			
Adams Clay Products Co.	Box 32 Martinsville, Ind. 46151	Pits and plant	Morgan.
American Brick Co.	6558 West Fullerton Ave. Chicago, Ill. 60635	Pit and plant	Lake.
AMVIT, Div. of Amvit Corp.	24480 Lakeland Blvd. Euclid, Ohio 44123	Pits and plants	Clay, Montgomery.
Arketex Ceramic Corp.	Box 347 Brazil, Ind. 47834	Pit and plants	Vermillion.
Colonial Brick Corp.	Box 365 Cayuga, Ind. 47928	Pits and plants	Do.
Hydraulic-Press Brick Co.	705 Olive St. St. Louis, Mo. 63101	Pit and plant	Morgan.
The Krick-Tyndall Co., Sub. Hancock Brick & Tile Co.	Box 450 Findlay, Ohio 45840	----do	Adams.
Lehigh Portland Cement Co.	Young Bldg. 718 Hamilton St. Allentown, Pa. 18105	Pit	Jackson.
Log Cabin Coal Co.	304 South Depot St. Brazil, Ind. 47834	Pits	Clay.
Louisville Cement Co.	501 South 2nd St. Louisville, Ky. 40202	----do	Cass, Clark.
S. L. Turner Coal & Clay Co., Inc.	Box 337 Carbon, Ind. 47837	Pit	Parke.
Coal (bituminous):			
Ayrshire Coal Co., Div. of American Metal Climax, Inc.	430 Big Four Bldg. Indianapolis, Ind. 46225		
Chinook	----------	Strip mine; cleaning plant.	Clay.
Ayrcoe	----------	Strip mine	Pike.
Minnehaha	----------	Strip mine; cleaning plant.	Sullivan.
Thunderbird	----------	Underground mine; cleaning plant.	Do.
Wright	----------	Strip mine	Warrick.
Cornell Excavating, Inc.	Route 4 Boonville, Ind. 47601	----do	Do.
Enos Coal Corp., Old Ben Coal Corp.	10 South Riverside Plaza Chicago, Ill. 60606		
Enos	----------	----do	Pike, Warrick.
		Cleaning plant	Pike.
Blackfoot No. 5	----------	Strip mine; cleaning plant.	Do.
J. R. Coal Corp.	Route 1 Chandler, Ind. 47610	Strip mine	Warrick.
Kings Station Coal Corp.	10 South Riverside Plaza Chicago, Ill. 60606	Underground mine; cleaning plant.	Gibson.
Lemmons & Co., Inc.	535 South Second St. Boonville, Ind. 47601	Strip mine	Warrick.
Mount Pleasant Mining	Route 25, Box 19 Terre Haute, Ind. 48701	Underground mine; cleaning plant.	Vigo.
Mulzer Crushed Stone Co.	Box 248 Tell City, Ind. 47586	Strip mine	Spencer.
Parke Coal Co.	Box 236 Petersburg, Ind. 47567	----do	Pike.
Peabody Coal Co.:	301 North Memorial Dr. St. Louis, Mo. 63102		
Hawthorn	----------	----do	Greene, Sullivan.
		Cleaning plant	Greene.
Latta	----------	Strip mine; coal cleaned at Miller plant.	Do.
Miller Preparation Plant.	----------	Cleaning plant	Do.

See footnote at end of table.

Table 15.—Principal producers [1]—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous)—Continued			
Peabody Coal Co—Continued			
Old Glory	----------	Strip mine	Greene.
Dugger	----------	Strip mine; coal cleaned at Miller plant.	Sullivan.
Lynnville	----------	Strip mine; cleaning plant.	Warrick.
Squaw Creek	----------	----do	Do.
R & H Mining, Inc	Route 1 Jasper, Ind. 47546	Underground mine	Pike.
R. S. & K. Coal Corp	Route 2 Shelburn, Ind. 47879	----do	Sullivan.
Coke:			
Citizens Gas & Coke Utility	2020 North Meridian Indianapolis, Ind. 46209	Coke ovens	Marion.
Indiana Gas & Chemical Corp.	1341 Hulman St. Terre Haute, Ind. 47802	----do	Vigo.
Inland Steel Co	3210 Watling St. East Chicago, Ind. 46312	----do	Lake.
United States Steel Corp	Gary, Ind. 46400	----do	Do.
The Youngstown Sheet & Tube Co.	Box 900 Youngstown, Ohio 44501	----do	Do.
Gypsum:			
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	Underground mine; calcining and board plant.	Martin.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	Underground mine; calcining and board plants.	Lake, Martin.
Iron and Steel:			
Bethlehem Steel Corp., Burns Harbor Plant.	701 East 3rd St. Bethlehem, Pa. 18016	Iron blast furnace and basic-oxygen steel furnace.	Porter.
Inland Steel Co	3210 Watling St. East Chicago, Ind. 46312	Iron blast furnaces and open-hearth steel furnaces.	Lake.
United States Steel Corp., Gary Steel Works.	Gary, Ind. 46400	----do	Do.
The Youngstown Sheet & Tube Co	Box 900 Youngstown, Ohio 44501	----do	Do.
Lime: Marblehead Lime Co	300 West Washington St. Chicago, Ill. 60606	Quicklime, 3 rotary kilns.	Do.
Peat:			
Glacier Peat Moss Corp	Route 1 Jonesboro, Ind. 46938	Bog; processing plant	Grant.
Millburn Peat Co., Inc	Box 297 Otterbein, Ind. 47970	----do	Warren.
Peat Moss Co	1981 East 56th St. Indianapolis, Ind. 46204	----do	Marion.
Organic Products Co	Route 1 Gaston, Ind. 47342	----do	Delaware.
Expanded perlite:			
Airlite Processing Corp	P.O. Scottsburg Vienna, Ind. 47170	Processing plant	Scott.
Federal Cement Products, Inc.	24 Marble St. Hammond, Ind. 46320	----do	Lake.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Martin.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	Processing plants	Lake, Martin.
Petroleum Refineries:			
American Oil Co	2400 New York Ave. Box 710 Whiting, Ind. 46394		Lake.
Atlantic Richfield Co	3500 Indianapolis Blvd. East Chicago, Ind. 46312		Do.
Cities Service Oil Co	4900 Cline Ave., Box 718 East Chicago, Ind. 46312		Do.
Mobil Oil Corp	3821 Indianapolis Blvd. East Chicago, Ind. 46312		Do.
Roofing granules: H. B. Reed & Co., Inc.	6937 Kennedy Ave. Hammond, Ind. 46323	2 plants; produced from slag.	Do.
Sand and gravel:			
Aggregate Service McMahan Constr. Co.	Box 378 Rochester, Ind. 47975	Pit; portable and stationary plants.	Marshall.
American Aggregates Corp	Garst Ave. at Ave. B Greenville, Ohio 45331	Pits; stationary plants.	Hamilton, Marion, Wayne.
Paul C. Brudi Stone & Gravel Co., Inc.	Box 2837 Fort Wayne, Ind. 46808	----do	Allen, De Kalb.

See footnote at end of table.

Table 15.—Principal producers [1]—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Crisman Sand Co., Inc	6480 Melton Rd. Portage, Ind. 46368	Pit; stationary plant	Porter.
Driftwood Gravel, Inc., Jefferson Corp.	Box 9 Columbus, Ind. 47201	do	Johnson.
Hilltop Concrete Corp	Box 11056 Cincinnati, Ohio 45211	do	Switzerland.
Indiana Glass Sand Corp	Box 614 New Albany, Ind. 47150	do	Harrison.
Interstate Sand & Gravel Co., Inc.	Box 38 Covington, Ind. 47932	do	Warren.
Irving Bros. Gravel Co., Inc.	Route 3 Marion, Ind. 46952	do	Grant.
Irving Materials, Inc., No. 2	Box 369 Greenfield, Ind. 46140	Pits; portable and stationary plants.	Hamilton, Henry.
Knox County Sand Co., Ralph Rogers & Co., Inc.	Box 483 Vincennes, Ind. 47591	Pit; stationary plant	Knox.
Manley Sand Division, Martin Marietta Corp.	110 East Main St. Rockton, Ill. 61072	do	La Porte.
May Stone & Sand, Inc	Box 2927 Fort Wayne, Ind. 46809	Pits; stationary plants.	Allen.
Myers Sand & Gravel Corp	Box 212 Anderson, Ind. 46015	Pit; stationary plant	Madison.
Neal Gravel Co., Inc., Interstate Sand & Gravel Co., Inc.	Box 38 Covington, Ind. 47932	do	Fountain.
S & G Excavating, Inc	Route 21, Box 698 Terre Haute, Ind. 47801	do	Vigo.
Spray Sand & Gravel, Inc	Route 4 Seymour, Ind. 47274	Pits; dredges; stationary plants.	Jackson.
Standard Materials Corp., Martin Marietta Corp.	11 North Penn St. Indianapolis, Ind. 46204	Pits; portable and stationary plants.	Clark, Hamilton, Marion, Vermillion, Vigo.
Sturm & Dillard Gravel Co., Inc.	Box 98 Syracuse, Ind. 46567	Pit; stationary plant	Kosciusko.
Western Indiana Aggregates, Inc., Medusa Portland Cement Co.:	500 North 6th St. Lafayette, Ind. 47901		
Anderson Gravel Division.		do	Madison.
Eagle Materials, Inc		Dredge; stationary plant.	Lake.
Hanna Sand & Gravel Co., Inc.		do	La Porte.
Lafayette No. 1 Gravel Division.		Pit; stationary plant	Tippecanoe.
Lafayette Portable Gravel Division.		Pit; portable plant	Do.
Leesburg Gravel Division.		Pit; stationary plant	Kosciusko.
Montezuma Gravel Division.		do	Parke.
South Bend Gravel Division.		do	St. Joseph.
Nonferrous Smelters and Refineries:			
Aluminum Company of America.	Newburgh, Ind. 47630	Aluminum smelter	Warrick.
American Smelting & Refining Co.	2230 Indianapolis Blvd. Whiting, Ind. 46394	Lead secondary plant	Lake.
National Lead Co., American Lead Plant.	1600 East 21st St. Indianapolis, Ind. 46218	do	Marion.
United States Smelting Lead Refinery, Inc.	5300 Kennedy Ave. East Chicago, Ind. 46312	Lead primary and secondary plant.	Lake.
Stone:			
Limestone and dolomite:			
American Aggregates Corp.	Garst Ave. at Avenue B Greenville, Ohio 45331	Quarries; stationary plants.	Hamilton, Owen.
Bloomington Crushed Stone Co., Inc., Ralph Rogers & Co., Inc.	Box 849 Bloomington, Ind. 47401	do	Lawrence, Monroe.
Bloomington Limestone Corp.	Box 250 Bloomington, Ind. 47401	Quarry; stationary plant.	Monroe.
Empire Stone Co	Box 788 Bloomington, Ind. 47401	do	Do.
Independent Limestone Co.	Route 5, Box 395 Bloomington, Ind. 47401	do	Do.
Indiana Limestone Co., Inc.	405 North 1st St. Bedford, Ind. 46421	Quarries; stationary plants.	Lawrence, Monroe.

See footnote at end of table.

Table 15.—Principal producers [1]—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone and dolomite —Continued			
Irving Bros. Gravel Co., Inc.:	Route 3 Marion, Ind. 46952		
Erie Stone, Inc	----------	Quarries; stationary plants.	Huntington, Wells.
Irving Bros. Stone & Gravel.	----------	Quarry; stationary plant.	Delaware.
Pipe Creek Stone Co.	----------	----do----------	Grant.
Lehigh Portland Cement Co.	Young Bldg. 718 Hamilton St. Allentown, Pa. 18105	----do----------	Lawrence.
Lone Star Cement Corp.	2511 East 46th St., Suite K Indianapolis, Ind. 46205	----do----------	Putnam.
Louisville Cement Co	501 South 2nd St. Louisville, Ky. 40202	Quarries; stationary plants.	Cass, Clark.
May Stone & Sand, Inc.	Box 2927 Fort Wayne, Ind. 46800	----do----------	Allen.
Midwest Aggregates Corp., Old Fort Industries, Inc.	2013 S. Anthony Blvd. Fort Wayne, Ind. 46805	Quarry; stationary plant.	Do.
Mitchell Crushed Stone Co., Inc., Ralph Rogers & Co., Inc.	Box 849 Bloomington, Ind. 47401	----do----------	Lawrence.
Mulzer Crushed Stone Co.	Box 248 Tell City, Ind. 47586	Quarries; underground mine; stationary plants.	Crawford, Perry.
Newton County Stone Co., Inc., Ralph Rogers & Co., Inc.	Box 147 Kentland, Ind. 47951	Quarry; stationary plant.	Newton.
The Ohio & Indiana Stone Corp., The France Stone Co.	1800 Toledo Trust Bldg. Toledo, Ohio 43604	----do----------	Putnam.
Victor Oolitic Stone Co.	Box 668 Bloomington, Ind. 47401	----do----------	Monroe.
Reed Quarries, Inc	Box 64 Bloomington, Ind. 47401	----do----------	Do.
Standard Materials Corp., Martin Marietta Corp.	11 North Penn St. Indianapolis, Ind. 46204	Quarries; stationary plants.	Clark, Floyd, Madison, Putnam.
Western Indiana Aggregates, Inc., Medusa Portland Cement Co., Francesville Stone Division.	500 North 6th St. Lafayette, Ind. 47901	Quarry; stationary plant.	Pulaski.
Woolery Stone Co., Inc.	Box 40 Bloomington, Ind. 47401	----do----------	Monroe.
Marl:			
Vernon M. Kaufman	Route 1 Topeka, Ind. 46571	Pit----------	Noble.
Miller Marl	Middlebury, Ind. 46540	Pit----------	Lagrange.
Willis Speicher	Middlebury, Ind. 46540	Pit----------	Do.
Taylor and Son	Route 1 Orland, Ind. 46776	Pit----------	Steuben.
Marion W. Wolkins	Box 332 Union, Mich. 49130	Pit----------	Elkhart.
Sandstone:			
High Bluff Quarry	Route 3, Box 267 Mooresville, Ind. 46158	Quarry; finishing plant.	Morgan.
Indiana Sandstone Co., Inc.	Box 501 Bedford, Ind. 47421	Quarry; finishing plant.	Lawrence.
Springs Valley Sandstone Co.	Route 1 West Baden Springs, Ind. 47469	Quarries----------	Lawrence, Orange.
		Finishing plant------	Martin.
Recovered Sulfur: American Oil Co.	910 South Michigan Ave. Chicago, Ill. 60680	Mathieson-Fluor Process	Lake.

[1] Data regarding producers of natural gas and petroleum not available.

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 Guy A. Johnson [1] and Don N. West [2]

Value of 1969 Iowa mineral production increased slightly over 2 percent to a record high of $119.9 million. The largest increase, over 17 percent, was in the value of sand and gravel production. Other increases of note were recorded in the value of lime and bituminous coal production, 7 percent and 3 percent, respectively. The only major decrease was reported for gypsum, the value of which was down 9 percent from that of 1968. Values of masonry cement and clays also declined, but by only a moderate amount.

Nonmetals again comprised 97 percent of the total State mineral production value, with fuels comprising the remaining 3 percent. Nonmetal production consisted mostly of cement, stone, and sand and gravel. Gypsum, clays, lime, and a very minor amount of gem stones were also produced. Coal made up the majority of the mineral fuel production in Iowa, with peat comprising the remainder in this category of the mineral industry. No production of, or exploration drilling for, oil and gas was recorded in 1969. No metallic mineral production was reported.

Mineral production was reported from 97 of 99 Iowa counties. Cerro Gordo County led the State in mineral output value and accounted for about 22 percent of the total. Polk and Scott Counties, with 14 and 13 percent, respectively, ranked second and third. Fifteen other counties recorded values of mineral production over $1 million. Value of mineral production increased in 35 counties and decreased in 63.

[1] Mining engineer, Bureau of Mines, Minneapolis, Minn.
[2] Statistical assistant, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Iowa [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	13,900	$47,275	14,084	$47,265
Masonry—thousand 280-pound barrels	624	1,986	606	1,912
Clays—thousand short tons	1,264	1,747	1,199	1,660
Coal (bituminous)—do	876	3,289	903	3,892
Gypsum—do	1,351	5,838	1,169	5,274
Sand and gravel—do	16,332	15,192	18,391	17,867
Stone—do	26,150	40,397	26,233	40,895
Value of items that cannot be disclosed:				
Other nonmetals and peat	XX	1,573	XX	1,665
Total	XX	117,297	XX	119,930
Total 1967 constant dollars	XX	116,200	XX	p 116,559

p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

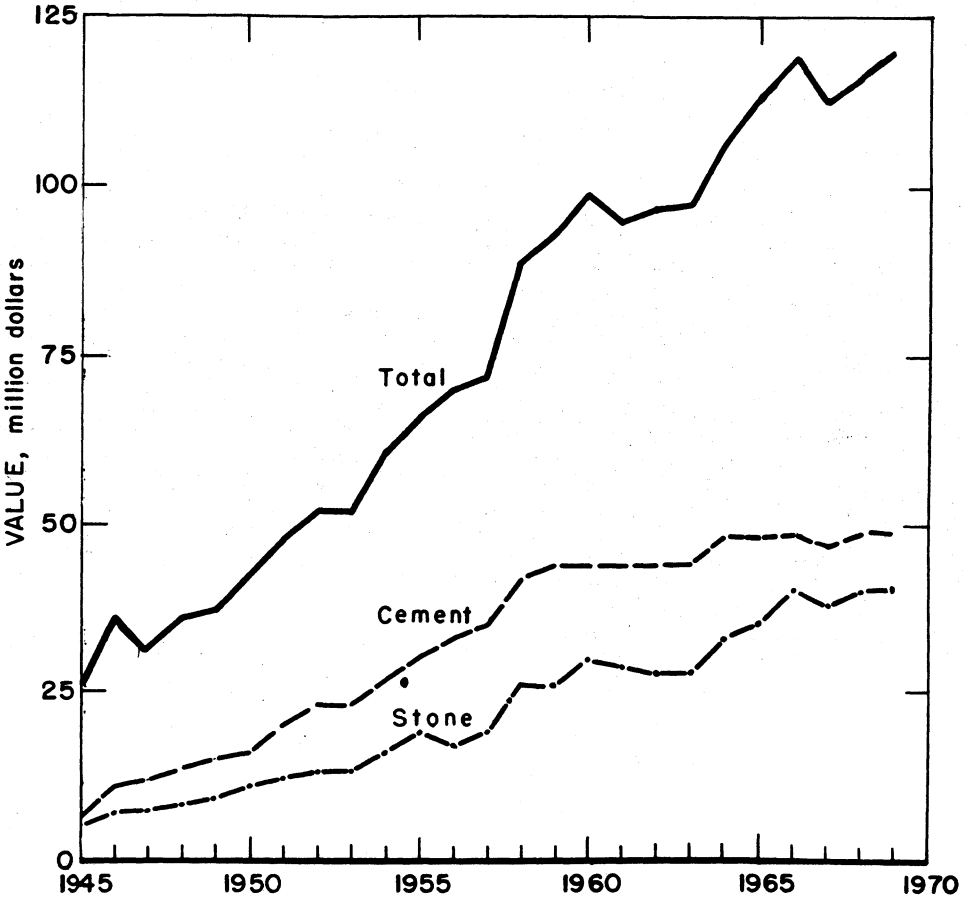

Figure 1.—Value of cement, stone, and total value of mineral production in Iowa.

Table 2.—Value of mineral production in Iowa, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adair	W	W	Stone.
Adams	W	W	Do.
Allamakee	$287	$279	Stone, sand and gravel.
Appanoose	757	740	Stone, clays, coal.
Audubon	W	W	Sand and gravel.
Benton	W	W	Sand and gravel, stone.
Black Hawk	1,550	2,081	Stone, sand and gravel.
Boone	267	W	Sand and gravel, clays.
Bremer	W	W	Stone, sand and gravel.
Buchanan	319	321	Do.
Buena Vista	483	149	Sand and gravel.
Butler	481	467	Stone, sand and gravel.
Calhoun	67	45	Sand and gravel.
Carroll	136	215	Do.
Cass	W	W	Stone.
Cedar	263	W	Do.
Cerro Gordo	26,979	27,001	Cement, stone, clays, sand and gravel, lime.
Cherokee	276	494	Sand and gravel.
Chickasaw	223	162	Stone, sand and gravel.
Clarke	W	W	Stone.
Clay	175	205	Sand and gravel.
Clayton	826	733	Stone, sand and gravel.
Clinton	1,181	1,161	Do.
Crawford	76	W	Sand and gravel.
Dallas	654	584	Sand and gravel, clays, stone.
Decatur	786	W	Stone, sand and gravel.
Delaware	279	312	Do.
Des Moines	2,425	2,015	Gypsum, stone, sand and gravel.
Dickinson	164	252	Sand and gravel.
Dubuque	782	743	Stone, sand and gravel.
Emmet	272	281	Sand and gravel.
Fayette	587	697	Stone, sand and gravel.
Floyd	285	396	Stone, clays, sand and gravel.
Franklin	375	384	Sand and gravel, stone, clays.
Fremont	W	W	Stone, sand and gravel.
Greene	W	270	Sand and gravel.
Grundy	W	167	Stone, sand and gravel.
Guthrie	74	88	Sand and gravel.
Hamilton	342	W	Sand and gravel, stone.
Hancock	230	210	Do.
Hardin	1,724	1,623	Stone, sand and gravel.
Harrison	694	756	Do.
Henry	193	279	Sand and gravel, stone.
Howard	179	148	Stone, sand and gravel.
Humboldt	982	1,161	Do.
Ida	--	W	Sand and gravel.
Iowa	W	W	Do.
Jackson	317	326	Stone, sand and gravel.
Jasper	W	W	Sand and gravel, stone.
Jefferson	155	203	Stone.
Johnson	1,577	1,354	Stone, sand and gravel.
Jones	662	563	Do.
Keokuk	W	W	Stone, clays.
Kossuth	160	269	Sand and gravel.
Lee	406	608	Stone, sand and gravel.
Linn	2,694	3,020	Do.
Louisa	W	W	Stone.
Lucas	W	596	Coal.
Lyon	92	194	Sand and gravel.
Madison	3,785	3,705	Stone, clays.
Mahaska	1,423	1,576	Coal, sand and gravel, stone, clays.
Marion	1,911	1,528	Coal, stone, sand and gravel.
Marshall	1,472	1,172	Stone, sand and gravel.
Mills	W	W	Do.
Mitchell	280	554	Do.
Monona	W	W	Sand and gravel.
Monroe	W	802	Coal.
Montgomery	W	W	Stone.
Muscatine	959	1,122	Sand and gravel, stone.
O'Brien	135	99	Sand and gravel.
Osceola	199	203	Do.
Page	W	W	Stone, sand and gravel.
Palo Alto	87	203	Sand and gravel.
Plymouth	371	497	Do.
Pocahontas	W	W	Stone, sand and gravel.
Polk	16,728	16,964	Cement, sand and gravel, clays.
Pottawattamie	W	W	Stone, sand and gravel.
Poweshiek	W	W	Stone.
Ringgold	W	--	
Sac	503	768	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Iowa, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Scott	$15,340	$15,420	Cement, stone, lime, clays, sand and gravel.
Shelby	W	W	Sand and gravel.
Sioux	652	821	Do.
Story	858	1,109	Sand and gravel, stone, clays.
Tama	165	W	Stone, sand and gravel.
Taylor	W	W	Stone.
Union	W	W	Do.
Van Buren	713	778	Stone, sand and gravel, coal.
Wapello	W	425	Stone, sand and gravel, clays.
Warren	W	W	Sand and gravel, clays.
Washington	W	W	Stone.
Wayne	W	183	Do.
Webster	5,789	5,385	Gypsum, stone, sand and gravel, clays.
Winnebago	W	W	Peat, sand and gravel.
Winneshiek	742	676	Stone, sand and gravel.
Woodbury	399	334	Sand and gravel, clays.
Worth	583	344	Stone, sand and gravel, peat.
Wright	145	166	Sand and gravel.
Undistributed [2]	12,620	13,544	
Total [3]	117,297	119,930	

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

[1] Davis County is 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.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Iowa business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average: [1]				
Total labor force	thousands	r 1,212.9	1,235.6	+1.9
Agricultural employment	do	r 191.9	188.9	−1.6
Nonagricultural employment [2]	do	r 990.1	1,013.4	+2.4
Manufacturing	do	r 222.5	224.7	+1.0
Construction	do	r 40.5	40.7	+0.5
Mining	do	r 3.3	3.1	−6.1
Stone, clay, and glass products	do	6.6	6.5	−1.5
Primary metal industries	do	r 8.1	8.7	+7.4
All other	do	r 723.8	744.9	+2.9
Payrolls, manufacturing [3]	millions	$1,607	$1,724	+7.3
Personal income:				
Total	do	$9,057	$9,782	+8.0
Per capita		$3,264	$3,517	+7.8
Construction activity:				
Building permits: [4]				
Valuation of authorized residential construction	millions	r $181.5	$158.3	−12.8
Number of private and public residential units authorized		r 12,596	11,249	−10.7
Contract construction work performed:				
Total	millions	$699	$733	+4.9
Nonresidential building	do	$255	$296	+16.1
Residential building	do	$262	$225	−14.1
Nonbuilding	do	$183	$212	+15.8
State highway commission contracts awarded [5]	do	$91.9	$109.4	+19.0
Portland cement shipments to and within Iowa	thousand 376-pound barrels	r 8,096	8,865	+9.5
Retail sales	millions	$5,124	$5,435	+6.1
Farm marketing receipts	do	$3,461.5	$3,828.2	+10.6
Mineral production	do	$117.3	$119.9	+2.2
Utility production and consumption:				
Production of electric energy by electric utilities	million kilowatt hours	12,684	13,456	+6.1
Natural gas consumption	million cubic feet	297,498	318,341	+7.0

p Preliminary. r Revised.

[1] Adjusted to March 1969 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Includes workers covered under the Iowa Employment Security Law.

[4] Based on a Nationwide universe of 13,000 permit issuing places.

[5] Fiscal year ending June 30.

Sources: Iowa Employment Security Commission in cooperation with the U.S. Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, Iowa State Highway Commission, Sales Management, Farm Income Situation, and Federal Power Commission.

Table 4.—Worktime 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
1968:								
Coal and peat	173	252	44	391	--	10	25.57	575
Nonmetal	625	270	169	1,364	--	53	38.84	1,019
Sand and gravel	1,038	212	220	2,011	1	34	17.40	3,311
Stone	2,568	272	698	5,971	4	85	14.90	4,388
Total [1]	4,404	257	1,130	9,738	5	182	19.20	3,541
1969: [p]								
Coal and peat	175	257	45	403	--	10	24.83	571
Nonmetal	535	249	134	1,075	1	33	31.62	6,171
Sand and gravel	925	206	191	1,762	1	28	16.46	5,326
Stone	2,470	273	676	5,844	1	87	15.06	2,429
Total [1]	4,110	254	1,046	9,084	3	158	17.72	3,351

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of portland cement, which comprised the majority of State cement production, increased about 1 percent in quantity over 1968. However, total value of shipments remained nearly identical because of the drop in unit mill value, from $3.40 per 376-pound barrel in 1968 to $3.36 in 1969.

Five companies operated a total of 19 kilns, the same as in the previous year. Types I and II (general use and moderate-heat) cements accounted for nearly 97 percent of the total Iowa portland cement production; about 15 percent of which was air-entrained and 85 percent non-air-entrained. Type III (high-early-strength) cement accounted for 3 percent of the total production; 53 percent of Type III output was air-entrained and 47 percent non-air-entrained. Three companies used a wet process to manufacture their product, while the other two employed a dry process. Electrical energy consumed in portland cement production totaled 322.3 million kilowatt-hours, a decrease of 1 percent from that of 1968. Nearly 84 percent of the power was purchased, and 16 percent was home generated. Both Iowa and Minnesota received approximately 42 percent of the portland cement produced. Other States receiving shipments, listed in decreasing order of quantities received, were as follows: Wisconsin, Illinois, North Dakota, Nebraska, South Dakota, Missouri, New York, and Colorado. Truck transportation moved nearly 61 percent of the material, and railroads carried the remaining 39 percent. Some cement was transported by barge to a company-owned distribution terminal for transshipment to consumers. Of the total shipments, about 94 percent was in bulk form and the other 6 percent was in containers. Over 2.9 million barrels of portland cement were shipped into Iowa, principally from plants in Kansas, Missouri, and Nebraska.

As in past years, ready-mixed concrete companies consumed the majority of the portland cement produced in Iowa, about 68 percent. Nearly 16 percent was used by concrete product manufacturers, 9 percent by highway contractors, and 4 percent by building material dealers. About 3 percent was shipped to other contractors and Federal, State, and local governments.

Raw materials utilized in the manufacture of portland cement included over 3.7 million tons of limestone, 594,000 tons of clay and shale, and 129,000 tons of gypsum. Small quantities of such items as mill scale and blast furnace slag were also consumed.

Two new 7,000-barrel barges were built for the Dewey Portland Cement Co., Davenport, Iowa, and transported cement to Dewey's St. Paul, Minn., distribution terminal. The barges are compartmentalized and thus are able to carry three types of cement at one time. They have completely self-contained unloading systems. Dewey

has also constructed new riverfront storage silos of 7,000-barrel capacity and installed a new 2,000-barrel-per-hour loading system at the Davenport plant. In addition, the company has expanded its St. Paul, Minn., terminal to a 26,000-barrel storage capacity.

The quantity of masonry cement produced in Iowa decreased by nearly 3 percent in 1969; the value decreased about 4 percent. The average value per 280-pound barrel, f.o.b. mill, fell 3 cents to $3.15. Four of the five operations that produced portland cement also produced masonry cement; Penn-Dixie Cement Corp. was the only exception. Minnesota consumed about 54 percent of Iowa's masonry cement production, and Iowa internally consumed about 26 percent. Illinois used a little over 10 percent of the production; Wisconsin and North Dakota received 7 and 3 percent, respectively. Minor amounts were shipped to Nebraska and South Dakota.

Clays.—Total production of clay and shale dropped 5 percent in quantity and value from that of 1968. The major decrease was reported in the use of clays for the manufacture of cement. A 3-percent increase was reported in the use of clays for manufacturing building brick, which utilized nearly 22 percent of the clays produced in Iowa. Increases were also recorded for sewer pipe manufacture and lightweight aggregate.

Twenty-four pits were operated by 16 companies in 16 counties in 1969. No fire clay was produced in Iowa in 1969.

The Fort Dodge Brick & Tile Co., a subsidiary of Harsco Corp., closed its pit in Webster County. The Garrison Brick & Tile Works operation in Benton County was idle in 1969.

The Sioux City Brick & Tile Co. initiated production at its Adel plant in 1969. The operation is a near-duplicate of the company's 3-year-old plant at Sergeant Bluff. The new plant is designed to produce 80,000 bricks per day.

Gypsum.—Iowa ranked fourth in the United States in quantity of crude gypsum produced in 1969. Production decreased over 13 percent, and the value fell nearly 10 percent. The gypsum was produced from one underground mine in Des Moines County by the United States Gypsum Co., and from four openpit mines in Webster County. Companies operating the openpit mines were The Celotex Corp., Georgia-Pacific Corp., National Gypsum Co., and United States Gypsum Co. Calcining plants fueled by natural gas were operated at all five locations. Producers operated a total of 22 kettles, four hydrocal digestors, and six board machines.

Uncalcined gypsum, of which only a minor amount was produced, was sold for use as portland cement retarder, agricultural use, brewer's fixe, and filler. The major use of calcined gypsum was for building purposes such as basecoat plasters, veneer plaster, mill-mixed basecoats, gaging and molding plasters, prepared finishes, roof-deck plasters, lath, wallboard, sheathing, and formboard for poured-in-place gypsum roof decks. Calcined gypsum was also sold for use in industrial manufacturing as plate glass and terra cotta works, dental and orthopedic plaster, industrial molding, art, and casting plasters.

Lime.—Total Iowa production of quicklime and hydrated lime increased 1 percent in 1969, and the value of production increased over 7 percent. Largest increases in the use of lime were recorded in sewage treatment and water purification. Other chemical and industrial uses were in sugar refining, open-hearth steel furnaces, electric steel furnaces, and basic oxygen converters. The above usages accounted for over 95 percent of the lime consumed. Soil stabilization in the construction industry accounted for the remainder.

In order of rank, Illinois, Iowa, and Wisconsin received the majority of Iowa's lime shipments. Indiana, Nebraska, and Minnesota also received shipments.

Perlite.—Crude perlite mined outside of Iowa was processed at the four gypsum plants near Fort Dodge, in Webster County. Expanded perlite production was down 22 percent in quantity, and the value dropped 27 percent. The principal use was in the manufacture of building plaster.

Sand and Gravel.—Iowa sand and gravel production increased nearly 13 percent in 1969, and the value rose about 18 percent. Production was reported from 79 counties. Polk County produced a major portion of Iowa's sand and gravel. Story, Sioux, Black Hawk, and Sac Counties also recorded notable production. The major uses were in the construction industry, where nearly 64 percent of Iowa's sand and gravel production was used in paving. Building uses and

fill were the next two major consumers. A small quantity was used for railroad ballast. Lesser amounts of unground industrial sand were used for molding, sand blasting, and for filtration.

The average value of sand and gravel in Iowa rose to $0.96 per ton in 1969. This was an increase of $0.03 over the value that had been reported since 1965, $0.93 per ton.

Nearly 98 percent of Iowa's commercial sand and gravel production moved by truck. Less than 2 percent moved by rail, and the small remainder was transported by water.

Stone.—Production of stone, consisting entirely of limestone and dolomite, increased less than 1 percent; value increased a little over 1 percent in 1969. The average value for crushed and broken stone was $1.56 per ton compared with $1.54 in 1968 and $1.44 in 1967.

Madison, Scott, Linn, and Cerro Gordo Counties each produced major amounts of stone, over 1 million tons. In order of importance, Humboldt, Black Hawk, Johnson, Pottawattamie, Clinton, and Des Moines Counties made up the remainder of the top 10 stone-producing counties. These 10 counties produced about 46 percent of the State total. Stone production was reported from 66 of Iowa's 99 counties.

Concrete aggregate and roadstone uses utilized the major amount of Iowa's production, especially surface treatment aggregate, dense graded road base stone, and concrete aggregate needs. Cement manufacturing and agricultural purposes utilized most of the remainder.

Ninety-seven percent of Iowa's 1969 stone production was moved by truck; railroads transported most of the remainder.

Table 5.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,995	$3,090	3,396	$3,487
Paving	2,606	2,618	3,106	3,339
Fill	1,216	768	1,472	1,026
Other [1]	145	377	166	390
Total [2]	6,962	6,853	8,140	8,243
Gravel:				
Building	1,263	2,180	1,362	2,419
Paving	5,600	4,569	6,939	5,871
Other [3]	193	144	287	221
Total [2]	7,056	6,893	8,589	8,510
Total sand and gravel [2]	14,018	13,746	16,730	16,753
Government-and-contractor operations:				
Sand:				
Building	1	[4]	-----	-----
Paving	85	49	37	21
Fill	41	20	2	1
Other	4	1	3	1
Total [2]	131	70	42	24
Gravel:				
Paving	2,182	1,376	1,611	1,086
Other	1	[4]	9	4
Total [2]	2,183	1,376	1,620	1,091
Total sand and gravel [2]	2,314	1,446	1,662	1,114
All operations:				
Sand [2]	7,093	6,923	8,182	8,266
Gravel	9,239	8,269	10,209	9,601
Total	16,332	15,192	18,391	17,867

[1] Includes blast, filtration, molding, railroad ballast, and other construction sand.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes fill, railroad ballast, and other construction gravel.
[4] Less than ½ unit.

Waterway transportation moved only a very minor amount of stone.

Dimension limestone, produced in three counties, increased 20 percent in quantity and 7 percent in value. The Wm. Becker & Sons Stone Co. operated two quarries in Dubuque County, the Wm. C. Weber Stone Co. a quarry in Jones County, and Mo-Keta Stone Quarry a quarry in Jackson County.

Table 6.—Limestone and dolomite sold or used by producers, by uses

Use	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural—thousand cubic feet	-----	-----	W	W
Rubble—thousand short tons	3	$28	W	W
Dressed architectural:				
Cut—thousand cubic feet	10	41	6	$19
House stone veneer—do	26	64	26	62
Sawed—do	-----	-----	W	W
Other dressed construction—do	78	96	W	W
Flagging—do	8	10	W	W
Total dimension approximate thousand short tons	11	239	13	255
Crushed and broken:				
Concrete aggregate and roadstone:				
Concrete aggregate—thousand short tons	2,828	5,224	2,945	5,649
Bituminous aggregate—do	2,025	3,186	2,284	3,649
Macadam aggregate—do	361	536	(1)	(1)
Dense graded road base stone—do	4,988	7,204	5,693	8,263
Surface treatment aggregate—do	8,454	12,202	7,032	10,373
Unspecified aggregate and roadstone—do	NA	NA	[1] 1,415	[1] 1,849
Total aggregate and roadstone [2]—do	18,655	28,352	19,369	29,783
Agricultural limestone—do	2,544	4,508	1,970	3,558
Cement—do	3,737	4,538	3,680	4,637
Railroad ballast—do	192	170	216	241
Riprap and jetty stone—do	450	833	569	941
Other [3]—do	561	1,756	415	1,480
Total crushed and broken [2]—do	26,139	40,158	26,219	40,640
Grand total [2]—do	26,150	40,397	26,233	40,895

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Total dimension."

[1] Macadam aggregate combined with "Unspecified aggregate and roadstone" to avoid disclosing individual company confidential data.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes stone used for asphalt filler and other fillers or extenders; flux; lime; poultry grit and mineral food; other and unspecified uses (1968–69); and mine dusting (1969).

Table 7.—Production of sand and gravel and stone in 1969, by counties

(Thousand short tons and thousand dollars)

County	Sand and gravel		Stone	
	Quantity	Value	Quantity	Value
Adair	---	---	W	W
Adams	---	---	W	W
Allamakee	W	W	212	W
Appanoose	---	---	320	W
Audubon	W	W	---	---
Benton	W	W	W	W
Black Hawk	781	$706	805	$1,375
Boone	W	W	---	---
Bremer	W	W	W	W
Buchanan	2	1	252	320
Buena Vista	222	149	---	---
Butler	137	141	250	326
Calhoun	64	45	---	---
Carroll	290	215	---	---
Cass	---	---	W	W
Cedar	---	---	198	W
Cerro Gordo	214	216	1,796	2,041
Cherokee	505	494	---	---
Chickasaw	52	W	W	W
Clarke	---	---	W	W
Clay	265	205	---	---
Clayton	W	W	258	W

See footnotes at end of table.

Table 7.—Production of sand and gravel and stone in 1969, by counties—Continued

(Thousand short tons and thousand dollars)

County	Sand and gravel		Stone	
	Quantity	Value	Quantity	Value
Clinton	282	$281	582	$880
Crawford	W	W	---	---
Dallas	407	403	W	W
Decatur	1	(1)	W	W
Delaware	W	W	204	W
Des Moines	210	162	W	W
Dickinson	282	252	---	---
Dubuque	W	W	443	W
Emmet	360	281	---	---
Fayette	116	137	478	560
Floyd	W	W	W	W
Franklin	190	203	W	128
Fremont	W	W	W	W
Greene	275	270	---	---
Grundy	10	12	76	155
Guthrie	116	88	---	---
Hamilton	116	W	W	W
Hancock	255	W	W	W
Hardin	269	W	W	W
Harrison	203	W	320	W
Henry	127	141	138	138
Howard	17	15	92	133
Humboldt	W	W	859	W
Ida	64	W	---	---
Iowa	W	W	---	---
Jackson	25	37	W	289
Jasper	W	W	W	W
Jefferson	---	---	127	203
Johnson	W	W	696	W
Jones	48	59	272	504
Keokuk	---	---	W	W
Kossuth	383	269	---	---
Lee	84	106	298	502
Linn	454	502	1,862	2,518
Louisa	---	---	W	W
Lyon	291	194	---	---
Madison	---	---	2,190	3,703
Mahaska	176	W	W	W
Marion	164	W	W	W
Marshall	273	W	W	W
Mills	96	132	W	W
Mitchell	75	54	337	500
Monona	269	W	---	---
Montgomery	---	---	W	W
Muscatine	612	W	W	W
O'Brien	138	99	---	---
Osceola	218	203	---	---
Page	W	W	W	W
Palo Alto	217	203	---	---
Plymouth	592	497	---	---
Pocahontas	29	20	W	W
Polk	2,061	2,378	---	---
Pottawattamie	W	W	W	W
Poweshiek	---	---	W	W
Sac	703	768	---	---
Scott	W	W	2,062	3,207
Shelby	W	W	---	---
Sioux	832	821	---	---
Story	864	729	237	W
Tama	83	W	W	W
Taylor	---	---	W	W
Union	---	---	W	W
Van Buren	75	105	396	602
Wapello	W	W	W	W
Warren	W	W	---	---
Washington	---	---	W	W
Wayne	---	---	104	183
Webster	319	226	370	W
Winnebago	183	128	---	---
Winneshiek	130	157	353	519
Woodbury	442	288	---	---
Worth	74	W	127	246
Wright	283	166	---	---
Undistributed [2]	2,365	5,311	9,518	21,864
Total [3]	18,391	17,867	26,233	40,895

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

[1] Less than ½ unit.

[2] Includes production for which no county breakdown is available, and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

MINERAL FUELS

Coal (Bituminous).—Production and value of bituminous coal mined in Iowa increased 3 percent in 1969. The per ton value for undergound coal increased 2 cents to $3.77, and the value of stripped coal rose 4 cents to $3.75 per ton. The average value for all coal increased from $3.75 to $3.76 per ton.

Strip mining accounted for approximately 59 percent of Iowa's production; underground mining produced the remainder. Mich Coal Co. closed its No. 2 strip mine in Marion County in April. The company also initiated production at a new strip mine, the No. 3 in Monroe County.

Rail transportation hauled two-thirds of Iowa's coal production, and trucks moved most of the remainder. Tonnage transported by trucks increased 16 percent in 1969. Use of Iowa coal by electric utilities rose 16 percent in 1969; this industry utilized nearly 88 percent of the total coal that was internally produced. Of the 5.7 million tons of coal consumed in Iowa in 1969, approximately 64 percent was supplied from Illinois mines. Nearly 16 percent was furnished from mines within the State.

Thickness of undergound coal seams mined during the year ranged from 32 inches to 70 inches. Thickness of strip coal seams ranged from 33 inches to 60 inches. Overburden thickness in the strip pits ranged from 25 feet to 60 feet. No mechanical cleaning plants were operated.

Table 8.—Coal (bituminous) production in 1969, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines		Production (short tons)			Value (thousands)
	Underground	Strip	Underground	Strip	Total	
Appanoose	1	--	2,192	-----	2,192	$18
Lucas	1	--	149,000	-----	149,000	596
Mahaska	--	5	-----	269,255	269,255	978
Marion	--	4	-----	243,246	243,246	927
Monroe	1	1	217,045	8,374	225,419	802
Van Buren	--	1	-----	13,614	13,614	71
Total	3	11	368,237	534,489	902,726	3,392

Table 9.—Shipments of bituminous coal for consumption in Iowa, by district of origin and consumer use [1]

(Thousand short tons)

Use	District of origin [2]									Total
	7 and 8	9	10	11	12	15	17	19	20	
1965:										
Electric utilities	---	54	1,593	---	724	392	---	---	---	2,763
Retail dealers	207	181	124	10	2	34	7	---	1	566
All others	89	47	1,672	60	272	39	---	---	---	2,179
Total	296	282	3,389	70	998	465	7	---	1	5,508
1966:										
Electric utilities	---	179	1,653	---	731	352	---	---	---	2,915
Retail dealers	185	127	98	4	1	21	6	---	---	442
All others	97	67	1,577	29	260	53	---	---	---	2,083
Total	282	373	3,328	33	992	426	6	---	---	5,440
1967:										
Electric utilities	---	225	1,950	---	683	369	---	---	---	3,227
Retail dealers	133	136	75	---	---	5	6	---	---	355
All others	67	58	1,544	77	191	30	---	---	---	1,967
Total	200	419	3,569	77	874	404	6	---	---	5,549
1968:										
Electric utilities	---	W	2,240	---	666	W	---	17	---	3,426
Retail dealers	112	W	56	---	---	W	6	---	---	263
All others	56	W	1,485	29	124	W	---	---	---	1,788
Total	168	418	3,781	29	790	268	6	17	---	5,477
1969:										
Electric utilities	---	312	2,204	---	776	229	---	155	---	3,676
Retail dealers	98	54	62	---	---	2	16	---	---	232
All others	79	84	1,368	108	108	18	---	---	---	1,765
Total	177	450	3,634	108	884	249	16	155	---	5,673

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

[1] Data are based on voluntary reports submitted on separate distribution survey, and may not agree with data derived from mine production survey.

[2] States or portion of States represented by each district are as follows: District 7 and 8—Eastern Kentucky, Virginia, Southern West Virginia, and North Central Tennessee; 9—Western Kentucky; 10—Illinois; 11—Indiana; 12—Iowa; 15—Kansas, Missouri, and Northeastern Oklahoma; 17—Western Colorado and Northeastern New Mexico; 19—Wyoming and Idaho; 20—Utah.

Peat.—Peat production fell both in quantity and value in 1969. The quantity decreased nearly 12 percent, and the value decreased 2 percent. Eli Colby Co. mined moss peat in Winnebago County near Lake Mills and processed it at its plant in Hanlontown. Colby Pioneer Peat Co. mined reed-sedge peat from its new deposit near Joice, in Worth County, and processed the material at its plant, which is also in Hanlontown. Peat was sold for general soil improvement; for packing flowers, plants, and shrubs; and as an ingredient for potting soils.

METALS

Ferroalloys.—The Foote Mineral Co. produced ferrosilicon and silvery iron at its Keokuk, Iowa plant, utilizing an electric furnace. The company was the only producer of ferroalloys in the State.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Dewey Portland Cement Co. Div. Martin Marietta Corp.	Box 4288, 802 Kahl Bldg. Davenport, Iowa 52808	Portland and masonry, wet process	Scott.
Lehigh Portland Cement Co	Young Bldg. 718 Hamilton St. Allentown, Pa. 18105	Portland and masonry, dry process	Cerro Gordo.
Marquette Cement Mfg. Co	20 N. Wacker Dr. Chicago, Ill. 60606	Portland and masonry, wet process	Polk.
Northwestern States Portland Cement Co	Box 1008, 12-2nd St. NE. Mason City, Iowa 50401	Portland and masonry, dry process	Cerro Gordo.
Penn-Dixie Cement Corp	Box 152 Nazareth, Pa. 18064	Portland, wet process	Polk.
Clays and shale:			
Ballou Brick Co	Sergeant Bluff, Iowa 51054	Pit and plant	Woodbury.
Carter-Waters Corp	2440 Pennway Kansas City, Mo. 64100	----do	Appanoose.
Des Moines Clay Co	4400 N. Harding Road Des Moines, Iowa 50316	----do	Polk.
Dewey Portland Cement Co. Div. Martin Marietta Corp.	Box 4288, 802 Kahl Bldg. Davenport, Iowa 52808	Pit	Scott.
W. S. Dickey Clay Mfg. Co	1818 Commerce Tower Kansas City, Mo. 64105	Pit and plant	Webster.
Iowa Clay Pipe Co	Box 3510 Des Moines, Iowa 50300	----do	Polk.
Kalo Brick & Tile Co	1230 E. First Ave. South Fort Dodge, Iowa 50501	----do	Webster.
Lehigh Portland Cement Co	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Pit	Cerro Gordo.
Mason City Brick & Tile Co	Box 619 Mason City, Iowa 50401	Pit and plant	Do.
Northwestern States Portland Cement Co	Box 1008, 12-2nd St. NE Mason City, Iowa 50401	Pit	Do.
Ottumwa Brick & Tile Co	Box 352 Ottumwa, Iowa 52501	Pit	Keokuk.
Redfield-Adel Brick & Tile	Box "A" Redfield, Iowa 50233	Pit and plant ----do	Wapello. Dallas.
Rockford Brick & Tile Co	Rockford, Iowa 50468	----do	Floyd.
Sheffield Brick & Tile Co	Sheffield, Iowa 50475	----do	Franklin.
United Brick & Tile Co. of Iowa	209 Benson Bldg. Sioux City, Iowa 51102	----do	Dallas.
Coal (bituminous):			
Beard Coal Co	Route 2 Knoxville, Iowa 51038	Strip mine	Marion.
Big Ben Coal Co	Route 3 Chariton, Iowa 50049	Underground mine	Lucas.
Jude Coal Co	Box 265 Bussey, Iowa 50044	Strip mine	Mahaska.
Lovilia Coal Co	Route 2 Melrose, Iowa 52569	Underground mine	Monroe.
Mich Coal Co	Box 16 Oskaloosa, Iowa 52577	Three strip mines	Mahaska, Marion, Monroe.
Weldon Coal Co	Harvey, Iowa 50119	Two strip mines	Marion.

Ferroalloys:			
Foote Mineral Co	320 Concert St. Keokuk, Iowa 52632	Electric furnace	Lee.
Gypsum:			
The Celotex Corp	1500 N. Dale Mabry Tampa, Fla. 33607	Open pit mine, and calcining and board plants.	Webster.
Georgia-Pacific Corp., Gypsum Division	900 SW. 5th Portland, Oreg. 97204	----do	Do.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Do.
United States Gypsum Co	101 S. Wacker Dr. Chicago, Ill. 60606	----do	Do.
		Underground mine, and calcining and board plant.	Des Moines.
Lime:			
American Crystal Sugar Co	Boston Bldg. Denver, Colo. 80201	Quicklime, shaft kiln	Cerro Gordo.
Linwood Stone Products Co., Inc	Route 2 Davenport, Iowa 52804	Quicklime and hydrated lime, three rotary kilns.	Scott.
Peat:			
Eli Colby Co	Box 248 Lake Mills, Iowa 50450	Bog	Winnebago.
		Processing plant	Worth.
Colby Pioneer Peat Co	Box 8 Hanlontown, Iowa 50444	Bog, processing plant	Worth.
Expanded Perlite:			
The Celotex Corp	1500 N. Dale Mabry Tampa, Fla. 33607	Processing plant	Webster.
Georgia-Pacific Corp., Gypsum Division	900 SW. 5th Portland, Oreg. 97204	----do	Do.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Do.
United States Gypsum Co	101 S. Wacker Dr. Chicago, Ill. 60606	----do	Do.
Sand and Gravel:			
Acme Fuel & Material Co. (W. G. Block Co.)	Box 34 Muscatine, Iowa 52761	Dredges; stationary plants	Muscatine.
K. H. Buttler	204 State St. Guthrie Center, Iowa 50115	Pits; portable plants	Dallas, Guthrie.
Concrete Materials Div., Martin Marietta Corp	4096 First Ave., NE. Cedar Rapids, Iowa 52401	Pits, underground mine; portable and stationary plants.	Black Hawk, Clayton, Linn, Mahaska, Marshall, Polk, Wapello, Worth, Various.
Concrete Sand & Materials Co	Box 288 Spencer, Iowa 51301	Pits; stationary plants	Clay, Dickinson.
Coon Valley Gravel Co. (E. W. Hallett)	1108–30th St., SE. Des Moines, Iowa 50317	Pit; stationary plant	Polk.
Elmer Dole Co	Irvington, Iowa 50550	Pits; portable plants	Kossuth.
Eden Construction, Inc	Nemaha, Iowa 50567	Pit; portable plant	Woodbury.
L. G. Everist, Inc	302 Paulton Bldg. Sioux Falls, South Dakota 57102	Pit; stationary plant	Sioux.
G. A. Finley, Inc	Harlan, Iowa 51537	Pits; portable and stationary plants	Audubon, Crawford, Dallas, Pottawattamie, Sac, Shelby.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and Gravel—Continued			
Hallett Construction Co	Crosby, Minn. 56441	Pits; portable and stationary plants	Boone, Buena Vista, Cherokee, Decatur, Franklin, Fremont, Iowa, Marshall, Osceola, Page, Polk, Sac, Story, Winnebago.
Hanson Sand & Gravel Co	1901 Commercial St. Waterloo, Iowa 50702	Dredge; stationary plant	Black Hawk.
Higman Sand & Gravel Co	Akron, Iowa 51001	Pit; stationary plant	Plymouth.
Hogan Construction Co	Rock Rapids, Iowa 51246	Pits; portable plants	Dickinson, Lyon, Osceola, Plymouth.
Ronald Kenyon Construction Co	1211 Grand Ave. West Des Moines, Iowa 50265	----do	Dallas, Polk.
LaHarv Construction Co	Box 173 Forest City, Iowa 50436	----do	Hancock, Winnebago.
Maudlin Construction Co	Box 134 Webster City, Iowa 50595	----do	Audubon, Boone, Buena Vista, Butler, Carroll, Cerro Gordo, Cherokee, Clay, Crawford, Dallas, Dickinson, Emmet, Franklin, Hamilton, Hardin, Harrison, Ida, Kossuth, Lyon, Marshall, Monona, O'Brien, Plymouth, Polk, Pottawattamie, Sac, Story, Webster, Woodbury, Wright.
Peters Construction Co	5225 E. University Des Moines, Iowa 50317	----do	Monona, Polk.
Pound Construction Co., Inc	Box 217 Scranton, Iowa 51462	----do	Carroll, Greene, Webster.
Raid Quarries Corp	Farmers & Merchants Bank Bldg., Box 1085 Burlington, Iowa 52601	Pits; portable and stationary plants	Des Moines, Henry, Lee, Jefferson.
Stevens Sand & Gravel Co., Inc	Route 4 Iowa City, Iowa 52240	Dredge; portable plant	Johnson.
Van Dusseldorp Sand & Gravel, Inc	Box 156 Colfax, Iowa 50054	Dredges; stationary plants	Jasper.
Waterloo Dredging Co., Inc	2261 LaPorte Road Waterloo, Iowa 50702	Pit; portable plant	Black Hawk.
Welp & McCarten, Inc	522 S. 22nd St. Fort Dodge, Iowa 50501	Pits; portable plants	Cerro Gordo, Hancock, Howard, Lyon, Sioux, Webster.
West Des Moines Sand Co	Box 98 West Des Moines, Iowa 50265	Pit; stationary plant	Polk.
White Materials Corp	SE. 36th & Carlisle Road Des Moines, Iowa 50317	Dredge; stationary plant	Do.

Stone: Limestone and Dolomite:			
B. L. Anderson, Inc	327 Guaranty Bldg. Cedar Rapids, Iowa 52400	Quarries; portable plants	Linn, Jones.
Concrete Materials Div. Martin Marietta Corp	4096 First Ave. NE. Cedar Rapids, Iowa 52401	Quarries; portable and stationary plants.	Black Hawk, Chickasaw, Johnson, Linn, Madison, Marshall, Tama, Worth, Various.
DeWees Potthoff Stone Co	Box 39 Marion, Iowa 52302	Quarries; portable plants	Black Hawk, Cedar, Dubuque, Jones, Linn.
Dewey Portland Cement Co Div. Martin Marietta Corp.	Box 4288, 802 Kahl Bldg. Davenport, Iowa 52800	Quarry; stationary plant	Scott.
Douds Stone, Inc	611 Church St., Box 187 Ottumwa, Iowa 52501	Quarries, underground mine; portable and stationary plants.	Van Buren, Wapello.
Gendler Stone Products Co	1075 Polk Blvd. Des Moines, Iowa 50311	Quarries; portable plants	Dallas, Madison, Page, Taylor.
Kaser Construction Co	3111 Ingersoll Des Moines, Iowa 50312	----do	Des Moines, Fremont, Jasper, Keokuk, Mahaska, Marion, Mills, Montgomery, Poweshiek, Washington.
Lehigh Portland Cement Co	Young Bldg., 718 Hamilton St. Allentown, Pa. 18105	Quarry; stationary plant	Cerro Gordo.
Linwood Stone Products Co., Inc. (McCarthy Improvement Co.).	Route 2 Davenport, Iowa 52804	Underground mine and stationary plant.	Scott.
Lowe & Eschman Construction Co	Box 267 Marion, Iowa 52302	Quarries; portable plants	Clinton.
Marquette Cement Mfg. Co	20 N. Wacker Dr. Chicago, Ill. 60606	Quarry; stationary plant	Madison.
Paul Niemann Construction Co	Box 38 Sumner, Iowa 50674	Quarries; portable plants	Bremer, Buchanan, Butler, Fayette.
Northwestern States Portland Cement Co	Box 1008, 12-2nd St., NE. Mason City, Iowa 50401	Quarry; stationary plant	Cerro Gordo.
P & M Stone Co., Inc	Box 569 Humboldt, Iowa 50548	Quarries; portable plants	Cerro Gordo, Humboldt.
Penn-Dixie Cement Corp	Box 152 Nazareth, Pa. 18064	Quarry; stationary plant	Madison.
Raid Quarries Corp	217 Farmers & Merchants Bank Bldg., Box 1085 Burlington, Iowa 52601	Quarries; portable and stationary plants.	Des Moines, Jefferson, Lee, Van Buren.
The River Products Co	220 Savings & Loan Bldg. Iowa City, Iowa 52240	Quarries, underground mines; portable and stationary plants.	Johnson, Louisa, Washington.
E. I. Sargent Quarries, Inc	2525 W. Euclid St. Des Moines, Iowa 50310	Quarries; portable plants	Clarke, Decatur, Madison.
Schildberg Construction Co., Inc	Box 358 Greenfield, Iowa 50849	----do	Adair, Adams, Cass, Madison, Union.
Schildberg Rock Products Co., Inc	----do	----do	Adams, Pottawattamie.
Weaver Construction Co	Box 817 Iowa Falls, Iowa 50126	Quarries, portable and stationary plants.	Cedar, Cerro Gordo, Franklin, Hamilton, Hardin, Scott, Story.
Welp & McCarten, Inc	522 S. 22nd St. Fort Dodge, Iowa 50501	----do	Black Hawk, Cerro Gordo, Howard, Humboldt, Mitchell, Worth.

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 Mark H. Hibpshman [1] and A. L. Hornbaker [2]

The value of mineral production in Kansas reached an alltime high of $577.8 million, exceeding the previous high of $574.1 recorded in 1967. The principal mineral commodities, in order of descending value, were petroleum, natural gas, helium, natural gas liquids, cement, stone, and salt. Mineral fuels and related products comprised about 85 percent of total value; nonmetals, about 15 percent; and metals, less than 1 percent. Crude zinc-lead ore output was 63 percent less than that of 1968, a result of the termination of several small operations. Kansas ranked seventh among the States in oil production, fifth in natural gas production, and fifth in natural gas liquids production.

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Table 1.—Mineral production in Kansas [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Portland cement—thousand 376-pound barrels	9,680	$29,898	9,764	$29,365
Masonry cement—thousand 280-pound barrels	383	1,177	348	1,023
Clays—thousand short tons	932	1,433	[2] 797	[2] 1,070
Coal (bituminous)—do	1,268	6,526	1,313	7,108
Helium:				
High-purity—thousand cubic feet	291,700	7,300	329,500	7,579
Crude—do	2,749,700	33,600	2,669,400	32,667
Lead (recoverable content of ores, etc.)—short tons	1,227	324	395	118
Natural gas—million cubic feet	835,555	115,307	883,156	122,759
Natural gas liquids:				
Natural gasoline and cycle products—thousand 42-gallon barrels	4,824	10,977	4,855	11,848
LP gases—do	15,748	25,827	19,574	26,229
Petroleum (crude)—do	94,505	285,405	88,716	283,891
Pumice—thousand short tons	11	10	W	W
Salt [3]—do	1,128	15,520	1,270	17,090
Sand and gravel—do	12,427	10,559	12,029	10,061
Stone—do	14,372	r 20,650	15,828	22,645
Zinc (recoverable content of ores, etc.)—short tons	3,012	813	1,900	555
Value of items that cannot be disclosed: Natural cement, fire clay (1969), gypsum, lime, salt (brine), and items indicated by symbol W	XX	3,311	XX	3,808
Total	XX	r 568,637	XX	577,816
Total 1967 constant dollars	XX	567,450	XX	p 555,315

p Preliminary. r Revised. W Withheld to avoid disclosing individual company confidential data; included in "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."
[3] Excludes salt in brine included with "Value of items that cannot be disclosed."

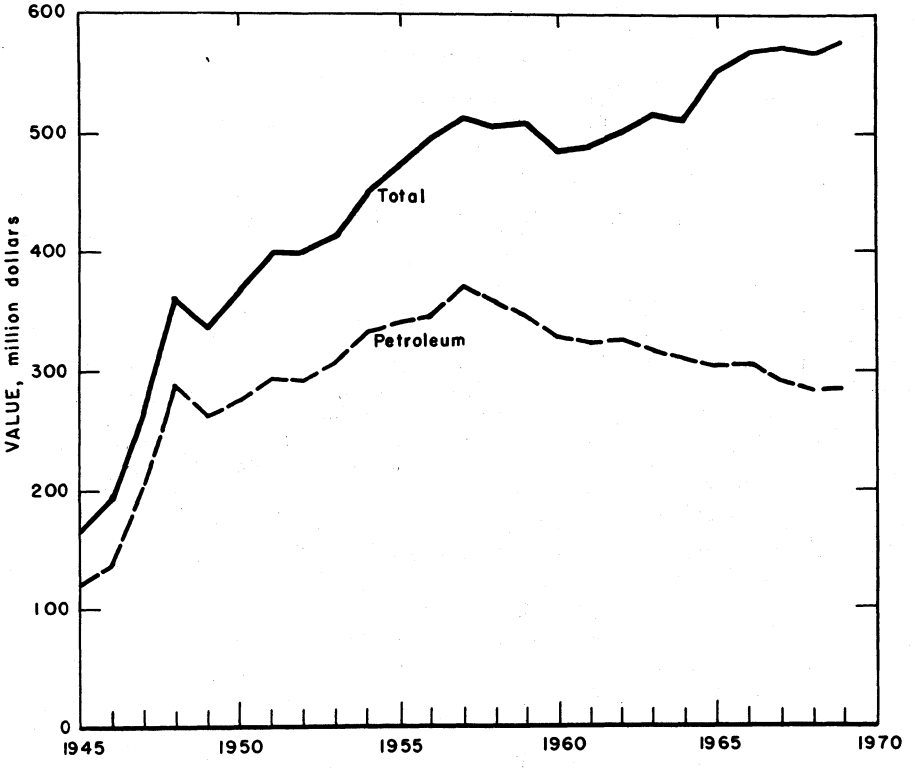

Figure 1.—Value of petroleum, and total value of mineral production in Kansas.

Table 2.—Value of mineral production in Kansas, by counties

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Allen	$13,629	$13,819	Cement, petroleum, stone, clays, natural gas.
Anderson	765	750	Petroleum, stone.
Atchison	305	528	Stone.
Barber	8,508	8,413	Natural gas, petroleum, gypsum, natural gas liquids, sand and gravel.
Barton	17,460	17,544	Petroleum, salt, sand and gravel, natural gas, clays.
Bourbon	784	989	Stone, petroleum, cement.
Brown	25	36	Petroleum, stone.
Butler	13,557	13,654	Petroleum, stone, natural gas, sand and gravel.
Chase	250	W	Stone, sand and gravel, petroleum.
Chautauqua	1,970	1,984	Petroleum, natural gas, stone.
Cherokee	6,517	W	Coal, zinc, clays, stone, lead.
Cheyenne	W	99	Sand and gravel.
Clark	1,630	1,549	Natural gas, petroleum, sand and gravel.
Clay	107	203	Stone, sand and gravel, petroleum.
Cloud	266	W	Clays, sand and gravel, stone.
Coffey	133	93	Stone, petroleum.
Comanche	1,061	1,435	Natural gas, petroleum, sand and gravel.
Cowley	9,184	9,004	Petroleum, sand and gravel, stone, natural gas.
Crawford	1,740	W	Coal, petroleum, clays, stone.
Decatur	1,806	1,781	Petroleum, sand and gravel.
Dickinson	555	614	Stone, sand and gravel, petroleum.
Doniphan	307	785	Stone, sand and gravel.
Douglas	575	299	Sand and gravel, petroleum.
Edwards	1,190	1,213	Natural gas, petroleum, sand and gravel.
Elk	1,229	1,500	Stone, petroleum, natural gas, sand and gravel.
Ellis	25,729	25,658	Petroleum, sand and gravel, stone.
Ellsworth	21,835	22,782	Natural gas liquids, helium, petroleum, salt, clays, sand and gravel, natural gas.
Finney	7,724	15,488	Natural gas, petroleum, sand and gravel, natural gas liquids.
Ford	489	484	Petroleum, natural gas liquids, sand and gravel, natural gas.
Franklin	395	893	Stone, clays, petroleum.
Geary	241	W	Sand and gravel, stone, petroleum.
Gove	716	701	Petroleum, sand and gravel.
Graham	12,960	12,904	Do.
Grant	41,388	33,525	Natural gas, natural gas liquids, helium, petroleum, sand and gravel.
Gray	W	W	Sand and gravel.
Greeley	12	W	Do.
Greenwood	8,328	8,425	Petroleum, stone, natural gas.
Hamilton	1,234	1,352	Natural gas, sand and gravel, petroleum.
Harper	3,539	3,738	Natural gas, petroleum, natural gas liquids, sand and gravel.
Harvey	2,735	2,576	Petroleum, natural gas, natural gas liquids.
Haskell	13,735	16,522	Natural gas, petroleum, sand and gravel.
Hodgeman	4,478	4,499	Petroleum, sand and gravel.
Jackson	84	151	Stone, petroleum, sand and gravel.
Jefferson	W	W	Stone.
Jewell	W	W	Stone, pumicite.
Johnson	2,389	2,290	Stone, sand and gravel, petroleum.
Kearny	13,101	13,941	Natural gas, petroleum, natural gas liquids, sand and gravel.
Kingman	19,569	19,181	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	4,820	4,818	Natural gas, petroleum, sand and gravel.
Labette	268	331	Stone, petroleum.
Lane	155	154	Petroleum.
Leavenworth	533	W	Stone, sand and gravel, petroleum.
Lincoln	1,166	W	Stone, pumicite.
Linn	316	W	Petroleum, stone, sand and gravel.
Logan	W	W	Pumicite, sand and gravel.
Lyon	1,259	1,444	Petroleum, stone, sand and gravel.
McPherson	7,723	7,151	Petroleum, stone, natural gas, clays, sand and gravel, pumicite.
Marion	3,487	4,335	Petroleum, natural gas, stone, natural gas liquids.
Marshall	953	W	Gypsum, sand and gravel, stone.
Meade	4,084	4,012	Natural gas, petroleum, sand and gravel.
Miami	1,089	1,019	Petroleum, stone.
Mitchell	370	86	Sand and gravel.
Montgomery	6,339	4,716	Cement, petroleum, stone, clays.
Morris	1,010	985	Petroleum, stone, sand and gravel.
Morton	23,860	29,453	Natural gas, petroleum, helium, natural gas liquids.
Nemaha	98	100	Stone, petroleum, sand and gravel.
Neosho	9,895	W	Cement, petroleum, stone, sand and gravel, clays.
Ness	8,549	8,548	Petroleum, sand and gravel, stone.
Norton	1,289	1,305	Petroleum, sand and gravel, pumicite.
Osage	-----	3	Stone.

See footnote at end of table.

Table 2.—Value of mineral production in Kansas, by counties—Continued

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Osborne	$221	$199	Petroleum, sand and gravel.
Ottawa	33	74	Sand and gravel.
Pawnee	2,878	3,069	Petroleum, natural gas, sand and gravel.
Phillips	6,411	6,399	Petroleum, sand and gravel, stone.
Pottawatomie	111	171	Stone, sand and gravel.
Pratt	5,406	5,282	Petroleum, natural gas, sand and gravel.
Rawlins	1,171	1,169	Petroleum, sand and gravel.
Reno	14,778	15,417	Salt, petroleum, sand and gravel, natural gas.
Republic	W	W	Sand and gravel, stone.
Rice	20,462	21,076	Petroleum, salt, stone, sand and gravel, natural gas.
Riley	954	1,327	Stone, petroleum, sand and gravel.
Rooks	14,956	14,754	Petroleum, sand and gravel.
Rush	8,562	6,749	Petroleum, helium, natural gas, natural gas liquids, sand and gravel.
Russell	25,527	25,367	Petroleum, sand and gravel, natural gas.
Saline	1,502	1,304	Petroleum, sand and gravel.
Scott	1,997	5,812	Helium, natural gas liquids, petroleum, sand and gravel, natural gas.
Sedgwick	9,451	10,247	Petroleum, salt, sand and gravel, natural gas liquids.
Seward	30,392	34,040	Helium, natural gas, natural gas liquids, petroleum, sand and gravel.
Shawnee	1,516	1,519	Stone, sand and gravel.
Sheridan	1,967	1,950	Petroleum, sand and gravel.
Sherman	326	487	Sand and gravel, lime, petroleum.
Smith	3	17	Sand and gravel, stone.
Stafford	12,690	12,643	Petroleum, natural gas, natural gas liquids, sand and gravel.
Stanton	4,352	5,364	Natural gas, petroleum, natural gas liquids.
Stevens	27,936	18,047	Natural gas, petroleum, sand and gravel.
Sumner	6,178	6,212	Petroleum, natural gas, sand and gravel.
Thomas	W	91	Sand and gravel, petroleum.
Trego	3,770	3,821	Petroleum, sand and gravel.
Wabaunsee	908	864	Do.
Wallace	W	W	Sand and gravel, stone.
Washington	W	W	Do.
Wichita	46	W	Sand and gravel.
Wilson	5,813	5,537	Cement, stone, petroleum, clays, natural gas.
Woodson	2,957	2,940	Petroleum, stone.
Wyandotte	8,049	9,338	Cement, stone, sand and gravel.
Undistributed	5,817	26,668	
Total	568,637	577,816	

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

Table 3.—Indicators of Kansas business activity

	1968	1969 p	Change, percent
Employment and labor force, annual average:			
Total labor force (nonagricultural)—thousands	790.6	798.8	+1.0
Unemployment—do	23.2	26.0	+12.1
Employment:			
Construction—do	35.0	35.9	+2.6
Mining—do	11.4	11.7	+2.6
Manufacturing—do	146.8	146.2	−.4
All industries—do	767.4	772.8	+.7
Personal income:			
Total—millions	$7,574.0	$8,197.0	+8.2
Per capita	$3,306.0	$3,531.0	+6.8
Construction activity:			
Building permits, total private nonresidential—millions	$98.5	$91.3	−7.3
Cement shipments to and within Kansas—thousand 376-pound barrels	5,729	5,656	−1.3
Farm marketing receipts—millions	$1,535.9	$1,704.0	+10.9
Mineral production—do	$568.6	$577.8	+1.6

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Sources: Survey of Current Business, Construction Review, Farm Income Situation, Kansas Employment Security Division, and Bureau of Mines.

According to the Kansas Highway Commission, highway construction contracts awarded during 1969 totaled $73 million. Authorized projects included 258 miles of State highways with 113 bridges, 318 miles of secondary county roads with 67 bridges, and 989 miles of road maintenance and resurfacing. An additional 24 miles of interstate highway was opened to traffic during 1969. Since enactment of the Federal Highway Act in 1956, $363.4 million has been allocated to Kansas.

Trends and Developments.—Kansas Gas & Electric Co. and Kansas City Power & Light Co. continued a joint project to develop an 840-megawatt, mine-mouth, coal-fueled, generating station near La Cygne. Work started on a reservoir to supply water for the plant. The $125 million project is the largest single construction project ever undertaken in the State.

During the year, a power station of the Kansas Power & Light Co. at Lawrence was completed. The new plant will provide 430 megawatts of power and will consume 5,250 tons, or a 75-car trainload, of coal each day. The coal is to be provided by mines in southern Kansas.

Interpace Corp., at Mankato, Jewell County, made its first shipments during the year of Corcel 300, a filter-aid material made from expanded volcanic ash. The material was shipped to users on the east coast.

Kathol Natural Gas, Inc., announced that its new 10-million-cubic-feet-per-day Rattlesnake Creek gas processing plant in Stafford County began operating during the year. Gas residue from the plant will be sold to Kansas Power & Light Co.

Late in the year, Perlite Corp. made preliminary investigations of a combination of expanded volcanic ash and urethane for production of building materials at Mankato in Jewell County. A tentative plant production date of July 1970 was announced by officers of the new company after initial tests were termed successful.

Employment and Injuries.—According to the Employment Security Division of the Kansas Department of Labor, average annual employment in the mining industries increased in 1969 after declining for 9 consecutive years. Employment in 1969 was 11,700 compared with 11,400 in 1968. According to figures compiled by the Workmen's Compensation Commission, the mining industries experienced a total of 530 injuries in 1969 compared with 689 in 1968. Six injuries, all occurring in the petroleum and natural gas industries, were fatal.

Legislation and Government Programs.—The Kansas Legislature passed a new law requiring that approval by 75 percent (formerly 100 percent) of property and royalty owners will be needed to unitize an oilfield. The Kansas Corporation Commission asserted that this could result in recovery of an additional 19.3 million barrels of oil.

Contamination of fresh water by salt water caused the Kansas Corporation Commission to change the rules regarding core and exploratory well plugging. Beginning

Table 4.—Worktime 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
1968:								
Coal	196	294	58	419	--	18	42.98	432
Metal	69	202	14	111	--	7	62.79	1,839
Nonmetal	1,030	229	236	1,894	--	71	37.50	1,240
Sand and gravel	963	240	231	2,034	--	39	19.17	479
Stone	1,651	256	422	3,495	1	38	11.16	2,045
Total	3,909	246	960	7,953	1	173	21.88	1,365
1969: p								
Coal	235	311	73	529	--	18	34.06	341
Metal	30	256	7	57	--	4	69.69	2,230
Nonmetal	1,070	222	238	1,899	--	65	34.23	516
Sand and gravel	635	229	146	1,289	1	22	17.85	8,018
Stone	1,610	263	424	3,509	--	35	9.97	366
Total	3,580	248	887	7,282	1	144	19.91	1,772

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September 1, plugging of all holes penetrating salt water formations will be supervised by the State. Seismic holes that do not penetrate salt water formations are exempted from the new regulations.

Ronald G. Hardy, Chief, Mineral Resources Section, Kansas State Geological Survey, was selected to head a task force to develop a plan to restore mined-out coal lands in southeastern Kansas. Funds for the program are provided by the State of Kansas and the Ozark Regional Commission, of the U.S. Department of Commerce. Total funds for the program are $130,300, of which $102,600 is to be provided by the State and $27,700 by the Federal Government.

The second phase of the U.S. Bureau of Mines-sponsored project, "A Model for Regional Resources Output vs. Price Analysis", was begun in September by the Kansas Geological Survey. To date, the economic potential of limestone, gypsum, clay, petrochemicals, and salt has been examined. Future plans include further investigations of clay and investigations of brine, silica sand, and transportation in relation to the mineral industry. The entire project is funded by the U.S. Bureau of Mines for a total of about $55,000.

Drilling and Exploration.—During 1969 a total of 2,977 oil and gas wells was drilled in Kansas. Of these, 1,919 were production wells, and 1,058 were exploratory wells; 1,455 resulted in oil or gas recovery, and 1,522 were dry. Drilling activity resulted in 1,271 new oil wells and 184 new gas wells. Of these, 173 oil wells and 25 gas wells were the result of exploratory drilling. Total footage attributable to oil and gas drilling activity was 9,626,266 feet, of which 5,721,200 feet was for production, and 3,905,066 feet was exploration.

Ellis County was the site of the most drilling activity with 178 wells—111 production and 67 exploratory. Exploration resulted in 15 new wells in the county. Fifteen percent of all drilling occurred in Ness, Ellis, Graham, and Sheridan Counties in what was evidently an attempt to extend production from the central Kansas uplift. The 2,977 wells completed in Kansas during 1969 were well below the past 10-year average of 4,111.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Carbon Black.—Columbian Carbon Co. continued carbon black production at its Hickok, Kans., plant. Feedstocks were liquid hydrocarbons and natural gas.

Goodyear Tire & Rubber Co., at Topeka, began using a new 420-ton carbon black tower in July 1969. The carbon black is mixed with chemicals and rubber in a new Branbury mixer to produce rubber stock for manufacturing tires.

Coal.—Four strip-mining operations produced about 1.3 million tons of coal valued at about $7.1 million in 1969, a 3.5-percent increase in tonnage and a 9-percent increase in value over those of 1968.

P & M Coal Co. announced plans to mine coal for a new electric powerplant near La Cygne, Linn County; the strip mine will be opened near the plant.

The Bureau of Mines Bartlesville Mineral Supply Field Office conducted a study of the availability of strippable coals in southeastern Kansas. Resource estimates were calculated for economically minable coal in 11 counties. The estimates were presented in tabular form by coal seam thickness and sulfur content for each county. The study was part of a national study coordinated by the U.S. Bureau of Mines and will be published in a report entitled "The Availability of Bituminous Coal and Lignite for Strip Mining in the United States".

Table 5.—Coal (bituminous) production [1]

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	1,310	$6,072
1966	1,122	5,355
1967	1,136	5,294
1968	1,268	6,526
1969	1,313	7,108

[1] Excludes mines producing less than 1,000 short tons.

Helium.—A total of 329.5 million cubic feet of high-purity helium valued at about $7.6 million was produced at plants in Morton, Rush, and Scott Counties in 1969. Crude helium production was 2,669.4 million cubic feet valued at $32.7 million. Crude helium was produced in Ellsworth, Grant, Scott, and Seward Counties. All he-

lium produced in Kansas in 1969 was produced by commercial producers, and all high-purity helium was sold to commercial users.

Natural Gas.—Natural gas production reached a new high in 1969 with production of about 883.2 million cubic feet, a 6-percent increase over 1968 output.

According to an industry-wide report presented at Denver, Colo., in June by the American Gas Association Inc., estimated potential natural gas reserves in Kansas, Oklahoma, and Texas are about 125 trillion cubic feet. This figure includes probable, possible, and speculative reserves.

Table 6.—Marketed production of natural gas

Year	Million cubic feet	Value (thousands)
1965	793,379	$105,519
1966	847,495	114,412
1967	871,971	116,844
1968	835,555	115,307
1969	883,156	122,759

Construction of a 500,000-gallon-per-day ethane extraction plant was announced by Northern Gas Products at its Bushton Plant, Rice County. The additional facility will increase liquefied products capacity by about 50 percent. It is scheduled to go on stream in 1970.

Natural Gas Liquids.—Natural gas liquids production increased about 4 million barrels, or about 19 percent, above the 1968 total; total output in 1969 was about 24.4 million barrels. Much of the gain was due to the operation of Kathol Natural Gas, Inc.'s, new Rattlesnake Creek plant in Stafford County.

Petroleum.—Crude oil output in Kansas dropped in 1969 for the third consecutive year. A total of 88.7 million barrels of crude oil was produced in 1969 as compared with 94.5 million barrels in 1968. In the period from 1959 through 1969, crude oil output in Kansas decreased 25.8 percent from 119.5 million barrels in 1959 to 88.7 million barrels in 1969. Kansas retained its rank of seventh in the Nation in crude oil production.

Refineries.—Twelve refineries were operated in Kansas in 1969. According to the Oil and Gas Journal, crude oil capacity increased from 407,300 barrels per day in 1968 to 419,305 barrels per day in 1969. Kansas ranked ninth among the States in refinery capacity at yearend.

Table 7.—Natural gas liquids production

(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	3,654	$7,791	13,986	$22,322	17,640	$30,113
1966	4,168	9,399	15,813	25,902	19,981	35,301
1967	4,623	10,703	15,835	31,923	20,458	42,626
1968	4,824	10,977	15,748	25,827	20,572	36,804
1969	4,855	11,848	19,574	26,229	24,429	38,077

Table 8.—Natural gasoline and LP gases produced in 1969

(42-gallon barrels)

Company	Location		Natural gasoline	Butane	Propane	LP gases	Total
	Nearest town	County					
Alamo Chemical Co	Elkhart	Morton	219,868	180,085	22,321	---	422,274
Anadarko Production Co	Liberal	Seward	107,653	---	78,408	---	186,061
	Elkhart	Morton	100,434	---	55,140	---	155,574
Cities Service Helex, Inc	Ulysses	Grant	---	---	---	3,760,800	3,760,800
	Scott City	Scott	---	---	---	1,937,814	1,937,814
Cities Service Oil Co	Cheney	Kingman	---	---	---	617,000	617,000
	Midway	---do---	---	---	---	273,000	273,000
	Wichita	Sedgwick	365,000	395,000	303,000	---	1,063,000
	Wilburton	Morton	---	---	---	63,000	63,000
Colo. Interstate Gas Co	Lakin	Kearny	139,270	---	---	---	139,270
Kans. Refined Helium Co	Otis	Rush	38,480	---	---	---	38,480
Kathol Natural Gas Inc	St. John	Stafford	9,378	---	4,276	---	13,654
Mesa Petroleum Co	Ulysses	Grant	224,499	233,565	240,248	---	698,312
Mobil Oil Corp	Hickok	---do---	180,812	4,389	95,211	375,418	655,830
	Spivey	Harper	309,976	156,825	251,347	---	718,148
National Helium Corp	Liberal	Seward	1,021,896	1,326,062	1,920,311	---	4,268,269
Northern Gas Products Co	Bushton	Ellsworth	743,985	2,236,786	5,253,940	---	8,234,711
Northern Natural Gas Co	Holcomb	Finney	191,394	---	---	---	191,394
	Sublette	Seward	428,183	---	---	---	428,183
Pan American Petrol. Co	Ulysses	Grant	41,700	57,500	130,000	---	229,200
	---do---	---do---	825,000	1,130,000	720,000	---	2,675,000
Plateau Natural Gas Co	Burrton	Harvey	5,240	---	---	---	5,240
	Johnson City	Stanton	8,247	---	---	---	8,247
Rounds & Stewart Natural Gasoline Co	Marion	Marion	43,186	43,967	76,440	---	163,593
Skelly Oil Co	Medicine Lodge	Barber	52,794	---	44,970	---	97,764
	Minneola	Ford	57,571	---	48,789	---	106,360

Source: Kansas State Corporation Commission.

Table 9.—Crude petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1965	104,733	$305,820
1966	103,738	306,027
1967	99,200	297,600
1968	94,505	285,405
1969	88,716	283,891

Table 10.—Crude petroleum production, indicated demand, and stocks in 1969, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Kansas (end of month)
January	7,457	5,550	7,752
February	6,912	7,977	6,687
March	7,517	7,890	6,314
April	7,445	7,563	6,196
May	7,635	6,836	6,995
June	7,363	7,495	6,863
July	7,522	7,913	6,472
August	7,455	7,601	6,326
September	7,368	6,853	6,841
October	7,397	7,490	6,748
November	7,189	7,472	6,465
December	7,456	7,334	6,587
Total:			
1969	88,716	87,974	XX
1968	94,505	95,123	XX

XX Not applicable.

Table 11.—Crude petroleum production, by fields [1]

(Thousand 42-gallon barrels)

Field [2]	1966	1967	1968	1969	Cumulative, Dec. 31, 1969
Alameda	-----	1,441	1,378	-----	5,555
Bemis-Shutts	3,267	3,101	3,072	2,765	206,740
Chase-Silica	2,579	2,297	2,099	1,888	243,926
El Dorado	2,534	2,294	2,062	1,873	273,134
Geneseo-Edwards	1,187	1,138	1,027	-----	76,237
Gorham	1,275	1,191	1,128	894	74,860
Hall-Gurney	3,290	3,156	3,057	3,139	116,847
Interstate	-----	-----	-----	1,069	11,224
Kraft-Prusa	1,992	1,834	1,739	1,529	106,563
Ogallah	-----	-----	-----	1,055	11,293
Ray	1,132	1,140	1,117	1,104	35,888
Spivey-Grabs	2,796	2,540	2,403	2,162	39,813
Trapp	3,055	2,467	2,314	2,175	195,638
Other fields [3]	80,631	76,601	73,109	69,063	NA
Total	103,738	99,200	94,505	88,716	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] Bureau of Mines figures.

Table 12.—Oil and gas well drilling in 1969, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Allen	69	--	7	--	--	--	76
Anderson	5	--	3	1	--	4	13
Atchison	--	--	--	--	--	1	1
Barber	6	11	10	3	4	24	58
Barton	54	1	47	12	--	27	141
Bourbon	2	--	--	--	--	2	4
Butler	33	--	18	3	--	16	70
Chase	--	--	--	--	--	3	3
Chautauqua	15	--	12	1	1	3	32
Cheyenne	--	--	1	--	--	--	1
Clark	--	--	--	--	--	3	3
Clay	--	--	--	--	--	1	1
Coffey	1	--	1	--	--	2	4
Comanche	--	2	--	3	5	11	21
Cowley	26	--	30	5	1	24	86
Crawford	12	--	3	--	1	--	16
Decatur	20	--	6	7	--	24	57
Dickinson	1	--	2	--	--	--	3
Doniphan	--	--	--	--	--	1	1
Douglas	--	--	1	--	--	--	1
Edwards	8	3	3	1	1	12	28
Elk	26	--	2	--	--	2	30
Ellis	58	--	53	15	--	52	178
Ellsworth	18	1	10	4	--	13	46
Finney	1	--	1	--	--	3	5
Ford	--	--	1	--	--	4	5
Franklin	11	--	2	--	--	5	18
Geary	--	--	--	--	--	1	1
Gove	1	--	3	2	--	4	10
Graham	24	--	22	11	--	50	107
Grant	--	48	2	--	--	--	50
Gray	--	--	--	--	--	1	1
Greeley	--	--	--	--	--	2	2
Greenwood	56	--	36	4	--	22	118
Hamilton	--	3	--	--	--	--	3
Harper	6	1	4	1	--	6	18
Harvey	16	1	8	1	--	12	38
Haskell	2	2	1	--	--	2	7
Hodgeman	12	--	10	2	--	21	45
Jefferson	--	--	1	--	--	--	1
Johnson	--	--	--	--	1	--	1
Kearny	--	4	--	--	--	1	5
Kingman	13	7	15	3	1	27	66
Kiowa	4	1	3	2	3	6	19
Labette	1	--	5	--	--	2	8
Lane	--	--	1	--	--	--	1
Leavenworth	--	1	--	--	--	--	1
Linn	5	--	1	--	--	--	6
Logan	--	--	--	--	--	3	3
Lyon	3	--	4	2	--	10	19
McPherson	20	--	10	1	--	12	43
Marion	22	1	6	--	1	11	41
Meade	1	--	2	1	1	9	14
Miami	6	1	4	--	--	3	14
Mitchell	--	--	--	--	--	2	2
Montgomery	33	--	10	1	--	5	49
Morris	1	--	--	--	--	6	7
Morton	3	3	6	--	--	5	17
Nemaha	--	--	--	--	--	2	2
Neosho	24	--	10	--	--	2	36
Ness	15	--	23	8	--	47	93
Norton	5	--	2	2	--	8	17
Osage	--	--	--	--	--	1	1
Pawnee	9	4	12	4	--	19	48
Phillips	13	--	8	5	--	5	31
Pratt	10	--	10	2	--	21	43
Rawlins	11	--	1	2	--	9	23
Reno	26	--	7	5	--	11	49
Rice	55	1	24	4	--	8	92
Riley	--	--	--	--	--	1	1
Rooks	78	--	11	10	--	27	126
Rush	22	6	19	4	--	19	70
Russell	62	--	34	9	2	19	126
Saline	1	--	2	2	--	2	7
Scott	6	--	7	--	--	3	16
Sedgwick	1	--	4	1	--	11	17
Seward	11	5	10	3	3	8	40
Sheridan	9	--	18	5	--	41	73
Sherman	--	--	--	--	--	7	7

Table 12.—Oil and gas well drilling in 1969, by counties—Continued

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Stafford	35	1	30	6	--	19	91
Stanton	--	--	--	--	--	2	2
Stevens	2	48	3	--	--	2	55
Sumner	12	2	14	8	--	33	69
Thomas	--	--	--	1	--	17	18
Trego	11	--	19	2	--	17	49
Wabaunsee	2	--	4	--	--	13	19
Wallace	--	--	--	--	--	4	4
Wichita	--	--	--	--	--	1	1
Wilson	9	1	8	--	--	1	19
Woodson	74	--	15	4	--	20	113
Total	1,098	159	662	173	25	860	2,977

Source: American Association of Petroleum Geologists.

Table 13.—Estimated proved recoverable reserve of crude oil, natural gas liquids, and natural gas

Product	Proved reserves Dec. 31, 1968	Changes in proved reserves, due to extensions, revisions, and discoveries, in 1969	Proved reserves Dec. 31, 1969 (production was deducted)	Change from 1968 (percent)
Crude oil—thousand barrels	600,842	53,092	566,013	−5.8
Natural gas liquids [1]—do	270,556	17,642	269,261	−.5
Natural gas—million cubic feet	14,511,173	500,130	14,125,125	−2.7

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association.

American Oil Company closed its 30,400-barrel-per-day refinery at Neodesha in Wilson County. The reasons given for closing the 72-year-old facility were its small size and lack of modern equipment. Part of the attendant tank farm is to be retained as a products terminal.

Skelly Oil Co. completed addition of a new gas liquids unit at its El Dorado refinery. The new unit recovers ethane, ethylene, propane, propylene, and isobutane fractions from gas streams generated inside the plant.

Construction of a new crude oil column that increased plant capacity about 10 percent was completed by National Cooperative Refinery Association at its plant in McPherson County. The company also installed a mechanical aerator to double the dissolved-oxygen content of the discharge water. The catalytic cracker at the plant was modified to increase its capacity about 20 percent.

American Petrofina Co. of Texas completed expansion of facilities at its plant at El Dorado, Butler County. The expansion consisted of a new treating unit for alkylation feed and a new alkylation unit. New crude oil and product storage facilities were also included.

CRA, Inc., reported a 10-percent increase in gasoline capacity at its plant in Coffeyville, Montgomery County, with the operation of a new alkylation unit. The company also received an isostripper tower, reported to be the largest ever produced in Kansas. The 190-foot-long, 11.5-foot-diameter tank will be installed at the refinery in Coffeyville.

Pipelines.—Skelly Oil Co. completed two 70-mile pipelines connecting its El Dorado refinery with the Mid-America Pipeline Co. system at Conway, Kans. One 4-inch line carries an ethane-propane mix and the other carries LP-gas products.

Other pipeline construction includes an 85-mile, 4-inch-diameter network of gathering lines and appurtenances in Scranton and Grant Counties, Kans.; a 288-mile, 10-inch-diameter line from Skellytown, Tex., to Conway, Kans.; and a 280-mile, 8-inch-diameter line between Conway, Kans., and Whiting, Iowa. A 210-mile, 8-⅝-inch-diameter pipeline was planned between Conway, Kans., and Kearney, Mo.

Petrochemical.—Petrochemical plants continued production in Douglas, Ford, Wyandotte, Sedgwick, and Butler Counties during 1969.

NONMETALS

The total value of nonmetals produced in 1969 was about $85.1 million compared with $82.6 in 1968. Four nonmetals recorded gains in the value of production and four recorded decreases.

Cement.—Plants in Neosho, Wilson, Allen, Wyandotte, and Montgomery Counties produced about 9.8 million barrels of portland cement in 1969. Two plants used the dry process and four utilized the wet process.

Table 14.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1965	8,877	8,801	$26,972
1966	9,174	8,979	27,246
1967	9,023	8,833	25,545
1968	9,887	9,680	29,898
1969	9,737	9,764	29,365

Cement shipments totaled about 9.8 million barrels, an increase of about 1 percent; markets in Kansas consumed 48 percent, and 52 percent was shipped out of State.

Distribution of shipments by type of customer was as follows: Ready-mixed concrete companies, 53 percent; concrete product manufacturers, 20 percent; building material dealers, 8 percent; highway contractors, 8 percent; other contractors, 6 percent; and miscellaneous customers about 5 percent.

After a century of continuous cement production, Fort Scott Hydraulic Cement Company ceased operations during the year. The plant was one of only three operations producing natural cement in the Nation.

Masonry cement was produced at all cement plants in Kansas. Total shipments of masonry cement decreased about 9 percent in 1969 as compared with shipments in 1968. Forty-one percent of the output was consumed by users in Kansas.

Clays.—Production of clay and shale decreased 15 percent in volume and 25 percent in value from that of 1968. The reduced output reflected decreased activity in residential construction.

Thirteen companies produced clay from 21 sources during the year. The use pattern for Kansas clay and shale was 49 percent for cement, 22 percent for building brick, and 29 percent for lightweight aggregate, sewer pipe, heavy clay products, and stoneware and pottery. Lightweight aggregate was produced from shale mine in Franklin and McPherson Counties by Buildex, Inc.

Table 15.—Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	789	$953
1966	847	1,006
1967	935	1,339
1968	932	1,433
1969 [1]	797	1,070

[1] Excludes fire clay.

Dickey Clay Co. in Pittsburg, Crawford County, opened a new clay pit in June. The new pit is expected to be depleted in about 6 years and will cover about 8 acres.

Gypsum.—Crude gypsum was recovered at two mines in Barber and Russell Counties during the year. Production of crude gypsum increased about 8 percent in quantity and 6 percent in value over that of 1968. Crude gypsum was used principally as a retarder in cement manufacture, as soil conditioner, and as a filler in paper and paint products. Calcined gypsum gained 22 percent in volume and 43 percent in value as compared to 1968 quantities. Calcined gypsum was used chiefly in wallboard and plaster.

Lime.—Kansas' sole lime producer, Great Western Sugar Company in Sherman County, continued to produce lime for use in the processing of sugar at the company's Goodland plant.

Perlite.—Lite-Weight Products, Inc., of Kansas City continued processing crude perlite that was mined out of State and used primarily for agricultural purposes.

Pumice.—Increased use of pumice (volcanic ash) as filler in asphalt products more than doubled output in 1969. The material was also used as a filter aid and an insecticide carrier and in scouring compounds, insulation, and lightweight molded articles. Production of pumice was expected to increase in 1970 as a result of the new construction of the Perlite Corp.'s building materials plant in Mankato, Jew-

ell County. The company plans to use expanded volcanic ash and urethane to produce building materials.

Salt.—Salt production gained 13 percent in volume and 10 percent in value compared to that of 1968. The increase was attributed primarily to increased demand for salt for snow and ice removal during the first part of the year.

Salt was produced in Barton, Ellsworth, Reno, and Rice Counties. Three operations mined rock salt, and five recovered evaporated salt. Two companies produced both rock and evaporated salt. One company, Frontier Chemical Co., produced brine for making chlorine and caustic soda at Wichita, Sedgwick County.

Barton Salt Co. installed a new boiler, evaporating equipment, and made electrical improvements at its plant in Reno County. The company also drilled two new brine wells. The new facilities will increase plant capacity about 40 percent. Carey Salt Co. completed a new 100,000-ton inside storage building at its Hutchinson plant. Morton Salt Co. completed two new silos and added two brine wells in 1969.

Cargill, Inc., announced plans to spend between $2 and $2.5 million to expand its operation at Pawnee Rock, Pawnee County. When completed, the expansion will more than triple production and increase the number of employees from 17 to about 70.

Sand and Gravel.—Sand and gravel was produced in 80 counties from 183 operations; 72 were contractor operations and 111 were commercial. Total output decreased from nearly 12.4 million short tons in 1968 to about 12.0 million short tons; corresponding values dropped from about $10.6 million to about $10.1 million. Fifty-two percent of the material was used for paving and 33 percent for building. Commercial operations supplied 81 percent of the total tonnage; 88 percent was processed before use.

Ninety-two percent of commercial production was moved by truck and 8 percent by rail. Leading producing counties in terms of value were Wyandotte, Sedgwick, Saline, Ellsworth, and Lincoln.

Stone.—Total stone production gained 10 percent in volume and 10 percent in value over that of 1968. Ninety-seven percent of the output was limestone, 1 percent was sandstone, and 2 percent was quartzite and chat. Limestone production increased 13 percent over 1968. Twenty-one percent of the limestone produced in 1969 was for cement manufacture.

Crushed limestone was produced in 52 counties and dimension limestone in four counties. Leading counties in terms of value were Wyandotte and Johnson Counties. Crushed sandstone was produced in Atchison, Bourbon, McPherson, and Neosho Counties. Dimension sandstone was produced in Bourbon County. Quartzite was produced in Lincoln County and chat in Cherokee County.

Table 16.—Evaporated and rock salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt	
	Quantity	Value	Quantity	Value
1965	453	$9,828	600	$2,548
1966	452	10,836	517	2,552
1967	521	12,085	548	2,601
1968	556	12,875	572	2,644
1969	623	13,810	648	3,280

Table 17.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	9,960	$7,494	2,584	$979	12,544	$8,473
1966	9,316	7,193	2,311	1,181	11,627	8,374
1967	8,510	6,727	3,556	1,922	12,066	8,650
1968	10,267	8,953	2,160	1,608	12,427	10,559
1969	9,734	8,576	2,295	1,485	12,029	10,061

[1] Data may not add to totals shown because of independent rounding.

Table 18.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,753	$3,086	3,661	$3,374
Paving	3,489	3,068	2,888	2,630
Fill	884	444	1,306	659
Other [1]	115	137	253	288
Total	8,241	6,735	8,108	6,951
Gravel:				
Building	259	238	253	287
Paving	1,673	1,742	1,224	1,079
Fill	10	12	35	32
Other [2]	84	226	115	226
Total [3]	2,026	2,218	1,626	1,625
Total sand and gravel	10,267	8,953	9,734	8,576
Government-and-contractor operations:				
Sand:				
Building	-----	-----	75	75
Paving	1,316	950	965	613
Fill	23	18	59	30
Total [3]	1,339	968	1,099	719
Gravel:				
Paving	820	638	1,196	766
Fill	1	-----	-----	-----
Total	821	638	1,196	766
Total sand and gravel [3]	2,160	1,608	2,295	1,485
Grand total [3]	12,427	10,559	12,029	10,061

[1] Includes railroad ballast, other construction, and industrial sand (ground and unground).
[2] Includes other construction and miscellaneous gravel.
[3] Data may not add to totals shown because of independent rounding.

Table 19.—Sand and gravel production in 1969, by counties
(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Barber	143	$95	Meade	32	$24
Butler	3	6	Mitchell	90	86
Chase	18	9	Morris	24	12
Cheyenne	109	99	Nemaha	9	12
Clark	20	15	Norton	38	34
Clay	103	W	Osborne	36	27
Comanche	58	43	Ottawa	55	74
Cowley	349	279	Pawnee	87	80
Decatur	30	15	Pratt	151	94
Dickinson	107	107	Rawlins	8	9
Doniphan	1	1	Reno	472	350
Edwards	47	31	Republic	187	W
Elk	19	9	Rush	11	9
Ellis	267	198	Russell	67	51
Ellsworth	48	36	Scott	28	21
Finney	267	298	Sedgwick	2,482	1,614
Gove	29	22	Seward	77	65
Graham	44	32	Shawnee	593	404
Hamilton	25	12	Sheridan	65	33
Harper	92	57	Smith	31	15
Haskell	60	32	Stevens	62	47
Hodgeman	132	99	Trego	99	77
Jackson	40	30	Wabaunsee	4	2
Kearny	19	15	Wyandotte	1,794	1,806
Kiowa	76	55	Other counties [1]	3,331	3,443
Leavenworth	13	26			
Linn	10	7	Total [2]	12,029	10,061
McPherson	65	43			

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Barton, Cloud, Douglas, Ford, Geary, Grant, Gray, Greeley, Johnson, Kingman, Logan, Lyon, Marshall, Neosho, Ness, Phillips, Pottawatomie, Rice, Riley, Rooks, Saline, Sherman, Stafford, Sumner, Thomas, Wallace, Washington, and Wichita. Undistributed amounts from various counties are also included.
[2] Data may not add to totals shown because of independent rounding.

Table 20.—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
1965	14,673	$19,566	597	$972	15,270	$20,538
1966	13,503	17,886	524	903	14,027	18,789
1967	12,776	16,594	775	1,212	13,551	17,806
1968 r	13,527	19,203	845	1,447	14,372	20,650
1969	15,353	22,036	475	609	15,828	22,645

r Revised.
[1] Includes limestone for cement.

Table 21.—Stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Limestone:				
Riprap	369	$381	959	$1,150
Concrete aggregate and roadstone	r 8,843	r 12,741	10,240	15,124
Agriculture	r 778	r 1,279	755	1,241
Cement	3,162	3,726	3,209	3,849
Dimension	10	532	19	391
Other [1]	364	544	171	281
Total [2]	r 13,527	r 19,203	15,353	22,036
Other stone [3]	844	1,447	475	609
Total stone [2]	r 14,372	r 20,650	15,828	22,645

r Revised.
[1] Includes asphalt filler, filter stone, railroad ballast, whiting, and other uses.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes chat, quartzite, and sandstone.

Holland Quarries, Inc., opened a new underground quarry on company property in Johnson County. Four haulageways were started, and three to four were mined. The company acquired about 90 acres of additional property for ultimate use. After mining, the subsurface space will be used for underground storage. The company furnishes crushed limestone for highway and building construction.

A new crusher capable of crushing 180 cubic yards of limestone per hour was installed at a new quarry in Nemaha County.

Water.—During 1969 investigations were started, projects approved, or construction initiated on five Soil Conservation Service work plans, one Bureau of Reclamation project, and one U.S. Army Corps of Engineers project to develop Kansas water resources for flood control, land management recreation, water supply, and water quality control.

METALS

The Kansas lead- and zinc-producing area in Cherokee County is part of the Tri-State District which includes northeastern Oklahoma and southwestern Missouri.

Lead and Zinc.—Five small mine operations produced lead and zinc in Cherokee County in 1969, a loss of three from 1968. Principal producers in the area were John Henderson, Scotty Mining Co., and The Quapaw Co. Concentrate production included 555 short tons of lead and 3,554 short tons of zinc with a recoverable metal content valued at $673,000 collectively. The value of metal content decreased 41 percent from that of 1968.

Eagle-Picher Industries, Inc., completed at 1,760-foot incline at its new Swalley mine near Baxter Springs, Cherokee County. Work began on an underground crusher to reduce the ore, which will be conveyed to the surface by belt. All ore will be processed initially at the company's mill near Cardin, Okla., before being shipped to Galena, Kans., for roasting, and finally to the National Zinc Co. smelter at Bartlesville, Okla. Installation of pollution control facilities neared completion at the Swalley mine for abatement of acid mine drainage, at a cost of $300,000.

Table 22.—Mine production of lead and zinc, in terms of concentrates and recoverable metals [1]

(Short tons and thousand dollars)

Year	Mines producing	Material sold or treated	Lead concentrates		Zinc concentrates		Recoverable metal content			
			Quantity	Value [2]	Quantity	Value [2]	Lead		Zinc	
							Quantity	Value [2]	Quantity	Value [2]
1965	9	310,768	2,304	$380	12,003	$1,157	1,644	$513	6,508	$1,900
1966	9	269,097	1,574	242	8,911	849	1,109	335	4,769	1,383
1967	10	250,895	1,486	209	8,832	817	1,031	289	4,765	1,319
1968	10	160,112	1,780	234	5,588	490	1,227	324	3,012	813
1969	5	59,399	555	NA	3,554	NA	395	118	1,900	555

NA Not available.

[1] Based on Kansas ore and old tailings treated at mills during calendar year indicated.

[2] In comparing values of concentrates and metal, value given for concentrates is that actually received by producer, whereas value of recoverable metal is calculated from average price for all grades.

Eagle-Picher Industries, Inc.'s, pigment plant at Galena installed a new mist eliminator for air pollution control in the sulfuric acid plant. A modification of existing dust scrubbers was also completed during the year. Sulfuric acid from the plant is piped into Missouri for use in the manufacture of fertilizer.

The Sherwin-Williams pigment plant at Coffeyville, Montgomery County, became part of the company's chemical division. It was formerly part of the Ozark Smelting and Mining Division of the same company. As a result of passage or ordinances prohibiting use of high-leaded pigments in paints, the Coffeyville plant ceased production of 35-, 50-, and 55-percent-lead blends for pigments. The company processes lead and zinc ores imported from Canada and Mexico.

Table 23.—Principal producers

Commodity and company	Address	Type of activity	County
Carbon Black:			
Columbian Carbon Co	380 Madison Ave. New York, N.Y. 10017	Furnace	Grant.
Cement:			
Ash Grove Cement Co	1000 Tenmain Center Kansas City, Mo. 64105	Plant and quarry.	Neosho.
General Portland Cement Co	2800 Republic Bank Tower Dallas, Tex. 75201	----do	Wilson.
Lehigh Portland Cement Co	Young Bldg., 718 Hamilton Allentown, Pa. 18105	----do	Allen.
Lone Star Cement Corp	2511 East 46th St., Suite "K" Indianapolis, Ind. 46205	----do	Wyandotte.
The Monarch Cement Co	Humboldt, Kans. 66748	----do	Allen.
Universal Atlas Cement, Div. of U.S. Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	----do	Montgomery.
Clays:			
Acme Brick Co	Box 425 Fort Worth, Tex. 76101	Mine and plant.	Cherokee, Ellsworth.
Ash Grove Cement Co	1000 Tenmain Center Kansas City, Mo. 64105	----do	Neosho.
Buildex, Inc	Box 62299 Pittsburg, Kans. 66762	----do	Franklin, McPherson.
Cloud Ceramics	Box 417 Concordia, Kans. 66901	----do	Cloud.
W. S. Dickey Clay Manufacturing Co.	1818 Commerce Tower Kansas City, Mo. 64105	----do	Cherokee, Crawford.
Excelsior Clay Products, Inc	342 North Waco Wichita, Kans. 67202	----do	Wilson.
General Portland Cement Co	Box 479 Fredonia, Kans. 66736	----do	Do.
Humboldt Shale Mining Co	Box 185 Humboldt, Kans. 66748	Mine	Allen.
Kansas Brick & Tile Co., Inc	Box 126 Hoisington, Kans. 67544	Mine and plant.	Barton.
Lehigh Portland Cement Co	718 Hamilton Allentown, Pa. 18100	Mine and plant.	Allen.
The Monarch Cement Co	Humboldt, Kans. 66748	----do	Do.
Universal Atlas Cement Co., Div. of U.S. Steel Corp.	Box 2969 Pittsburgh, Pa. 15230	----do	Montgomery.
Wilkinsons, Inc	Rt. 1 Weir, Kans. 66781	Mine	Cherokee.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal:			
Cliff Carr Coal Co	Rt. 1 Mulberry, Kans. 66756	Strip mine	Crawford.
The Clemens Coal Co	Box 62299 Pittsburgh, Kans. 66762	----do	Do.
Pittsburg & Midway Coal Mining Co.	Tenmain Center Kansas City, Mo. 64105	----do	Cherokee.
Wilkinsons, Inc	Rt. 1 Weir, Kans. 66781	----do	Do.
Gypsum:			
Georgia-Pacific Corp., Gypsum Div.	900 Southwest 5th Portland, Ore. 97204	Quarry and plant.	Marshall.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Barber.
Lead and Zinc:			
John Henderson	Box 281 Picher, Okla. 74360	Underground	Cherokee.
Scotty Mining Co	Box 389 Baxter Springs, Kans. 66713	----do	Do.
The Quapaw Co	Box 187 Picher, Okla. 74360	----do	Do.
Lime: The Great Western Sugar Co	Box 5308 Denver, Colo. 80217	Plant	Sherman.
Perlite: Lite-Weight Products, Inc	707 Funston Rd. Kansas City, Kans. 66115	Expanding plant.	Wyandotte.
Pumice:			
Ernest Hanzlicek	Wilson, Kans. 67490	Mine	Lincoln.
Interpace Corp	Mankato, Kans. 66956	----do	Jewell.
San Ore Constr. Co., Inc	Box 417 McPherson, Kans. 67460	----do	Logan, McPherson, Norton.
Wyandotte Chemicals Corp	1609 Biddle Ave. Wyandotte, Mich. 48192	Mine and plant.	Norton.
Salt:			
American Salt Corporation	3142 Broadway Kansas City, Mo. 64111	Wells and underground.	Rice.
The Barton Salt Company	Box 989 Hutchinson, Kans. 67501	Wells	Reno.
The Carey Salt Company	1800 Carey Blvd. Hutchinson, Kans. 67501	Well and underground.	Do.
Cargill, Inc	Cargill Bldg. Minneapolis, Minn. 55402	Wells	Barton.
Independent Salt Company	Box 36 Kanopolis, Kans. 67454	Underground	Ellsworth.
Morton Salt Company	110 North Wacker Drive Chicago, Ill. 60606	Wells	Reno.
Vulcan Materials Co., Chemicals Div.	Box 545 Wichita, Kans. 67201	Brine wells	Sedgwick.
Sand and Gravel:			
John H. Alsop Sand Co	Belleville, Kans. 66935	Stationary	Clay, Republic.
American Sand Co	4600 Speaker Rd. Kansas City, Kans. 66106	Dredge	Wyandotte.
Assoc. Material & Supply Co., Inc.	Box 4158 North Wichita Station Wichita, Kans. 67214	Stationary	Sedgwick.
Blue River Sand & Gravel Co	Blue Rapids, Kans. 66411	Portable and dredge.	Marshall.
Builders Sand Co	Box 658, Argentine Station Kansas City, Kans. 66106	Stationary	Wyandotte.
Dolese Brothers Co	13 Northwest 13th St. Oklahoma City, Okla. 73103	----do	Sedgwick.
Holliday Sand & Gravel Co	6811 West 63rd Street Overland Park, Kans. 66202	Stationary and portable.	Wyandotte, Johnson, Douglas.
Peck-Woolf Sand & Material Co	7301 Kaw Dr. Kansas City, Kans. 66111	Dredge	Wyandotte.
Salina Sand Co., Inc	Mentor, Kans. 67465	Stationary	Saline.
San Ore Constr. Co., Inc	Box 417 McPherson, Kans. 67460	Portable	Sherman, Barber.
Stewart Sand & Material Co	4049 Pennsylvania Ave. Kansas City, Mo. 66108	Stationary	Wyandotte.
Superior Sand Co., Inc	6500 West 21st, Route 7 Wichita, Kans. 67212	Dredge	Sedgwick.
Wichita Big River Sand Co	990 North Westlink Wichita, Kansas 67212	Stationary	Do.

Table 23.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:			
General Portland Cement Co	2800 Republic Bank Tower Dallas, Tex. 75201	Quarry	Wilson.
Hallett Construction Co	Crosby, Minn. 56441	do	Chase, Clay, Dickinson, McPherson, Marion, Rice.
N. R. Hamm Quarry, Inc	Box 17 Perry, Kans. 66073	do	Jefferson, Leavenworth, Shawnee.
Holland Quarries	9131 Noland Rd. Lenexa, Kans. 66215	do	Johnson.
Ideal Cement Company	420 Ideal Cement Bldg. Denver, Colo. 80202	do	Jewell.
Lone Star Cement Corp	2511 East 46th St., Suite "K" Indianapolis, Ind. 46205	do	Wyandotte.
Midwest Minerals, Inc	Box 7 Girard, Kans. 66743	do	Various.
The Monarch Cement Co	Humboldt, Kans. 66748	do	Allen.
Reno Construction Co	Box 4278 Overland Park, Kans. 66204	do	Johnson.
Thompson-Strauss Quarries	7000 Holliday Dr. Kansas City, Kans. 66106	do	Wyandotte.
West-Lake Quarry & Material Co	Rt. 1, Box 206 Taussig Rd. Bridgeton, Mo. 63042	do	Doniphan.
Helium:			
Alamo Chemical Co., Gardner Cryogenics, Inc.	Elkhart, Kans. 67950	Plant	Morton.
Cities Service Cryogenics, Inc	Scott City, Kans. 67871	do	Scott.
Cities Service Helex, Inc	Ulysses, Kans. 67880	do	Grant.
Kansas Refined Helium Co	Otis, Kans. 67565	do	Rush.
National Helium Corp	Liberal, Kans. 67901	do	Seward.
Northern Helex Co	Bushton, Kans. 67427	do	Ellsworth.
Petroleum Operators:			
Cities Service Oil Co	Tulsa, Okla. 74100		Various.
Continental Oil Co	New York, N.Y. 10000		Do.
National Cooperative Refinery Association.	McPherson, Kans. 67460		Do.
Pan American Petrol. Corp	Tulsa, Okla. 74100		Do.
Skelly Oil Co	do		Do.
Sun Oil Co	Philadelphia, Pa. 19100		Do.
Texaco, Inc	New York, N.Y. 10000		Do.
Petroleum Refineries:			
American Oil Co	Neodesha, Kans. 66757	Refinery	Wilson.
American Petrofina Co. of Texas	El Dorado, Kans. 67042	do	Butler.
Apco Oil Corp	Arkansas City, Kans. 67005	do	Cowley.
Century Refining Co	Scott City, Kans. 67871	do	Scott.
CRA, Inc	Coffeyville, Kans. 67337	do	Montgomery.
	Phillipsburg, Kans. 67661	do	Phillips.
Derby Refining Co	Wichita, Kans. 67200	do	Sedgwick.
Mid-American Refining Co., Inc	Chanute, Kans. 66720	do	Neosho.
Mobil Oil Corp	Augusta, Kans. 67010	do	Butler.
National Cooperative Refinery Association.	McPherson, Kans. 67460	do	McPherson.
Phillips Petroleum Co	Kansas City, Kans. 66100	do	Wyandotte.
Skelly Oil Co	El Dorado, Kans. 67042	do	Butler.
Natural Gas Purchasers:			
Cities Service Gas Co	Okla. City, Okla. 73100		Various.
Colorado Interstate Gas Co	Colorado Springs, Colo. 80900		Do.
Kansas-Nebraska Natural Gas Co	Hastings, Nebr. 68901		Do.
Northern Natural Gas Co	Omaha, Nebr. 68100		Do.
Panhandle Eastern Pipeline Co	Houston, Tex. 77000		Do.

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 S. A. Friedman [1] and Preston McGrain [2]

The value of mineral production in Kentucky increased 10 percent above that of 1968, reaching a record high of $591 million. Kentucky advanced from 15th to 13th among the States in value of mineral production. Coal accounted for 76 percent of this mineral value. Kentucky ranked second in the production of bituminous coal in the United States.

Government Programs.—The U.S. Geological Survey with the cooperation of the Kentucky Geological Survey continued to map the areal geology of the State on 7.5-minute topographic quadrangle maps. A total of 338 geological maps covering parts or all of 358 quadrangles have been published.

[1] Geologist, Bureau of Mines, Knoxville, Tenn.
[2] Assistant State geologist, Kentucky Geological Survey, Lexington, Ky.

Table 1.—Mineral production in Kentucky [1]

	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	1,219	$1,952	1,232	$2,076
Coal (bituminous) do	101,156	395,039	109,049	450,950
Fluorspar short tons	17,050	878	W	W
Natural gas million cubic feet	89,024	22,256	81,304	20,407
Petroleum (crude) thousand 42-gallon barrels	14,036	41,125	12,924	40,194
Sand and gravel thousand short tons	7,478	8,081	8,364	9,628
Stone do	30,105	43,266	[3] 30,158	[3] 44,644
Value of items that cannot be disclosed: Native asphalt (1968), ball clay, cement, lead (1968), natural gas liquids, quartzite (1969), zinc (recoverable content of ores, etc.), and values indicated by symbol W	XX	22,266	XX	23,149
Total	XX	534,863	XX	591,048
Total 1967 constant dollars	XX	529,509	XX	p 549,142

p Preliminary. 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 ball clay, included with "Value of items that cannot be disclosed."
[3] Excludes quartzite, included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Kentucky, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value [2]
Adair	W	W	Limestone, petroleum.
Allen	W	W	Do.
Anderson	W	W	Limestone.
Ballard	$13	$10	Sand and gravel.
Barren	977	330	Limestone, petroleum.
Bath	9	12	Petroleum.
Bell	10,334	8,163	Coal, petroleum.
Boone	985	887	Sand and gravel.
Bourbon	W	W	Limestone.
Boyd	W	W	Coal, miscellaneous clay.
Boyle	W	W	Limestone.
Breathitt	5,410	W	Coal, petroleum.
Breckinridge	483	499	Limestone, sand and gravel, petroleum.
Bullitt	886	1,189	Limestone, miscellaneous clay.
Butler	W	W	Coal, limestone, petroleum.
Caldwell	W	W	Limestone, fluorspar.
Calloway	W	W	Sand and gravel, limestone.
Carlisle	12	18	Sand and gravel.
Carter	1,587	2,801	Limestone, fire clay, coal.
Casey	224	W	Limestone, petroleum.
Christian	3,179	1,887	Limestone, petroleum, miscellaneous clay.
Clay	2,706	2,275	Coal, petroleum.
Clinton	337	268	Petroleum, limestone, coal.
Crittenden	W	W	Limestone, fluorspar, zinc.
Cumberland	W	W	Petroleum, limestone.
Daviess	W	7,564	Petroleum, coal, sand and gravel, miscellaneous clay.
Edmonson	W	W	Limestone, petroleum.
Elliott	173	117	Petroleum.
Estill	W	W	Petroleum, limestone.
Fayette	W	W	Limestone.
Fleming	W	W	Do.
Floyd	26,118	26,390	Coal, petroleum, sand and gravel.
Franklin	W	W	Limestone.
Fulton	7	W	Sand and gravel.
Gallatin	W	W	Do.
Garrard	109	131	Limestone.
Graves	W	W	Ball clay, sand and gravel.
Grayson	W	W	Limestone.
Green	W	W	Petroleum, limestone.
Greenup	453	W	Limestone, fire clay, petroleum.
Hancock	516	694	Miscellaneous clay, petroleum, fire clay.
Hardin	1,601	1,309	Limestone.
Harlan	36,747	46,423	Coal, limestone.
Harrison	W	W	Limestone.
Hart	245	W	Limestone, sand and gravel, petroleum.
Henderson	8,502	7,890	Petroleum, sand and gravel, coal.
Henry	W	W	Limestone.
Hickman	1	W	Sand and gravel.
Hopkins	43,301	49,822	Coal, petroleum, miscellaneous clay.
Jackson	201	199	Limestone, coal, petroleum.
Jefferson	13,812	13,387	Cement, limestone, sand and gravel, miscellaneous clay.
Jessamine	W	W	Limestone.
Johnson	5,210	W	Coal, petroleum.
Knott	8,270	11,910	Do.
Knox	579	544	Do.
Laurel	W	W	Limestone, coal, petroleum.
Lawrence	W	1,221	Petroleum, coal.
Lee	W	W	Petroleum, limestone, coal.
Leslie	8,021	7,880	Coal, petroleum.
Letcher	29,568	34,476	Coal, limestone, petroleum.
Livingston	6,686	8,130	Limestone, sand and gravel, zinc, quartzite, fluorspar.
Logan	W	W	Limestone, petroleum.
Lyon	5	5	Sand and gravel.
Madison	W	W	Limestone, fire clay.
Magoffin	2,030	W	Coal, petroleum.
Marion	W	W	Limestone.
Marshall	15	15	Sand and gravel.
Martin	2,813	4,618	Coal, sand and gravel, petroleum.
Mason	165	118	Sand and gravel.
McCracken	W	W	Do.
McCreary	W	W	Coal, petroleum.
McLean	2,391	2,138	Petroleum.
Meade	W	W	Limestone.
Menifee	W	W	Do.
Mercer	W	W	Do.

See footnotes at end of table.

Table 2.—Value of mineral production in Kentucky, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value [2]
Metcalfe	W	W	Petroleum, limestone.
Monroe	$393	$330	Limestone, petroleum.
Montgomery	80	108	Limestone.
Morgan	777	980	Limestone, coal, fire clay, petroleum.
Muhlenberg	71,589	76,278	Coal, petroleum, limestone.
Nelson	W	W	Limestone.
Nicholas	W	W	Do.
Ohio	W	W	Coal, limestone, petroleum.
Oldham	1,666	1,236	Limestone.
Owsley	1	1	Petroleum.
Pendleton	W	W	Limestone.
Perry	18,033	26,527	Coal, petroleum.
Pike	78,693	93,637	Coal, limestone, petroleum.
Powell	W	W	Limestone, petroleum, miscellaneous clay.
Pulaski	2,423	W	Coal, limestone, petroleum.
Rockcastle	W	W	Limestone, coal.
Rowan	1,589	1,571	Limestone, fire clay, miscellaneous clay.
Russell	2	2	Petroleum.
Scott	W	W	Limestone.
Simpson	W	W	Limestone, petroleum.
Taylor	W	W	Do.
Todd	W	W	Do.
Trigg	224	W	Limestone.
Trimble	W	W	Sand and gravel.
Union	21,732	W	Coal, petroleum, sand and gravel.
Warren	880	1,080	Limestone, petroleum.
Wayne	W	W	Limestone, coal, petroleum.
Webster	9,671	W	Coal, petroleum.
Whitley	1,480	1,233	Coal, petroleum, miscellaneous clay.
Wolfe	W	176	Limestone, petroleum.
Undistributed [3]	100,949	144,575	
Total [4]	534,863	591,048	

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

[1] The following counties are not listed because no production was reported: Bracken, Campbell, Carroll, Clark, Grant, Kenton, Larue, Lewis, Lincoln, Owen, Robertson, Shelby, Spencer, Washington, and Woodford.

[2] Excludes natural gas and natural gas liquids; included in "Undistributed."

[3] Includes natural gas, natural gas liquids, and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

The Kentucky Geological Survey published nine reports on geology and mineral resources.[3]

The U.S. Geological Survey published a bulletin on clay deposits in Western Kentucky. [4]

Economic Indicators.—Personal per capita income increased 8 percent. Although Kentucky ranks only 43d in per capita income in the nation, it is 5th in a 12-state southeastern region. The total number of unemployed increased 7 percent, which paralleled the national trend. Agricultural employment decreased 12 percent, but farm marketing receipts increased 7 percent. Portland cement shipments into and within the State decreased 20 percent, re-

[3] Branson, E. R. Economic Geology of Simpson County, Kentucky. Kentucky Geol. Survey, Ser. X, County Rept. 3, 1969, 20 pp.

Dever, G. R., Jr., and Preston McGrain. High-Calcium and Low-Magnesium Limestone Resources in the Region of the Lower Cumberland, Tennessee, and Ohio Valleys, Western Kentucky. Kentucky Geol. Survey, Ser. X, Bull. 5, 1969, 192 pp.

Krieger, R. A., R. V. Cushman, and N. O. Thomas. Water in Kentucky. Kentucky Geol. Survey, Ser. X, Spec. Pub. 16, 1969, 51 pp.

Rose, W. D. (editor). Proceedings of the Technical Sessions, Kentucky Oil and Gas Association 32nd Annual Meeting, 1968. Kentucky Geol. Survey, Ser. X, Spec. Pub. 17, 1969, 84 pp.

———. Proceedings of the Technical Sessions, Kentucky Oil and Gas Association 33rd Annual Meeting, 1969. Kentucky Geol. Survey, Ser. X, Spec. Pub. 18, 1969, 47 pp.

Schwalb, H. R. Catalog of Devonian and Deeper Wells in Western Kentucky. Kentucky Geol. Survey, Ser. X, Inf. Circ. 17, 1969, 17 pp.

———. Paleozic Geology of the Jackson Purchase Region, Kentucky, With Reference to Petroleum Possibilities. Kentucky Geol. Survey, Ser. X, Rept. of Inv. 10, 1969, 39 pp.

Sedimentation Seminar (Indiana University and University of Cincinnati). Bethel Sandstone (Mississippian) of Western Kentucky and South-Central Indiana, A Submarine Channel-Fill. Kentucky Geol. Survey. Ser. X, Report of Inv. 11, 1969, 24 pp.

Whitesides, D. V. and P. D. Ryder. Effects of Pumping From the Ohio River Valley Alluvium Between Carrollton and Ghent, Kentucky. Kentucky Geol. Survey, Ser. X, Inf. Circ. 18, 1969, 20 pp.

[4] Olive, W. W. and W. I. Finch. Stratigraphic and Mineralogic Relationships and Ceramic Properties of Clay Deposits of Eocene Age in the Jackson Purchase Region, Kentucky and Adjacent parts of Tennessee. U.S. Geol. Survey Bull. 1282, 1969, 35 pp.

flecting a 12-percent decrease in housing construction value.

New business incorporations steeply increased 30 percent. Mineral production value increased 10 percent, and electrical energy sales (excluding those to AEC) increased 6 percent.

Trends and Developments.—In spite of numerous problems, some of which were mid-summer flooding in some mines, pressure to cause a ban on surface mining, action by county governments to delay or stop surface mining, wildcat strikes and other work stoppages, a shortage of railroad cars, and strict enforcement of reclamation regulations, bituminous coal production increased to a new high of 109 million tons in 1969.

The U.S. Bureau of Mines obtained data from representative coal mine operators, which indicated a large available supply of coal reserves at more than $5.51 per ton

Table 3.—Selected economic indicators of Kentucky business activity

	1968	1969	Change, percent
Employment and labor force, annual average:			
Total work force available—thousands	1,141	1,143	+0.2
Total unemployed—do	42	45	+7.1
Employment:			
Agricultural—do	122	107	−12.3
Nonagricultural—do	853	895	+4.9
Mining—do	27	27	0
Contract construction—do	51	55	+7.8
Service—do	116	123	+6.0
Government—do	160	167	+4.4
Manufacturing—do	232	247	+6.5
Personal income:			
Total—millions	$8,516	$9,210	+8.1
Per capita	$2,642	$2,850	+7.9
New business incorporations	2,802	3,657	+30.5
Construction activity:			
Housing units—private and public:			
Number	15,763	14,232	−9.7
Value—millions	$186	$164	−11.8
Cement shipments to and within Kentucky:			
Portland (includes high early strength) thousand 376-pound barrels	7,250	5,804	−20.0
Masonry ____thousand 280-pound barrels	632	634	+0.3
Farm marketing receipts—thousands	r $824,811	$881,685	+6.9
Mineral production—millions	$535	$591	+10.5
Electrical energy sales (sales to AEC excluded) million kilowatt hours	13,347	14,136	+5.9

r Revised.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Kentucky Department of Labor, and Kentucky Department of Economic Security.

Table 4.—Worktime 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
1968:								
Coal	22,840	197	4,491	35,689	58	1,704	49.37	13,259
Metal	67	282	19	151	1	15	106.03	41,101
Nonmetal	293	229	67	537	---	19	35.39	7,947
Sand and gravel	312	272	85	812	---	32	39.42	8,388
Stone	2,142	248	530	4,389	7	142	33.95	10,463
Total [1]	25,654	202	5,192	41,577	66	1,912	47.57	12,902
1969: p								
Coal	22,600	203	4,587	36,178	34	1,600	45.11	7,671
Metal	45	249	11	92	---	11	119.88	5,166
Nonmetal	235	236	55	440	---	19	43.19	10,925
Sand and gravel	305	262	79	754	---	15	19.89	736
Stone	2,200	251	552	4,608	6	125	28.43	9,244
Total [1]	25,345	209	5,285	42,073	40	1,770	42.97	7,747

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

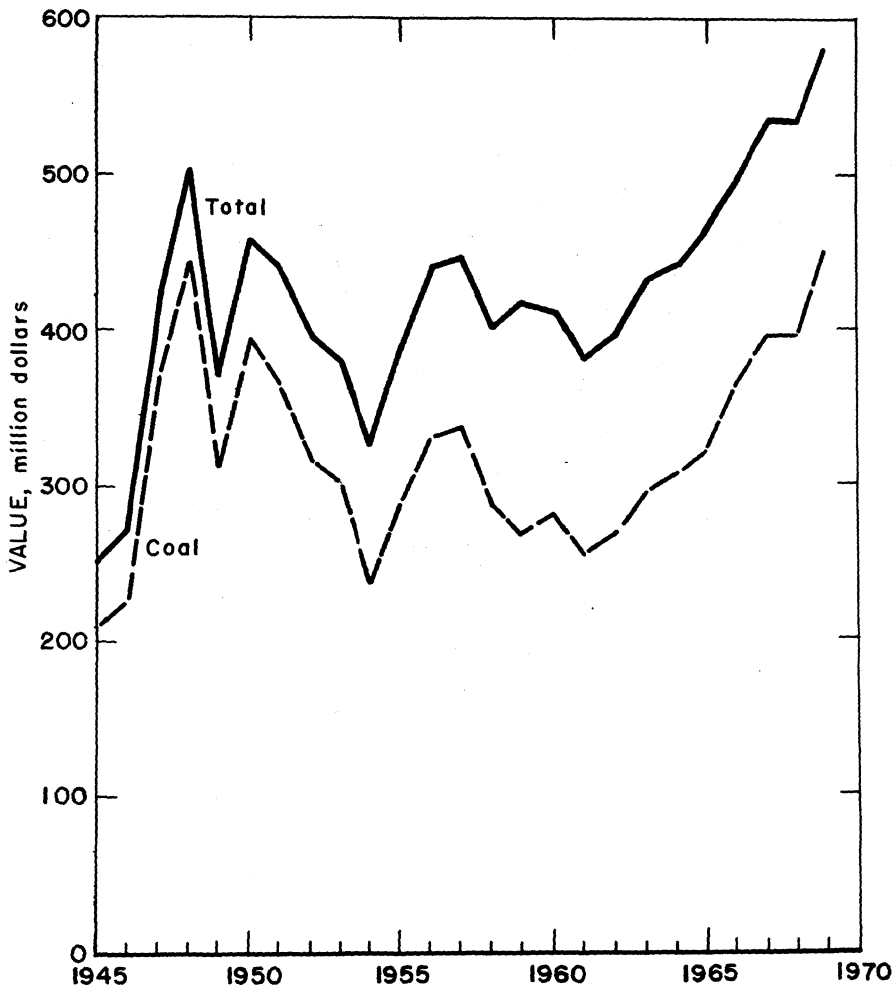

Figure 1.—Value of coal and total value of mineral production in Kentucky.

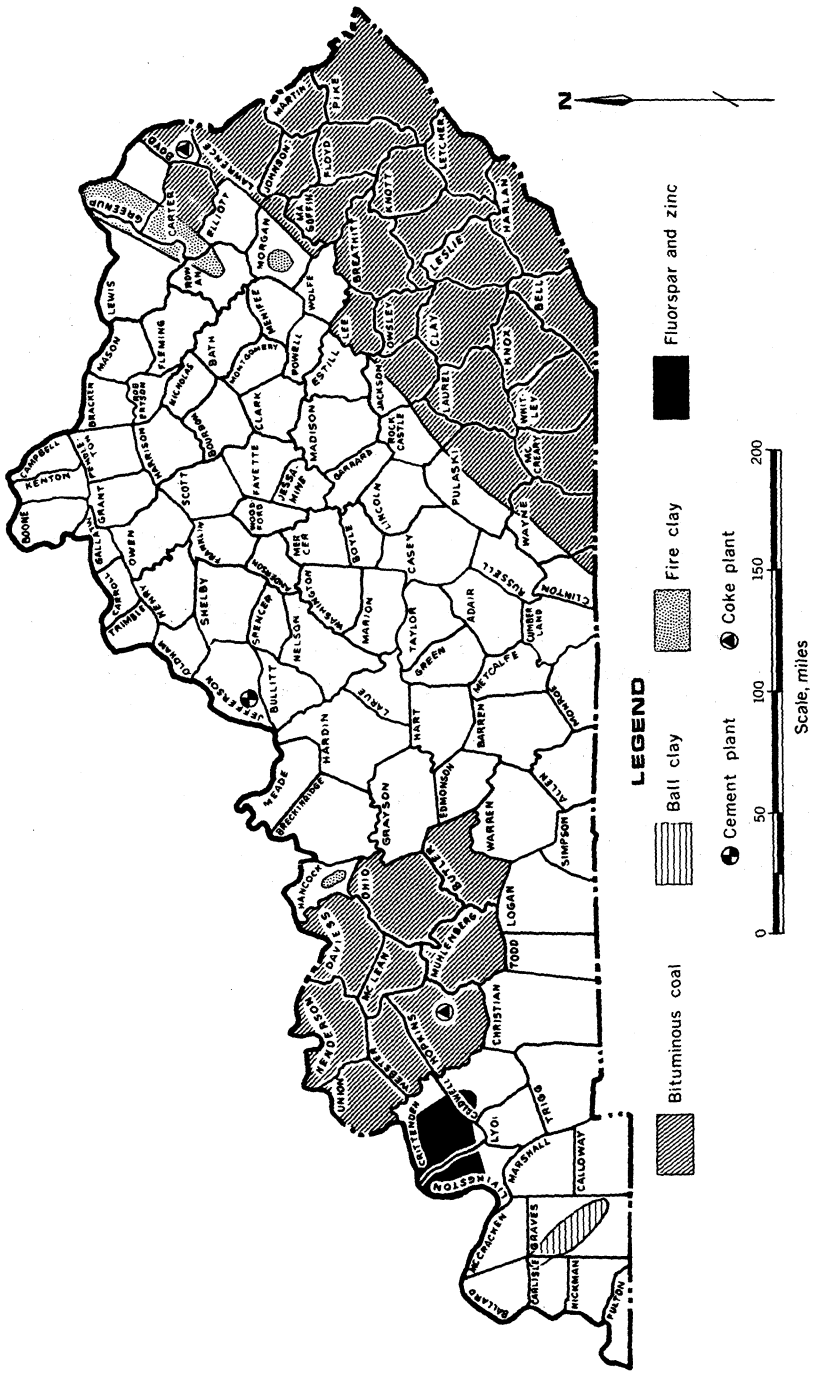

Figure 2.—Generalized map showing principal producing areas of selected mineral commodities, 1969.

f.o.b. mines. Top prices were paid for the low-sulfur coal for export and for coke manufacture.

Peabody Coal Co. and Island Creek Coal Co. announced plans for three new high-capacity underground mines in Union County and one in Hopkins County to supply the Tennessee Valley Authority. Island Creek Coal Co. and A.T. Massey scheduled two new underground mines in Martin County, which will supply nearly 5 million tons per year of utility coal via unit trains to Carolina Power and Light Co. and Duke Power Co. National Steel Corp. through its subsidiary, Beaver Creek Consolidated Coal Co., plans to open the underground Stinson Mine in Knott County, with a planned capacity of more than 1 million tons per year of metallurgical coal. Beth-Elkhorn Corp. began developing two new underground mines in Pike County to supply the Burns Harbor, Indiana, coke plant with low-sulfur coal. Beth-Elkhorn is contesting a suit to prevent it from augering utility coal in northern Letcher County.

Environmental Controls.—Regulations were rigidly enforced by the State to protect the environment from adverse effects of surface mining and mineral processing in Kentucky. The Kentucky Air Pollution Control Commission, the Kentucky Water Pollution Control Commission, and the Kentucky Reclamation Commission were the enforcing agencies. Fluorspar, sand and gravel (exclusive of river sand and gravel), stone, and rock asphalt came under a new Reclamation act in June 1969.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The combined value of bituminous coal, crude petroleum, and natural gas was $512 million, 87 percent of the mineral production value of the State.

Coal (Bituminous).—Production of coal increased 8 percent, and its value increased 14 percent above that of 1968. Value was $451 million, setting a new record high for the State.

Bituminous coal was produced at 1,341 mines in 35 counties, compared with 1,395 mines in 35 counties in 1968. Pike and Muhlenberg Counties each produced more than 21 million tons of coal. In eastern Kentucky 1,261 mines in 28 counties produced 62 million tons of coal, compared with 1,311 mines, which produced 55 million tons in 27 counties in 1968. Four percent fewer mines operated in eastern Kentucky; in western Kentucky the number was unchanged. All but one of the 150 auger mines were in eastern Kentucky, but 44 of the 163 strip mines were in western Kentucky. Muhlenberg County led in strip mine production in western Kentucky, and Perry County led in eastern Kentucky. Perry and Pike Counties led in auger production.

Underground mines produced 72 percent of the total output in eastern Kentucky, auger mines, 12 percent, and strip mines, 16 percent. Six percent more of the total was from surface mining than in 1968. Shipments were 94 percent by rail or water and 6 percent by truck. Unit trains carried 7 percent of the total rail shipments.

In western Kentucky 80 mines in eight counties produced 47.5 million tons of coal, compared with 84 mines in eight counties and 46.5 million tons in 1968. Strip mines produced 58 percent of the total coal; underground mines, 42 percent, and auger mines, less than 1 percent. Three percent less of the total was from strip mining than in 1968. Shipments were 86 percent by rail or water and 14 percent by truck. Unit trains carried 7 percent.

Natural Gas.—Marketed production of natural gas decreased in quantity and value, and amounted to 3.5 percent of the total mineral production value of the State. Production declined in Muhlenberg County because the Midland Gas Field was changed to a storage field. Excluding this field, western Kentucky gas production increased slightly. Gas production in eastern Kentucky also increased slightly. In 1969, 146 new gas wells and 16 gas storage wells were completed.

Natural Gas Liquids.—The quantity and value of natural gasoline sharply increased 21 and 29 percent, respectively. Value was 25 percent below that of 1955, the record year. Production of liquefied petroleum gases (LPG) increased 10 percent, but value decreased 4 percent.

Petroleum.—Crude oil production of 13 million barrels was 8 percent less and

Table 5.—Coal (bituminous) production [1] in 1969, by counties

(Thousand short tons and thousand dollars)

County	Number of mines in operation			Production [2]				
	Underground	Strip	Auger	Underground	Strip	Auger	Total	
							Quantity	Value
Bell	27	15	15	797	930	557	2,284	$8,162
Boyd	-----	2	---	------	13	-----	13	66
Breathitt	W	8	W	W	2,381	W	2,618	W
Butler	1	6	---	36	163	-----	198	945
Carter	W	---	---	W	------	-----	W	W
Clay	21	W	W	353	W	W	519	2,265
Clinton	W	---	---	W	------	-----	W	33
Daviess	-----	1	---	------	912	-----	912	2,735
Floyd	142	W	W	4,026	W	W	4,655	W
Harlan	83	10	17	7,076	448	530	8,055	W
Henderson	3	---	---	118	------	-----	118	W
Hopkins	W	15	1	W	5,072	W	12,438	W
Jackson	W	---	---	W	------	-----	W	W
Johnson	27	W	W	240	W	W	1,031	W
Knott	52	5	22	1,637	315	886	2,838	11,885
Knox	37	5	---	103	47	-----	150	540
Laurel	1	---	---	6	------	-----	6	23
Lawrence	1	2	---	15	56	-----	71	265
Lee	W	---	---	W	------	-----	W	W
Leslie	28	1	7	1,455	28	291	1,774	7,873
Letcher	119	11	18	4,496	837	644	5,977	W
McCreary	5	4	---	409	128	-----	537	W
Magoffin	-----	W	W	W	W	W	755	W
Martin	5	---	2	914	------	354	1,268	4,531
Morgan	W	W	---	W	W	-----	33	W
Muhlenberg	7	15	---	4,367	17,054	-----	21,420	W
Ohio	W	12	---	W	W	-----	6,317	W
Perry	50	16	22	2,677	1,657	1,728	6,062	26,044
Pike	368	12	31	19,588	661	1,524	21,773	W
Pulaski	5	5	---	445	359	-----	804	W
Rockcastle	-----	1	---	------	2	-----	2	6
Union	W	---	---	W	W	-----	W	W
Wayne	-----	W	---	------	W	-----	W	200
Webster	W	W	---	W	W	-----	1,362	W
Whitley	18	4	---	214	61	-----	275	W
Undistributed [3]	28	13	15	15,361	6,379	695	[4] 4,784	385,375
Total	1,028	163	150	64,336	37,503	7,211	109,049	450,950
Earliest record to date	-----	---	---	------	------	-----	3,493,421	NA

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Excludes mines producing less than 1,000 tons.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes counties indicated by symbol W.

[4] Does not equal the sum of undistributed underground, strip, and auger because some county totals are publishable.

value, 2 percent less than in 1968. Crude oil production has steadily decreased since 1959, the record year. Of 1,062 wells drilled during 1969, 308 were completed as oil wells, 510 were dry holes, and 82 were water injection and water supply wells for secondary recovery projects.

Union County in western Kentucky was the leading producing county in the State with 2.3 million barrels of oil. Lee County led in eastern Kentucky with 1.7 million barrels.

NONMETALS

Nonmetals provided 11 percent of the total value of mineral production in Kentucky in 1969.

Cement.—Kosmos Portland Cement Co. in Jefferson County operated Kentucky's only cement plant. Quantity and value of portland cement shipped decreased 5 and 4 percent, respectively, in part reflecting a slump in housing construction. Most of the cement was shipped by truck to ready mix plants in Kentucky. Shipments and value of masonry cement increased 3 and 11 percent, respectively, establishing a new record, with most of the shipments made to Kentucky and Indiana. Raw materials used in portland cement manufacture were limestone (76 percent), miscellaneous clay (20 percent), gypsum (3 percent), and iron ore (1 percent).

Clays.—Ball clay increased 13 percent in production and 29 percent in value. Kentucky ranked second in the nation in production of this commodity. Three companies produce from four open pit mines in

Table 6.—Crude petroleum production by counties

(Thousand 42-gallon barrels and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Adair	[1]	$1	8	$23
Allen	62	183	62	192
Barren	16	47	11	35
Bath	3	9	4	12
Bell	------	---------	[1]	1
Boyd	2	6	------	---------
Breathitt	29	85	25	77
Breckinridge	18	52	12	38
Butler	69	202	62	193
Casey	15	44	16	50
Christian	199	584	181	564
Clay	6	18	3	10
Clinton	50	147	42	132
Cumberland	37	107	28	86
Daviess	1,251	3,665	1,228	3,820
Edmonson	1	2	[1]	1
Elliott	43	127	38	117
Estill	302	884	278	866
Floyd	39	114	35	107
Green	143	420	112	348
Greenup	5	15	4	14
Hancock	89	260	76	235
Hart	21	63	17	52
Henderson	2,252	6,599	2,016	6,271
Hopkins	945	2,769	855	2,657
Jackson	[1]	[1]	[1]	[1]
Johnson	486	1,424	393	1,223
Knott	10	28	8	25
Knox	2	5	1	4
Laurel	4	12	3	9
Lawrence	362	1,062	307	956
Lee	1,668	4,888	1,558	4,843
Leslie	3	8	2	6
Letcher	113	330	258	802
Logan	1	3	1	4
McCreary	2	7	1	2
McLean	816	2,391	686	2,138
Magoffin	425	1,246	344	1,069
Marion	[1]	[1]	------	---------
Martin	12	34	11	35
Metcalfe	118	345	94	292
Monroe	29	85	23	72
Morgan	1	4	1	4
Muhlenberg	491	1,440	406	1,262
Ohio	514	1,505	467	1,454
Owsley	1	1	[1]	1
Perry	28	82	155	483
Pike	32	93	29	91
Powell	58	170	37	114
Pulaski	3	8	3	9
Russell	1	2	1	2
Simpson	6	19	4	12
Taylor	1	3	[1]	[1]
Todd	1	2	[1]	[1]
Union	2,291	6,713	2,077	6,457
Warren	22	65	24	74
Wayne	16	47	11	33
Webster	892	2,612	884	2,750
Whitley	20	58	16	49
Wolfe	10	28	6	19
Total [2]	14,036	41,125	12,924	40,194
Earliest record to date	558,470	1,348,049	571,394	1,388,243

[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.

Source: Kentucky Geological Survey.

Table 7.—Oil and gas well drilling in 1969

County	Development wells				Exploratory wells			
	Oil	Gas	Dry	Footage	Oil	Gas	Dry	Footage
Adair	6	---	3	12,975	6	---	9	15,199
Allen	6	---	7	4,560	1	---	4	1,763
Barren	5	---	5	3,279	2	---	15	11,043
Boyd	---	1	---	7,800	---	---	---	------
Breathitt	---	12	1	24,553	---	---	---	------
Breckinridge	---	---	6	2,443	---	---	2	568
Butler	2	---	6	2,733	---	---	3	1,800
Caldwell	---	---	---	------	---	---	1	1,900
Carter	---	---	---	------	---	---	3	9,939
Casey	3	---	2	8,807	---	---	3	4,732
Christian	4	---	8	6,409	---	---	2	1,154
Clark	---	---	---	------	---	---	1	4,937
Clay	---	9	2	12,916	---	2	3	6,493
Clinton	3	---	1	2,286	---	---	1	1,222
Crittenden	---	---	1	1,465	---	---	---	------
Cumberland	11	---	11	11,179	---	---	5	3,589
Daviess	54	---	60	145,965	1	---	16	26,084
Edmonson	---	---	3	3,074	---	---	1	1,548
Elliott	3	---	---	3,093	---	---	1	1,339
Estill	---	---	1	350	---	---	1	6,817
Floyd	2	9	3	26,109	---	1	---	2,867
Garrard	---	---	---	------	---	---	5	18,692
Grayson	---	---	---	------	---	---	3	2,583
Green	23	---	3	12,269	1	---	4	3,415
Greenup	---	1	---	1,735	---	---	2	5,224
Hancock	14	---	13	11,383	---	---	7	7,483
Hardin	---	1	---	871	---	---	1	1,051
Hart	2	1	2	2,953	---	---	3	3,700
Henderson	12	---	16	67,973	3	---	8	26,091
Hopkins	5	8	15	66,716	---	3	14	45,307
Johnson	2	1	4	11,794	---	2	1	5,777
Knott	---	3	1	10,134	---	---	---	------
Knox	---	9	4	22,915	---	1	3	7,863
Laurel	---	---	1	1,409	---	1	1	2,872
Lawrence	5	1	1	11,895	1	1	---	5,243
Lee	26	---	1	29,100	---	---	---	------
Leslie	---	1	1	6,614	---	1	---	3,179
Letcher	3	16	1	71,914	---	3	1	13,008
Lincoln	---	---	1	135	---	---	---	------
McCreary	---	---	---	------	---	---	1	1,442
McLean	6	---	17	40,864	2	---	13	28,939
Madison	---	---	---	------	1	---	1	6,575
Magoffin	1	---	1	2,243	---	---	---	------
Martin	---	8	2	17,160	---	---	---	------
Menifee	---	---	---	------	---	---	1	671
Metcalfe	8	---	15	8,047	---	---	14	10,491
Monroe	6	---	8	6,304	2	---	9	7,518
Morgan	---	---	1	1,630	---	---	1	5,757
Muhlenberg	7	2	13	19,388	2	---	2	7,247
Ohio	20	---	28	29,174	1	---	3	2,059
Owen	---	---	---	------	---	---	2	2,840
Owsley	---	---	---	------	---	---	2	3,116
Perry	1	23	1	81,901	1	3	1	14,392
Pike	---	15	2	49,646	---	2	---	7,261
Pulaski	2	---	---	3,672	---	---	4	16,731
Rockcastle	---	---	---	------	---	---	1	270
Rowan	---	---	---	------	---	---	2	4,355
Russell	---	---	2	1,286	---	---	1	1,899
Simpson	---	---	1	675	1	---	1	1,926
Todd	---	---	---	------	---	---	1	343
Union	19	---	26	91,705	4	---	7	27,534
Warren	---	---	---	------	---	---	2	3,164
Wayne	---	---	1	559	---	---	7	6,859
Webster	6	---	5	28,392	---	---	4	8,457
Whitley	---	---	---	------	---	---	3	3,596
Wolfe	---	1	---	2,014	---	---	---	------
Total	267	122	307	994,466	29	20	207	427,924

Source: American Association of Petroleum Geologists.

Graves County. Two producers in Graves County exemplify the industry. One company, which has expanded its markets, mines the clay and manufactures miscellaneous garden pottery, which it sells through sales representatives.

The larger companies mined, processed, packaged, and also shipped in bulk ball clay mostly by rail, to manufacturers of wall tile, sanitary ware, insulation products, pottery, and dinnerware. Production was off slightly because of the home building recession.

Fire clay production increased 1 percent, and value increased 11 percent. Fourteen companies produced 198,000 tons of fire clay valued at $1.1 million, from 20 open pit mines in Carter, Greenup, Hancock, Madison, Morgan, and Rowan Counties. Most of the clay was used to manufacture firebrick and other refractories.

About 1 million tons of miscellaneous clay, valued at approximately $1 million, was mined by 14 companies from 15 open pit mines in 10 counties. Production increased 1 percent for a new record high; value increased 2 percent. Most of the clay, which included shale, was used to manufacture lightweight aggregate and building brick.

Fluorspar.—Fluorspar was mined in Livingston, Crittenden, and Caldwell Counties by three companies at one underground and two open pit mines. Both production and value decreased drastically because of strikes and depletion of reserves. Most of the fluorspar was used in manufacturing hydrofluoric acid and glass.

Graphite, artificial.—About 7,000 tons of artificial graphite was manufactured by a company in Fulton County, for use in anodes and electrodes.

Perlite.—Crude perlite mined in western States was expanded at plants in Boone and Campbell Counties for use in industrial board, soil conditioning, and building plaster.

Sand and Gravel.—Sand and gravel was mined by 37 producers at 40 operations in 22 counties. Production increased 12 percent, and value increased 19 percent, setting record highs. End uses for this commodity were structural, paving, fill, and railroad ballast. Transportation of commercial production was 77 percent by truck, 17 percent by waterway, and 6 percent by rail.

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

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Ballard	1	13	$13	1	19	$10
Boone	3	971	985	3	879	887
Carlisle	1	11	12	1	35	18
Daviess	2	W	W	2	756	W
Fulton	1	6	7	2	W	W
Graves	1	68	72	2	W	W
Hickman	1	1	1	2	W	W
Jefferson	5	2,669	2,521	4	2,236	2,135
Livingston	1	6	7	2	W	W
Lyon	1	5	5	1	10	5
Marshall	1	14	15	1	30	15
Martin	1	34	W	1	36	53
Mason	2	W	165	2	W	118
Union	3	299	W	3	W	W
Other counties [1]	8	3,381	4,278	13	4,365	6,388
Total [2]	32	7,478	8,081	40	8,364	9,628

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

[1] Includes Breckinridge, Calloway, Floyd, Gallatin, Hart, Henderson, McCracken, Trimble, and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 9.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
SAND						
Structural	2,733	$2,869	$1.05	3,800	$4,456	$1.17
Paving	1,390	1,433	1.03	1,512	1,754	1.16
Fill	1,449	1,132	.78	875	768	.88
GRAVEL						
Structural	755	940	1.25	980	1,244	1.27
Paving	W	W	W	655	903	1.38
Fill	154	139	.90	121	87	.72
Railroad ballast	39	55	1.41	30	51	1.70
Total sand and gravel [1]	7,478	8,081	1.08	8,364	9,628	1.15

W Withheld to avoid disclosing confidential data; included with "Total sand and gravel."
[1] Includes blast, engine, foundry, and other sands; other gravel and uses indicated by symbol W.

Stone.—Crushed limestone production increased less than 1 percent, but its value increased 4 percent. Eighty-three producers, including one federal agency and three counties, crushed limestone at 119 quarries in 67 counties. Of the total produced, 78 percent was used for concrete and roads, 6 percent for aglime, and 16 percent for other uses. Shipments were 76 percent by truck, 5 percent by railroad, and 19 percent by waterway.

Crushed quartzite (orthoquartzite) was produced near Salem in Livingston County for use in manufacturing ferrosilicon.

Vermiculite.—Crude vermiculite from other States was exfoliated in a plant in

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

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Barren	2	689	$930	1	173	$294
Bourbon	1	W	W	1	183	W
Butler	1	103	W	1	W	W
Carter	4	774	1,166	4	1,489	W
Casey	1	98	180	1	W	W
Christian	4	1,955	W	3	1,041	W
Garrard	1	76	109	1	91	131
Greenup	1	100	183	1	W	W
Hardin	5	1,076	1,601	5	832	1,309
Harlan	1	W	W	1	152	297
Hart	1	107	182	1	W	W
Jackson	2	175	175	2	125	W
Jefferson	4	1,787	W	4	1,974	W
Logan	1	W	W	1	179	W
Monroe	1	W	307	1	W	258
Montgomery	1	W	80	1	W	108
Morgan	4	370	W	4	446	W
Oldham	5	1,239	1,666	4	974	1,236
Pulaski	3	W	W	2	W	W
Trigg	1	156	224	1	192	W
Warren	4	599	815	4	759	1,006
Wolfe	1	W	W	1	105	157
Other counties [1]	69	20,677	35,145	74	21,443	39,848
Total [2]	118	29,979	42,762	119	30,158	44,644

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Adair, Allen, Anderson, Boyle, Breckinridge, Bullitt, Caldwell, Calloway, Clinton, Crittenden, Cumberland, Edmonson, Estill, Fayette, Fleming, Franklin, Grayson, Green, Harrison, Henry, Jessamine, Laurel, Lee, Letcher, Livingston, Madison, Marion, Meade, Menifee, Mercer, Metcalfe, Muhlenberg, Nelson, Nicholas, Ohio, Pendleton, Pike, Powell, Rockcastle, Rowan, Scott, Simpson, Taylor, Todd, and Wayne Counties and counties indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

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

(Thousand short tons and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	23,341	$33,550	$1.44	23,409	$35,289	$1.51
Agstone	2,190	3,436	1.57	1,844	3,095	1.68
Railroad ballast	W	W	W	501	W	W
Riprap	W	W	W	W	3,450	W
Other uses [1]	4,449	5,776	1.30	4,405	2,810	.64
Total [2]	29,979	42,762	1.43	30,158	44,644	1.48

W Withheld to avoid disclosing confidential data; included with "Other uses."
[1] Includes filter stone (1968), stone sand, cement, flux stone (1968), ferrosilicon (1969), mine dusting, fertilizer filler (1968), acid neutralization (1969), drain fields (1968), building products, uses not specified, and figures indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Campbell County. Production increased 29 percent, and value increased 24 percent. The product was used for loose fill insulation, soil conditioning, in lightweight concrete, and in plaster.

METALS

The value of metallic ores was less than one-half of 1 percent of the total value of mineral production.

Ferroalloys.—Ferroalloy shipments increased 16 percent, and shipment value increased 15 percent, establishing new records. Steel scrap (shavings); iron ore from other States; imported chromium and manganese ores; quartzite, coal, and coke from Kentucky and other States; and woodchips are used in the manufacture of ferroalloys at two plants in Marshall County. The ferroalloys in turn are used in steel manufacture.

Pig Iron.—Shipments of pig iron from Kentucky increased 23 percent, and value increased 28 percent, establishing record highs. Armco Steel Corp. produced basic and foundry pig iron at its Ashland plant.

Zinc.—One company mined zinc sulfide ore, and a second company recovered zinc concentrates from fluorspar milling. Zinc production increased 8 percent, and value increased 17 percent.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Cement, masonry and portland:			
Kosmos Portland Cement Co.	802 Bank of Louisville Bldg. 510 West Broadway Louisville, Ky. 40202	Plant	Jefferson.
Clays:			
Ball:			
Bell City Pottery	Route 1 Farmington, Ky. 42040	Open pit mine and plant.	Graves.
Kentucky-Tennessee Clay Co.	Box 77 Mayfield, Ky. 42066	----do	Do.
Old Hickory Clay Co	Box 271 Paducah, Ky. 42001	2 open pit mines and plant.	Do.
Fire:			
American Olean Tile Co	Lewisport, Ky. 42351	Open pit mine and plant.	Hancock.
Ford Burchett Clay Co	Olive Hill, Ky. 41164	Open pit mine	Carter.
Burge & Fultz Clay Co	Route 2 Olive Hill, Ky. 41164	----do	Do.
General Refractories Co	1520 Locust St. Philadelphia, Pa. 19102	4 open pit mines and plant.	Carter and Rowan.
M. A. McCoy & Son	Oak Hill, Ohio 45656	2 open pit mines	Greenup.
Miscellaneous:			
General Shale Products Co.	Johnson City, Tenn. 37601	Open pit mine and plant.	Jefferson.
Harsco Corp	4th & Washington St. Cannelton, Ind. 47520	2 open pit mines	Hancock.
Kosmos Portland Cement Co.	802 Bank of Louisville Bldg. 510 West Broadway Louisville, Ky. 40202	Open pit mine	Jefferson.
Ohio River Sand Co., Inc.	129 River Road Louisville, Ky. 40202	Open pit mine and plant.	Bullitt.
Owensboro Brick & Tile Co.	Ewing Road Owensboro, Ky. 42302	----do	Hancock.
Coal:			
Beth-Elkhorn Corp	701 East Third St. Bethlehem, Pa. 18016	3 underground mines	Letcher and Pike.
Gibraltar Coal Co	150 South Meridian St. Indianapolis, Ind. 46225	Strip mine	Muhlenberg.
Island Creek Coal Co	Wheelwright, Ky. 41669	5 underground mines	Floyd.
	444 South Main St. Madisonville, Ky. 42431	8 underground mines	Hopkins, Muhlenberg, Union.
	Holden, W. Va. 25625	3 underground mines	Pike.
Peabody Coal Co	301 North Memorial Dr. St. Louis, Mo. 63102	2 underground and 6 strip mines.	Muhlenberg and Ohio.
The Pittsburgh and Midway Coal Mining Co.	Ten Main Center Kansas City, Mo. 64105	2 underground and 2 strip mines.	Hopkins and Muhlenberg.
United States Steel Corp	525 William Penn Place Pittsburgh, Pa. 15230	3 underground and 1 auger mine.	Harlan.
Coke:			
Chemical Coke Co	Dawson Springs, Ky. 42408	Plant	Hopkins.
Hooker Chemical Co	Box 33 South Shore, Ky. 41175	----do	Greenup.
Semet Solvay, Div. of Allied Chemical Corp.	40 Rector St. New York, N.Y. 10006	----do	Boyd.
Ferroalloys: Airco Alloys and Carbide.	Box 217 Calvert City, Ky. 42029	----do	Marshall.
Fluorspar:			
Calvert City Chemical Co	Box 305 Calvert City, Ky. 42029	Underground mine and mill.	Livingston.
Roy Conyer	Princeton, Ky. 42445	Open pit mine	Cardwell.
Minerva Oil Co	Eldorado, Ill. 62930	----do	Crittenden.
Nancy Hanks Mine, Inc	Marion, Ky. 42064	Underground mine	Livingston.
Kentucky Fluorspar Co	----do	Mill	Crittenden.
Graphite, artificial: Carborundum Co.	Hickman, Ky. 42050	Plant	Fulton.
Iron, pig: Armco Steel Corp	Middletown, Ohio 45042	----do	Boyd.
Natural gas:			
Plants:			
Columbia Hydrocarbon Corp.	South Shore, Ky. 41175	Refinery	Greenup.
Kentucky Hydrocarbon Corp.	Box 128 Langley, Ky. 41645	----do	Floyd.
Kentucky-West Virginia Gas Co.	Allen, Ky. 41601	----do	Do.
Tennessee Gas Pipeline Co.	Box 7 Greensburg, Ky. 42743	----do	Green.
Producers:			
Inland Gas Co	340 17th St. Ashland, Ky. 41101	Natural gas wells	Various.
Kentucky-West Virginia Gas Co.	Second National Bank Bldg. Ashland, Ky. 41101	----do	Do.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas—Continued			
Producers—Continued			
Petroleum Exploration Co.	Leeco Road Leeco, Ky. 41313	Natural gas wells	Various.
Texas Gas Transmission Co.	Owensboro, Ky. 42301	----do	Do.
United Fuel Gas Co	Box 1273 Charleston, W. Va. 25325	----do	Do.
Perlite, expanded:			
Grefco, Inc	Box 35 Florence, Ky. 41042	Plant	Boone.
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	----do	Campbell.
Petroleum:			
Producers:			
Ashland Oil Refining Co	1409 Winchester Ave. Catlettsburg, Ky. 41129	Crude oil wells	Various.
Har-Ken Oil Co	Box 616 Owensboro, Ky. 42301	----do	Do.
Humble Oil and Refining Co.	2010 W. Ohio St. Evansville, Ind. 47712	----do	Do.
Sinclair Oil and Gas Co.	300 Fidelity National Bank Bldg. Oklahoma City, Okla. 73102	----do	Do.
Sun Oil Co	Box 5026, Lawnsdale Evansville, Ind. 47715	----do	Do.
Refineries:			
Ashland Oil and Refining Co.	1409 Winchester Ave. Catlettsburg, Ky. 41129	Refinery	Boyd.
Kentucky Oil and Refining Co.	Box 325 Betsy Layne, Ky. 41605	----do	Floyd.
Louisville Refining Co	1300 South Western Parkway Louisville, Ky. 40212	----do	Jefferson.
The Somerset Refinery, Inc.	520 Monticello St. Somerset, Ky. 42501	----do	Pulaski.
Sand and Gravel:			
Evansville Materials, Inc	624 N.W. Riverside Dr. Evansville, Ind. 47708	Dredge	Henderson.
Ingram Materials, Inc	Box 1049 4304 Harding Road Nashville, Tenn.	----do	Livingston.
Nugent Sand Co	Box 6072 Louisville, Ky. 40206	----do	Jefferson.
Ohio River Sand Co., Inc	129 River Road Louisville, Ky. 40206	----do	Do.
Standard Materials Corp	11 North Penn St. Indianapolis, Ind. 46204	3 open pit mines and plants.	Boone, Gallatin, Trimble.
Stone:			
Limestone, crushed:			
Ken-mor Stone, Inc	Box 482 Georgetown, Ky. 40324	5 quarries	Carter, Morgan, Rowan.
Kentucky Stone Co	400 Sherburn Lane Louisville, Ky. 40207	5 underground mines and 7 quarries.	Various.
Reed Crushed Stone Co., Inc.	Box 35 Gilbertsville, Ky. 42044	1 quarry	Livingston.
Three Rivers Rock Co	Box 218 Smithland, Ky. 42081	----do	Do.
Vulcan Materials Co	Box 7 Knoxville, Tenn. 37901	3 quarries	Fayette, Jefferson.
Quartzite: Industrial Minerals Co., Inc.	Salem, Ky. 42078	1 quarry	Livingston.
Vermiculite, exfoliated: W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Campbell.
Zinc:			
Eagle-Picher Industries, Inc	Box 910 Miami, Okla. 74354	Underground mine and mill.	Livingston.
Minerva Oil Co	Eldorado, Ill. 60930	Open pit mine	Crittenden.

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 S. O. Wood, Jr.[1] and Leo W. Hough [2]

Louisiana mineral output in 1969 was valued at $4,685 million, an 8.4-percent increase. For the 12th consecutive year, Louisiana ranked second in value of domestic mineral production. New production and value records were established for crude petroleum, natural gas, natural gas liquids, clay, and salt.

Mineral fuels—crude petroleum, natural gas, and natural gas liquids—provided 94.9 percent of the total value of mineral output. The Louisiana Geological Survey listed 33 successful exploratory wells—15 oil and 18 gas. According to the American Petroleum Institute (API), net crude oil reserve increased 81 million barrels and established a new high of 5,689 million barrels at yearend. The largest change in crude oil reserves was from revisions and extensions categories—an increase of 721 million barrels. New field discoveries accounted for only 9 million barrels of oil, and new pool discoveries in oil fields accounted for 90 million barrels. In net increase of crude oil reservies, Louisiana ranked first in the Nation.

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Table 1.—Mineral production in Louisiana [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clay thousand short tons	863	$1,163	1,078	$2,943
Lime do	781	10,159	822	10,750
Natural gas million cubic feet	6,416,015	1,212,627	7,227,826	1,387,743
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels	49,928	156,903	53,565	171,434
LP gases do	57,165	91,464	71,867	96,302
Petroleum (crude) do	817,426	2,570,641	844,603	2,791,269
Salt thousand short tons	10,908	53,854	12,435	61,102
Sand and gravel do	20,411	26,504	18,131	21,895
Stone (shell) do	9,387	11,785	9,237	11,892
Sulfur (Frasch process) thousand long tons	4,074	162,664	3,999	108,299
Value of items that cannot be disclosed: Cement, gypsum, and miscellaneous stone	XX	23,246	XX	21,697
Total	XX	4,321,010	XX	4,685,326
Total 1967 constant dollars	XX	4,315,214	XX	p 4,499,377

p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

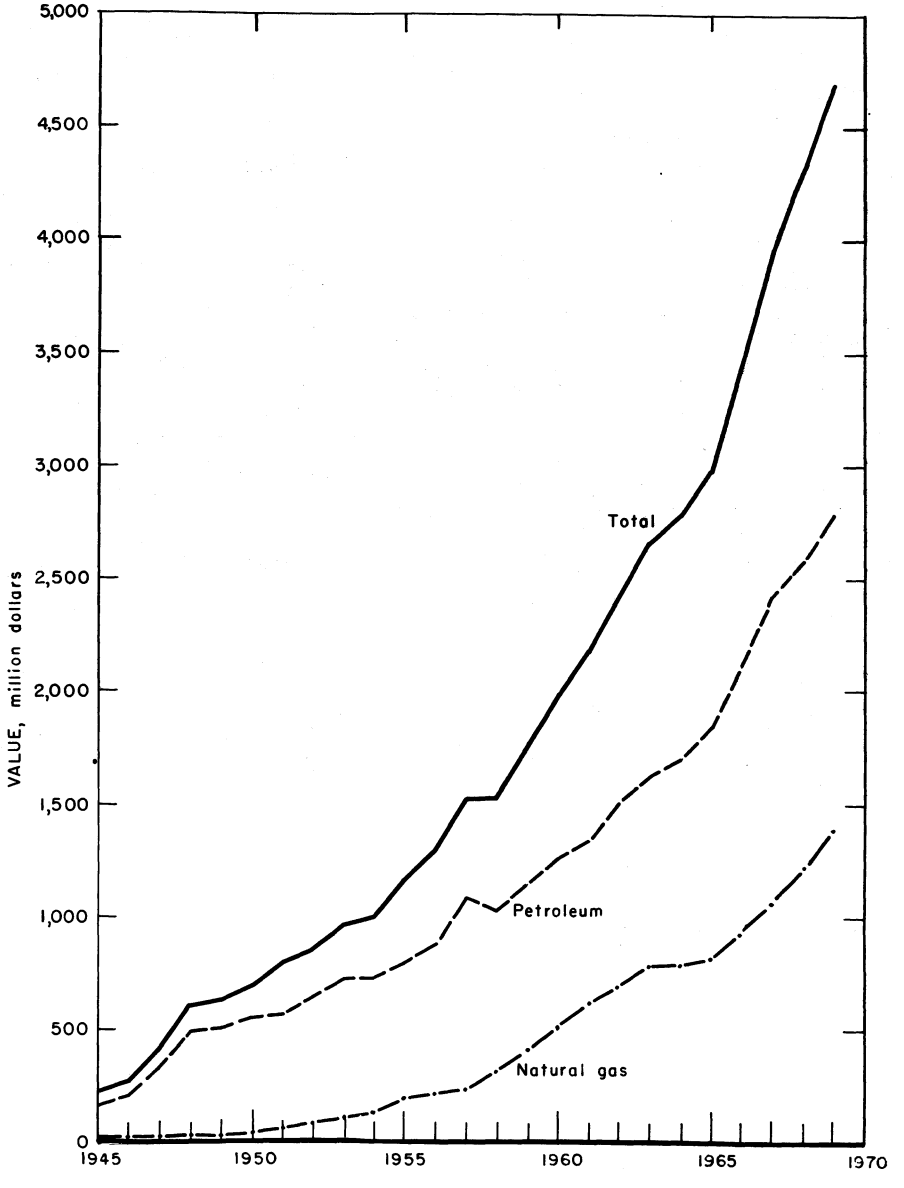

Figure 1.—Value of petroleum, natural gas, and total value of mineral production in Louisiana.

Table 2.—Value of mineral production in Louisiana, by parishes

(Thousands)

Parish	1968	1969	Minerals produced in 1969 in order of value
Acadia	$114,116	$109,633	Natural gas, natural gas liquids, petroleum.
Allen	6,361	7,341	Petroleum, natural gas, natural gas liquids, sand and gravel.
Ascension	10,117	11,178	Petroleum, salt, natural gas.
Assumption	27,708	28,800	Natural gas, petroleum, natural gas liquids.
Avoyelles	5,449	5,732	Petroleum, natural gas, natural gas liquids, sand and gravel.
Beauregard	9,315	9,261	Do.
Bienville	7,293	9,079	Natural gas, petroleum, sand and gravel, clays.
Bossier	24,005	22,972	Natural gas, petroleum, natural gas liquids, sand and gravel.
Caddo	26,324	26,246	Petroleum, natural gas, natural gas liquids, sand and gravel, clays.
Calcasieu	62,882	61,156	Petroleum, natural gas, natural gas liquids, salt, lime, sulfur, sand and gravel.
Caldwell	1,914	2,516	Natural gas, petroleum.
Cameron	218,472	270,883	Natural gas, petroleum, natural gas liquids, salt, shell.
Catahoula	9,513	9,526	Petroleum, sand and gravel, natural gas.
Claiborne	27,054	31,525	Petroleum, natural gas liquids, natural gas, sand and gravel.
Concordia	30,011	29,216	Petroleum, natural gas.
De Soto	6,458	7,493	Natural gas, petroleum, sand and gravel.
East Baton Rouge	16,689	16,320	Cement, lime, petroleum, sand and gravel, natural gas, clays.
East Carroll	28	28	Natural gas, sand and gravel.
East Feliciana	W	W	Sand and gravel.
Evangeline	11,022	10,460	Petroleum, natural gas, natural gas liquids, sand and gravel.
Franklin	2,188	2,185	Petroleum, natural gas.
Grant	2,272	2,875	Petroleum, sand and gravel.
Iberia	193,098	235,463	Petroleum, natural gas, salt, natural gas liquids, clays.
Iberville	53,620	60,166	Petroleum, salt, natural gas, natural gas liquids, sand and gravel.
Jackson	2,650	2,350	Natural gas, petroleum, sand and gravel.
Jefferson	220,804	303,743	Petroleum, sulfur, natural gas, salt, sand and gravel, natural gas liquids.
Jefferson Davis	57,825	55,846	Natural gas, petroleum, natural gas liquids, sand and gravel.
Lafayette	15,872	18,297	Natural gas, petroleum, natural gas liquids, sand and gravel, clays.
Lafourche	445,289	474,939	Petroleum, natural gas, sulfur, natural gas liquids.
La Salle	19,733	21,970	Petroleum, natural gas, sand and gravel.
Lincoln	19,835	31,862	Natural gas liquids, natural gas, petroleum, sand and gravel, clays.
Livingston	18	512	Sand and gravel.
Madison	814	912	Natural gas.
Morehouse	11,760	11,202	Natural gas, natural gas liquids, petroleum.
Natchitoches	33,227	29,248	Petroleum, natural gas, natural gas liquids, sand and gravel, clays.
Orleans	15,372	17,128	Cement, lime, shell, natural gas, sand and gravel.
Ouachita	24,791	20,961	Petroleum, natural gas, natural gas liquids, sand and gravel.
Plaquemines	1,093,662	1,059,429	Petroleum, natural gas, sulfur, natural gas liquids, salt, sand and gravel.
Pointe Coupee	25,087	30,378	Petroleum, natural gas, clays, natural gas liquids.
Rapides	7,548	7,643	Petroleum, sand and gravel, natural gas, natural gas liquids, clays.
Red River	595	473	Sand and gravel, petroleum, natural gas.
Richland	16,911	16,819	Petroleum, natural gas, natural gas liquids.
Sabine	3,743	2,021	Petroleum, sand and gravel, natural gas.
St. Bernard	32,225	27,659	Natural gas, petroleum, natural gas liquids, sand and gravel, clays.
St. Charles	74,516	84,852	Petroleum, natural gas, natural gas liquids.
St. Helena	W	1,932	Sand and gravel, clays.
St. James	10,382	10,360	Petroleum, natural gas, natural gas liquids.
St. John the Baptist	4,703	4,928	Petroleum, natural gas.
St. Landry	49,302	50,956	Natural gas, petroleum, natural gas liquids.
St. Martin	80,464	89,122	Petroleum, natural gas, salt, natural gas liquids, sand and gravel.
St. Mary	364,074	390,233	Petroleum, natural gas, natural gas liquids, salt, shell, lime, sand and gravel.
St. Tammany	7,837	6,875	Shell, sand and gravel, natural gas, petroleum, clays.
Tangipahoa	170	2,006	Sand and gravel, petroleum, clays.
Tensas	7,359	7,554	Natural gas liquids, petroleum, natural gas.
Terrebonne	529,991	626,619	Petroleum, natural gas, natural gas liquids, sulfur, salt.

See footnote at end of table.

Table 2.—Value of mineral production in Louisiana, by parishes—Continued
(Thousands)

Parish	1968	1969	Minerals produced in 1969 in order of value
Union	$ 2,114	$ 1,873	Natural gas, petroleum, sand and gravel.
Vermilion	220,785	259,542	Natural gas, petroleum, natural gas liquids, sand and gravel.
Vernon	17	348	Sand and gravel.
Washington	928	1,477	Do.
Webster	31,635	32,079	Natural gas, natural gas liquids, petroleum, sand and gravel.
West Baton Rouge	3,497	4,382	Petroleum, natural gas, clays, sand and gravel.
West Carroll	36	25	Natural gas.
West Feliciana	W	W	Sand and gravel.
Winn	2,823	5,050	Petroleum, stone, gypsum, natural gas, sand and gravel.
Undistributed	16,707	1,667	
Total	4,321,010	4,685,326	

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

Trends and Developments.—Under Louisiana's 10-year ad valorem tax exemption plan the Board of Commerce and Industry approved applications totaling $579 million for new and expanded industrial construction. Although the total surpassed the half-billion-dollar mark for the fourth consecutive year, it was about 7 percent lower than in 1968 and 19 percent below the record $718 million in 1967. The unsettled labor situation and the U.S. Treasury's restriction on the use of industrial revenue bonds for plant financing contributed toward the investment decline.

Chemical, petrochemical, and petroleum industries continued to lead all other categories of industrial construction. The $405 million applications approved for these industries accounted for about 70 percent of the total. Some of the larger construction projects approved by the Board for these industries included the following: Geigy Chemical Corp., Iberville Parish, $45.0 million (herbicides); Union Carbide Corp., St. Charles Parish, $40.6 million (miscellaneous chemicals); Stauffer Chemical Co., Iberville Parish, $32.1 million (chlorine and caustic soda); The Dow Chemical Co., Iberville Parish, $26.3 million (glycols) and $24.6 million (chlorine and caustic soda); and E. I. du Pont de Nemours & Co., Inc., St. John the Baptist Parish, $20.9 million (neoprene). Other industrial construction applications of interest to the mineral industry included electric power,

Table 3.—Indicators of Louisiana business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total labor force (nonagricultural)	thousands	1,064.7	1,076.8	+1.1
Unemployment	do	16.9	21.1	+24.9
Employment:				
Contract construction	do	91.9	89.6	−2.5
Mining	do	51.7	52.7	+1.9
All manufacturing	do	177.9	180.5	+1.5
Total all industries [1]	do	1,047.8	1,055.7	+0.8
Factory payrolls	millions	$1,124.3	$1,205.6	+7.2
Personal income:				
Total	do	$9,814	$10,413	+6.1
Per capita		$2,645	$2,780	+5.1
Construction activity:				
Building permits, total private nonresidential	millions	$190.8	$123.0	−35.5
Construction contracts awarded:				
Residential [2]	thousands	$486,065	$495,115	+1.9
Nonresidential [3]	do	$368,674	$378,814	+2.8
Nonbuilding	do	$242,792	$397,714	+63.8
Total	do	$1,097,531	$1,271,643	+15.9
Cement shipments to and within Louisiana	thousand 376-pound barrels	12,545	11,699	−6.7
Farm marketing receipts	millions	$629	$602	−4.3
Mineral production	do	$4,321.0	$4,685.3	+8.4

p Preliminary.
[1] Transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; services; and government included.
[2] Includes apartments, hotels, dormitories, one- and two-family dwellings, and other residential buildings.
[3] Includes commercial, manufacturing, educational, and other nonresidential buildings.

Sources: Employment and Earnings and monthly report on the Labor Force, Bureau of Labor Statistics; Survey of Current Business; Construction Review; Louisiana Business Review; Louisiana Labor Market; Bureau of Mines; and Farm Income Situation.

$90.7 million; metals, metal products, and machinery, $46.2 million; paper and paper products, $7.8 million; and stone, clay, and glass products, $2.6 million.

Louisiana Power and Light Co. placed in operation a 549,000-kilowatt generating unit (Unit No. 3) in the Little Gypsy steam-electric station at Montz. The company continued construction of a 750,000-kilowatt unit (Unit No. 4) at Ninemile Point steam-electric station at Westwego. At yearend the project was about half complete and start-up was scheduled for 1971.

The State's system of rivers, canals, and ports greatly facilitated transportation of mineral and mineral products. New Orleans continued as the Nation's second largest port, and Baton Rouge ranked seventh in the handling of cargo tonnages. To help keep the port of New Orleans competitive, a $64 million project to construct a nine-berth complex to serve containerized cargo was begun. Lake Charles, the State's third major port, handled considerable tonnages of oils and petrochemicals.

The U.S. Army Corps of Engineers continued to deepen to 9 feet a navigation channel beginning at the mouth of the Red River and extending to Camden, Ark., on the Ouachita River. Plans included the building of four new locks and dams, of which two were in Louisiana. The Louisiana portion of the channel is scheduled to be open to navigation in 1971.

Of $734 million total tax collection in Louisiana for the fiscal year ending June 30, 1969, $239 million was from severance taxes levied on minerals ($235 million from mineral fuels). Other mineral-related taxes accounted for an additional $109 million.

Legislation.—The dispute between Louisiana and the Federal Government over the location of Louisiana's offshore boundary continued. Both the Federal Government and Louisiana receive substantial income from the submerged lands. At yearend there was more than $1.3 billion in escrow in the Federal Treasury from mineral ownership in State-Federal disputed areas.

During 1969 the U.S. Supreme Court rejected Louisiana's claim to the Coast Guard Line as its seaward boundary and appointed Walter P. Armstrong, Jr., a Memphis, Tenn., attorney, as special master to help draw the Federal-State boundary off the coast of Louisiana.

In another decision, the Supreme Court ruled that Louisiana civil laws governing recovery of damages for accidental deaths apply to deaths on oil rigs anchored in Federal waters offshore Louisiana.

Employment and Injuries.—Employment in the petroleum production, refining, and related industries averaged 82,500 persons, an increase of 1,500. Oil and gas operations accounted for 92.8 percent of employment in the mineral industries and for 93.5 percent of the mineral industry wages.

Among labor strikes during 1969 were the following: An International Longshoremen's Association 64-day strike contributed to the overall decrease in tonnage handled at the port of New Orleans. An estimated 200 employees went on strike at the Oronite Chemical Co. plant at Oak Point near New Orleans. The main issues were the demand for seniority rights, a union safety program, and equal opportunities for overtime pay. At Celotex Corp.'s Marrero plant south of New Orleans 770 employees went on strike for a week and returned to work after a rejected contract had been modified.

A few deaths and several injuries occurred in industry operations. An explosion and fire at Continental Oil Co.'s Lake Charles 100-million-pound-per-year alfol alcohol plant resulted in two men killed and five injured. Chlorine production from one unit of the Wyandotte Chemical Corp.'s Geismar plant was halted by a flash explosion that injured five workmen. An employee of J. Ray McDermott Co. was killed while fabricating an oil rig deck section at Morgan City.

Table 4.—Worktime 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
1968:								
Metal	809	365	296	2,364	--	11	4.65	145
Native asphalt	-----	---	-----	-----	--	---	-----	-----
Nonmetal	2,001	298	597	5,335	24	115	26.05	28,520
Sand and gravel	1,000	235	235	2,122	1	34	16.50	3,235
Stone	682	337	230	1,954	--	47	24.06	638
Total [1]	4,492	302	1,357	11,775	25	207	19.70	13,641
1969: [p]								
Metal	1,100	365	401	3,057	--	14	4.58	169
Native asphalt	-----	---	-----	-----	--	---	-----	-----
Nonmetal	2,105	293	621	5,062	2	118	23.71	3,759
Sand and gravel	1,215	243	295	2,594	2	51	20.43	5,080
Stone	585	325	190	1,759	--	24	13.65	331
Total [1]	5,000	301	1,507	12,472	4	207	16.92	2,670

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 5.—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)	Chemicals and allied products [2]
1965	46,500	10,400	850	17,100
1966	47,200	9,200	900	20,200
1967	47,100	9,800	900	21,500
1968	47,800	10,400	900	21,900
1969 [p]	47,700	10,300	900	23,600

[p] Preliminary.
[1] Employment in chemical and petroleum refineries and petrochemicals manufactured in petroleum refineries.
[2] Employment in chemical and petrochemical manufacturing facilities located outside petroleum refineries.

Source: Louisiana State Department of Labor, Division of Employment Security.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

New record highs of production and value of all mineral fuels were established during 1969. Combined value of crude petroleum, natural gas, and natural gas liquids was $4,447 million, 94.9 percent of the entire mineral production value of the State. Crude petroleum gained over 5 percent in average unit price to $3.30 per barrel and contributed 59.6 percent of the total mineral value. Valuewise, natural gas and natural gas liquids contributed 29.6 and 5.7 percent, respectively.

At yearend, oilfields and gasfields had a total of 38,747 productive wells (39,429 in 1968). North Louisiana had 13,648 oil and 4,552 natural gas wells; onshore south Louisiana, 10,818 oil and 3,407 natural gas wells; and offshore south Louisiana, 4,927 oil and 1,395 natural gas wells.

Leasing Activity.[3]—The State held 10 lease sales in 1969 and approved leases on 175,326 acres. Average bonus was $85.62 per acre.

In north Louisiana, block leasing activity was concentrated in the northern and northeastern parishes. Lease bonuses ranged from $5 to $50 per acre, the same as in 1968. In onshore south Louisiana, leasing activity continued to decline.

The Federal Government held two offshore (zone 4) drainage lease sales in 1969. At the January 14 sale, 20 tracts (48,505 acres) were leased for an average bonus of $908 per acre. Main Pass Block 95 (4,995 acres) received the highest total bid on a single tract, almost $10.8 million. This bonus of $2,161 per acre was also the highest per-acre bid. At the December 16 sale, 16 tracts (60,153 acres) were leased

[3] Adapted from the American Association of Petroleum Geologists Bulletin, v. 54, No. 6, June 1970.

for an average bonus of about $1,112 per acre. A bid of $33 million ($6,600 per acre) for Eugene Island Block 258 was substantially higher than other bids. The December 16 sale had been originally scheduled for February 25, but was postponed until the moratorium on Federal offshore lease sales was lifted. The moratorium was declared following an oil leak in the Santa Barbara Channel in California during February.

Exploration, Development, and Reserves.—According to the Louisiana Geological Survey, total wells[4] drilled including offshore, totaled 3,821 compared with 4,097 in 1968. Both oil and gas completions at 1,534 and 708, respectively, were below the 1968 levels; however, there was a small increase in the number of dry holes. A total of 2,209 of the 3,260 developmental wells, about two out of three, were completed to produce oil or gas. About 6 percent of the 561 exploratory wells were successful.

[4] Each completion is counted as one well.

Table 6.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1969

Location	Drilling						Geophysical crew-weeks			
	Proved field wells[1]			Exploratory wells[1]			Total	Gravity meter method	Reflection seismograph method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
North:										
Bienville	---	18	1	---	---	12	31	-----	-----	-----
Bossier	1	2	28	---	---	6	37	-----	12.5	12.5
Caddo	116	3	27	---	1	2	149	-----	8.5	8.5
Caldwell	---	1	6	---	1	6	14	-----	1.5	1.5
Catahoula	11	---	14	2	---	42	69	-----	3.0	3.0
Claiborne	27	10	26	---	---	2	65	-----	20.0	20.0
Concordia	25	---	37	---	---	58	120	-----	-----	-----
De Soto	7	15	27	---	---	2	51	-----	2.5	2.5
East Carroll	---	---	---	---	---	3	3	-----	6.0	6.0
Franklin	---	---	1	---	---	4	5	-----	16.0	16.0
Grant	8	---	4	---	---	7	19	-----	-----	-----
Jackson	---	4	5	---	---	1	10	-----	-----	-----
La Salle	77	1	56	2	---	19	155	-----	2.0	2.0
Lincoln	---	4	5	---	---	---	9	-----	9.5	9.5
Madison	---	---	---	---	---	1	1	-----	12.0	12.0
Morehouse	---	17	2	---	---	2	21	-----	18.5	18.5
Natchitoches	---	---	2	---	---	2	4	-----	9.0	9.0
Ouachita	---	23	1	---	---	1	25	-----	10.5	10.5
Red River	44	---	4	---	---	4	52	-----	1.5	1.5
Richland	5	22	36	---	1	6	70	-----	16.0	16.0
Sabine	5	---	15	---	---	2	22	-----	10.0	10.0
Tensas	1	2	5	1	---	---	9	-----	10.0	10.0
Union	---	13	2	---	---	3	18	-----	23.0	23.0
Webster	2	5	11	---	---	2	20	-----	5.0	5.0
West Carroll	---	---	---	---	---	3	3	-----	4.5	4.5
Winn	18	---	7	1	---	9	35	-----	4.5	4.5
Total:										
1969	347	140	322	6	3	199	1,017	-----	206.0	206.0
1968	325	204	308	4	4	195	1,040	-----	253.5	253.5
South:										
Acadia	10	20	27	---	---	5	62	-----	15.0	15.0
Allen	1	6	8	---	---	2	17	-----	32.0	32.0
Ascension	8	2	4	---	---	4	18	-----	9.0	9.0
Assumption	---	9	9	---	1	6	25	-----	14.0	14.0
Avoyelles	10	1	9	1	---	16	37	-----	56.0	56.0
Beauregard	1	2	16	2	---	9	30	-----	42.0	42.0
Calcasieu	20	16	22	1	---	12	71	-----	43.0	43.0
Cameron	51	27	51	1	---	22	152	-----	73.0	73.0
East Baton Rouge	3	---	---	---	---	---	3	-----	4.0	4.0
East Feliciana	---	---	---	---	---	---	-----	-----	18.0	18.0
Evangeline	1	---	3	---	---	5	9	-----	7.0	7.0
Iberia	13	14	10	---	1	7	45	-----	11.0	11.0
Iberville	18	1	18	---	1	7	45	-----	31.0	31.0
Jefferson	20	5	13	---	---	5	43	-----	24.0	24.0
Jefferson Davis	8	11	33	---	1	9	62	-----	31.0	31.0
Lafayette	2	2	1	---	---	1	6	-----	30.0	30.0
Lafourche	45	18	41	---	1	16	121	-----	68.0	68.0
Livingston	---	---	1	---	---	---	1	-----	22.0	22.0
Orleans	---	---	1	---	---	---	1	-----	10.0	10.0
Plaquemines	111	25	28	---	---	11	175	-----	50.0	50.0
Pointe Coupee	15	4	4	---	---	---	23	-----	10.0	10.0
Rapides	7	2	18	---	---	4	31	-----	40.0	40.0

See footnote at end of table.

Table 6.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1969—Continued

Location	Drilling						Geophysical crew-weeks			
	Proved field wells [1]			Exploratory wells [1]			Total	Gravity meter method	Reflection seismograph method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
South—Continued										
St. Bernard	1	---	1	---	---	13	15	-----	56.0	56.0
St. Charles	11	5	8	---	---	2	26	-----	11.0	11.0
St. Helena	---	---	---	---	---	2	2	-----	19.0	19.0
St. James	1	3	6	---	---	7	17	-----	2.0	2.0
St. John the Baptist	---	---	3	---	---	6	9	-----	-----	-----
St. Landry	8	21	9	---	---	4	42	-----	60.0	60.0
St. Martin	19	11	46	---	---	9	85	-----	40.0	40.0
St. Mary	77	27	17	---	2	3	126	-----	85.0	85.0
St. Tammany	---	---	---	---	---	2	2	-----	54.0	54.0
Terrebonne	90	49	41	---	1	22	203	-----	94.0	94.0
Vermilion	7	14	26	---	1	21	69	-----	38.0	38.0
Vernon	---	---	---	---	---	2	2	-----	-----	-----
Washington	---	---	---	---	---	---	---	-----	9.0	9.0
West Baton Rouge	1	1	3	---	---	2	7	-----	-----	-----
West Feliciana	---	---	---	---	---	2	2	-----	13.0	13.0
Total:										
1969	559	296	477	5	9	238	1,584	-----	1,121.0	1,121.0
1968	683	287	430	5	11	180	1,596	-----	1,102.0	1,102.0
Offshore:										
Bay Marchand	26	2	9	---	---	---	37	-----	-----	-----
Breton Sound	4	2	8	---	---	4	18	-----	31.0	31.0
Chandeleur Sound	3	2	---	---	1	5	11	-----	48.0	48.0
East Cameron	6	6	12	---	2	3	29	-----	67.0	67.0
Eugene Island	53	43	28	---	---	6	130	10.0	73.0	83.0
Grand Isle	83	28	16	---	---	3	130	1.0	10.0	11.0
Main Pass	75	12	28	1	1	27	144	1.0	17.0	18.0
Marsh Island	---	7	---	---	---	---	7	-----	-----	-----
Ship Shoal	96	34	32	1	---	9	172	5.0	19.0	24.0
South Marsh Island	13	22	14	---	---	---	49	-----	37.0	37.0
South Pass	124	3	26	1	1	7	162	1.0	9.0	10.0
South Pelto	4	1	6	---	---	---	11	-----	1.0	1.0
South Timbalier	46	23	13	---	---	5	87	-----	1.0	1.0
Vermilion	14	26	29	---	1	6	76	-----	65.0	65.0
West Cameron	---	30	12	1	---	5	48	-----	82.0	82.0
West Delta	66	13	19	---	---	11	109	1.0	22.0	23.0
Total:										
1969	613	254	252	4	6	91	1,220	19.0	482.0	501.0
1968	712	330	265	5	4	145	1,461	4.0	592.0	596.0
Grand total:										
1969	1,519	690	1,051	15	18	528	3,821	19.0	1,809.0	1,828.0
1968	1,720	821	1,003	14	19	520	4,097	4.0	1,947.5	1,951.5

[1] Each completion is counted as 1 well.

Sources: Louisiana Geological Survey and International Oil Scouts Association.

Table 7.—Crude petroleum, natural gas, and natural gas liquids production and net changes in proved reserves

Year	Crude petroleum (million barrels)		Natural gas (billion cubic feet)		Natural gas liquids (million barrels)	
	Production	Net changes in reserves	Production	Net changes in reserves	Production	Net changes in reserves
1965	595	+83	4,467	+3,735	65	+227
1966	674	+163	5,081	+873	72	+114
1967	775	+48	5,717	+2,606	86	+325
1968	817	+152	6,416	+1,726	107	+60
1969	845	+81	7,228	−2,959	125	−98
	Total proved reserves, Dec. 31, 1969					
1969	5,689		85,057		2,570	

Source: American Petroleum Institute and American Gas Association, Inc.

Offshore drilling totaled 1,220 wells—1,119 developmental wells and 101 exploratory wells. Developmental drilling resulted in 613 oil completions, 254 gas completions, and 252 dry holes (77 percent successful). Exploratory drilling resulted in the completion of four oil and six gas producers (10 percent successful).

Inland drilling totaled 2,601 wells—2,141 developmental wells and 460 exploratory wells. The developmental wells resulted in 906 oil completions, 436 gas completions, and 799 dry holes (63 percent successful). Developmental wells drilled in north Louisiana totaled 809, of which 347 were oil, 140 gas, and 322 dry holes (60 percent successful). In south Louisiana developmental wells resulted in 559 oil, 296 gas, and 477 dry holes (64 percent successful).

Inland exploratory wells totaled 460—208 in north Louisiana and 252 in south Louisiana. North Louisiana exploratory well completions were six oil and three gas (4 percent successful). South Louisiana exploratory well completions were five oil and nine gas (6 percent successful).

According to the American Association of Petroleum Geologists (AAPG), north Louisiana developmental drilling for Wilcox (Eocene) production in Concordia, La Salle, and Catahoula Parishes accounted for about one-third of the total developmental wells. One-fifth of the total developmental wells were drilled for Upper Cretaceous production in the Caddo-Pine Island field. Exploratory drilling for Wilcox (Eocene) production in Concordia, Catahoula, and La Salle Parishes accounted for more than one-half of the total exploratory wells. Five exploratory wells penetrated the Smackover (Jurassic) Formation, but all tests were dry. In south Louisiana, including offshore, average depth of developmental wells was 9,794 feet, and average depth of exploratory wells was 11,700 feet. Some notable field discoveries were: Lake Verret, Assumption Parish; Wyandotte, St. Mary Parish; and South Pass Block 54 and Block 65.

Geophysical activity declined throughout the State except in south Louisiana where total crew-weeks reported were 1,121 in 1969 up from 1,102 in 1968. Total offshore crew-weeks declined from 598 in 1968 to 501 in 1969. North Louisiana geophysical activity decreased 19 percent to 206 crew-weeks in 1969.

An average of 230 drilling rigs operated statewide, down slightly from the 1968 average of 233. Offshore had an average of 85 drilling rigs, six less than in 1968. According to the AAPG, 27.1 million feet of hole was drilled during 1969, about 9 percent less than in 1968.

According to the API, proved reserves of crude oil reached a new high, whereas proved reserves of natural gas and natural gas liquids declined. At yearend, Louisiana's reserves and percentages of U.S. totals were as follows: Crude oil, 5,689 million barrels (19.2 percent); natural gas, 85,057 billion cubic feet (30.9 percent); and natural gas liquids, 2,570 million barrels (31.6 percent).

Carbon Black.—Production was 1,046 million pounds valued at $70.8 million. The unit value was virtually unchanged from 1968, and production increased slightly, less than 1.5 percent. Louisiana ranked second in production of carbon black and accounted for 35 percent of the Nation's output. About 27.8 billion cubic feet of natural gas yielded an average 11.7 pounds of carbon black per 1,000 cubic feet of gas. Average yield from 153 million gallons of liquid hydrocarbons was 4.7 pounds per gallon. All carbon black production was from furnace plants. There were three plants in St. Mary Parish, two in Ouachita Parish, and one each in the parishes of Avoyelles, Calcasieu, Evangeline, and West Baton Rouge. Daily plant capacity in the State increased 12 percent to almost 3.6 million pounds. Sid Richardson Carbon & Gasoline Co. commenced production at its 70-million-pound-per-year carbon black plant in West Baton Rouge Parish and was making quality control runs at yearend. Cabot Corp. increased capacity of their plant in St. Mary Parish.

Table 8.—Carbon black production and value

(Million pounds and million dollars)

Year	Quantity	Value
1965	821	$55.3
1966	899	60.5
1967	923	61.1
1968	1,031	70.4
1969	1,046	70.8

Natural Gas.—Marketed production of gas increased 12.7 percent to 7,228 billion cubic feet. Louisiana ranked second in marketed gas production nationwide and supplied 34.9 percent of the U.S. total.

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]
1965	3,912,300	852,000	4,764,300	4,466,786	$812,955	174,951	122,563
1966	4,168,820	1,196,457	5,365,277	5,081,435	929,902	182,734	101,108
1967	5,070,825	1,016,600	6,087,425	5,716,857	1,057,619	208,719	161,849
1968	5,623,961	1,153,555	6,777,516	6,416,015	1,212,627	195,062	166,439
1969	6,305,897	1,255,130	7,561,027	7,227,826	1,387,743	174,349	158,852

[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.

Natural gas pipeline construction underway during 1969 in the State totaled more than 900 miles of line. Four offshore projects comprised about half of the pipeline mileage. Operators of these projects and estimated installation costs were Sea Robin Pipeline Co., 170 miles at $76 million; Tennessee Gas Pipeline Co., 90 miles at $37 million; Texas Eastern Transmission Corp., 143 miles at $55 million, and Southern Natural Gas Co., 75 miles at $27 million. Some of the other large offshore pipeline projects (either complete, underway, or scheduled for completion) reported in 1969 were: Chandeleur Pipeline Co., 80 miles of 16-inch pipe; Trunkline Gas Co., 45 miles of 26-inch pipe; and Offshore Drilling & Exploration Co., 37 miles of 12-inch pipe.

Mississippi River Transmission Corp. received approval by the Federal Power Commission to convert the depleted West Unionville field in Lincoln Parish into an underground gas storage reservoir. Estimated cost of the project was $20.6 million for compressors (1,000 horsepower requirement), 16 new wells, and reworking of 12 wells for injection-withdrawal or observation service. The development of the natural gas storage reservoir will enable Mississippi River Transmission Corp. to help meet winter gas requirements through better year-round utilization of its contracted gas supplies.

Natural Gas Liquids.—Production again ranked second in the Nation and set a new record for Louisiana. According to the annual Oil and Gas Journal survey, there were 137 gas processing plants in the State. Throughput capacity of these plants was 20,064 million cubic feet per day (MMcfd), about 30 percent of the U.S. capacity. Plants in Louisiana processed 16,102 MMcfd, about 29 percent of the U.S. total.

Natural gasoline and cycle products were recovered in 35 parishes at 115 gasoline plants, 17 cycling plants, and five fractionators. Production of natural gasoline and cycle products increased 7 percent, and unit value increased 2 percent to $3.20 per 42-gallon barrel. Production of liquefied petroleum gases increased 26 percent; however, unit value decreased 16 percent to $1.34 per 42-gallon barrel.

The increase in plant throughput capacity from 16 billion to 20 billion cubic feet per day was accomplished by the building of new plants and expansion of others. A few of the 1969 changes were as follows: California Co., Division of Chevron Oil Co., completed its new East Cameron Block 17 plant. The plant has a throughput capacity of 200 MMcfd and recovers liquids from gas produced from West Cameron

Table 10.—Natural gas liquids production

(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	34,091	$102,731	30,953	$46,101	65,044	$148,832
1966	37,192	113,802	34,993	72,016	72,185	185,818
1967	41,777	130,212	43,921	92,234	85,698	222,446
1968	49,928	156,903	57,165	91,464	107,093	248,367
1969	53,565	171,434	71,867	96,302	125,432	267,736

Blocks 17 and 49 in the Gulf of Mexico. Cities Service Oil Co. placed two new plants in operation. One plant at Lake Charles can process 150 MMcfd and the other plant at Crowley 45 MMcfd. In association with its natural gas liquids operations, the company was leaching storage caverns in the West Hackberry salt dome near Lake Charles. Projected storage capacity was 2.5 million barrels, and natural gas liquids to be stored were ethane, butane, ethylene, and propylene.

At yearend, Shell Oil Co. was nearing completion of its fractionation plant at Norco. The plant was designed to produce about 28,000 barrels daily of hydrocarbon products consisting of propane, butane, isobutane, and debutanized gasoline. Wanda Petroleum Co. expanded the throughput capacity of its Breaux Bridge fractionating plant and also commenced operating three natural gas liquids extraction plants: Cypress Isle plant in St. Martin Parish (25 MMcfd cpaacity), Eugene Island plant in St. Mary Parish (100 MMcfd capacity), and Lake Arthur plant in Jefferson Parish (25 MMcfd capacity). Substantial increases in capacities apparent from the Oil and Gas Journal annual surveys were noted for the following plants: Cities Service Oil Co., Lake Charles plant in Calcasieu Parish; Gulf Oil Corp., Venice plant in Plaquemines Parish; Mississippi River Transmission Corp., Perryville plant in Morehouse Parish, Shell Oil Co., North Terrebonne plant in Terrebonne Parish; and Ysclosky plant in St. Bernard Parish; Southern Natural Gas Co., Toca plant in St. Bernard Parish; and Texaco, Inc., Henry plant in Vermilion Parish.

Petroleum.—Crude petroleum production increased 3.3 percent to 844.6 million 42-gallon barrels. Louisiana ranked second nationwide in crude petroleum production and accounted for 25.0 percent of the U.S. total. Petroleum was produced in 54 of the 64 parishes. Allowable market demand factor at yearend 1968 was 40 percent of base depth-bracket allowable. The percentage factors by months for 1969 were January and February, 40; March, 42; April, 43; May, 45; June, 46; July, August, September, October, and November, 44; and December, 46.

According to the Louisiana Department of Conservation, production was reduced nearly 400,000 barrels of oil per day in August 1969 owing to Hurricane Camille. A month later, the production loss was about 100,000 barrels per day.

On January 1, 1969, the Louisiana Department of Conservation issued new provisions relating to the assigning of allowables to poolwide units. The Department also issued orders amending rules for waste control in the Gulf of Mexico, directional drilling and well surveys, and measurements of fluid with oil meters.

Table 11.—Crude petroleum production
(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1965	594,853	$1,841,714
1966	674,318	2,097,129
1967	774,527	2,419,823
1968	817,426	2,570,641
1969	844,603	2,791,269
1902–69	11,189,683	30,784,894

Table 12.—Crude petroleum production, indicated demand, and stocks in 1969, by months
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks (end of month)
January	68,139	66,071	38,524
February	61,914	65,451	34,987
March	71,551	69,581	36,957
April	70,395	69,805	37,547
May	73,594	72,079	39,062
June	72,534	71,313	40,283
July	72,336	73,446	39,173
August	66,703	68,637	37,239
September	70,314	70,171	37,382
October	69,885	69,748	37,519
November	72,140	73,594	36,065
December	75,098	75,932	35,231
Total:			
1969	844,603	845,828	XX
1968	817,426	807,524	XX

XX Not applicable.

Table 13.—Number of producing oil wells and average production per well per day

Year	Approximate number of producing wells Dec. 31	Average production per well per day (barrels) [1]
1965	30,179	54.0
1966	31,063	59.5
1967	30,670	69.2
1968	30,266	74.0
1969	29,393	78.7

[1] Based on number of wells producing Dec. 31.

Table 14.—Production of crude petroleum by districts and selected fields

(Thousand 42-gallon barrels)

District and field [1]	1968	1969
GULF COAST ONSHORE [2]		
Bastian Bay	5,308	4,571
Bay St. Elaine	8,912	8,525
Bayou Sale	9,070	8,798
Caillou Island	34,028	32,955
Cote Blanche Bay West	9,720	10,954
Cote Blanche Island	(3)	6,140
Delta Farms	2,286	2,229
Erath	3,191	5,358
Garden Island Bay	15,336	15,125
Golden Meadow	4,084	3,854
Grand Bay	6,926	5,149
Hackberry, East	(3)	3,285
Hackberry, West	4,447	4,477
Iowa	766	827
Jennings	336	304
La Fitte	11,814	11,282
Lake Barre	12,696	9,276
Lake Pelto	(3)	4,182
Lake Washington	13,105	11,623
Leeville	4,086	4,233
Paradis	5,487	6,752
Quarantine Bay	9,017	7,533
Venice	7,128	5,164
Vinton	2,127	2,149
Weeks Island	9,638	10,535
West Bay	12,084	10,315
Other	245,932	181,788
Total onshore	437,524	377,383
GULF COAST OFFSHORE [2]		
Bay Marchand Block 2	29,797	28,763
Eugene Island Block 126	6,162	6,041
Grand Isle Block 16	15,592	21,112
Grand Isle Block 47	3,087	3,514
Grand Isle Block 43	13,756	19,207
Main Pass Block 35	4,438	3,943
Main Pass Block 41	18,272	15,961
Main Pass Block 69	11,672	10,866
South Marsh Island Block 73	4,970	5,018
South Pass Block 24	21,647	20,904
South Pass Block 27	21,889	20,548
South Timbalier Block 135	14,941	17,342
Timbalier Bay	35,815	34,458
West Delta Block 27	(3)	14,805
West Delta Block 30	23,473	23,949
West Delta Block 73	12,910	18,651
Other	90,610	169,059
Total offshore	329,031	434,141
Total Gulf Coast	766,555	811,524
NORTHERN		
Black Lake	(3)	5,396
Caddo-Pine Island	4,298	4,122
Cotton Valley	3,174	3,486
Delhi	4,747	4,860
Haynesville	1,804	2,164
Homer	438	337
Lake St. John	2,318	2,141
Pendleton-Many	632	232
Rodessa	540	978
Other	32,920	9,363
Total Northern	50,871	33,079
Total Louisiana	817,426	844,603

[1] Breakdown for individual fields from The Oil and Gas Journal.
[2] Some fields include onshore and offshore.
[3] Included in others.

According to the Louisiana Department of Conservation, production from secondary-recovery projects was 199 million barrels, a gain of 27 million barrels over 1968 production. Secondary-recovery projects totaled 792 in 172 fields and accounted for 23.6 percent of the 1969 crude petroleum production. There were 145 projects started. During the year, 34 projects were abandoned, raising the total number of abandonments to 340.

At yearend 12,973 producing wells were classified as "stripper"wells. Crude petroleum production from these wells was 9.4 million barrels, a decline of about 800,000 barrels from the 1968 rate. The "stripper" wells represented 44 percent of the total oil wells, whereas the oil production from these wells was 1 percent of the total.

Refineries.—At yearend 16 refineries were operating in Louisiana. Crude-oil throughput capacity increased from 1,190,850 barrels per calendar day in 1968 to 1,253,150 barrels per calendar day in 1969, according to the Oil and Gas Journal annual survey. Crude oil runs to stills totaled 423.8 million barrels in 1969, a gain of 25 million barrels over the 1968 level according to the Bureau of Mines.

Operators continued to increase throughput capacity of their refineries during 1969. Some notable changes were as follows: Texaco, Inc., completed expansion of their refinery at Convent and increased capacity from 100,000 to 145,000 barrels per calendar day. Cities Service Oil Co. concluded its topping unit expansion program at Lake Charles. Total crude-oil capacity was increased by 20,000 barrels to 205,000 barrels per calendar day. Gulf Oil Corp. added a pretreating catalytic-cracking-reformer feed unit with a capacity of 14,400 barrels per stream-day at their Venice refinery. Humble Oil & Refining Co. placed in operation a Powerformer with a capacity of 50,000 barrels per stream-day at its Baton Rouge refinery. Good Hope Refineries, Inc., was expanding its refining capacity to 10,000 barrels per calendar day at Good Hope. Murphy Oil Corp. started expansion of their Meraux refinery to increase refining capacity about 10 percent to 33,500 barrels per stream-day and vacuum capacity from 7,000 to 9,700 barrels per stream-day. Gulf Oil Corp. continued construction of a 155,000-barrel-per-stream-day refinery in Plaquemines Parish about 20 miles south of New Orleans. Completion was scheduled for 1971.

Table 15.—Crude petroleum production and estimated reserves of selected fields in Louisiana offshore area

(Thousand 42-gallon barrels)

Offshore area	Number of wells		Production			Estimated reserve Dec. 31, 1969
	1968	1969	1968	1969	Cumulative total	
Bay Marchand Block 2 [1] [2]	413	406	29,797	28,763	273,002	327,534
East Cameron Block 64	61	62	1,315	1,362	6,398	5,702
Eugene Island:						
Block 18	49	52	2,931	3,190	31,506	18,494
Block 32	37	39	1,565	1,600	17,646	17,354
Block 126 [1]	130	132	6,162	6,041	64,235	60,765
Block 128	67	70	2,931	3,030	29,705	30,295
Block 188	63	62	3,589	3,601	19,578	30,422
Block 208	34	30	1,212	1,133	10,403	24,597
Block 238	----	18	------	1,134	4,315	19,605
Block 276	74	78	4,094	4,831	12,904	31,076
Grand Isle:						
Block 16 [1]	167	164	15,592	21,112	117,172	57,828
Block 18	32	31	2,087	2,676	30,688	19,312
Block 41	37	59	2,730	4,400	8,890	22,901
Block 43 [1]	242	257	13,756	19,207	57,808	62,192
Block 47 [1]	36	65	3,087	3,514	46,430	53,994
Main Pass:						
Block 41 [1]	170	138	18,272	15,961	61,470	38,530
Block 69 [1]	211	216	11,672	10,866	138,332	161,668
Mound Point	28	47	1,373	1,468	5,092	13,143
Rabbit Island	40	69	2,690	5,268	13,983	22,042
Ship Shoal:						
Block 28	6	27	1,635	1,258	14,427	15,673
Block 107	48	50	3,945	3,647	28,553	31,447
Block 113	62	71	2,645	3,643	9,293	15,077
Block 154	56	57	2,738	3,015	23,188	24,822
Block 176	38	39	2,136	1,553	11,770	10,230
Block 208	104	156	6,626	12,610	33,217	65,159
South Marsh Island:						
Block 6	28	37	1,997	2,727	9,654	14,600
Block 23	40	31	1,647	1,751	11,515	42,467
Block 73	86	58	4,970	5,018	15,063	40,056
South Pass:						
Block 24 [1] [2]	626	514	21,647	20,904	322,144	427,856
Block 27 [1]	458	435	21,889	20,548	176,737	134,263
Block 62	46	78	1,626	3,979	5,633	24,023
South Pelto Block 20	46	50	2,141	2,376	11,525	18,476
Tiger Shoal	50	44	2,442	2,665	12,755	16,893
Timbalier Bay [1] [2]	597	594	35,815	34,458	262,493	97,507
South Timbalier:						
Block 54	29	12	2,220	2,317	7,265	20,684
Block 131	53	51	3,162	2,829	20,928	29,072
Block 135 [1]	204	240	14,941	17,342	71,341	58,659
Block 176	88	63	3,349	3,924	10,220	22,744
Vermilion:						
Block 14	75	73	2,364	2,299	15,538	16,462
Block 16	17	18	1,585	2,387	6,373	14,615
Block 245	41	41	2,620	3,414	10,606	23,216
West Delta:						
Block 27 [1]	104	109	15,972	14,805	53,257	60,001
Block 30 [1]	279	379	23,473	23,949	192,812	207,188
Block 41	82	124	5,137	4,580	20,353	44,421
Block 73 [1]	188	162	12,910	18,651	63,390	66,610
Block 105	54	52	2,925	2,992	10,600	18,991
Block 117	20	60	1,333	1,901	4,467	14,804
Block 133	23	26	1,380	1,322	3,764	17,578
Total	5,439	5,646	332,125	362,021	2,388,438	2,611,048

[1] Estimated ultimate recovery of 100 million barrels or more.
[2] Combined onshore and offshore.

Source: The Oil and Gas Journal. V. 68, No. 4, Jan. 26, 1970, pp. 131–132. The Oil and Gas Journal. V. 67, No. 4, Jan. 27, 1969, pp. 138–141.

Petrochemicals.—The industry continued as one of the fastest growing segments in the State's manufacturing economy. The Louisiana Board of Commerce and Industry approved applications for $405 million of new and expanded construction in the petroleum, chemical, and petrochemical industries. This was a $55 million increase over the comparable 1968 approvals. Some of the new and expanded construction projects in the petrochemical industries are presented below by geographic areas.

In the Baton Rouge area, Uniroyal Chemical Corp. added an ABS latex unit to their plant. Allied Chemical Corp. completed a 500- to 600-million-pound-per-year vinyl chloride plant and also enlarged their high-density polyethylene plant. Copolymer Rubber and Chemical Corp. was installing a new nitrile rubber plant. Foster Grant Co. was building a 500-million-pound-per-year styrene unit. At Geismar, Uniroyal Chemical Co. completed a 38-million-pound-per-year ethylene-propylene terpolymers plant. Rubicon Chemicals, Inc., was constructing a 10-million-pound-per-year toluene and di-isocyante plant. At Plaquemine, Goodyear Tire & Rubber Co. acquired The Dow Chemical Co. unfinished 40-million-pound-per-year polyvinyl chloride plant and was to increase capacity to 80 million pounds per year. Enjay Chemical Co. completed a 3-year expansion of its isopropyl alcohol plant. The Dow Chemical Co. placed its vinylidene chloride monomer plant in operation and continued expansion of its ethylene facilities. Georgia Pacific Corp. continued building plants having facilities to produce 1,000 tons per day methanol and 200 million pounds per year of phenol and acetone by-products. Hercules, Inc., started production of methanol at their 80-million-gallon-per-year plant. At Donaldsonville, Central Farmers Fertilizer Co.'s operation became one of the Nation's largest anhydrous ammonia plants with addition of a 1,000-ton-per-day ammonia producing facility. Triad Chemical Co. completed its 1,000-ton-per-day ammonia plant and added a 1,200-ton-per-day urea plant. Melamine Chemicals, Inc. (joint venture of Ashland Oil & Refining Co. and First Mississippi Corp.), started construction of a 70-million-pound-per-year melamine plant. By yearend, Gulf Oil Corp. had started construction of a 500-million-pound-per-year styrene plant at Faustina near Donaldsonville.

In the New Orleans area, American Cyanamid Co. was building a 70-million-pound-per-year melamine unit. Union Carbide Corp. placed in operation a 100-million-pound-per-year alkyl amines unit at Taft. This is the largest unit of its kind in the industry. At yearend, E. I. du Pont de Nemours & Co., Inc.'s, neoprene plant at Laplace was nearing completion.

In the Lake Charles area, Pittsburgh Plate Glass Co. increased its vinyl chloride monomer capacity to 300 million pounds per year and tripled 1,1,1-trichloroethane capacity. Ancon Chemical Corp. (joint venture of Ansul Co. and Continental Oil Co.) was expanding their Lake Charles facilities to double methyl chloride capacity to 150 million pounds per year. Cities Service Oil Co. was installing a 140-million-pound-per-year low-density polyethylene unit. Columbian Carbon Co., a subsidiary of Cities Service Oil Co., was building a 500-million-pound-per-year ethylene plant and a 300-million-pound-per-year propylene plant. Firestone Synthetic Rubber & Latex Co. began construction of a 50,000-ton-per-year synthetic rubber plant. Hercules, Inc., was building a 180-million-pound-per-year plant to increase propylene capacity from 320 to 500 million pounds per year.

In the northeastern Louisiana area at Sterlington, Commercial Solvents Co. expanded its plant to double capacity for nitromethane, nitroethane, 1-nitropropane, and 2-nitropropane.

NONMETALS

Value of nonmetals production decreased $50.8 million to $238.6 million and was 5.1 percent of total value of mineral production in the State.

Barite.—Crude barite was not mined in Louisiana. Barite ore, principally from Arkansas, Georgia, Missouri, Nevada, and various foreign countries, was crushed and ground at one plant at Lake Charles and three plants at New Orleans. Virtually all of the output was used as a weighting agent in oil-well drilling fluids. The 6.7-percent decrease in the number of wells drilled in Louisiana contributed toward the 4.7-percent decline in barite output.

Cement.—Portland cement was produced at two New Orleans plants and one at Baton Rouge. Portland cement shipments declined 9 percent from that in 1968; however, the average unit price was about 4 percent higher. Ready-mix concrete companies received 46 percent of cement shipments and were the largest consumers. About 16 percent of shipments were to concrete product manufacturers. Lesser amounts were used by building material dealers and highway contractors. Almost 8 billion cubic feet of natural gas and 125

million kilowatt-hours of electricity were used in the manufacture of cement during 1969.

Clays.—There was a substantial increase in the production of clays. Twelve companies mined clay from 14 pits. Forty-nine percent of the clay production was consumed in making lightweight aggregates, 31 percent was used in the manufacture of cement, and 20 percent was used for making bricks. Big River Industries, Inc., increased the annual capacity of their plant in Pointe Coupee Parish to 450,000 cubic yards of aggregate.

Table 16.—Miscellaneous clay sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	909	$936
1966	1,005	983
1967	995	1,260
1968	863	1,163
1969	1,078	2,943

Gypsum.—Winn Rock, Inc., mined gypsum in Winn Parish for use as a retarder in portland cement. United States Gypsum Co. at New Orleans and National Gypsum Co. at Westwego calcined imported gypsum and manufactured wallboard. The amounts of both mined and calcined gypsum were less than the comparable 1968 amounts; however, the value of calcined gypsum increased.

Lime.—Production increased 5.2 percent, and value was 5.8 percent higher than in 1968. Allied Chemical Corp. in Baton Rouge Parish and Olin Corp. in Calcasieu Parish produced quicklime (calcium oxide). United States Gypsum Co. in Orleans Parish and Pelican State Lime Division of Radcliff Materials, Inc., in St. Mary Parish produced both quicklime and hydrated lime. Pelican State Lime attempted to increase plant capacity by installing a vertical kiln; however, it did not function properly and was being replaced by a rotary kiln. Almost 71 percent of the lime sold and used was in chemical applications. Other significant quantities were utilized for refractory purposes and in soil stabilization.

Perlite.—Although not mined in Louisiana, perlite was expanded at two plants—Zonolite Division of W. R. Grace & Co. in Orleans Parish; and Filter-Media Co. of Louisiana, Inc., in St. John the Baptist Parish. Most important sources of perlite processed in these plants were California and Colorado. Principal uses for expanded perlite were in concrete, horticulture and masonry aggregates, filter aids and filters, and insulation.

Salt.—Louisiana ranked first in salt production and provided 28 percent of the Nation's output. State production increased 14 percent to 12.4 million short tons valued at $61.1 million. The average unit value for salt was $4.91 per ton, down slightly from 1968. Production of brine and rock salt increased from 1968. Production of brine and rock salt increased 19 and 9 percent, respectively, but there was a small decrease in production of evaporated salt. Thirteen companies mined salt at 17 operations. Eleven of the operations produced brine, three produced evaporated and rock salt, one produced evaporated salt only, and two produced rock salt only. Salt was consumed principally as a chemical feedstock in the manufacture of chlorine, caustic soda (sodium hydroxide), and soda ash (sodium carbonate). There were numerous other uses including snow and ice removal, food processing, agriculture, and industrial applications.

Sand and Gravel.—Production was 18.1 million tons, 11 percent less than 1968 production. There was a total of 97 operations reported—87 commercial and 10 Government-and-contractor. Operations were in 44 of the State's 64 parishes. Commercial operations accounted for almost 98 percent of sand and gravel production.

Table 17.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt		Brine		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1965	256	$6,293	3,016	$17,828	4,854	$17,691	8,126	$41,812
1966	267	6,354	3,502	19,681	4,967	18,154	8,736	44,189
1967	301	7,619	4,183	22,131	5,101	18,733	9,585	48,483
1968	293	7,183	4,793	26,556	5,822	20,115	10,908	53,854
1969	277	7,598	5,237	29,160	6,921	24,344	12,435	61,102

Table 18.—Sand and gravel sold or used by producers
(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	14,024	$16,306	274	$99	14,298	$16,405
1966	18,171	22,459	45	45	18,216	22,504
1967	20,216	27,346	96	96	20,312	27,442
1968	20,208	26,354	203	150	20,411	26,504
1969	17,715	21,278	416	616	18,131	21,895

[1] Data may not add to totals shown because of independent rounding.

Table 19.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,988	$5,027	5,988	$6,183
Paving	2,129	2,135	2,232	2,272
Other [1]	291	1,129	196	479
Total sand	7,408	8,291	8,416	8,934
Gravel:				
Building	8,575	11,321	6,269	8,275
Paving	4,042	6,485	3,024	4,059
Other [2]	183	257	7	10
Total gravel [3]	12,800	18,063	9,299	12,345
Total sand and gravel [3]	20,208	26,354	17,715	21,278
Government-and-contractor operations:				
Sand: Building	------	------	79	166
Gravel:				
Building	------	------	151	314
Paving	203	150	186	136
Total gravel	203	150	337	450
Total sand and gravel	203	150	416	616
Grand total [3]	20,411	26,504	18,131	21,895

[1] Includes fill, other construction (1968), and industrial sand (ground and unground).
[2] Includes fill (1968) and other construction.
[3] Data may not add to totals shown because of independent rounding.

The Louisiana Geological Survey continued a study of Louisiana sands from the standpoint of suitability for industrial use—glass manufacture, foundry sand, polishing compounds, fillers and extenders, etc. Results of the study are to be published.

Stone.—Production consisted principally of shell (clam and oyster) along the coastal area and some anhydrite produced in Winn Parish. Total output of shell by seven companies at nine operations was 1.6 percent less than the 1968 output; however, total value increased almost 1.0 percent to $11.9 million. About 70 percent of the shell output was crushed for use principally in roads and general construction. Cement manufacturing consumed 17 percent of the output, and lime manufacture used 12 percent. Small amounts of shell were consumed in the preparation of feed for chickens and cattle and in the manufacture of glass.

Louisiana State University researchers completed a study of the shell industry in the State for the Louisiana Wild Life and Fisheries Commission.[5] Purposes of the study were to determine the importance of the shell industry to the State's economy; to determine effects of changes in royalty; to study methods of leasing, markets, methods of marketing; and to make recommendations regarding royalty and methods

[5] Burford, Roger L., Jan W. Duggar, and Lee Richardson. The Shell Dredging Industry in Louisiana. Louisiana State University, April 1969, 55 pp.

of leasing. The researchers recommended that consideration be given to increasing the combined royalty and severance tax range (15 to 18 per cubic yard at present) to 20 to 24 cents per cubic yard. Also recommended was that all leases for shell dredging be awarded on a competitive bid basis.

Sulfur.—Although Louisiana retained national leadership in sulfur production, the impact of worldwide oversupply was indicated by a decline of 2 percent in sales and 33 percent in value from 1968. Increased amounts of sulfur derived from sour gas in Canada contributed significantly to the oversupply that continued to lessen selling prices at yearend. Because of decreases in sulfur demand, Freeport Sulphur Co. suspended operations at its offshore Caminada mine. The company stated that although operations were still profitable when suspended, other company mines could produce the required tonnage at lower costs. The U.S. Bureau of Land

Table 20.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1965	3,582	3,577	$81,372
1966	4,085	4,018	104,472
1967	4,059	4,233	139,739
1968	4,255	4,074	162,664
1969	3,857	3,999	108,299

Managment sold sulfur leases for Federal lands offshore Louisiana in May. Six companies or groups submitted bids on 38 of the 120 tracts offered, but only four bids were accepted. Successful bids ranged from $42 to $215 per acre and totaled $715,150. The total value of rejected bids was almost $3 million.

Vermiculite.—This mineral was not mined in Louisiana; however, exfoliated vermiculite was produced by two companies—Zonolite Division of W. R. Grace & Co., in Orleans Parish; and Filter-Media Co. of Louisiana, Inc., in St. John the Baptist Parish. Production was about 3 percent higher than in 1968. Principal uses for exfoliated vermiculite were concrete aggregate, loose fill insulation, and soil conditioning.

METALS

Aluminum.—Although bauxite, the primary ore used in the manufacture of aluminum, was not mined in Louisiana, both alumina and aluminum were produced in the State. Kaiser Aluminum and Chemical Corp. produced aluminum at their Chalmette plant and alumina at the Gramercy and Baton Rouge plants. Ormet Corp. produced alumina at its Burnside plant.

Kaiser Aluminum and Chemical Corp. started an expansion program at their Gramercy operation to increase aluminum floride production capacity to 66,000 tons per year. The expanded capacity will make this corporation the largest producer of aluminum fluoride in the world. Aluminum fluoride is used in the production of primary aluminum metal.

Gulf Coast Aluminum Corp. continued construction of its Lake Charles complex and started producing calcined coke. Coke is made into electrodes and used in the manufacture of aluminum. When completed, the Lake Charles complex will inclued an aluminum reduction plant in addition to electrode manufacturing facilities.

Table 21.—Principal producers and processors of minerals

Commodity and company	Address	Type of activity	Parish
Barite:			
Dresser Minerals	P.O. Box 6504 Houston, Tex. 77005	Grinding plant.	Orleans and Calcasieu.
Milchem, Inc	P.O. Box 22111 Houston, Tex. 77027	----do	Orleans.
National Lead Co	Box 1675 Houston, Tex. 77001	----do	Do.
Carbon black:			
Ashland Chemical Co	P.O. Box 1503 Houston, Tex. 77005	Furnace plant	St. Mary.
Cabot Corp	125 High St. Boston, Mass. 02110	----do	St. Mary and Evangeline.
Columbian Carbon Co	380 Madison Ave. New York, N.Y. 10017	----do	Ouachita, Avoyelles, St. Mary.
Continental Carbon Co	P.O. Box 22085 Houston, Tex. 77027	----do	Calcasieu.
Sid Richardson Carbon & Gasoline Co.	1200 Ft. Worth National Bank Bldg. Ft. Worth, Tex.	----do	West Baton Rouge.
Thermatomic Carbon Co	245 Park Ave. New York, N.Y. 10017	----do	Ouachita.
Cement:			
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	Plant	East Baton Rouge.
Lone Star Cement Corp	P.O. Box 47327 Dallas, Tex. 75247	----do	Orleans.
Louisiana Cement Co	14900 Intracoastal Dr. New Orleans, La. 70129	----do	Do.
Clay:			
Acme Brick Co	Box 425 Ft. Worth, Tex. 76101	Mine and plant.	East Baton Rouge.
Athens Caddo Brick Co	Box 70 Athens, Tex. 75751	----do	Caddo.
Big River Industries, Inc	Box 66377 Baton Rouge, La. 70806	----do	Pointe Coupee.
Hammond Baton Rouge Brick Co.	Box 329 Hammond, La. 70401	----do	Tangipahoa.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	----do	West Baton Rouge,
Kentwood Brick & Tile Manufacturing Co., Inc.	Drawer F Kentwood, La. 70444	----do	St. Helena.
Louisiana Cement Co	14900 Intracoastal Dr. New Orleans, La. 71029	----do	St. Bernard.
Louisiana Lightweight Aggregate Co., Div. of Texas Industries, Inc.	8100 Carpenter Freeway Dallas, Tex. 75247	----do	Rapides.
Gypsum:			
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	Calcining plant.	Jefferson.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	----do	Orleans.
Winn Rock, Inc	P.O. Box 790 Winnfield, La. 71483	Quarry and plant.	Winn.
Lime:			
Allied Chemical Corp	P.O. Box 70 Morristown, N.J. 07960	Plant	East Baton Rouge.
Olin Corp	P.O. Box 2896 Lake Charles, La. 70601	----do	Calcasieu.
Pelican State Lime Div. of Radcliff Materials, Inc.	P.O. Box 1637 Morgan City, La. 70380	----do	St. Mary.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	----do	Orleans.
Perlite:			
Filter-Media Co. of La., Inc	P.O. Box 19156 Houston, Tex. 77024	Expanding plant.	St. John the Baptist.
W. R. Grace & Co., Zonolite Div.	62 Whittemore Ave. Cambridge, Mass. 02140	----do	Orleans.
Salt:			
Allied Chemical Corp., Industrial Chemical Div.	Box 70 Morristown, N.J. 07960	Brine wells	Iberville.
The Carey Salt Co	1800 Carey Blvd. Hutchinson, Kans. 67501	Underground mine.	St. Mary.
Cargill, Ind	Cargill Building Minneapolis, Minn. 55402	----do	Do.
Diamond Crystal Salt Co., Jefferson Island Div.	916 Riverside Ave. St. Clair, Mich. 48079	----do	Iberia.
The Dow Chemical Co	Midland, Mich. 48640	Brine wells	Plaquemines.
Freeport Sulphur Co	Box 61520 New Orleans, La. 70160	----do	Plaquemines, Jefferson, Terrebonne.
Gordy Salt Co., Inc	Box 638 New Iberia, La. 70560	----do	St. Martin.

Table 21.—Principal producers and processors of minerals—Continued

Commodity and company	Address	Type of activity	Parish
Salt—Continued			
International Salt Co., Avery Mine & Refinery.	Clarks Summit, Pa. 18411	Underground mine.	Iberia.
Kaiser Aluminum & Chemical Corp.	900 17th St., N.W. Washington, D.C. 20006	Brine wells	Ascension.
Morton Salt Co	110 North Wacker Dr. Chicago, Ill. 60606	Underground mine.	Iberia.
Olin Corp	Box 991 Little Rock, Ark. 72203	Brine wells	Cameron.
PPG Industries, Inc., Industrial Chemical Div.	Box 1000 Lake Charles, La. 70604	----do	Calcasieu.
Wyandotte Chemicals Corp	1609 Biddle Ave. Wyandotte, Mich. 48192	----do	Ascension.
Sand and gravel:			
Braswell Sand & Gravel Co., Inc	Box 798 Minden, La. 71055	Stationary	Webster.
Gifford-Hill & Co., Inc	Box 47127 Dallas, Tex. 75247	Stationary and dredge.	Evangeline, Jefferson Davis, Webster, Tangipahoa.
Jahncke Service, Inc	814 Howard Ave. New Orleans, La. 70104	Dredge	St. Tammany.
Louisiana Industries, Inc	Box 5472 Alexandria, La. 71301	----do	Ouachita, Rapides, Washington.
Mid-State Materials, Inc	212 Maryland St. Alexandria, La. 71301	----do	Rapides.
Northwest Mining Corp	Coushatta, La. 71019	Stationary	Red River.
Ouachita Gravel Co., Inc	Box 1241 Monroe, La. 71201	----do	Ouachita.
Red Stick Gravel Co	Box 847 Baton Rouge, La.		East Baton Rouge.
Standard Gravel Co., Inc	Rt. 4, Box 17 Franklinton, La. 70438	----do	Washington.
Trinity Concrete Products	Box 47524 Dallas, Tex. 75247	Stationary and dredge.	Beauregard.
Shell:			
Ayers Materials Co., Inc	P.O. Box 382 Harvey, La. 70058	Dredge	St. Tammany.
W. T. Burton Industries, Inc	P.O. Box 100 Sulphur, La. 70663	----do	Cameron.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	----do	St. Mary.
Jahncke Service Co., Inc	814 Howard Ave. New Orleans, La. 70113	----do	St. Tammany.
Lake Charles Dredging & Towing Co.	Lafayette, La. 70501	----do	St. Mary.
Louisiana Materials Co	P.O. Box 8214 New Orleans, La. 70122	----do	St. Tammany.
Radcliff Materials, Inc	P.O. Drawer 946 Mobile, Ala. 36601	----do	Orleans, St. Mary, St. Tammany.
Stone: Winn Rock, Inc	P.O. Box 790 Winnfield, La. 71483	Quarry and plant.	Winn.
Sulfur, native:			
Freeport Sulphur Co	161 East 42d St. New York, N.Y. 10017	Frasch process	Jefferson, Plaquemines, Terrebonne.
Jefferson Lake Sulphur Co	Box 1185 Houston, Tex. 77001	----do	Plaquemines.
Texas Gulf Sulphur Co	200 Park Ave. New York, N.Y. 10017	----do	Lafourche.
U.S. Oil of Louisiana, Ltd	Box 430 Thibodaux, La. 70301	----do	Do.
Union Texas Petroleum	Box 230 Sulphur, La. 70663	----do	Calcasieu.
Sulfur, byproduct:			
Shell Oil Co	Box 60673 New Orleans, La. 71060	Secondary recovery.	St. Charles.
Stauffer Chemical Co	299 Park Ave. New York, N.Y. 10017	----do	East Baton Rouge.
Vermiculite:			
W. R. Grace & Co., Zonolite Div.	62 Whittemore Ave. Cambridge, Mass. 02140	Exfoliating plant.	Orleans.
Filter-Media Co. of La., Inc	P.O. Box 19156 Houston, Tex. 77024	----do	St. John the Baptist.

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 Robert E. Ela [1]

Mineral production values in 1969 continued to climb upward and established a new high of $20.2 million. This was 13 percent greater than the $17.8 million reported in 1968, the previous record high value year. The growth was attributed to a substantial increase in the milling of copper and zinc and greater demand for dimension stone and cement, coupled with higher values for each.

Considerable interest has been shown in the recommendation to create a foreign trade subzone in eastern Maine. Atlantic-Richfield, Atlantic World Port, Inc., and Occidental Petroleum Corp. all have announced intentions to build a refinery and deep-water oil port in the Machiasport area if they can obtain an import quota and a free trade subzone designation. The three companies have also pledged installation designs completely protecting the existing environment.

The Maine Geological Survey Mapping Program was directed toward satisfying the immediate needs of the State. Priorities for future geological mapping were established. The program represented a continuing effort to provide detail and comprehensive basic geological investigation on a 7-½-minute and 15-minute quadrangle basis. Special emphasis was given to work on the coastal areas of Casco Bay, Camden-Rockland, Penobscot Bay, and several locations in western Hancock County.

Interest continued in exploration and development of metallic mineral deposits in the State. Areas being prospected included an area south of Jackman in Somerset County and along the Maine coast from New Brunswick through Knox County. Knox Mining Co., doing nickel exploration work near Union, entered into an agreement with the University of Maine for a study of metal content in the St. George River's drainage area. Fundy Exploration, Ltd., announced it is starting a diamond drilling program to test the nickel-copper zone on its property. Humble Oil Co. explored an area about 500 yards from the limits of Baxter State Park for copper and molybdenum and may continue investigation work there for another 3 to 5 years. Noranda Mines, Ltd., of Toronto, through its subsidiary, East Range Co., continued exploration of the copper-molybdenum deposit south of Jackman.

[1] Supervisory statistical assistant, Bureau of Mines, Pittsburgh, Pa.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Dragon Cement Co., Division of Martin Marietta Corp., operated the only cement plant in the State. Raw materials, principally cement rock, in a slurry of controlled consistency were fed into two rotary kilns at Thomaston to produce clinker for use in the manufacture of cement. Shipments of both portland and masonry cement were greater than those of

Table 1.—Mineral production in Maine [1]

Mineral		1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Clays [2]	thousand short tons	42	$65	42	$56
Gem stones		NA	35	NA	35
Sand and gravel	thousand short tons	11,866	5,978	11,275	6,026
Stone	do	1,187	3,205	1,101	3,798
Value of items that cannot be disclosed: Beryllium concentrate, cement (portland and masonry), fire clay, copper, feldspar, peat, silver, and zinc		XX	8,527	XX	10,273
Total		XX	17,810	XX	20,188
Total 1967 constant dollars		XX	17,516	XX	p 19,145

p Preliminary. NA Not available. 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 Maine, by counties

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Androscoggin	$520	$559	Sand and gravel, clays.
Aroostook	909	664	Sand and gravel, stone.
Cumberland	1,491	1,747	Sand and gravel, stone, clays.
Franklin	W	215	Sand and gravel.
Hancock	W	W	Zinc, copper, sand and gravel, silver, stone, clays.
Kennebec	610	691	Sand and gravel, stone.
Knox	W	W	Cement, stone, sand and gravel.
Lincoln	122	140	Sand and gravel.
Oxford	286	323	Sand and gravel, feldspar, beryllium.
Penobscot	734	812	Sand and gravel.
Piscataquis	W	W	Stone, sand and gravel.
Sagadahoc	W	W	Sand and gravel.
Somerset	367	W	Do.
Waldo	320	334	Do.
Washington	W	W	Sand and gravel, peat.
York	W	712	Sand and gravel, stone.
Undistributed [1]	12,450	13,988	
Total [2]	17,810	20,188	

W Withheld to avoid disclosing individaul company confidential data.
[1] Includes value of gem stones and sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.
[2] Data does not add to totals shown because of independent rounding.

Table 3.—Indicators of Maine business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average: [1]				
Total labor force	thousands	394.4	402.6	+2.1
Unemployment	percent of work force	4.1	4.6	+12.2
Employment:				
Manufacturing employment	thousands	118.0	115.9	−1.8
Durable goods	do	r 33.5	34.3	+2.4
Lumber and wood products	do	r 14.4	14.4	------
Nondurable goods	do	r 81.6	84.5	+3.6
Food products	do	r 12.6	12.3	−2.4
Textile mill products	do	12.4	11.8	−4.8
Paper and allied products	do	18.0	17.9	−0.6
Leather and leather products	do	r 30.8	28.3	−8.1
Nonmanufacturing	do	r 205.2	214.4	+4.5
Agricultural	do	15.4	14.9	−3.2
Personal income: [2]				
Total	millions	r $2,757	$2,972	+7.8
Per capita		r $2,819	$3,039	+7.8
Portland cement shipments to and within Maine	thousand 376-pound barrels	r 1,017	1,069	+5.1
Mineral production value	thousands	$17,810	$20,188	+13.4

p Preliminary. r Revised.
[1] Maine Employment Security Commission.
[2] Survey of Current Business.

Table 4.—Worktime 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
1968:								
Metal and peat	79	295	23	162	---	6	36.93	535
Nonmetal	83	219	18	148	---	3	20.29	162
Sand and gravel	1,437	167	241	2,084	---	42	20.15	461
Stone	411	216	89	726	---	18	24.79	705
Total [1]	2,010	185	371	3,121	---	69	22.11	507
1969: [p]								
Metal and peat	105	269	28	222	---	5	22.55	433
Nonmetal	75	201	15	122	---	5	40.98	172
Sand and gravel	625	198	124	1,105	---	23	20.82	386
Stone	200	314	63	521	---	12	23.05	311
Total [1]	1,005	229	230	1,970	---	45	22.85	358

[p] Preliminary.

[1] Data may not add to totals shown because of independent rounding.

1968 and were made to the New England area. Most of the portland cement was shipped in bulk by truck; less than one-fifth of the cement shipped was bagged. Consumers of portland cement were ready-mixed concrete companies, concrete product manufacturers, and building material dealers.

Clay.—Output of miscellaneous clay remained virtually the same as in 1968. Production was reported from three pits in Cumberland County and two pits in Androscoggin County. Miscellaneous clay, the predominant kind of clay produced, was used to manufacture building brick; no use of shale was reported. A small quantity of stoneware clay recovered from various properties in Hancock County was used to manufacture dinnerware, art pottery, flowerpots, and glazed ware.

Feldspar.—Production of marketable crude feldspar was reported only from mines in Oxford County and was 17 percent lower than in 1968. All the output, together with a substantial quantity of high potash feldspar from the Ruggles Mines in Grafton, N.H., was processed at West Paris, Oxford County, by Bell Minerals Co. Ground feldspar was nearly one-third less than the previous year because a fire destroyed a portion of Bell Minerals Co.'s grinding mill near West Paris. The ground feldspar was sold primarily for ceramic applications to consumers chiefly in Pennsylvania, New York, Ohio, New Jersey, and Massachusetts.

Gem Stones.—Various mineral specimens continued to be collected from old mines, quarries, and dumps throughout the State. Mineral collectors were particularly active in Oxford County, acquiring specimens of agate, autunite, beryl, gem-quality aquamarine, lithium minerals, and amethyst.

Mica.—Scrap mica, the first since 1962, was recovered at the Bumpus Mine by Bell Minerals Co. The mica was stockpiled at a plant nearby for grinding at a later date.

Nitrogen Compounds.—Northern Chemical Industries, Searsport, Waldo County, produced anhydrous ammonia for use as a fertilizer component.

Peat.—Sales of peat continued to decline and reached its lowest level since 1961 when no sales were reported. The inability to hire sufficient personnel by New England Peat Industries, Inc., together with the inactivity of Eric W. Kelly Peat Moss Co., Inc., were the reasons for the drop in sales. Improvement of business in the peat industry was indicated when the Small Business Administration sold the property and plant facilities formerly owned by Richland Peat Corp. to the Acadia Peat Corp. However, owing to the late acquisition, activity was limited to stockpiling of the peat for winter processing. Acadia Peat Corp. has developed and will use a mechanical dewooding device for raw peat

and a mechanical squeeze dewaterer. They will also employ both thermal and air drying techniques to produce 35 percent moisture sphagnum moss. The product will be pin shredded and packaged. The peat operation owned by Eric W. Kelly was sold to the Northeast Peat Co. at the end of the year.

Perlite.—Crude perlite mined in Southwestern United States was expanded by the Chemrock Corp. at its Rockland plant for use as a filter aid.

Sand and Gravel.—Total output from both commercial and Government-and-contractor operations was almost 600,000 tons less than the 11.9 million tons produced in 1968, and 6 million tons below the record high of 17.3 million in 1965. A 10-percent rise is output of sand and gravel by commercial producers was not sufficient to overcome a similar decline recorded for Government-and-contractor operations. Commercial producers who have steadily increased their percentage of the total output accounted for more than 3 million tons. More than one-third of the State's production was provided by commercial and Government-and-contractor operators in Cumberland, Penobscot, and Aroostook Counties.

A total of 68 commercial operations was reported during the year. Of these, 32 reported production of less than 25,000 tons, 17 ranged from 25,000 to 50,000 tons; 10 from 50,000 to 100,000 tons; seven produced from 100,000 to 200,000 tons, and two were in excess of 200,000 tons. Commercial production was reported in all counties except Lincoln and Piscataquis, and was centered mainly in Cumberland Penobscot, Androscoggin, York, and Kennebec Counties.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	267	$239	334	$326
Paving	331	321	574	530
Fill	432	155	327	148
Other [1]	103	83	93	77
Total	1,133	798	1,328	1,081
Gravel:				
Structural	174	170	198	224
Paving	931	1,026	1,008	988
Fill	284	125	256	128
Other [2]	242	151	257	182
Total	1,631	1,472	1,719	1,522
Total sand and gravel	2,764	2,270	3,047	2,603
Government-and-contractor operations:				
Sand:				
Paving	410	164	465	198
Other	120	41	29	10
Total	530	205	494	208
Gravel:				
Paving	8,567	3,501	7,702	3,204
Fill	5	2	33	12
Total	8,572	3,503	7,735	[3] 3,215
Total sand and gravel	9,102	[3] 3,711	[3] 8,228	3,423
All operations:				
Sand	1,663	1,003	1,822	1,289
Gravel	10,203	4,975	9,454	4,737
Total	11,866	5,978	[3] 11,275	6,026

[1] Includes engine and other sands.
[2] Includes miscellaneous, other, and railroad ballast gravel.
[3] Data does not add to totals shown because of independent rounding.

The Maine State Highway Commission, the State's largest single user, reported production of paving sand and gravel in all counties; output was obtained by the Commission's own crews and by workers under contract.

Stone.—Heavy demand for dressed architectural granite was the prime factor in a 19-percent rise in the value of stone. Early in 1969 the John Swenson Granite Co., Inc., Concord, N.H., attained full operation at its Vinalhaven Island quarry. Approximately 80,000 cubic feet or 8,000 short tons of granite were removed. The unfinished blocks weighing approximately 20 tons each were trucked from the quarry, ferried 10 miles to the mainland at Rockland, and then carried on the Maine Central Railroad to the company's finishing plant located in Concord, N.H. The blocks were sawed into slabs 2 inches thick, faced with a stipple finish, and numbered. The finished stone will be transferred by railroad to Wilmington, Del., to be used in the construction of the new E. I. du Pont headquarters building scheduled for completion in 1972. The Deer Island Granite Corp. discontinued operations at its Deer Island and Settlement quarries and was taken over by the Small Business Administration in mid-year. Crushed granite was produced and marketed as concrete aggregate and roadstone.

Knox County continued as the leading limestone-producing area; output was also reported in Aroostook and Kennebec Counties. Limestone was consumed for a variety of uses, but principally in the manufacture of cement and as construction aggregate. Blue Rock Industries, formerly Blue Rock Quarry, produced miscellaneous stone near Portland and crushed limestone near Sidney for use as construction aggregate. Slate, mined underground by Portland-Monson Slate Co. near Monson, was sold for use as electrical slate, floor tile, and flagging.

METALS

Beryllium.—Sales of small quantities of beryl concentrates, averaging 12 percent beryllium oxide, were reported for the first time since 1962. The beryl concentrates were recovered by Bell Minerals Co. from the Bumpus Mine in Oxford County.

Zinc, Copper, and Silver.—Output of zinc-copper ore mined in an open pit by Callahan Mining Corp. at Harborside was 64 percent greater than in the previous year. The ore occurs as lenticular pods in talc-carbonate rock. The pit will eventually be oval in shape, cover approximately 9.4 acres, and have a maximum depth of 340 feet. Average slope of the pit wall is 60° and benches are 30 feet high. The haulage ramp into the pit is 40 feet wide and has an average grade of 12 percent; when completed, the ramp will be 2,800 feet long. Mill water is recycled to avoid discharging dissolved heavy metals into Goose Neck Bay. Concentrates from the flotation mill were trucked to Bucksport for loading onto railroad cars. Zinc concentrates were shipped to Josephtown, Pa., and the copper concentrates to Gaspe, Quebec, for the recovery of copper and silver.

Continued exploration by the Penobscot Unit of Callahan Mining Corp. located a promising deposit of ore not far from the present open pit operation. Underground operations started at two locations; one entrance was made from the pit and the other about 1 mile distant, through a newly drilled shaft. The shaft, which measures 48 inches in diameter and is 280 feet deep, is reported to be the largest diameter hole ever drilled in the state of Maine. The underground mining crew is expected to number 35 to 40 men when peak production is reached.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Dragon Cement Co., Division of Martin Marietta Corp. [1]	5A Joyce Kilmer Ave. New Brunswick, N.J. 08901	Plant	Knox.
Clay:			
Dennis Brick Co., Inc	R.F.D. No. 1 33 Old Washington Rd. Auburn, Maine 04210	Pit	Androscoggin.
Lachance Bros. Brick Co	R.F.D. No. 2 Gorham, Maine 04038	Pit	Cumberland.
Fred S. Liberty & Son, Inc	R.F.D. No. 1, Gray, Maine 04039	Pit	Do.
Morin Brick Co	Danville, Maine 04223	Pit	Androscoggin.
Rowantrees, Inc	Bluehill, Maine 04614	Pit	Hancock.
Royal River Brick Co., Inc	Box 191, Gray, Maine 04039	Pit	Cumberland.
Feldspar (crude):			
Arden Andrews	R.F.D. No. 1 West Paris, Maine 04289	Pit	Oxford.
Bell Minerals Co. [2]	West Paris, Maine 04289	Pit [3]	Do.
Albert Herrick	----do----	Pit	Do.
Norman Jack	Buckfield, Maine 04220	Pit	Do.
Frank Perham	West Paris, Maine 04289	Pit	Do.
Peat:			
Acadia Peat Corp	Penobscot, Maine 04476	Bog	Hancock.
New England Peat Industries, Inc.	Mason's Bay Road Jonesport, Maine 04649	Bog	Washington.
Perlite (expanded):			
Chemrock Corp	End of Osage Street Nashville, Tenn. 37208	Plant	Knox.
Sand and gravel:			
Blue Rock Industries	58 Main Street Westbrook, Maine 04092	Pit	Androscoggin.
Philip R. Boston, Inc	Elm Street North Berwick, Maine 03906	Pit	York.
Brown Co	650 Main St., Berlin, N.H. 03570	Pit	Oxford.
Harry C. Crooker & Sons, Inc	Brunswick, Maine 04011	Pit [3]	Cumberland.
Cumberland Sand & Gravel Co., Inc.	58 Main St. Westbrook, Maine 04092	Pit	Do.
Goding Ready-Mix Concrete Co.	Lincoln, Maine 04457	Pit	Penobscot.
Hamlin Sand & Gravel Co., Inc.	920 Riverside St. Portland, Maine 04103	Pit [4]	Cumberland.
Lane Construction Co	965 E. Main St. Meriden, Conn. 06450	Pit	Aroostook.
Lane Construction Co	----do----	Pit	Penobscot.
Lewiston Crushed Stone Co., Inc.	South Ave. Lewiston, Maine 04240	Pit [3]	Androscoggin.
C. M. Page Co., Inc	234 Main St. Orono, Maine 04473	Pit	Penobscot.
Leroy S. Prout Sand & Gravel	Scarborough, Maine 04074	Pit	Cumberland.
Maynard W. Robinson & Sons	R.F.D. No. 2 Cumberland Center, Maine 04021	Pit	Do.
Frank Rossi & Sons, Inc	National Bank Bldg. Gardiner, Maine 04345	Pit	Various.
Warren Bros. Company	Fairfield, Maine 04937	Pit	Kennebec.
Stone:			
Granite, dimension:			
Deer Island Granite Corp	Stonington, Maine 04681	Quarry	Hancock.
Hocking Granite Industries, Inc. [5]	Saint George, Maine 04857	----do----	Knox.
Joseph Musetti	Mount Desert, Maine 04660	----do----	Hancock.
The John Swenson Granite Co., Inc.	North State St. Concord, N.H. 03301	----do [6]	York, Knox.
Granite, crushed:			
Cook and Co., Inc	150 Causeway St. Boston, Mass. 02114	Quarry	Cumberland.
Limestone, crushed:			
Blue Rock Industries	58 Main St. Cumberland Mills, Maine 04092	----do----	Kennebec.
Dragon Cement Co., Division of Martin Marietta Corp.	5A Joyce Kilmer Ave. New Brunswick, N.J. 08901	----do----	Knox.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone, crushed—Continued			
Lime Products Corp	P.O. Box 357 Union, Maine 04862	Quarry	Knox.
McKay Rock Products, Inc.	Box 656, Reach Road Presque Isle, Maine 04769	----do	Aroostook.
Miscellaneous, crushed:			
Blue Rock Industries	58 Main St. Cumberland Mills, Maine 04092	----do	Cumberland.
Slate, dimension:			
Portland-Monson Slate Co	Middle Granville, N.Y. 12849	Underground	Piscataquis.
Zinc:			
Callahan Mining Corp.[7]	Harborside, Maine 04642	Pit and underground	Hancock.

[1] Portland and masonry.
[2] Also beryllium concentrate and scrap mica from the Bumpus mine.
[3] 2 pits.
[4] 3 pits.
[5] Also crushed.
[6] Includes 4 quarries: 3 in York (Pink, Green, and Black) and 1 in Knox (Gray).
[7] Also copper and silver.

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 Curtis D. Edgerton [1]

Maryland's mineral production reached an alltime high of $83.5 million. Nearly $8.0 million of the $11.6 million gain over the 1968 value was due to increased production of stone and sand and gravel. Stone remained the leading revenue producer among mineral commodities and accounted for 37 percent of the total value of all minerals produced. Sand and gravel represented one-fourth of the total value of minerals. The increased demand for construction materials was attributed largely to building activity in Prince Georges County (now the State's most populous) and Baltimore County, and to the construction of Interstate Highway 95 between Washington and Baltimore. Large tonnages of construction materials were also used at the new City of Columbia (Howard County) and at Baltimore Gas and Electric Co.'s Calvert Cliffs nuclear plant (Calvert County). Baltimore, Carroll, Frederick, Prince Georges, and Washington Counties maintained their positions as leading mineral-producing counties in the State.

The Maryland Geological Survey continued its program of geologic mapping and environmental studies in Baltimore and Frederick Counties. Topographic maps of Charles, Prince Georges, and Kent Counties were revised. The Survey cooperated with the U.S. Geological Survey in the geologic mapping of Cecil County and aeromagnetic mapping of Frederick County.

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Maryland [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Clays [2] ——thousand short tons	1,078	$1,252	1,152	$1,369
Coal (bituminous) ——do	1,447	5,318	1,368	5,261
Gem stones	NA	3	NA	3
Natural gas ——million cubic feet	864	221	978	248
Peat ——short tons	5,554	94	4,481	78
Sand and gravel ——thousand short tons	11,719	17,157	14,230	21,226
Stone ——do	13,344	26,606	15,067	30,504
Value of items that cannot be disclosed: Ball and fire clay, cement (portland and masonry), diatomite (1969), greensand marl, lime, potassium salts, and talc and soapstone	XX	21,193	XX	24,794
Total	XX	71,844	XX	83,483
Total 1967 constant dollars	XX	71,182	XX	p80,967

p Preliminary. NA Not available. XX Not applicable.

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

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

Table 2.—Value of mineral production in Maryland, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Allegany	$2,727	$2,520	Coal, sand and gravel, stone.
Anne Arundel	2,675	2,595	Sand and gravel.
Baltimore	12,880	W	Stone, sand and gravel, clays.
Calvert	W	W	Greensand marl, sand and gravel, diatomite.
Caroline	W	W	Sand and gravel.
Carroll	W	W	Cement, stone, clays.
Cecil	3,401	6,333	Stone, sand and gravel.
Charles	W	W	Sand and gravel.
Dorchester	73	91	Do.
Frederick	8,256	9,867	Cement, stone, clays, lime, sand and gravel.
Garrett	4,538	4,589	Coal, stone, natural gas, sand and gravel, peat.
Harford	1,479	1,489	Stone, sand and gravel, clays, talc.
Howard	W	W	Stone.
Kent	W	63	Peat, clays.
Montgomery	W	W	Stone.
Prince Georges	6,720	8,477	Sand and gravel, clays.
St. Marys	W	W	Sand and gravel.
Somerset	----	W	Do.
Talbot	W	31	Do.
Washington	W	W	Cement, stone, clays, potassium salts.
Wicomico	W	W	Sand and gravel.
Worcester	W	6	Do.
Undistributed [2]	29,097	47,422	
Total	[3] 71,844	83,483	

W Withheld to avoid disclosing individual company confidential data.

[1] Queen Annes County is not listed because no production was reported.

[2] Includes some sand and gravel that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

[3] Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Maryland business activity

	1968	1969 p	Change, percent
Employment and labor force, annual average:[1]			
Total labor force —thousands	r1,416.0	1,467.3	+ 3.6
Unemployment —percent of labor force	3.2	3.0	— 6.2
Employment:			
Manufacturing —thousands	r280.6	281.3	+ .2
Durable goods —do	r154.0	154.5	+ .3
Nondurable goods —do	126.6	126.8	+ .2
Nonmanufacturing —do	r946.4	996.1	+ 5.3
Mining —do	1.8	1.8	.0
Contract construction —do	r80.3	84.7	+ 5.5
Payroll—average weekly earnings:[1]			
Manufacturing	$122.61	$131.38	+ 7.2
Durable goods	$135.96	$146.14	+ 7.5
Nondurable goods	$105.87	$112.92	+ 6.7
Personal income:[2]			
Total —millions	r $14,048	$15,416	+ 9.7
Per capita	$3,780	$4,095	+ 8.3
Construction activity:			
Portland cement shipments to and within Maryland —thousand 376-pound barrels	r6,438	7,230	+12.3
Mineral production —thousands	$71,844	$83,483	+16.2

p Preliminary. r Revised.

[1] Department of Employment Security, Maryland.

[2] Survey of Current Business.

Table 4.—Worktime 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
1968:								
Coal and peat	336	212	71	571	------	6	10.50	954
Nonmetal	153	256	39	313	------	16	51.04	1,215
Sand and gravel	680	264	179	1,570	------	37	23.56	331
Stone	1,076	277	298	2,461	------	59	23.97	481
Total [1]	2,245	262	588	4,916	------	118	24.00	535
1969: [p]								
Coal and peat	345	216	75	600	------	6	10.00	910
Nonmetal	185	249	47	372	------	17	45.67	768
Sand and gravel	775	253	196	1,750	------	30	17.14	679
Stone	1,280	279	358	2,976	1	52	17.81	3,046
Total [1]	2,590	260	675	5,698	1	105	18.60	1,945

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Production and shipments of portland cement increased significantly during 1969, but declines marked production and shipments of masonry cement. The unit value of both portland and masonry cements declined. Cement plants were located in Carroll, Frederick, and Washington Counties.

Clays.—Clays were mined in seven counties. Production and value increased over those of 1968. Clays classed as miscellaneous and used in the manufacture of structural clay products, aggregate, and cement accounted for virtually all of the State's total output. United Sierra Division of Cyprus Mines Corp. mined ball clay in Baltimore County. Fire clay was mined in Harford County by Maryland Clay (William D. Bowman).

Diatomite.—Kaylorite Corp. produced some diatomite, supplemented with additional stockpile material, for sale for experimental purposes. The operation is located at Dunkirk, Calvert County.

Gem Stones.—A small quantity of gem stones, worth a few thousand dollars was collected by dealers and amateur collectors.

Lime.—Lime was produced by S. W. Barrick & Sons, Inc., LeGore Lime Co., and Everett V. Moser, all operating in Frederick County. Nearly all of the production was quicklime, which was marketed for agricultural purposes. A small amount of hydrated lime was also produced and sold, mainly for agricultural purposes.

Marl, Greensand.—Kaylorite Corp. mined greensand marl in Calvert County. The product was sold for agricultural use.

Perlite.—National Gypsum Co. (Baltimore County), Atlantic Perlite Co. (Prince Georges County), and Zonolite Division of W. R. Grace & Co. (Prince Georges County) reported production of expanded perlite. The product was sold for use in plaster and concrete aggregate, for insulation, as a filtering aid, and for horticultural purposes.

Potassium Salts.—Byproduct potassium salts, sold for agricultural purposes, were produced at Marquette Cement Manufacturing Co.'s plant in Washington County.

Sand and Gravel.—Production of sand and gravel increased 2.5 million tons to 14.2 million tons, reflecting the increase in the State's construction activity. Commercial sand and gravel production accounted for 98 percent of total output. The average unit value of the commercial product was $1.51 per ton, $0.02 more than in 1968. Eighty-five percent of commercial sand and gravel went into building and

highway construction; the remainder was used for fill and miscellaneous purposes. Commercial producers, using 49 stationary plants, 11 portable plants, and one dredge, carried on operations at 66 sites. Five Government-and-contractor operations utilized one stationary plant to produce noncommerical sand and gravel; the remainder of this production was bank run. Counties leading in value of sand and gravel production (not in order of rank) were Anne Arundel, Baltimore, Cecil, Charles, and Prince Georges.

Stone.—Total value of stone produced in Maryland increased $3.9 million to $30.5 million. Crushed and broken stone was produced at 38 quarries; 10 quarries yielded dimension stone. Production of stone was confined to the eight counties in the northern tier and Montgomery, Howard, and Baltimore City Counties. Four counties accounted for about two-thirds of the State's output of stone. Sixty-five percent of this was limestone, 30 percent was traprock, and the remaining 5 percent was granite, oystershell, sandstone, marble, and miscellaneous stone. Of the total crushed and broken stone produced, 82 percent was used in various aggregates, 13 percent went into the manufacture of cement, and 5 percent was used for other purposes.

Talc and Soapstone.—Harford Talc Co. produced talc in Harford County. The product was used in ceramics, foundry facings, and toilet preparations.

Vermiculite (Exfoliated).—Zonolite Division of W.R. Grace & Co. processed vermiculite at a plant in Prince Georges County and sold the product for aggregates, loose-fill insulation, agricultural, and other purposes.

MINERAL FUELS

Coal (Bituminous).—Bituminous coal was mined in Allegany and Garrett Counties, where 20 underground mines, 31 strip mines, and seven auger mines produced 1,368,000 tons—79,000 tons less than in 1968. Strip mines produced 70 percent, underground mines produced 24 percent, and auger mines accounted for the remainder. The average value for coal mined from underground mines and from strip mines was $3.77 and $4 per ton, respectively.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	4,459	$6,443	5,705	$8,014
Paving	1,273	1,967	1,403	2,285
Other [1]	402	838	410	834
Total	6,134	9,248	7,518	11,133
Gravel:				
Structural	2,587	4,522	3,588	6,170
Paving	1,302	1,996	1,240	2,295
Other [2]	1,332	1,193	1,640	1,542
Total	5,221	7,711	6,468	[3] 10,008
Total sand and gravel	11,355	16,959	13,986	21,141
Government-and-contractor operations:				
Sand	182	105	91	32
Gravel	182	93	153	54
Total sand and gravel	364	198	244	86
All operations:				
Sand	6,316	9,353	7,609	11,165
Gravel	5,403	7,804	6,621	[3] 10,061
Total	11,719	17,157	14,230	21,226

[1] Includes sand for glass, grinding and polishing, blast (1969), foundry (1969), fill, and other uses.
[2] Includes miscellaneous gravel, fill, and other uses (1969).
[3] Data may not add to totals shown because of independent rounding.

Coke and Coal Chemicals.—Bethlehem Steel Corp. produced coke and coal chemicals at Sparrows Point. Coproducts and byproducts included coke breeze, coke oven gas, ammonium sulfate, soft tar pitch, crude tar, crude chemical oil, crude light oil and derivatives, and napthalene.

Natural Gas and Petroleum.—Natural gas was produced in Garrett County, where 13 wells in the Mountain Lake Park and Negro Mountain fields produced 978 million cubic feet with a marketed value of $196,000. No crude petroleum was produced in the State, but American Oil Co. and Chevron Asphalt Co. operated refineries near Baltimore. Daily throughput capacities were 12,000 and 7,400 barrels, respectively.

Peat.—Garrett County Processing & Packaging Corp. harvested reed-sedge peat and humus peat from a bog in Garrett County; Maryland Peat and Humus Co. harvested peat from a bog in Kent County. The processed material from the bogs was sold in bulk or packaged for general soil improvement.

METALS

Copper.—American Smelting & Refining Co., Inc., and Kennecott Copper Corp. refined copper at plants in Baltimore from anodes shipped in from out of State. Gold and silver were produced as byproducts.

Iron and Steel.—Basic and off-grade pig iron, steel ingot, and semifabricated products were produced by Bethlehem Steel Corp. at its Sparrows Point (Baltimore County) plant.

Lead.—Baltimore Lead Burning Corp. produced lead and other alloys and products from lead remelt, primary metals, and scrap.

Table 6.–Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Portland:			
Alpha Portland Cement Co.[1]	15 South Third St. Easton, Pa. 18042	Plant	Frederick.
Lehigh Portland Cement Co.[2]	718 Hamilton St. Allentown, Pa. 18101	do	Carroll.
Marquette Cement Mfg. Co.[3]	20 North Wacker Dr. Chicago, Ill. 60606	do	Washington.
Masonry:			
M. J. Grove Lime Co., Division of the Flintkote Co.	Lime Kiln, Md. 21763	do	Frederick.
Clays:			
Ball:			
United Sierra Division, Cyprus Mines Corp.	P.O. Box 1201 Trenton, N.J. 08606	Pit	Baltimore.
Fire:			
Maryland Clay and/or William D. Bowman.	R.F.D. 2, Box 303 Aberdeen, Md. 21001	Pit	Harford.
Miscellaneous clay and shale:			
Baltimore Brick Co	501 St. Paul Place Baltimore, Md. 21202	Pit	Baltimore.
Do	do	Pit	Frederick.
Chestertown Brick Co	Chestertown, Md. 21620	Pit	Kent.
Victor Cushwa & Sons, Inc	201 West Potomac St. Williamsport, Md. 21795	Pit	Washington.
Lehigh Portland Cement Co.[4]	718 Hamilton St. Allentown, Pa. 18101	Pit	Frederick.
Structural Components Corp.	7600 Pulaski Highway Baltimore, Md. 21237	Pit	Baltimore.
United Brick Corp	2801 New York Ave., NE. Washington, D.C. 20002	Pit	Prince Georges.
The Washington Brick Division, Thos. Somerville Co.	6th & Decatur, NE. Washington, D.C. 20002	Pit	Do.
West Brothers Brick Co	6600 Sheriff Road, NE. Washington, D.C. 20027	Pit	Do.
Coal:			
Buffalo Coal Co	P.O. Box 275 Bayard, W. Va. 26707	Strip	Allegany.
Do	do	5 strip mines	Garrett.
Do	do	Underground	Do.
Franklin & Polce Coal Co	Route 1 Masontown, W. Va. 26542	do	Do.
G & S Coal Co. for W. R. Nethken & Co., Inc.	Keyser, W. Va. 26726	Strip	Do.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
COAL—Continued			
Ginniman & Ware Coal Co	P.O. Box 182 Barton, Md. 21521	Strip	Allegany.
Do	ditto	ditto	Garrett.
Moran Coal Co., Inc	Drawer E Westernport, Md. 21562	3 strip mines	Do.
Smeltzer Augering Coal Co	Bloomington, Md. 21523	4 auger mines	Do.
W. & W. Coal Co	P.O. Box 221 Westernport, Md. 21562	Underground	Allegany.
Winner Brothers Coal Co	243 Upper Consol Road Frostburg, Md. 21532	Strip	Do.
Greensand marl:			
Kaylorite Corp.[5]	Dunkirk, Md. 20754	Pit	Calvert.
Gypsum (calcined):			
National Gypsum Co.[6]	325 Delaware Ave. Buffalo, N.Y. 14202	Plant	Baltimore.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	ditto	Do.
Finished iron oxide pigments (natural and manufactured):			
Mineral Pigments Corp	Washington Blvd. Muirkirk, Md. 20705	Plant	Prince Georges.
Lime:			
S. W. Barrick & Sons, Inc	Woodsboro, Md. 21798	ditto	Frederick.
LeGore Lime Co	Le Gore, Md. 21761	ditto	Do.
Everett V. Moser	R.F.D. 1 Middletown, Md. 21769	ditto	Do.
Peat:			
Garrett County Processing & Packaging Corp.	R.F.D. 1 Accident, Md. 21520	Bog	Garrett.
Maryland Peat & Humus Co	90 Cricket Ave. Ardmore, Pa. 19003	Bog	Kent.
Perlite (expanded):			
Atlantic Perlite Co	7950 New Hampshire Ave. Suite 6 Langley Park, Md. 20787	Plant	Prince Georges.
Petroleum refineries:			
American Oil Co	Baltimore, Md. 21200	Refinery	Baltimore.
Chevron Asphalt Co	ditto	ditto	Do.
Sand and gravel:			
Annapolis Sand & Gravel Co., Inc	P.O. Box 322 Waldorf, Md. 20601	Pit	Anne Arundel.
Arundel Corp	501 St. Paul Place Baltimore, Md. 21202	Pit	Do.
Buffalo Sand & Gravel Co., Inc	Auth Road, Camp Springs Washington, D.C. 20023	Pit	Charles.
Do	ditto	2 pits	Prince Georges.
Campbell Sand Co., Inc	4911 Calvert Rd. College Park, Md. 20740	Pit	Do.
Harry T. Campbell Sons' Corp	Towson Baltimore, Md. 21204	2 pits	Baltimore.
Charles County Sand & Gravel Co., Inc.	P.O. Box 322 Waldorf, Md. 20601	Pit	Charles.
Contee Sand & Gravel Co., Inc	Laurel, Md. 20810	Pit	Prince Georges.
Inland Materials, Inc	5401 Kirby Road Clinton, Md. 20735	Pit	Do.
Manley Sand Division, Martin Marietta Corp.	P.O. Box 1341 Cumberland, Md. 21502	Pit	Allegany.
Nottingham Properties, Inc	Regester Ave. & Overbrook Rd. Baltimore, Md. 21212	Pit	Baltimore.
Potomac Sand & Gravel Co	3020 K St., NW. Washington, D.C. 20007	Dredge and 3 pits	Charles.
Silver Hill Sand & Gravel Co	4600 St. Barnabas Rd., SE. Washington, D.C. 20031	Pit	Prince Georges.
A. H. Smith Co	Branchville, Md. 20721	Pit	Do.
Stancill's, Inc	P.O. Box 236 Aberdeen, Md. 21001	Pit	Harford.
York Building Products Co., Inc	P.O. Box 1708 York, Pa. 17405	3 pits	Cecil.
Smelters:			
American Smelting & Refining Co	120 Broadway New York, N.Y. 10005	Plant	Baltimore.
Kennecott Refining Corp	161 East 42d St. New York, N.Y. 10017	Refinery	Anne Arundel.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:			
Granite, crushed:			
Maryland Materials, Inc	P.O. Box 159 Elkton, Md. 21921	Quarry	Cecil.
Limestone, crushed and broken:			
Appalachian Stone Division, Martin Marietta Corp.	Box 120 Mercersburg, Pa. 17236	4 quarries	Washington.
The Arundel Corp	501 St. Paul Place Baltimore, Md. 21202	Quarry	Baltimore.
Harry T. Campbell Sons' Corp., Div. of the Flintkote Co.	Towson Baltimore, Md. 21204	Underground mine and 2 quarries.	Do.
Cumberland Cement & Supply Co.	Rear 419 North Centre St. Cumberland, Md. 21501	Quarry	Allegany.
M. J. Grove Lime Co., Division of the Flintkote Co.	Lime Kiln, Md. 21763	--do	Frederick.
Howard-Montgomery Crushed Stone Co., Div. Contee Sand & Gravel Co., Inc.	Brighton Dam Rd. Clarksville, Md. 21029	--do	Howard.
LeGore Lime Co	Le Gore, Md. 21761	--do	Frederick.
Superior Concrete, Inc	Frederick, Md. 21701	--do	Do.
Teeter Stone, Division Harry T. Campbell Sons' Corp.	Towson Baltimore, Md. 21204	--do	Carroll.
Marble, crushed:			
The Maryland Green Marble Corp.	Box 1198 Roanoke, Va. 24006	--do	Harford.
Miscellaneous (crushed and broken):			
The Arundel Corp	501 St. Paul Place Baltimore, Md. 21202	--do	Baltimore.
Miscellaneous (dimension):			
Stoneyhurst Quarries [7]	7501 Persimmon Tree Lane Bethesda, Md. 20034	3 quarries	Montgomery.
Oystershell, crushed:			
Oyster Shell Products, a division of Radcliff Materials, Inc.	607 Keyser Bldg. Baltimore, Md. 21202	Plant	Baltimore
Quartzite (crushed):			
Harbison Walker Refractories Co., Div. of Dresser Industries.	2 Gateway Center Pittsburgh, Pa. 15222	Quarry	Cecil.
Quartzite (dimension):			
Piccirilli Quarries	Marriottsville Rd. & Driver Rd. Marriottsville, Md. 21104	--do	Howard.
The Weaver Stone Co	Box 96 Reisterstown, Md. 21136	--do	Baltimore.
Sandstone (dimension):			
M & S Stone Quarries	Grantsville, Md. 21536	--do	Garrett.
Trap rock (basalt), crushed and broken:			
The Arundel Corporation	501 St. Paul Place Baltimore, Md. 21202	--do	Baltimore.
Do	---------do	--do	Harford.
Do	---------do	--do	Howard.
Gatch Crushed Stone Co., Inc	P.O. Box 70-A Bel Air, Md. 21014	--do	Harford.
Rockville Crushed Stone, Inc.	P.O. Box 407 Rockville, Md. 20850	--do	Montgomery.
D. M. Stoltzfus & Son, Inc	Talmage, Pa. 17580	--do	Cecil.
Do	---------do	--do	Harford.
Talc:			
Harford Talc Co	Box 527 Bel Air, Md. 21014	Pit	Do.
Vermiculite (exfoliated):			
W. R. Grace & Co. Zonolite Division [6]	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Prince Georges.

[1] Also masonry cement, sand, and limestone.
[2] Also limestone, sandstone, and shale.
[3] Also masonry cement, limestone, and potassium salts.
[4] Lightweight aggregate manufacture.
[5] Also diatomite.
[6] Also expanded perlite.
[7] Also crushed and broken.

The Mineral Industry of Massachusetts

By George C. Evans [1]

Massachusetts mineral production rose to a new high of $49.8 million, a 15 percent increase over the previous high set in 1968. Sand, gravel, and stone accounted for 91 percent of mineral production value. The quantity of sand, gravel, and stone produced increased 10 percent, and the total value increased 15 percent. The total value of lime production increased 10 percent, however, the quantity produced increased only 0.5 percent.

Middlesex County, with mineral output valued at $13.6 million or 27 percent of the State total, retained its lead as the State's chief mineral-producing county; Berkshire County remained second with a mineral output value of $8.3 million; Worcester County mineral output increased 56 percent to $5.7 million.

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Massachusetts [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Clays thousand short tons	257	$314	332	$624
Gem stones	NA	2	NA	2
Lime thousand short tons	198	3,380	199	3,718
Sand and gravel do	17,799	20,106	19,456	22,950
Stone do	6,917	19,501	7,847	22,521
Value of items that cannot be disclosed: Nonmetals	XX	37	XX	28
Total	XX	43,340	XX	49,843
Total 1967 constant dollars	XX	42,924	XX	p 48,523

p Preliminary. 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 Massachusetts, by counties
(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Barnstable	W	W	Sand and gravel.
Berkshire	$8,063	$8,321	Stone, lime, sand and gravel.
Bristol	3,211	3,626	Sand and gravel, stone.
Dukes	W	W	Sand and gravel.
Essex	3,107	3,802	Stone, sand and gravel.
Franklin	951	1,158	Sand and gravel, stone.
Hampden	3,739	4,423	Stone, sand and gravel, clays.
Hampshire	613	608	Sand and gravel, stone.
Middlesex	12,614	13,648	Stone, sand and gravel.
Nantucket	W	4	Sand and gravel.
Norfolk	5,228	5,546	Stone, sand and gravel, clays.
Plymouth	630	994	Sand and gravel, stone, clays.
Suffolk	453	453	Stone, sand and gravel.
Worcester	3,657	5,716	Sand and gravel, stone, peat.
Undistributed [1]	1,073	1,546	
Total [2]	43,340	49,843	

W Withheld to avoid disclosing individual company confidential data.
[1] Includes gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.
[2] Data does not add to totals shown because of independent rounding.

Table 3.—Indicators of Massachusetts business activity

		1968	1969	Change, percent
Employment and labor force, annual average: [1]				
Total labor force	thousands	2503.0	2536.5	+1.3
Unemployment	percent of work force	4.1	3.8	−7.3
Employment:				
Manufacturing	thousands	690.4	681.6	−1.3
Durable goods	do.	350.7	350.3	−0.1
Primary metals	do.	22.4	22.2	−0.9
Fabricated metal products	do.	43.4	44.1	+1.6
Machinery	do.	76.4	76.4	------
Electrical equipment	do.	100.2	97.7	−2.5
Transportation equipment	do.	r 27.9	26.9	−3.6
Instruments, optical, watches	do.	30.9	32.4	+4.9
Nondurable goods	do.	339.7	331.3	−2.5
Nonmanufacturing	do.	1509.7	1557.0	+3.1
Mining and services	do.	433.2	453.3	+4.6
Construction	do.	93.1	94.4	+1.4
Personal income: [2]				
Total	millions	r $20,974	$22,623	+7.9
Per capita		r $3,857	p $4,138	+7.3
Construction activity:				
Cement shipments to and within Massachusetts	thousand 376-pound barrels	6,546	6,962	+6.4
Mineral production value	thousands	$43,340	$49,843	+15.0

p Preliminary. r Revised.
[1] Division of Employment Security (Massachusetts).
[2] Survey of Current Business.

Table 4.—Worktime 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
1968:								
Nonmetal and peat	72	275	20	158	---	11	69.42	1,950
Sand and gravel	931	227	211	1,741	---	32	18.38	892
Stone	916	262	240	1,931	---	45	23.30	639
Total [1]	1,919	245	471	3,831	---	88	22.97	809
1969: p								
Nonmetal and peat	65	291	19	150	---	8	53.33	927
Sand and gravel	1,055	228	240	2,029	---	45	22.17	417
Stone	785	249	196	1,641	---	49	29.87	628
Total [1]	1,905	238	454	3,820	---	102	26.70	528

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Production of miscellaneous clay and shale increased 29 percent. Of the three counties reporting production, Norfolk County was the leading producer. Miscellaneous clay was mined in Hampden and Plymouth Counties for use in building brick. Shale is mined in Norfolk County for use in manufacturing lightweight aggregate.

Gypsum.—A plant in Suffolk County manufactured calcined gypsum products from imported crude gypsum.

Lime.—Since 1968, the value of lime produced increased at a greater rate than the quantity. The chemical industry consumed the major portion of lime produc-

tion. The quantity consumed by the building industry decreased while the quantity consumed by agriculture increased. Three companies in Berkshire County produced all the lime in the State.

Peat.—Reed-sedge peat was mined by one company in Worcester County. The total value decreased slightly from that in 1968. The peat is used mainly by nursery men, landscapers, and greenhouses.

Perlite (Expanded).—Crude perlite mined outside the State was expanded at two plants in Suffolk County that sold the product mainly for lightweight aggregate, low-temperature insulation, masonry and cavity fill insulation, and horticultural aggregate.

Sand and Gravel.—Greater activity in highway and building construction resulted in a higher output and value of sand and gravel over that of 1968. The $23 million of sand and gravel produced accounted for 46 percent of the total mineral value in the State, making it the leading mineral commodity produced. Gravel accounted for 63 percent of the 19.5 million tons of sand and gravel output. Nearly 85 percent of the total tonnage was mined at commercial operations; Government-and-contractor operations produced the balance.

Commercial sand and gravel was produced in all counties in the State except Suffolk, in which production was all noncommercial. Building and paving markets consumed 79 percent of the production. Small quantities of sand were used for fill, molding, blast, and filtration. Besides building and paving, gravel was used for railroad ballast and fill.

A total of 123 reports were received covering 204 mining operations, of which 147 were commercial operations. Middlesex and Worcester Counties each had nearly a 4.2-million-short-ton production. Three counties produced nearly 2 million tons.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	2,897	$3,414	3,150	$3,813
Paving	2,480	2,661	2,534	2,842
Fill	608	287	561	280
Blast	7	65	10	100
Filtration	8	16	7	16
Undistributed [1]	691	1,044	922	1,522
Total	6,691	7,487	[2] 7,185	8,573
Gravel:				
Structural	2,801	4,470	3,149	5,115
Paving	3,064	3,589	3,539	4,252
Fill	920	551	1,849	1,356
Other [3]	141	222	261	370
Miscellaneous	769	615	506	513
Total	7,695	9,447	9,304	11,606
Total sand and gravel	14,386	16,934	16,489	[2] 20,178
Government-and-contractor operations:				
Sand:				
Paving	45	34	90	85
Other	11	10	5	7
Total	56	44	95	92
Gravel:				
Paving	3,354	3,124	2,868	2,676
Fill	W	W	2	2
Other	W	W	1	2
Total	[2] [4] 3,357	[2] [4] 3,128	[2] 2,872	2,680
Total sand and gravel	3,413	[2] 3,171	2,967	2,772
All operations:				
Sand	6,747	7,531	7,280	[2] 8,664
Gravel	11,052	12,575	12,176	14,286
Total	17,799	20,106	19,456	22,950

W Withheld to avoid disclosing individual company confidential data.
[1] Includes molding and other sand.
[2] Data does not add to totals shown because of independent rounding.
[3] Includes railroad ballast.
[4] Includes fill and other gravel.

Stone.—Production of stone increased 13 percent, and the value increased 15 percent over that of 1968. The value of stone, amounting to $22.5 million was second highest among the minerals produced, and contributed 45 percent of the State's total mineral value. Middlesex County led the State in both quantity and value of stone produced.

Stone, quarried in 11 counties, included basalt, granite, limestone, dolomite, sandstone, and miscellaneous stone. Basalt was the most important stone in both quantity and value. Output increased from that in 1968. Output of limestone, granite, and miscellaneous stone also increased, but dolomite and sandstone decreased. Crushed and broken stone accounted for 98 percent of the total stone output sold in 1969.

Basalt, sold as crushed stone, was produced by 13 commercial companies at 15 quarries located in seven counties. Middlesex County led in value, but Essex County led in quantity. The value of basalt accounted for 40 percent of the total value of stone. The crushed stone was used mainly for construction aggregate; other uses were for riprap, railroad ballast, and filter stone.

Granite, sold as crushed and dimension stone, was quarried by 11 commercial companies located in five counties. Middlesex County led in value of granite produced, but Norfolk led in quantity. Granite was the second most important stone produced in the State. The chief use for dimension stone was for curbing; other uses in order of decreasing output were for rough blocks, construction, rubble, irregular shaped stone, paving blocks, cut stone, monumental, house stone veneer, and flagging. Crushed granite was used mainly for construction aggregate; smaller quantities were used for riprap and manufactured fine aggregate.

Limestone and dolomite were mined only in Berkshire County by four companies. The chief uses of crushed limestone in descending order were lime, whiting, asphalt fill, poultry grit, construction aggregate, agricultural limestone, flux stone, and other filter.

Sandstone was produced by one company in Hampden County as cut stone for architectural work.

Miscellaneous stone was quarried in Bristol, Norfolk, and Worcester Counties. All the miscellaneous stone was crushed.

Table 6.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Dimension stone	161	$4,826	137	$5,191
Crushed and broken stone:				
Construction aggregates [1]	5,617	10,413	6,418	12,490
Agricultural limestone	144	498	W	617
Undistributed [2]	995	3,765	1,292	4,222
Total	6,917	[3] 19,501	7,847	[3] 22,521

W Withheld to avoid disclosing individual company confidential data.

[1] Includes dense graded road base stone; concrete, bituminous, macadam, and surface treatment aggregates; and unspecified construction aggregate and roadstone (1969).

[2] Includes crushed and broken stone for railroad ballast, riprap, furnace flux, other uses, and data indicated by symbol W.

[3] Data does not add to totals shown because of independent rounding.

Roofing Granules.—Output of rhyolite to make roofing granules increased slightly. The rhyolite is mined in Norfolk County and for statistical purposes is classified as miscellaneous stone.

Vermiculite.—Sales of vermiculite increased in value from those of 1968. One plant in Hampshire County exfoliated vermiculite mined outside the State. The material was used mainly as insulation; other uses in order of production were for concrete aggregate, soil conditioning, and plaster.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
K-F Brick Co., Inc.	River Street Middleboro, Mass. 02346	Pit	Plymouth.
Masslite Co	Box 1747 Cross St., Plainville, Mass. 02762	Pit	Norfolk.
The Stiles & Hart Brick Co.	Box J., Bridgewater, Mass. 02324	Pit	Plymouth.
Westfield Clay Products Co.	Westfield, Mass. 01085	Pit	Hampden.
Gypsum, calcined:			
United States Gypsum Co.	101 S. Wacker Dr., Chicago, Ill. 60606	Plant	Suffolk.
Lime:			
Lee Lime Corporation	Marble St., Lee, Mass. 01238	----do	Berkshire.
Minerals, Pigments & Metals Div., Chas. Pfizer & Co., Inc.	260 Columbia St., Adams, Mass. 01220	----do	Do.
United States Gypsum Co.	101 S. Wacker Dr., Chicago, Ill. 60606	----do	Do.
Peat:			
Sterling Peat Co	Sterling Junction, Mass. 01565	Bog	Worcester.
Perlite, expanded:			
United States Gypsum Co.	101 S. Wacker Dr., Chicago, Ill. 60606	Plant	Suffolk.
Whittemore Products, Inc.	35 Harrison St., Roslindale, Mass. 02131	----do	Do.
Roofing Granules:			
Bird & Son, Inc.	East Walpole, Mass. 02032	----do	Norfolk.
Sand and Gravel:			
Ashland Sand & Concrete Co.	Box 347, Chestnut Street Ashland, Mass. 01721	Pit	Middlesex.
Assonet Sand & Gravel Co., Inc	South Main St., Assonet, Mass. 02702	Pit	Bristol.
Burlington Sand & Gravel Co., Inc.	Blanchard Rd., Box 116 Burlington, Mass. 01803	Pit	Middlesex.
Courtois Sand & Gravel Co.	Box 84 Central Falls, R.I. 02863	Pit	Bristol.
J. J. Cronin Co	P.O. Box 176, N. Reading, Mass. 01864	Pit	Middlesex.
E. L. Dauphinais, Inc.	160 Worcester Rd., N. Grafton, Mass. 01536	Pit	Middlesex and Worcester.
General Sand & Stone Corp.	444 Merrill Rd., Pittsfield, Mass. 01201	Pit	Berkshire.
P. J. Keating Co	P.O. Box 345, Fitchburg, Mass. 01420	Pit	Worcester.
Merrimack Materials, Inc.	Yemma Rd., Groveland, Mass. 01830	Pit	Essex.
Morse Sand & Gravel Co.	P.O. Box 175, Pawtucket, R.I. 02863	Pit	Bristol.
North Wilbraham Sand & Gravel & Concrete Co., Inc.	2420 Boston Rd., N. Wilbraham, Mass. 01067	Pit	Hampden.
Northfield Washed Sand & Gravel Co., Inc.	Northfield, Mass. 01360	Pit	Franklin.
Pomerleau Bros., Inc.	P.O. Box 236 N. Chelmsford, Mass. 01863	Pit	Middlesex.
Thomas Qunn Co., Inc.	20 Hobbs Court Arlington, Mass. 02174	Pit	Middlesex and Worcester.
L. Romano Const. Co.	835 Taunton Ave., East Providence, R.I. 02914	Pit	Norfolk.
Rosenfeld Washed Sand & Stone Co.	40 Cedar St., Milford, Mass. 01757	Pit	Worcester.
San-Vel Contracting Co.	Route No. 2, Ayer Rd., Littleton, Mass. 01460	Pit	Middlesex.
Stow Sand & Gravel Co.	Box 861, Acton, Mass. 01720	Pit	Do.
Tresca Bros. Sand & Gravel, Inc.	66 Main Street Millis, Mass. 02054	Pit	Norfolk.
Varney Bros. Sand & Gravel, Inc.	Hartford Ave. Bellingham, Mass. 02019	Pit	Do.
Warner Bros., Inc.	Sunderland, Mass. 01375	Pit	Franklin.
A. A. Will Sand & Gravel Corp.	Turnpike Street Canton, Mass. 02021	Pit	Norfolk.
Worcester Sand & Gravel Co.	182 Holden Street Shrewsbury, Mass. 01545	Pit	Worcester.
Wrentham Sand & Gravel Co., Inc.	Riverside Road Wrentham, Mass. 02093	Pit	Norfolk.
Stone:			
Basalt, crushed and broken:			
B. & M. Crushed Stone Division Bayer & Mingolla Industries, Inc.	Spring St., Ashland, Mass. 01721	Quarry	Middlesex.
George Brox, Inc.	1471 Methuen St., Dracut, Mass. 01826	----do	Do.
Essex Bituminous Concrete Corp.	Russell St., West Peabody, Mass. 01960	----do	Essex.

See footnotes at end of table.

Table 7.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Basalt, crushed and broken—Continued			
Essex Bituminous Concrete Corp. of Dracut.	2140 Bridge St. Dracut, Mass. 01826	Quarry	Middlesex.
Holden Trap Rock Co	N. Main St., Holden, Mass. 01520	do	Worcester.
P. J. Keating Co	P.O. Box 345 Fitchburg, Mass. 01420	do	Do.
John S. Lane & Son, Inc.	P.O. Box 125 Westfield, Mass. 01085	do	Hampden and Hampshire.
Lynn Sand & Stone Co	30 Danvers Rd., Swampscott, Mass. 01907	do	Essex.
Massachusetts Broken Stone Co.	Boston Post Road, Weston, Mass. 02193	do	Middlesex.
Mario Pandolf Co., Inc.	106 Sachem Rd., Needham Heights, Mass. 02194	Quarry	Worcester.
Rowe Contracting Co	1500 Salem St., Malden, Mass. 02148	do	Middlesex.
Simeone Stone Corp	P.O. Box 218, Wrentham, Mass. 02093	do	Norfolk.
Trimount Bituminous Products Co.	1840 Parkway St. Everett, Mass. 02149	do	Essex.
Warner Bros., Inc	Sunderland, Mass. 01375	do	Franklin.
Granite, dimension:			
Bates Bros. Seam Face Granite Co.[1]	1372 Hancock St., Quincy, Mass. 02169	do	Norfolk.
H. E. Fletcher Co.[1]	W. Chelmsford, Mass. 01824	do	Middlesex.
Forrest Road Granite Co., Inc.	20 Adams St. N. Chelmsford, Mass. 01863	do	Do.
Guilmette Bros. Corp	57 Ledge Rd., N. Chelmsford, Mass. 01863	do	Do.
Le Masurier Granite Quarry, Inc.	P.O. Box 71, Ledge Rd., N. Chelmsford, Mass. 01863	do	Do.
Oak Hill Granite Co., Inc.	Middlesex St., Lowell, Mass. 01852	do	Do.
Plymouth Quarries, Inc.[1]	East Weymouth, Mass. 01402	do	Plymouth.
Rockport Quarries Co., Inc.	210 Kingsley Ave., Providence, R.I. 02903	do	Essex.
Granite, crushed and broken:			
Old Colony Crushed Stone Co.	P.O. Box 230, Quincy, Mass. 02169	do	Norfolk.
Simeone Stone Corp	P.O. Box 218, Wrentham, Mass. 02093	do	Do.
West Roxbury Crushed Stone Co.	10 Grove St., West Roxbury, Mass. 02132	do	Suffolk.
Limestone and dolomite, crushed:			
John S. Lane & Son, Inc.	P.O. Box 125, Westfield, Mass. 01085	Quarry	Berkshire.
Lee Lime Corp	Marble St., Lee, Mass. 01238	do[2]	Do.
Minerals, Pigments & Metals Div., Chas. Pfizer & Co., Inc.	260 Columbia St., Adams, Mass. 01220	do	Do.
United States Gypsum Co.	101 So. Wacker Dr., Chicago, Ill. 60606	do	Do.
Miscellaneous stone, crushed:			
Berlin Stone Co	Sawyer Hill Rd., Berlin, Mass. 01503	do	Worcester.
Dedham Sand & Gravel, Inc.	Walpole, Mass. 02081	do	Norfolk.
S. M. Lorusso & Sons, Inc.	331 West St., Walpole, Mass. 02081	do	Do.
Warren Bros. Co., Division of Ashland Oil & Refining Co.	430 Howard St., Brockton, Mass. 02402	do	Bristol.
Sandstone, dimension:			
McCormick Longmeadow Stone Co., Inc.	East Longmeadow, Mass. 01028	do[3]	Hampden.
Vermiculite, exfoliated:			
W. R. Grace & Co., Zonolite Div.	62 Whittemore Ave., Cambridge, Mass. 02140	Plant	Hampshire.

[1] Also crushed and broken granite.
[2] 2 quarries; 1 dolomite, 1 limestone.
[3] 2 quarries.

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 Natural Resources, for collecting information on all minerals except fuels.

By Donald F. Klyce [1] and Richard J. Bishop [2]

In 1969 the value of mineral production in Michigan continued its upward trend and totaled $668.2 million, 7 percent above the 1968 record high.

Thirteen mineral commodities showed an increase in value. Many of the gains in value were substantial with the most significant increases reported for copper, iron ore, magnesium compounds, sand and gravel, and stone. Most of the losses in value of production were minor, with the exception of natural gas and natural gas liquids.

Nonmetals, as a group, increased in value nearly 4 percent and accounted for 55 percent of the value of State mineral production. Its principal component, construction materials, registered a gain of about 3 percent, and chemicals, recovered mostly from natural salines, increased 7 percent. Metallic minerals, which accounted for 36 percent of the mineral value, gained more than 14 percent. All types of mineral fuels (natural gas, natural gas liquids, peat, and petroleum) showed a decline in value; and as a group the value of production was nearly 6 percent less than in 1968.

[1] Industry economist, Bureau of Mines, Minneapolis, Minn.
[2] Statistical clerk, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Michigan [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	31,375	$99,158	30,373	$98,425
Masonry—thousand 280-pound barrels	2,006	5,527	1,904	5,473
Clays—thousand short tons	2,599	2,906	2,667	3,037
Copper (recoverable content of ores, etc.)—short tons	74,805	62,607	75,226	71,516
Gypsum—thousand short tons	1,405	5,196	1,327	5,384
Iron ore (usable)—thousand long tons, gross weight	12,699	148,890	14,058	169,756
Lime—thousand short tons	1,630	19,870	1,589	20,372
Magnesium compounds—short tons, MgO equivalent	266,406	25,087	328,047	30,604
Natural gas—million cubic feet	40,480	10,160	36,163	9,294
Natural gas liquids:				
Natural gasoline—thousand 42-gallon barrels	1,066	3,177	921	2,481
LP gases—do	1,384	3,432	1,197	2,561
Peat—short tons	237,513	2,919	186,278	2,724
Petroleum (crude)—thousand 42-gallon barrels	12,974	38,287	12,213	37,494
Salt—thousand short tons	4,893	44,481	4,819	45,961
Sand and gravel—do	56,663	54,979	58,092	58,968
Silver (recoverable content of ores, etc.)—thousand troy ounces	473	1,014	1,009	1,807
Stone—thousand short tons	37,279	41,092	39,186	43,572
Value of items that cannot be disclosed: Bromine, calcium chloride, calcium-magnesium chloride, gem stones, iodine, and potassium salts	XX	58,293	XX	58,818
Total	XX	627,075	XX	668,247
Total 1967 constant dollars	XX	615,421	XX	p 642,176

p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

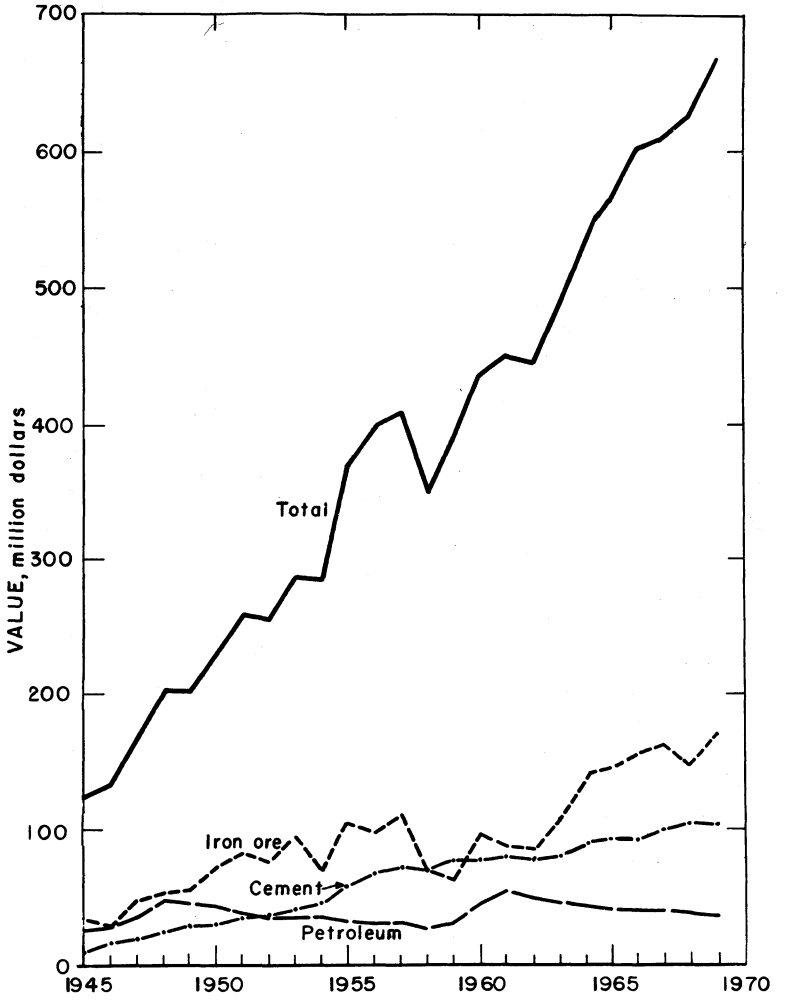

Figure 1.—Value of iron ore, petroleum, cement, and total value of all minerals produced in Michigan.

Table 2.—Value of mineral production in Michigan, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Alcona	$117	$225	Sand and gravel.
Alger	39	38	Do.
Allegan	1,020	[2] 972	Sand and gravel, petroleum, peat, stone, natural gas.
Alpena	W	W	Cement, stone, clays, sand and gravel.
Antrim	431	475	Clays, sand and gravel.
Arenac	[r] 1,037	1,005	Petroleum, stone, sand and gravel.
Baraga	105	99	Sand and gravel.
Barry	572	783	Sand and gravel, petroleum, stone.
Bay	10,230	9,851	Cement, petroleum, sand and gravel, lime.
Benzie	4	9	Sand and gravel.
Berrien	2,450	2,827	Sand and gravel, stone.
Branch	W	399	Do.
Calhoun	[r] 7,326	[2] 6,697	Petroleum, sand and gravel, stone, natural gas.
Cass	224	452	Sand and gravel, stone, petroleum.
Charlevoix	8,928	11,761	Cement, stone, sand and gravel.
Cheboygan	123	125	Sand and gravel, stone.
Chippewa	W	W	Stone, sand and gravel.
Clare	W	W	Petroleum, sand and gravel, natural gas.
Clinton	539	710	Sand and gravel, clays.
Crawford	1,049	[2] 1,405	Petroleum, sand and gravel, natural gas.
Delta	165	205	Sand and gravel, stone.
Dickinson	23,819	26,663	Iron ore, sand and gravel, stone.
Eaton	652	887	Sand and gravel, stone, clays, peat, petroleum.
Emmet	8,956	8,275	Cement, stone, sand and gravel.
Genesee	[r] 544	645	Sand and gravel, petroleum.
Gladwin	[r] 993	1,011	Petroleum, sand and gravel.
Gogebic	197	W	Sand and gravel.
Grand Traverse	274	189	Do.
Gratiot	W	W	Salines, salt, sand and gravel, petroleum, natural gas.
Hillsdale	10,801	[2] 9,525	Petroleum, sand and gravel, stone, natural gas.
Houghton	3,015	210	Sand and gravel, stone.
Huron	886	970	Stone, sand and gravel, lime, petroleum.
Ingham	1,177	1,240	Sand and gravel, peat.
Ionia	260	483	Sand and gravel.
Iosco	4,836	5,011	Gypsum, sand and gravel.
Iron	11,344	9,565	Iron ore, sand and gravel.
Isabella	[r] 1,087	[2] 1,136	Petroleum, sand and gravel, natural gas.
Jackson	[r] 4,490	[2] 4,190	Petroleum, sand and gravel, stone, natural gas.
Kalamazoo	1,358	1,219	Sand and gravel, stone, peat.
Kalkaska	221	296	Petroleum, sand and gravel.
Kent	4,580	[2] 4,945	Sand and gravel, gypsum, petroleum, peat, natural gas.
Keweenaw	1,989	27	Sand and gravel.
Lake	W	626	Petroleum, sand and gravel.
Lapeer	2,112	[2] 1,479	Peat, petroleum, sand and gravel, salines, natural gas.
Leelanau	92	274	Sand and gravel, stone.
Lenawee	940	[2] 665	Sand and gravel, clays, petroleum, natural gas.
Livingston	3,819	3,738	Sand and gravel, petroleum.
Luce	112	92	Sand and gravel.
Mackinac	W	W	Stone, sand and gravel.
Macomb	[r] 2,454	[2] 2,770	Sand and gravel, petroleum, natural gas.
Manistee	20,795	25,790	Salt, salines, sand and gravel.
Marquette	114,494	134,424	Iron ore, sand and gravel.
Mason	W	W	Salines, lime, sand and gravel, petroleum.
Mecosta	[r] 1,026	[2] 910	Petroleum, sand and gravel, peat, natural gas.
Menominee	705	W	Lime, sand and gravel.
Midland	W	W	Salines, salt, petroleum, sand and gravel.
Missaukee	1,476	[2] 1,791	Petroleum, sand and gravel, natural gas.
Monroe	W	W	Cement, stone, clays, peat, petroleum.
Montcalm	W	[2] 636	Petroleum, sand and gravel, natural gas.
Montmorency	53	31	Sand and gravel.
Muskegon	[r] 2,348	2,267	Salt, sand and gravel, petroleum.
Newaygo	[r] 423	443	Sand and gravel, petroleum.
Oakland	10,458	12,006	Sand and gravel, peat, petroleum.
Oceana	[r] 381	507	Sand and gravel, petroleum.
Ogemaw	[r] 1,757	[2] 1,412	Petroleum, sand and gravel, natural gas.
Ontonagon	59,041	73,412	Copper, silver, sand and gravel.
Osceola	[r] 1,907	[2] 2,384	Petroleum, sand and gravel, natural gas.
Oscoda	51	20	Sand and gravel, petroleum.
Otsego	W	[2] 212	Sand and gravel, petroleum, natural gas.
Ottawa	2,412	[2] 3,066	Do.
Presque Isle	W	W	Stone, sand and gravel, petroleum.
Roscommon	W	[2] 772	Petroleum, sand and gravel, natural gas.
Saginaw	[r] 636	655	Clays, sand and gravel, lime, petroleum.
St. Clair	[r] 15,765	[2] 17,773	Salt, cement, petroleum, peat, clays, sand and gravel, natural gas.
St. Joseph	W	282	Sand and gravel, peat, stone.
Sanilac	1,095	1,468	Peat, sand and gravel, lime.
Schoolcraft	W	W	Stone, sand and gravel.
Shiawassee	[r] 773	830	Sand and gravel, peat, clays, petroleum.

See footnotes at end of table.

Table 2.—Value of mineral production in Michigan, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Tuscola	$2,690	$1,906	Sand and gravel, petroleum, lime.
Van Buren	349	273	Sand and gravel, petroleum.
Washtenaw	r 2,357	1,479	Do.
Wayne	r 54,477	56,213	Cement, lime, salt, sand and gravel, salines, stone, clays, petroleum.
Wexford	122	114	Sand and gravel.
Undistributed [3]	r 206,121	202,999	
Total [4]	627,075	668,247	

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

[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 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.

[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Michigan business activity

	1968	1969	Change, percent
Employment and labor force, annual average: [1]			
Total labor force—thousands	r 3,520.2	3,571.9	+1.5
Agricultural employment—do	63.8	60.0	−6.0
Nonagricultural employment [2]—do	r 3,279.1	3,361.0	+2.5
Manufacturing—do	r 1,154.8	1,170.3	+1.3
Motor vehicles and equipment—do	r 378.3	388.0	+2.6
Construction—do	r 103.7	114.2	+10.1
Mining—do	r 12.8	12.8	------
Primary metal products—do	r 101.3	104.3	+3.0
Stone, clay, and glass products—do	17.4	19.8	+13.8
All other—do	r 2,007.8	2,063.7	+2.8
Payrolls, manufacturing—millions	$10,740.6	$11,518.2	+7.2
Personal income:			
Total—do	$32,119	p $34,574	+7.6
Per capita	$3,703	p $3,944	+6.5
Construction activity:			
Building permits: [3]			
Valuation of authorized residential construction—millions	r $885.1	p $858.3	−3.0
Number of private and public residential units authorized	r 59,987	p 55,329	−7.8
Contract construction work performed—millions	$2,350	$2,729	+16.1
State highway department:			
Contracts awarded—do	$136.3	$147.6	+8.3
Contract work performed—do	126.7	128.4	+1.3
Portland cement shipments to and within Michigan, thousand 376-pound barrels	16,158	16,459	+1.9
Farm marketing receipts—millions	$849.5	p $873.6	+2.8
Mineral production—do	$627.1	$668.2	+6.6
Raw steel production—thousand tons	9,218	10,036	+8.9
Utility production and consumption:			
Production of electric energy by electric utilities, million kilowatt-hours	52,102	p 55,267	+6.1
Natural gas consumption—million cubic feet	703,782	779,278	+10.7
Export trade [4]—millions	$3,485	$4,172	+19.7
Import trade [4]—do	r $3,238	$3,676	+13.5

r Revised. p Preliminary.

[1] Adjusted to March 1969 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Based on a nationwide survey of 13,000 permit issuing places.

[4] Includes Detroit Customs District.

Sources: Michigan Employment Security Division in cooperation with the U.S. Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, State of Michigan Department of Highways, Farm Income Situation, American Iron & Steel Institute, Federal Power Commission, and U.S. Department of Commerce.

Table 4.—Worktime 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
1968:								
Peat	167	187	31	293	------	------	------	------
Metal	5,181	296	1,549	12,393	1	400	32.36	1,850
Nonmetal	1,798	275	494	3,952	------	84	21.25	635
Sand and gravel	2,569	215	554	4,789	------	104	21.72	963
Stone	3,412	288	983	7,918	------	75	9.47	1,134
Total [1]	13,127	274	3,611	29,344	1	663	22.63	1,330
1969: [p]								
Peat	183	189	35	332	------	1	3.01	84
Metal	5,170	268	1,393	11,147	5	310	28.26	4,159
Nonmetal	1,825	275	503	4,023	------	96	23.86	475
Sand and gravel	2,635	219	577	4,968	3	100	20.73	4,924
Stone	3,435	289	993	7,941	2	59	7.68	1,980
Total [1]	13,250	264	3,501	28,412	10	566	20.27	3,114

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Portland cement shipments reversed the upward trend which began in 1960 and were 3 percent less than in 1968. The value of shipments, however, declined less than 1 percent as the unit value (barrels) increased to $3.24 from $3.16 in the previous year. Masonry cement output declined 5 percent, but value dropped only 1 percent because of an increase in price of 12 cents per barrel to $2.87. Portland cement was produced at nine plants in seven counties (Alpena, Bay, Charlevoix, Emmet, Monroe, St. Clair, and Wayne); masonry cement, as in 1968, was shipped from six of these plants. Annual finished portland cement capacity exceeded 39 million barrels. Yearend stocks of portland cement at mills were 4.3 million barrels compared with 3.9 million barrels in 1968. More than 96 percent of portland cement shipped was types I and II (general use and moderate heat); the remainder was principally type III (high-early-strength) and portland-pozzolan. More than 49 percent of the portland cement and 63 percent of the masonry cement were shipped to consumers within the State. Out-of-State distribution went mostly to Wisconsin, Ohio, Illinois, Indiana, Minnesota, and New York.

Ready-mixed concrete companies purchased about three-fifths of the shipments with the remainder going principally to concrete product manufacturers (16 percent), highway contractors (13 percent), and building material dealers (9 percent). About 1.7 million barrels of cement, mostly portland, were shipped into Michigan. About three-fourths of these shipments originated in Ohio, with the remainder coming mostly from Indiana and Pennsylvania.

Raw materials used in portland cement manufacture included 7.9 million tons of limestone, about 2.3 million tons of clay or shale, as well as quantities of gypsum, sand, iron ore, slag, mill scale, air-entraining compounds, and grinding aids. Over 757 million kilowatt-hours of electricity

Table 5.—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	
1965	8	27,018	27,565	$86,996	2,110
1966	8	28,848	28,171	87,413	3,219
1967	9	29,862	29,645	94,515	3,813
1968	9	31,195	31,375	99,158	[r] 3,911
1969	9	30,565	30,373	98,425	4,320

[r] Revised.

was used, of which 410 million was purchased and the remainder generated by the consumer. Shipments of portland cement were by truck (85 percent), water (10 percent), and rail (5 percent).

American Cement Corp. announced that site preparation had begun in Detroit on the $75 million cement plant for its Peerless Division. The new plant, to be operational in 1971, with one 580-foot kiln, will have an annual capacity of 5 million barrels initially. When completed, the plant will be a three-kiln operation with a capacity of 12 million barrels. The first phase will replace the oldest of two existing Detroit plants. The other Detroit plant, as well as the Port Huron operation, will be discontinued when the entire program is completed.

Clays.—Miscellaneous clays and shale were mined at 15 pits in 10 counties. Clay for use in manufacturing pottery and stoneware, lightweight aggregate, and cement was in greater demand than in 1968, while lesser quantities were required for heavy clay products (brick, tile, and sewer pipe). Total clay production was about 3 percent greater than in 1968. About 88 percent of the clay or shale was used in cement manufacture, and the remainder was used for lightweight aggregate, heavy clay products, pottery, and stoneware. The largest production was reported from Alpena, Wayne, Monroe, Antrim, Saginaw, and St. Clair Counties. Construction Aggregates Corp. completed a $2 million lightweight aggregate plant near Grand Haven. The 1,200-ton-per-day plant incorporates a Dwight-Lloyd sinter machine with a rated capacity of 50 tons per hour, reportedly the largest ever used for the production of lightweight aggregate.

Gem Stones.—Gem stones were found along Lake Superior beaches in the Upper Peninsula, as well as on Isle Royale. Agates, thomsonite, and other semiprecious stones, as well as specimens of native copper and hematite, were collected by hobbyists.

Gypsum.—Crude gypsum production declined nearly 6 percent, but value increased by nearly 4 percent. Underground mines were operated at Grand Rapids; the output was processed at adjoining plants for plaster, lath, and wallboard. In Iosco County, gypsum was produced at several quarries at Whittemore, Tawas City, and Alabaster. Crude gypsum was sold for portland cement retarder and also supplied building material plants at National City, Detroit, and in Ohio and Wisconsin. Gypsum materials were shipped by lake transport from company-owned port facilities at National City and Alabaster.

Lime.—Lime output declined by nearly 3 percent, but value increased by the same amount because of higher prices. An increased demand for lime was reported for use in sugar refining, water purification, paper manufacture, sewage treatment, and chemical manufacture. Lime for metallurgical use declined slightly, while demand for lime for alkali production decreased substantially. Lime plants were operated in eight counties. Plants in Wayne County produced 78 percent of the State total and supplied steel mills and chemical plants in the Detroit area. About 51 percent of the lime output was used by the producers, and the remainder was sold. Only 7 percent was shipped out of the State. About 287,000 tons of lime, mostly quicklime, was shipped into Michigan, with 225,000 tons coming from Ohio. Lime regenerated at paper mills and water purification plants is not included in the total State production.

Natural Salines.—Bromine, calcium chloride, calcium-magnesium chloride, iodine, magnesium compounds, and potash were extracted from natural well brines at chemical plants in Gratiot, Lapeer, Manistee, Mason, Midland, and Wayne Counties. Total value of output was 7 percent larger than in 1968. Record highs for production of bromine, calcium compounds, and iodine were established in 1969. Standard Lime & Refractories Co., a division of Martin Marietta Corp., started production of high-purity, lightburn magnesia products at Manistee. The new facility is part of an $8 million expansion program underway at the Manistee plant.

Perlite.—Crude perlite, mined in Western States, was expanded at plants in Iosco, Kent, and Wayne Counties. The material was used for building plaster.

Salt.—Salt was recovered from natural and artificial brines at plants in Gratiot, Manistee, Midland, Muskegon, St. Clair, and Wayne Counties and produced from an underground mine at Detroit. Production declined less than 2 percent, and

value was more than 3 percent higher than in 1968. Michigan salt was widely distributed with the largest shipments going to contiguous States.

Sand and Gravel.—Production of sand and gravel increased nearly 3 percent and was valued at $59 million, more than 7 percent higher than in 1968. Michigan ranked second nationally in sand and gravel output. In 1969, sand and gravel demand increased 11 percent for building use and 9 percent for industrial use (molding, glass, engine, etc.), while demand for paving use and for fill material declined about 1 and 5 percent, respectively. Nearly every county in Michigan reported sand and gravel production. In each of 11 counties, output exceeded 1 million tons. These counties provided nearly three-fifths of the State production. Five of these counties make up metropolitan Detroit and produced nearly 23 million tons. Most of the sand and gravel was moved by truck (91 percent); the remainder was shipped by rail (6 percent) and water (3 percent). Production was reported from 415 commercial and 119 Government-and-contractor operations.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	7,475	$6,481	8,179	$7,172
Paving	6,704	5,585	5,366	4,886
Fill	3,956	1,743	4,189	2,076
Molding	4,129	7,637	4,468	8,734
Other [1]	914	2,177	941	2,448
Total [2]	23,178	23,623	23,143	25,315
Gravel:				
Building	6,425	9,727	7,291	11,087
Paving	18,666	16,915	19,647	17,637
Fill	393	293	325	247
Railroad ballast	W	W	173	260
Other	188	304	80	90
Total [2]	25,672	27,239	27,518	29,321
Total sand and gravel	48,850	50,862	50,661	54,636
Government-and-contractor operations:				
Sand:				
Building	------	------	13	6
Paving	1,839	845	1,715	903
Fill	747	310	356	148
Other	151	58	135	63
Total [2]	2,737	1,213	2,218	1,121
Gravel:				
Building	21	11	11	7
Paving	4,753	2,759	4,956	3,094
Fill	301	134	246	111
Other	1	(3)	------	------
Total	5,076	2,904	5,213	3,212
Total sand and gravel [2]	7,813	4,111	7,431	4,332
All operations:				
Sand	25,915	24,836	25,362	26,436
Gravel	30,748	30,143	32,730	32,532
Total	56,663	54,979	58,092	58,968

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

[1] Includes chemical and railroad ballast (1968), abrasives, blast, enamel, engine, glass, pottery, porcelain, tile, and other construction and industrial sand.

[2] Data may not add to totals shown because of independent rounding.

[3] Less than ½ unit.

Table 7.—Production of sand and gravel by counties

(Thousand short tons and thousand dollars)

County	1968		1969		County	1968		1969	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Alcona	230	$117	391	$225	Leelanau	148	$92	250	W
Alger	63	39	64	38	Lenawee	1,122	915	709	$656
Allegan	751	462	776	525	Livingston	3,593	3,816	3,435	3,736
Alpena	135	120	112	110	Luce	221	112	172	92
Antrim	92	W	95	W	Mackinac	205	98	196	102
Arenac	49	39	50	41	Macomb	2,838	2,423	3,202	2,747
Baraga	214	105	150	99	Manistee	W	W	W	W
Barry	537	531	797	740	Marquette	363	W	490	W
Bay	W	W	W	W	Mason	W	W	1,145	W
Benzie	12	4	17	9	Mecosta	324	W	331	W
Berrien	1,982	2,445	1,828	2,824	Menominee	407	W	400	238
Branch	455	W	332	398	Midland	327	W	272	W
Calhoun	760	W	481	335	Missaukee	5	3	88	68
Cass	245	203	580	436	Monroe	------	------	------	------
Charlevoix	114	W	113	W	Montcalm	328	W	487	266
Cheboygan	86	W	114	W	Montmorency	81	53	50	31
Chippewa	285	209	456	345	Muskegon	487	W	463	W
Clare	186	W	205	W	Newaygo	701	354	517	328
Clinton	601	W	773	W	Oakland	10,365	10,395	11,779	11,944
Crawford	30	19	21	24	Oceana	320	210	558	405
Delta	264	W	293	W	Ogemaw	1,099	937	773	567
Dickinson	143	W	104	W	Ontonagon	234	144	141	89
Eaton	402	313	730	589	Osceola	221	176	374	316
Emmet	81	W	86	W	Oscoda	91	46	29	15
Genesee	572	517	805	614	Otsego	11	W	W	W
Gladwin	29	17	47	33	Ottawa	2,479	2,184	2,729	2,835
Gogebic	276	197	163	W	Presque Isle	565	W	470	W
Grand Traverse	548	274	253	189	Roscommon	W	W	331	289
Gratiot	326	297	425	395	Saginaw	W	W	308	W
Hillsdale	W	W	493	576	St. Clair	141	75	109	55
Houghton	269	223	255	W	St. Joseph	538	W	301	276
Huron	157	126	398	W	Sanilac	342	W	339	W
Ingham	1,378	1,175	1,293	1,237	Schoolcraft	29	19	92	56
Ionia	425	260	575	483	Shiawassee	699	W	761	564
Iosco	672	W	700	490	Tuscola	2,350	W	1,525	W
Iron	226	W	181	197	Van Buren	416	318	364	245
Isabella	502	401	593	449	Washtenaw	1,942	2,306	1,548	1,461
Jackson	318	308	406	391	Wayne	2,686	4,477	2,696	4,978
Kalamazoo	1,110	1,304	941	1,163	Wexford	158	122	143	114
Kalkaska	17	9	19	11	Undistributed [1]	3,008	12,296	1,083	9,484
Kent	2,913	3,496	2,946	3,822					
Keweenaw	40	18	48	27	Total [2]	56,663	54,979	58,092	58,968
Lake	W	W	35	20					
Lapeer	324	180	292	176					

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes production for which no county breakdown is available and data indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Stone.—The upward trend in stone production continued in 1969, with value up 6 percent and volume 5 percent larger than in 1968. Stone was quarried in 27 counties; five counties with production of 1 million tons or more contributed 91 percent of the State total. Nearly all the stone produced was crushed limestone and dolomite, chiefly from very large quarries and crushing plants in Alpena, Chippewa, Mackinac, Monroe, and Presque Isle Counties.

A large proportion of the material (73 percent) was shipped by boat from company-operated ports on Lakes Huron and Michigan to steel mills, cement and lime plants, and other consumers. In table 9, the distribution of crushed and broken stone shipments by type of use is shown. Little change in pattern from 1968 was evident. Small quantities of dimension limestone and sandstone were produced for building use. Dimension limestone was quarried and milled in Eaton, Huron, Presque Isle, and Schoolcraft Counties; in Jackson County sandstone was produced and used as rubble; in Dickinson County granite was quarried and crushed for use as terrazzo and exposed aggregate; and in Houghton County basalt was quarried and crushed for road use. Marl was produced in 10 counties for agricultural use, with the bulk of the material being dipped from pits in Cass, Calhoun, and Kalamazoo Counties.

Table 8.—Dimension stone sold or used by producers, by kinds

Year	Limestone		Sandstone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1965	5,286	$76,989	6,396	$42,760	11,682	$119,749
1966	4,266	64,166	8,109	53,510	12,375	117,676
1967	3,241	61,150	2,770	16,690	6,011	77,840
1968	2,680	51,271	1,500	15,000	4,180	66,271
1969	4,242	58,954	1,000	10,000	5,242	68,954

Table 9.—Crushed and broken stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Kind and use	1968		1969	
	Quantity	Value	Quantity	Value
Granite: Exposed aggregate	2	$60	W	W
Limestone and dolomite:				
Concrete aggregate and roadstone:				
Concrete aggregate	3,490	4,035	3,372	$3,574
Bituminous aggregate	1,023	1,352	1,268	1,652
Macadam aggregate	214	307	266	357
Dense graded road base stone	936	1,151	1,137	1,640
Surface treatment aggregate	334	485	378	513
Unspecified aggregate and roadstone	NA	NA	518	604
Total aggregate and roadstone [1]	5,997	7,329	6,940	8,340
Agricultural limestone	689	872	624	768
Cement	9,370	7,954	9,310	8,174
Flux	11,376	14,327	12,351	15,591
Lime	6,792	7,102	7,729	8,175
Railroad ballast	281	370	107	124
Other [2]	2,612	2,873	2,005	2,197
Total [1]	37,116	40,827	39,067	43,368
Marl: Agricultural purposes	134	106	99	86
Traprock (basalt): Surface treatment aggregates	21	33	W	W
Grand total [1]	37,275	41,026	39,180	43,503

NA Not available. W Withheld to avoid disclosing individual company confidential data; included in "Grand total."

[1] Data may not add to totals shown because of independent rounding.

[2] Includes stone used for asphalt filler and other fillers or extenders; mine dusting (1968); chemical uses; dead-burned dolomite; poultry grit and mineral food; riprap and jetty stone; stone sand; terrazzo and exposed aggregate; and other uses.

Sulfur.—Byproduct sulfur was recovered from crude petroleum at oil refineries in Alma, Detroit, and Trenton. Shipments increased about 17 percent, but value of output declined by 10 percent because of lower prices.

Vermiculite.—Crude vermiculite, mined outside the State, was exfoliated at a plant in the Detroit area. It was sold for use in loose fill insulation, building plaster, concrete aggregate, and for agricultural and other uses.

METALS

Copper.—Production of copper, in terms of recoverable metal, increased slightly in 1969 but value increased 14 percent. The average weighted price for copper increased from 41.8 cents in 1968 to 47.5 cents per pound. The labor strike which began on August 21, 1968, at the Calumet Division, Universal Oil Products Co., continued into 1969. On April 8 the facilities of the Calumet Division in Upper Michigan were closed. The 104-year-old copper operation employed more than 1,000 miners, millmen, and smelter workers in the Houghton-Keweenaw area and accounted for more than half of the taxes in the area. The White Pine mine of White Pine Copper Co., in Ontonagon County, is now the only producer of primary copper in Michigan.

Iron Ore.—Iron ore shipments in 1969 were 11 percent higher than in 1968. Pellets accounted for 83 percent of the total shipments compared with 77 percent in 1968. The average weighted mine value for Michigan usable iron ore in 1969 was

Table 10.—Mine production of copper, in terms of recoverable metal

Year	Mines producing		Material treated		Copper	
	Lode	Tailing	Ore (thousand short tons)	Tailing (thousand short tons)	Short tons	Value (thousands)
1965	10	3	7,368	1,611	71,749	$50,798
1966	10	3	8,000	1,851	73,449	53,133
1967	8	3	6,091	1,307	58,458	44,692
1968	4	--	8,027	------	74,805	62,607
1969	1	--	8,200	------	75,226	71,516

$12.08 compared with $11.72 the previous year. About 86 percent of the crude ore came from open pit mines, and the remainder came from five underground mines. The average iron content of usable ore produced was 60.99 percent natural, compared with 60.56 percent in 1968.

The Homer and Wauseca underground mines at Iron River, operated by The Hanna Mining Co., were closed permanently on June 27 after 58 years of operation and shipment of 31.5 million tons of ore. The Bristol underground mine at Crystal Falls, operated by Inland Steel Co. was closed in July because of lessening demand for Bristol-type ore. The Bristol mine had produced 15 million tons of ore since its opening in 1892. The Chicago & Northwestern Railway Co. began operating its new $16 million ore storage and loading facilities at Escanaba. A new ore shipping record of 6.9 million tons was established at the port in 1969, surpassing the previous high of 6.6 million tons in 1966. The lake shipping season for Michigan iron ore opened at Escanaba on April 6 and closed at the same port on December 24.

Table 11.—Crude iron ore data, in 1969, 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	------	------	5,200	------	5,200	------
Iron	r 1,131	1,299	------	1,284	------	1,146
Marquette	r 590	2,708	20,378	688	22,393	595
Total [1]	r 1,722	4,006	25,577	1,972	27,592	1,741
Range:						
Marquette	r 590	2,708	20,378	688	22,393	595
Menominee	r 1,131	1,299	5,200	1,284	5,200	1,146
Total [1]	r 1,722	4,006	25,577	1,972	27,592	1,741

r Revised.
[1] Data may not add to totals shown because of independent rounding.

Table 12.—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		
				Gross weight		Iron content (percent)
				Ore [2]	Iron content	
1854–1964	330,807	270,514	248,710	850,031	NA	NA
1965	8,973	4,595	753	14,322	8,343	58.25
1966	9,589	4,620	113	14,322	8,432	58.87
1967	10,231	3,750	49	14,030	8,453	60.25
1968	10,086	3,684	--------	13,770	8,339	60.56
1969	10,048	3,369	--------	13,417	8,183	60.99
Total [2]	379,734	[3] 290,531	[3] 249,626	919,892	NA	NA

NA Not available.
[1] Exclusive, after 1905, of iron ore containing 5 percent or more manganese.
[2] Data may not add to totals shown because of independent rounding.
[3] Distribution by range partly estimated before 1906.

Table 13.—Iron ore shipped from mines

(Thousand long tons)

Year	Direct-shipping ore [1]	Concentrates			Total usable ore [2]	Proportion of concentrates to total usable ore (percent)
		Agglomerates	Other	Total [2]		
1965	4,969	7,554	1,004	8,558	13,527	63.26
1966	4,272	8,690	1,415	10,106	14,377	70.28
1967	3,011	10,336	783	11,119	14,130	78.69
1968	2,353	9,786	560	10,346	12,699	81.47
1969	1,972	11,657	429	12,086	14,058	85.97

[1] Includes crushed, screened, and sized ore not further treated.
[2] Data may not add to totals shown because of independent rounding.

Pig Iron and Steel.—Pig iron and steel were manufactured in the Detroit area by the Ford Motor Co. at Dearborn; National Steel Corp. at Ecorse; and McClouth Steel Corp. at Trenton. Pig iron shipments and value increased 4 and 6 percent, respectively, compared with 1968. Basic and foundry grades were produced, and a small quantity of low-phosphorus grade was shipped from stock. About 2.8 million tons of iron and manganiferous ores, mostly domestic, was consumed in agglomerating plants and blast and steel furnaces. The American Iron & Steel Institute reported Michigan steel production of 10.0 million tons, compared with 9.2 million tons in 1968.

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 an outside smelter where the silver was recovered. Silver output more than doubled while value was 78 percent higher than in 1968.

MINERAL FUELS

Natural Gas and Natural Gas Products.—Natural gas was produced in 21 counties from both gas and oil wells, with 92 percent coming from five counties—Calhoun, Hillsdale, Jackson, Macomb, and St. Clair. Natural gas liquids were stripped from Michigan gas principally at the Albion-Scipio, Bell River Mills, Boyd, and Reed City gas plants. Additional natural gas liquids were stripped from out-of-State gas delivered by interstate pipeline to a plant in Washtenaw County.

Peat.—Although State output declined 22 percent in 1969, Michigan continued to be the largest producer of peat, accounting for 33 percent of the U.S. total. Peat was produced in 13 counties; Sanilac County and Lapeer County accounted for 36 percent and 33 percent of the State total, respectively. Nearly 95 percent of the total output was used for general soil improvement, with the remainder being used as an ingredient for potting soils, for mushroom beds, and packing flowers, shrubs, etc. Over 77 percent of the sales was in packaged form. Reed-sedge peat accounted for 83 percent of the total sales, humus peat 12 percent, and moss peat 5 percent.

Petroleum.—Petroleum was produced in 47 counties. The largest output was from Calhoun, Jackson, and Hillsdale Counties (Albion-Pulaski-Scipio trend). In October, oil and gas discoveries near Gaylord and Traverse City indicated that a major oil and gas-producing area might develop in the Niagaran formation that extends 170 miles across the northern part of the lower peninsula from Alpena to Ludington. According to the Geological Survey Division, Michigan Department of Natural Resources, the statewide discovery-to-dry hole ratio for exploratory or new field wildcat wells was about 1 to 16 as compared with 1 to 12 in 1968. In St. Clair and Macomb Counties, where about 27 percent of the wildcats were drilled in 1969 (about 40 percent in 1968), the ratio was about 1 to 42 as compared with 1 to 16 in 1968. In the northern district, an area covering about 8,226 square miles, the success ratio was about 1 to 5 in 1969. About 38 percent of the exploratory wells bottomed out in Devonian age rocks, 37 percent in Silurian, 19 percent in Ordovician, and about 1 percent in Cambrian or older rocks. The remaining 5 percent was drilled in rocks younger than Devonian. There were eight new field discoveries and two new pool discoveries in 1969. One Precambrian test

was drilled in Wayne County in connection with a brine disposal well used in LPG storage operations. There were eight active refineries having an operating capacity of 159,400 barrels per day. Two additional refineries were closed during the year. Their capacities are not included in the preceding figures.

Table 14.—Crude petroleum production, by counties

(Thousand 42-gallon barrels and thousand dollars)

County	1968		1969	
	Quantity [1]	Value [2]	Quantity [1]	Value [2]
Allegan	185	$546	141	$432
Arenac	r 253	r 746	231	708
Barry	12	35	12	37
Bay	309	911	285	876
Calhoun	r 2,325	r 6,862	2,067	6,344
Cass	1	3	1	3
Clare	r 562	r 1,659	539	1,654
Crawford	349	1,030	450	1,381
Eaton	------	------	[3]	1
Genesee	r 9	r 27	10	31
Gladwin	r 331	r 976	319	978
Gratiot	17	51	12	36
Hillsdale	3,511	10,362	2,915	8,949
Huron	2	5	2	6
Ionia	[3]	[3]	------	------
Isabella	r 232	r 686	224	687
Jackson	r 1,401	r 4,135	1,223	3,755
Kalkaska	72	212	93	285
Kent	76	224	74	227
Lake	r 56	r 166	197	606
Lapeer	70	208	71	219
Lenawee	[3]	1	[3]	1
Livingston	1	3	1	2
Macomb	10	r 31	7	23
Mason	70	r 207	57	175
Mecosta	r 276	r 814	222	682
Midland	206	607	200	615
Missaukee	499	1,473	561	1,723
Monroe	4	11	3	10
Montcalm	r 149	r 438	121	370
Muskegon	r 72	r 211	54	167
Newaygo	r 23	r 69	38	115
Oakland	1	r 3	[3]	1
Oceana	58	r 171	33	102
Ogemaw	278	r 820	275	845
Osceola	r 587	r 1,731	673	2,068
Oscoda	2	5	2	5
Otsego	------	------	13	39
Ottawa	77	227	75	231
Presque Isle	------	------	1	4
Roscommon	163	r 481	157	483
Saginaw	23	68	22	67
St. Clair	r 581	r 1,716	721	2,214
Shiawassee	r 12	r 34	10	31
Tuscola	71	209	67	205
Van Buren	11	31	9	28
Washtenaw	r 17	r 51	6	18
Wayne	r 11	r 31	19	57
Total [4]	12,974	38,287	12,213	37,494

r Revised.
[1] Source: State of Michigan, Department of Natural Resources.
[2] County values calculated by using State average value per barrel; $2.95 for 1968 and $3.07 for 1969.
[3] Less than ½ unit.
[4] Data may not add to totals shown because of independent rounding.

Table 15.—Oil and gas wells drilled in 1969

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage [1]
Allegan	1	--	1	--	--	3	5	8,132
Antrim	--	--	--	--	--	3	3	19,773
Arenac	--	--	--	--	--	1	1	3,058
Barry	--	--	--	--	--	1	1	4,703
Bay	--	--	--	--	--	---	---	[2] 730
Benzie	--	--	--	--	--	1	1	5,282
Branch	--	--	--	--	--	8	8	30,424
Calhoun	7	1	20	--	--	4	32	149,945
Cass	--	--	--	--	--	1	1	1,154
Cheboygan	--	--	--	--	--	1	1	4,495
Clare	2	1	3	--	--	---	6	25,664
Clinton	--	--	--	--	--	1	1	7,787
Crawford	--	--	--	--	--	1	1	7,241
Eaton	--	--	--	1	--	6	7	35,722
Genesee	--	--	--	--	--	1	1	3,143
Gladwin	--	--	--	--	--	1	1	3,962
Grand Traverse	--	--	--	--	1	---	1	6,922
Gratiot	--	--	--	--	--	7	7	21,187
Hillsdale	--	--	2	--	--	2	4	13,605
Ionia	--	--	--	--	--	1	1	6,400
Isabella	1	--	--	1	--	---	2	9,641
Jackson	1	--	2	--	--	5	8	34,753
Kalamazoo	--	--	--	--	--	2	2	4,760
Kalkaska	--	--	--	--	--	2	2	14,290
Kent	--	--	--	--	--	1	1	359
Lake	15	--	8	--	--	3	26	66,133
Lapeer	1	--	2	1	--	---	4	12,230
Lenawee	--	1	1	--	1	---	3	4,591
Livingston	--	1	1	--	--	---	2	9,525
Macomb	--	--	1	--	--	18	19	62,000
Manistee	--	--	--	--	--	2	2	7,226
Mason	1	--	5	--	--	4	10	23,010
Mecosta	1	--	3	--	--	4	8	29,666
Missaukee	3	--	4	--	--	3	10	35,087
Montcalm	--	--	--	--	--	2	2	6,798
Muskegon	--	--	4	--	--	1	5	9,131
Newaygo	1	--	9	--	--	4	14	39,568
Oakland	--	2	--	--	--	---	2	8,679
Oceana	--	--	2	2	--	9	13	24,608
Ogemaw	--	--	1	----	--	---	1	4,272
Osceola	2	--	3	--	--	9	14	50,952
Otsego	1	--	1	1	--	2	5	32,997
Ottawa	--	--	1	--	--	2	3	6,737
Presque Isle	--	--	1	1	--	3	5	16,888
Saginaw	--	--	--	--	--	1	1	1,750
St. Clair	27	--	14	--	1	23	65	203,392
Shiawassee	1	--	1	--	--	1	3	5,979
Tuscola	1	--	--	--	--	1	2	5,825
Van Buren	--	--	--	--	--	1	1	2,771
Washtenaw	--	--	1	--	--	1	2	7,104
Wexford	--	--	--	--	--	1	1	4,045
Total	66	6	91	7	3	148	321	1,104,096

[1] Includes only wells drilled and completed for oil and gas.
[2] Old well drilled deeper.

Table 16.—Principal producers [1]

Commodity and company	Address	Type of activity	County
Cement:			
Aetna Portland Cement Co., div. of Martin Marietta Corp.	Box 8 Bay City, Mich. 48706	Portland and masonry, wet process.	Bay.
Dundee Cement Co	Box 317 Dundee, Mich. 48131	----do----	Monroe.
Huron Cement Co., div. of National Gypsum Co.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	Portland and masonry, dry process.	Alpena.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Portland, wet process	Charlevoix.
Peerless Cement Co., div. of American Cement Corp.:	900 Detroit Trade Center Detroit, Mich. 48226		
Port Huron Plant	----------	Portland, wet process	St. Clair.
Brennan Ave. Plant	----------	----do----	Wayne.
Jefferson Ave. Plant	----------	Portland and masonry, wet process.	Do.
Penn-Dixie Cement Corp	Box 152 Nazareth, Pa. 18064	----do----	Emmet.
Wyandotte Chemicals Corp	1609 Biddle Ave. Wyandotte, Mich. 48192	----do----	Wayne.
Clays and shale:			
Aetna Portland Cement Co., div. of Martin Marietta Corp.	Box 8 Bay City, Mich. 48706	Pit	Saginaw.
Dundee Cement Co	Box 317 Dundee, Mich. 48131	Pit	Monroe.
Huron Cement Co., div. of National Gypsum Co.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	Pit	Alpena.
Light Weight Aggregate Corp.	12720 Farmington Rd. Livonia, Mich. 48150	Pit and plant	Wayne.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Pit	Antrim.
Peerless Cement Co., div. of American Cement Corp.	900 Detroit Trade Center Detroit, Mich. 48226	Pits	St. Clair, Wayne.
Penn-Dixie Cement Corp	Box 152 Nazareth, Pa. 18064	Pit	Antrim.
Coke:			
Industrial Chemicals Div. Allied Chemical Corp.	Box 70 Morristown, N.J. 07960	Coke ovens	Wayne.
Ford Motor Co	The American Rd. Dearborn, Mich. 48121	----do----	Do.
National Steel Corp. (Great Lakes Steel Div.)	2800 Grant Bldg. Pittsburgh, Pa. 15219	----do----	Do.
Copper:			
White Pine Copper Co	Box 427 White Pine, Mich. 49971	Mine and mill	Ontonagon.
Gypsum:			
Georgia-Pacific Corp. Gypsum Division.	900 SW. 5th Portland, Oreg. 97204	Underground mine, and calcining and board plant.	Kent.
Grand Rapids Gypsum Co	Box 1674 Grand Rapids, Mich. 49501	----do----	Do.
Michigan Gypsum Co	2840 Bay Rd. Saginaw, Mich. 48601	Open pit mine	Iosco.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	Open pit mine and calcining and board plant.	Do.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	Open pit mine Calcining and board plant.	Do. Wayne.
Iron ore:			
Cleveland-Cliffs Iron Co.:	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Cliffs Shaft	----------	Stockpile shipments	Marquette.
Eagle Mills pellet plant	----------	Pelletizes ore from the Republic mine.	Do.
Empire	----------	Open pit mine, concentrator, and agglomerator.	Do.
Humboldt	----------	----do----	Do.
Mather	----------	Underground mine. Ore treated at the Ore Improvement Plant and Pioneer Pellet Plant.	Do.
Ore improvement plant	----------	Processes Mather ore	Do.
Pioneer pellet plant	----------	Pelletizes ore from the Mather mine.	Do.

See footnote at end of table.

Table 16.—Principal producers [1]—Continued

Commodity and company	Address	Type of activity	County
Iron ore—Continued			
Cleveland-Cliffs Iron Co.—Continued	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Republic	----------	Open pit mine, concentrator. Part of the concentrates pelletized at the Eagle Mills plant.	Marquette.
Tilden	----------	Open pit mine	Do.
The Hanna Mining Co.:			
Groveland	100 Erieview Plaza Cleveland, Ohio 44114	Open pit mine, concentrator, and agglomerator.	Dickinson.
Homer	----------	Underground mine	Iron.
Wauseca	----------	Stockpile shipments	Do.
Inland Steel Co.:			
Bristol	30 West Monroe St. Chicago, Ill. 60603	Underground mine	Do.
Sherwood	----------	----do	Do.
Jones & Laughlin Steel Corp.: Tracy.	Michigan Ore Division Negaunee, Mich. 49866	----do	Marquette.
Iron and steel:			
Ford Motor Co	The American Rd. Dearborn, Mich. 48121	Iron blast furnaces and open-hearth steel furnaces.	Wayne.
McLouth Steel Corp	300 South Livernois Ave. Detroit, Mich. 48217	----do	Do.
National Steel Corp., Great Lakes Steel Div.	2800 Grant Bldg. Pittsburgh, Pa. 15219	----do	Do.
Lime:			
Detroit Lime Co., subsidiary of Edward C. Levy Co.	8800 Dix Ave. Detroit, Mich. 48209	Quicklime, shaft and rotary kilns.	Do.
The Dow Chemical Co	Midland, Mich. 48640	Quicklime, 3 rotary kilns, continuous hydrator.	Mason.
Marblehead Lime Co	300 West Washington St. Chicago, Ill. 60606	Quicklime, 2 rotary kilns.	Wayne.
Wyandotte Chemicals Corp	1609 Biddle Ave. Wyandotte, Mich. 48192	Quicklime, 9 shaft kilns.	Do.
Peat:			
Anderson Peat Co	2562 Graham Rd. Imlay City, Mich. 48444	Bog, processing plant	Lapeer.
Fletcher & Rickard	54001 Grand River Rd. New Hudson, Mich. 48165	----do	Oakland.
J. M. Huber Corp	(Peat Department) Thornall St. Edison, N.J. 08817	----do	Sanilac.
Michigan Peat	1 Decker Sq., Suite 325 Bala-Cynwyd, Pa. 19004	Bogs, processing plant	St. Clair, Sanilac.
Scenic Lakes, Inc	Box 566 East Lansing, Mich. 48823	Bog, processing plant	Shiawassee.
Expanded Perlite:			
Georgia-Pacific Corp. Gypsum Division	900 SW. 5th Portland, Oreg. 97204	Processing plant	Kent.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Iosco.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	----do	Wayne.
Petroleum refineries:			
Bay Refining Division, The Dow Chemical Co.	4868 Wilder Rd. Bay City, Mich. 48709	----------	Bay.
Crystal Refining Co	901 North Williams Carson City, Mich. 48811	----------	Montcalm.
Lakeside Refining Co	2705 East Cork Kalamazoo, Mich. 49001	----------	Kalamazoo.
Leonard Refineries, Inc.:			
Alma Division	East Superior St. Alma, Mich. 48801	----------	Gratiot.
Roosevelt Oil & Refining Division	Box 271 Pickard Ave. & A.A.R.R. Mount Pleasant, Mich. 48858	----------	Isabella.
Marathon Oil Co	1300 South Fort St. Detroit, Mich. 48217	----------	Wayne.
Naph-Sol Refining Co	1222 M-20, Box 630 Muskegon, Mich. 49443	----------	Muskegon.
Osceola Refining Co	Box 178 Reed City, Mich. 49677	----------	Ogemaw.
Petroleum Specialties, Inc	Box 448 Trenton, Mich. 48183	----------	Wayne.
Socony Mobil Oil Co., Inc	Box 477 Trenton, Mich. 48183	----------	Do.
Salt and salines:			
American Salt Corp	3142 Broadway Kansas City, Mo. 64111	Processing plant: Salt	Midland.

See footnote at end of table.

Table 16.—Principal producers [1]—Continued

Commodity and company	Address	Type of activity	County
Salt and salines—Continued			
Diamond Crystal Salt Co	916 South Riverside St. Clair, Mich. 48079	Brine wells and processing plant: Salt.	St. Clair.
The Dow Chemical Co.:			
Ludington Plant	Midland, Mich. 48640	Brine wells and processing plant: Bromine, calcium compounds, magnesium compounds.	Mason.
Midland Plant	----------	Brine wells and processing plant: Bromine, calcium compounds, iodine, magnesium compounds, potash, salt.	Midland.
Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	Processing plant: Magnesium compounds.	Mason.
Hardy Salt Co	P.O. Drawer 449 St. Louis, Mo. 61366	Processing plant: Salt	Manistee.
Hooker Chemical Corp	Box 295 Montague, Mich. 49437	----do----------	Muskegon.
International Salt Co	Clarks Summit, Pa. 18411	Underground salt mine	Wayne.
Kaiser Aluminum & Chemical Corp.	900 17th St., NW. Washington, D.C. 20006	Processing plant: Magnesium compounds.	Midland.
Michigan Chemical Corp.:	321 East Ohio St. Chicago, Ill. 60611		
Manistee Plant	----------	Processing plant: Bromine.	Do.
St. Louis Plant	----------	Brine wells and processing plant: Bromine, calcium compounds, magnesium compounds, salt.	Gratiot.
Morton Chemical Co., div. of Morton-Norwich Products, Inc.	110 North Wacker Dr. Chicago, Ill. 60606	Brine wells and processing plant: Bromine, calcium compounds, magnesium compounds.	Manistee.
Morton Salt Co., div. of Morton-Norwich Products, Inc.			
Manistee Plant	----------	Brine wells and processing plant: Salt.	Do.
St. Clair Plant	----------	----do----------	St. Clair.
Pennwalt Corp	3 Penn Center Philadelphia, Pa. 19102	Brine wells and processing plant: Salt.	Wayne.
Standard Lime & Refractories Co., div. of Martin Marietta Corp.	2000 First National Bank Bldg. Baltimore, Md. 21203	Brine wells and processing plant: Magnesium compounds.	Manistee.
Wilkinson Chemical Corp	Mayville, Mich. 48744	Brine wells and processing plant: Calcium compounds.	Lapeer.
Wyandotte Chemicals Corp	1609 Biddle Ave. Wyandotte, Mich. 48192	Brine wells and processing plant: Calcium compounds and salt.	Wayne.
Sand and gravel:			
American Aggregates Corp	Garst Ave. at Ave. B Greenville, Ohio 45331	Pits and stationary plants.	Kalamazoo, Livingston, Macomb, Oakland.
Arrowhead Silica Corp., Manley Bros. Division	128 South 15th St. Chesterton, Ind. 46304	Pit and stationary plant	Berrien.
J. V. Burkett Contractors Co., Inc.	St. Joseph, Mich. 49085	Pits and portable plant	Kent, Newaygo.
Cole Brothers, Cole Brothers Contractors, Inc.	Route 3, Box 346 Battle Creek, Mich. 49017	Pits and stationary and portable plants.	Barry, Calhoun, Hillsdale, Ionia, Kalamazoo, St. Joseph.
Construction Aggregates Corp.	120 South LaSalle St. Chicago, Ill. 60603	Pit and stationary plants	Ottawa.
R. E. Glancy, Inc	1055 South Bay Dr. Tawas City, Mich. 48763	Pit and portable plant	Iosco.
Grand Rapids Gravel Co	2700 28th St., SW. Grand Rapids, Mich. 49509	Pits and stationary plants.	Kent.
Great Lakes Foundry Sand Co.	1217 Francis Palms Bldg. Detroit, Mich. 48201	Pit and stationary plant	Tuscola.
Holloway Sand & Gravel Co.	29250 Wixom Rd., Box 247 Wixom, Mich. 48096	Pits and portable plants	Genesee, Oakland, Ogemaw, Otsego.

See footnote at end of table.

Table 16.—Principal producers [1]—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Holly Sand & Gravel Plant, J. P. Burroughs & Sons, Inc.	16240 Tindall Rd. Davisburg, Mich. 48019	Pit and stationary plant	Oakland.
Koenig Fuel & Supply Co	1486 Gratiot Ave. Detroit, Mich. 48207	do	Do.
Lyon Sand & Gravel Co., div. of E. C. Levy Co.	9300 Dix Dearborn, Mich. 48120	do	Do.
Manley Sand Division, Martin Marietta Corp.	Rockton, Ill. 61072	do	Berrien.
Mickelson Corp	435 Granger Rd. Oxford, Mich. 48051	Pit, dredges, portable plant.	Oakland.
Molesworth Contracting Co	321 Park Ave. Yale, Mich. 48097	Pits and portable plants	Genesee, Lapeer, Macomb, St. Clair, Sanilac.
Natural Aggregates Corp	65545 Mound Rd. Romeo, Mich. 48065	Pits, dredge, portable and stationary plants.	Livingston, Macomb.
New Hudson Sand & Gravel, Inc., Texas Industries, Inc.	Box H New Hudson, Mich. 48165	Pits and stationary plants.	Oakland.
The Nugent Sand Co., Inc	2875 Lincoln St. Muskegon, Mich. 49441	Pit and stationary plant	Muskegon.
Ottawa Silica Co., Michigan Division.	Box 577 Ottawa, Ill. 61350	do	Wayne.
Oxford Mining Co	9820 Andersonville Rd. Davisburg, Mich. 48019	do	Oakland.
Pickitt & Schreur, Inc	Box 149 Allegan, Mich. 49010	Pits and portable plants	Allegan, Calhoun, Clinton, Eaton, Ionia, Jackson, Kalamazoo, Kent, Missaukee, Ottawa.
Sand Products Corp	2489 First National Bank Bldg. Detroit, Mich. 48226	Pit and stationary plant	Manistee.
Sargent Sand Co	2840 Bay Rd. Saginaw, Mich. 48604	Pits and stationary plants.	Bay, Mason, Saginaw, Tuscola.
West Branch Concrete Products, Inc.	2250 Rau West Branch, Mich. 48661	Pit and stationary plant	Ogemaw.
Whittaker & Gooding Co	5800 Cherry Hill Rd. Ypsilanti, Mich. 48197	do	Washtenaw.
John G. Yerington	Route 2, Box 34 Benton Harbor, Mich. 49022	Pits and portable plants	Barry, Berrien, Branch, Calhoun, Cass, Lenawee, Muskegon, Newaygo, Van Buren.
Silver:			
White Pine Copper Co	Box 427 White Pine, Mich. 49971	Byproduct silver	Ontonagon.
Smelters:			
Quincy Mining Co	Hancock, Mich. 49930	Secondary smelter	Houghton.
White Pine Copper Co	Box 427 White Pine, Mich. 49971	Primary copper smelter.	Ontonagon.
Stone:			
Granite: Caspian Construction Co.	Caspian, Mich. 49915	Quarry and stationary plant.	Dickinson.
Limestone and dolomite:			
Bethlehem Mines Corp., Bethlehem Steel Corp.	701 East Third St. Bethlehem, Pa. 18016	do	Chippewa.
Detroit Edison Co	2000 South Second Ave. Detroit, Mich. 48226	Quarry and portable plant.	Monroe.
Dundee Cement Co	Box 317 Dundee, Mich. 48131	Quarry and stationary plant.	Do.
The France Stone Co	1800 Toledo Trust Bldg. Toledo, Ohio 43604	do	Do.
Huron Cement Co., div. of National Gypsum Co.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	do	Alpena.

See footnote at end of table.

Table 16.—Principal producers [1]—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone and dolomite—Continued			
Inland Lime & Stone Co.	Gulliver, Mich. 49840	Quarries and stationary plants.	Mackinac, Schoolcraft.
Medusa Portland Cement Co.	Box 5668 Cleveland, Ohio 44101	Quarry and stationary plant.	Charlevoix.
Michigan Foundation Quarry.	110 West Jefferson Ave. Trenton, Mich. 48183	----do----	Wayne.
The Michigan Stone Co.	Ottawa Lake, Mich. 49267	Quarries and stationary plants.	Monroe.
Penn-Dixie Cement Corp.	Box 152 Nazareth, Pa. 18064	Quarry and stationary plant.	Emmet.
Presque Isle Corp	Box 426 Alpena, Mich. 49707	----do----	Presque Isle.
United States Steel Corp. Michigan Limestone Operations.	Rogers City, Mich. 49779	Quarries and stationary plants.	Mackinac.
The Wallace Stone Co., div. of J. P. Burroughs & Son, Inc.	Bay Port, Mich. 48720	Quarry and stationary plant.	Huron.
Marl:			
Gerald Arnsman	Route 1 Hopkins, Mich. 49328	Pit	Allegan.
Case Brothers	Route 2, Box 136 Union City, Mich. 49094	Pit	Calhoun.
Darrell L. Hamilton	Route 3 Nashville, Mich. 49073	Pit	Barry.
Hayward Dry Marl	Route 2 Vicksburg, Mich. 49097	Pit	Kalamazoo.
Poehlman & Son	Route 2 Cassopolis, Mich. 49031	Pit	Cass.
Sandstone: Ray's Stone Quarry.	303 Natawasaeppe St. Napoleon, Mich. 49261	Quarry and finishing plant.	Jackson.
Traprock (basalt): Houghton County Road Comm.	Hancock, Mich. 49930	Quarry and stationary plant.	Dickinson.
Recovered sulfur:			
Leonard Refineries, Inc., Alma Division.	East Superior St. Alma, Mich. 48801	Byproduct sulfur recovery.	Gratiot.
Marathon Oil Co	1300 South Fort St. Detroit, Mich. 48217	----do----	Wayne.
Mobil Oil Co., Inc	Box 477 Trenton, Mich. 48183	----do----	Do.
Exfoliated vermiculite:			
Zonolite Division W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	Processing plant	Do.

[1] Data regarding producers of natural gas, natural gas liquids, and petroleum not available.

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 Keith S. Olson [1] and Ella R. Humenansky [2]

Sparked by a 12-percent increase in value of iron ore shipments, Minnesota's 1969 mineral output increased to a record high of $635.6 million. Minnesota continued to lead the Nation in shipments of usable iron ore and contributed more than 63 percent of the total iron ore shipped from mines in the United States in 1969. Iron-bearing ores (including manganiferous ores) comprised 90 percent of the State total value of mineral production. A continually growing demand for high-quality blast furnace feed was evidenced by the announcement that United States Steel Corp. plans to double the present output of taconite pellets at its Minntac plant near Mountain Iron. Production of taconite pellets continued to surpass that of natural ores as output of the former increased 13 percent. Production of abrasive stone, clays (excluding fire clay), portland cement, manganiferous ore, peat, sand and gravel, and stone increased in quantity and value. Decreases in quantity and value were reported for masonry cement, fire clay, and lime.

One or more mineral commodities were produced in each of the 87 counties in Minnesota. St. Louis and Itasca Counties, because of their large-scale iron mining operations, ranked first and second in value of mineral production with 78 and 13 percent of the State total, respectively. The value of mineral production exceeded $1 million in 15 counties.

[1] Industry economist, Bureau of Mines, Minneapolis, Minn.
[2] Statistical clerk, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Minnesota [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	240	$359	275	$412
Iron ore (usable) thousand long tons, gross weight	51,275	508,814	56,957	570,446
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight	191,846	W	381,491	W
Peat short tons	6,400	96	12,026	249
Sand and gravel thousand short tons	44,674	36,414	48,121	40,191
Stone do	4,427	13,045	5,035	14,253
Value of items that cannot be disclosed: Abrasive stone, cement, fire clay, gem stones, lime, and values indicated by symbol W	XX	8,699	XX	10,085
Total	XX	567,427	XX	635,636
Total 1967 constant dollars	XX	557,369	XX	p 612,452

p Preliminary. 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."

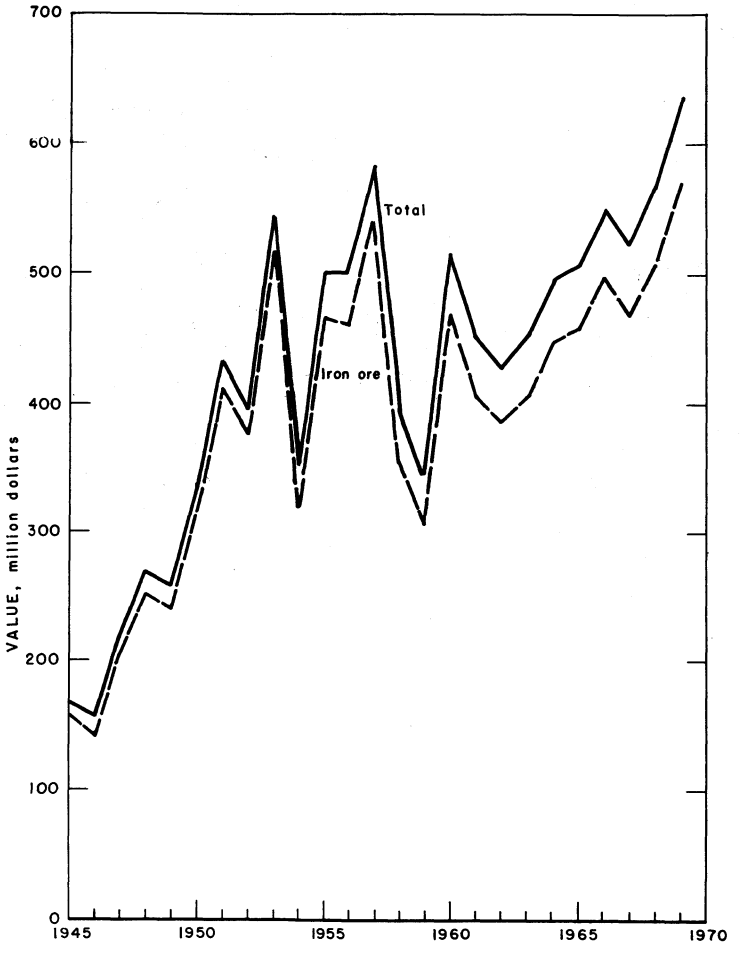

Figure 1.—Value of iron-ore shipments and total value of mineral production in Minnesota.

Table 2.—Value of mineral production in Minnesota, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Aitkin	$41	$50	Sand and gravel, peat.
Anoka	W	W	Sand and gravel.
Becker	460	433	Sand and gravel, peat.
Beltrami	258	304	Sand and gravel, stone.
Benton	W	355	Sand and gravel.
Big Stone	731	553	Stone, sand and gravel.
Blue Earth	1,518	1,706	Do.
Brown	417	439	Sand and gravel, clays.
Carlton	431	814	Sand and gravel, peat, clays.
Carver	750	673	Sand and gravel, lime.
Cass	92	202	Sand and gravel, stone.
Chippewa	178	264	Sand and gravel.
Chisago	114	947	Do.
Clay	2,639	2,645	Sand and gravel, lime.
Clearwater	678	197	Sand and gravel.
Cook	W	W	Do.
Cottonwood	91	75	Do.
Crow Wing	5,450	6,518	Iron ore, manganiferous ore, sand and gravel.
Dakota	3,239	3,308	Sand and gravel, stone.
Dodge	W	W	Stone, sand and gravel.
Douglas	325	172	Sand and gravel.
Faribault	151	67	Do.
Fillmore	1,174	639	Stone, iron ore, sand and gravel.
Freeborn	396	477	Sand and gravel.
Goodhue	637	371	Stone, sand and gravel, clays.
Grant	168	176	Sand and gravel.
Hennepin	4,423	4,794	Sand and gravel, clays.
Houston	W	285	Stone, sand and gravel.
Hubbard	39	103	Sand and gravel.
Isanti	W	48	Do.
Itasca	73,808	80,679	Iron ore, sand and gravel, peat.
Jackson	163	105	Sand and gravel.
Kanabec	W	70	Do.
Kandiyohi	545	1,090	Do.
Kittson	19	288	Do.
Koochiching	108	126	Do.
Lac qui Parle	520	651	Stone, sand and gravel.
Lake	143	192	Sand and gravel.
Lake of the Woods	47	40	Do.
Le Sueur	2,270	2,328	Sand and gravel, stone.
Lincoln	157	177	Sand and gravel.
Lyon	409	252	Do.
McLeod	271	94	Do.
Mahnomen	W	303	Do.
Marshall	210	394	Do.
Martin	178	305	Do.
Meeker	170	84	Do.
Mille Lacs	470	317	Stone, sand and gravel.
Morrison	405	W	Sand and gravel.
Mower	728	885	Sand and gravel, stone.
Murray	96	160	Sand and gravel.
Nicollet	861	769	Sand and gravel, stone.
Nobles	576	424	Sand and gravel.
Norman	41	172	Do.
Olmsted	1,067	1,127	Stone, sand and gravel.
Otter Tail	1,091	399	Sand and gravel.
Pennington	11	315	Do.
Pine	53	W	Sand and gravel, peat.
Pipestone	73	196	Sand and gravel.
Polk	1,791	1,470	Lime, sand and gravel.
Pope	108	87	Sand and gravel.
Ramsey	W	466	Sand and gravel, clays.
Red Lake	102	26	Sand and gravel.
Redwood	329	365	Sand and gravel, stone, clays.
Renville	766	612	Sand and gravel, stone.
Rice	407	569	Do.
Rock	983	481	Sand and gravel, abrasives, stone.
Roseau	W	418	Sand and gravel.
St. Louis	438,407	494,477	Iron ore, cement, sand and gravel, lime, stone, peat.
Scott	960	1,302	Stone, sand and gravel.
Sherburne	563	1,111	Sand and gravel.
Sibley	178	W	Do.
Stearns	5,154	6,025	Stone, sand and gravel.
Steele	484	469	Sand and gravel, stone.
Stevens	133	202	Sand and gravel.
Swift	36	114	Do.
Todd	434	316	Do.
Traverse	57	59	Do.
Wabasha	276	263	Stone, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Minnesota, by counties—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Wadena	$72	$78	Sand and gravel, stone.
Waseca	60	24	Sand and gravel.
Washington	3,242	4,628	Sand and gravel, stone.
Watonwan	69	8	Sand and gravel.
Wilkin	148	233	Do.
Winona	W	843	Stone, sand and gravel.
Wright	530	608	Sand and gravel.
Yellow Medicine	294	624	Stone, sand and gravel.
Undistributed [1]	2,955	1,197	
Total [2]	567,427	635,636	

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

[1] Includes some sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Minnesota business activity

	1968	1969	Change, percent
Employment and labor force, annual average: [1]			
Total labor force—thousands	r 1,599.5	1,647.3	+3.0
Agricultural employment—do	r 154.5	149.6	−3.2
Nonagricultural employment [2]—do	r 1,393.7	1,449.3	+4.0
Manufacturing—do	r 315.4	330.3	+4.7
Construction—do	r 63.8	54.2	−15.0
Mining and quarrying—do	r 15.1	14.4	−4.6
Metal mining—do	r 13.3	13.0	−2.3
Stone, clay, and glass products—do	7.4	7.8	+5.4
Primary metal industries—do	6.9	7.3	+5.8
All other—do	r 999.4	1,050.4	+5.1
Payrolls, manufacturing [3]—millions	$2,323.7	$2,616.2	+12.6
Personal income:			
Total—do	$12,185	p $13,350	+9.6
Per capita	$3,326	p $3,608	+8.5
Construction activity:			
Building permits: [4]			
Valuation of authorized residential construction—millions	r $455.4	p $417.1	−8.4
Number of private and public residential units authorized	r 31,776	p 30,024	−5.5
Contract construction work performed—millions	$1,291	$1,159	−10.2
State highway commission contracts awarded—do	$119.6	$146.0	+22.0
Portland cement shipments to and within Minnesota, thousand 376-pound barrels	8,764	9,150	+4.4
Retail sales—millions	$6,489	$6,532	+0.7
Farm marketing receipts—do	$1,864.9	p $1,985.9	+6.5
Mineral production—do	$567.4	$635.6	+12.0
Utility production and consumption:			
Production of electric energy by electric utilities, million kilowatt hours	15,832	p 16,695	+5.5
Natural gas consumption—million cubic feet	311,898	325,687	+4.4
International trade: [5]			
Value of exports through Minnesota—millions	$292	$301	+3.1
Value of imports through Minnesota—do	$506	$574	+13.5

p Preliminary. r Revised.

[1] Adjusted to March 1969 benchmark levels.

[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.

[3] Includes only workers covered under the Minnesota Employment Security Law.

[4] Based on a Nationwide universe of 13,000 permit issuing places.

[5] Includes Duluth and Minneapolis-St. Paul Customs Districts.

Sources: Minnesota Department of Employment Security in cooperation with U.S. Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, Minnesota Department of Highways, Sales Management, Farm Income Situation, Federal Power Commission, and U.S. Department of Commerce.

Table 4.—Worktime 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
1968:								
Peat	37	153	6	26	--	2	78.25	861
Metal	9,027	315	2,856	22,867	4	87	3.98	1,441
Nonmetal	154	264	41	326	--	12	36.78	208
Sand and gravel	2,147	171	367	3,282	1	59	18.28	2,252
Stone	1,414	264	373	3,060	--	55	17.98	1,663
Total	12,779	284	3,643	29,561	5	215	7.44	1,540
1969: p								
Peat	32	74	2	17	--	1	57.33	229
Metal	8,730	317	2,763	22,102	--	92	4.16	343
Nonmetal	155	263	40	324	--	11	33.99	578
Sand and gravel	2,655	172	456	4,095	1	70	17.34	1,973
Stone	1,390	259	361	2,960	2	83	28.72	4,845
Total [1]	12,960	280	3,622	29,498	3	257	8.81	1,023

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

METALS

Copper-Nickel.—Interest in developing northern Minnesota's copper-nickel deposits continued. Major companies either exploring for copper-nickel and/or holding copper-nickel leases included the following: American Smelting & Refining Company; Bear Creek Mining Co. (the exploration division of Kennecott Copper Corp.); Cerro Exploration Co., Inc.; Duval Corp.; Humble Oil & Refining Co.; The Hanna Mining Co.; The International Nickel Co.; W. S. Moore Co.; The New Jersey Zinc Co.; Phelps Dodge Corp.; Ridge Mining Corp.; and United States Steel Corp. Two areas of interest were the Duluth Gabbro Formation in Cook, Lake, and St. Louis Counties and portions of Koochiching, Itasca, Lake of the Woods, and St. Louis Counties underlain by the Greenstone Formations. The Iron Range Resources and Rehabilitation Commission (IRRRC) appropriated $50,000 for an accelerated mineral evaluation program conducted by the Minnesota Geological Survey in cooperation with the Minnesota Department of Conservation.

Iron Ore.—Shipments of usable iron ore (excluding ore containing 5 percent or more manganese, natural) in 1969 from Minnesota mines were nearly 57 million tons, an increase of 11 percent over those of 1968. Value of shipments was $570.4 million, or $61.6 million more than in the previous year. Taconite pellets continued to make up the greater portion of the State total iron ore shipments, increasing from 29.8 million tons, or 58 percent of the total in 1968, to 33.7 million tons, or 59 percent of the State total iron ore shipments in 1969. More than 90 percent of the usable iron ore shipped in 1969 was concentrated; the remainder was direct-shipping ore. Average iron content of usable iron ore produced was 58.9 percent in 1969 compared with 58.3 percent in 1968.

Lake Erie base prices for iron ore remained unchanged throughout 1969. United States Steel Corp. announced, but later rescinded, a 75 cents-per-ton decrease in price for Mesabi Range natural iron ores. Cleveland-Cliffs Iron Co. and The Hanna Mining Co. announced increases, effective in 1970, for Lake Superior natural iron ores of 25 cents per ton and in the price of pelletized Lake Superior iron ore from 25.2 cents per unit of iron to 26.6 cents. The former company originally increased the price of pellets to 26 cents per iron unit, but later increased the price to 26.6 cents. Average weighted mine value of Minnesota iron ores increased from $9.92 per ton in 1968 to $10.02 per ton in 1969.

Nearly all Minnesota iron ore was used in the manufacture of pig iron and steel. A small quantity was sold for manufacturing cement.

Eleven companies produced iron ore from open-pit mines on the Mesabi Range in St. Louis and Itasca Counties. Mines in the Spring Valley district were inactive in 1969. Mining on the Cuyuna Range consisted only of manganiferous ore. However, more than 448,000 tons of Cuyuna Range

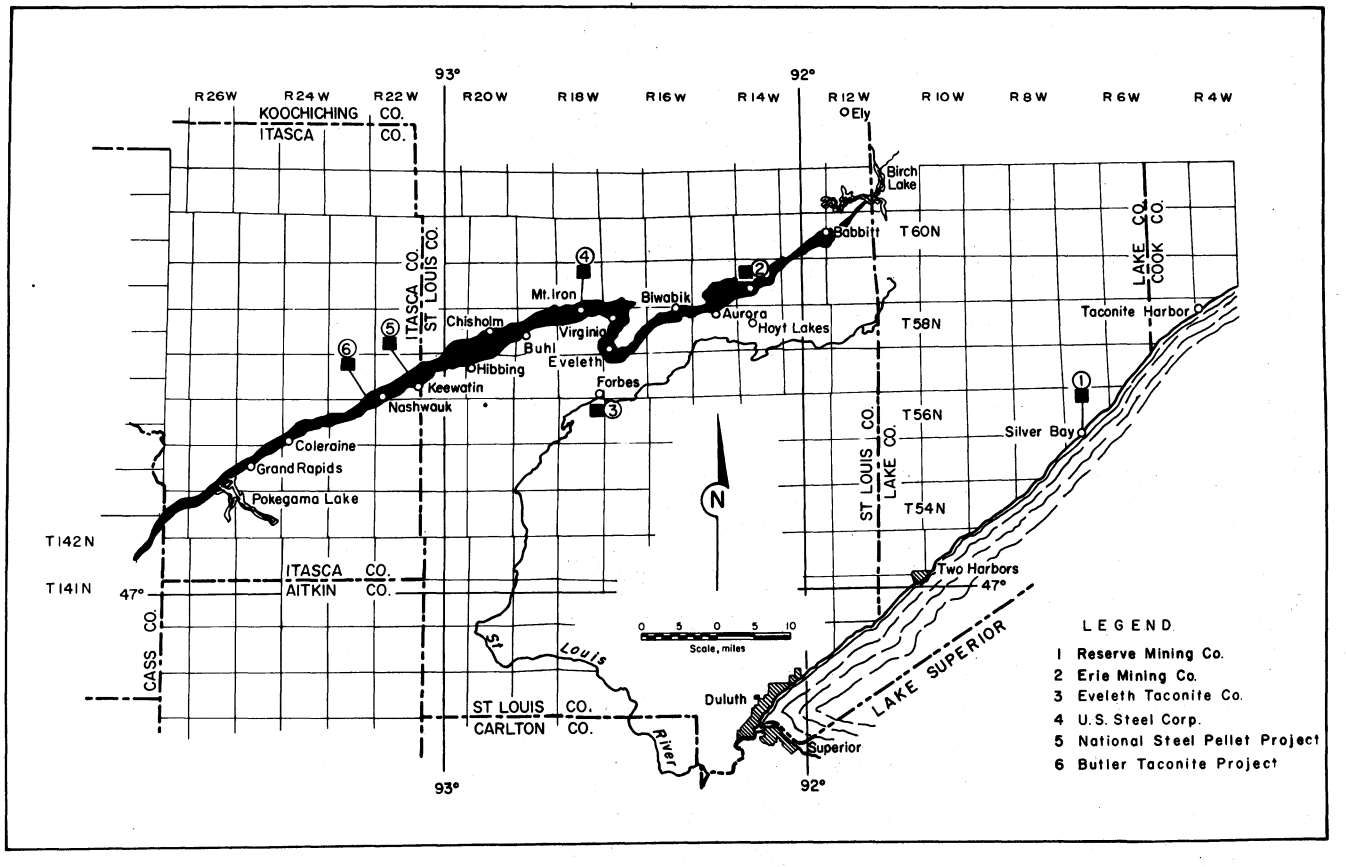

Figure 2.—Location of Mesabi Range Taconite-processing plants.

iron ore and nearly 18,000 tons of ore from the Spring Valley district were shipped from stockpiles.

Upon completion of a new pelletizing section, The Hanna Mining Co. resumed production of taconite pellets at its National Steel Pellet Plant near Keewatin. Production at the plant had been halted in mid-1968 to allow for construction of the new pelletizer after the original process proved unsatisfactory. The new pelletizing section, incorporating a 15- by 120-foot traveling grate furnace and a 20- by 140-foot rotary kiln is nearly identical to the indurating section of the company's Butler taconite project near Nashwauk. Combined production at the two Hanna plants was 8 million tons in 1969. Pellets were transported from the two plants to the Great Northern Railway Co. docks at Superior, Wis. During the winter months, pellets were stockpiled at Superior for shipment during the navigation season.

United States Steel Corp. announced plans to increase capacity at its Minntac facility near Mountain Iron to 12 million tons of pellets per year. Construction was scheduled to begin in early 1970 and be completed by mid-1972. Completion of the project will make Minntac the largest iron ore pellet plant in the world. Output of the Minntac installation, including concentrates produced at the company's Pilotac plant and agglomerated at Minntac, was nearly 6 million tons. Crude ore for the operation was supplied by rail from the Minntac mine located 3½ miles from the plant. The Minntac plant employed three grate-kiln lines. Each line contained a 12- by 112-foot traveling grate and an 18- by 120-foot gas-fired rotary kiln. Pellets were transported by unit train to the Duluth, Missabe & Iron Range Railroad (D.M. & I.R.) docks at Duluth and Two Harbors. Pellets were stored at the D.M. & I.R.'s Lakehead storage area in Duluth during the winter.

Reserve Mining Co., owned jointly by Armco Steel Corp. and Republic Steel Corp., shipped a record high of 10,649,000 tons of taconite pellets from its Silver Bay plant. Crude ore was mined at the company's Peter Mitchell mine near Babbitt and transported to Silver Bay at the rate of about 90,000 tons per day for further crushing, concentrating, agglomerating, and shipping to lower Lake ports. Reserve has shipped more than 100 million tons of taconite pellets from its Silver Bay plant since shipments began in 1956.

Erie Mining Co. (Pickands Mather & Co., operating agents), owned by Bethlehem Steel Corp., Youngstown Sheet & Tube Co., Interlake Iron Corp., and Steel Co. of Canada, operated its mine and pelletizing plant near Hoyt Lakes. Pellets were transported 74 miles on the company-owned railroad from the plant to Taconite Harbor for shipment by lake vessel to lower Lake ports. Shipments in 1969 were 10,174,000 tons.

Eveleth Taconite Co., owned by Ford Motor Co. (85 percent) and Oglebay Norton Co. (15 percent), operated its Thunderbird mine and Fairlane pellet plant near Forbes. The company established new records for both production and shipments in 1969. Shipments were nearly 2.0 million tons, and production exceeded rated capacity by about 16 percent. Crude ore was transported about 10 miles by rail from the mine to the plant. Pellets were hauled about 61 miles to Duluth for shipment to lower Lake ports.

Upon completion of the expansion announced by United States Steel Corp., Minnesota's six taconite plants will be capable of producing nearly 40 million tons of pellets a year.

Natural iron ore operations producing over 1 million tons in 1969, in descending order of tonnage, were as follows: the Sherman group, Stephens, Rouchleau group, and Plummer group, all operated by United States Steel Corp.; Pierce group, operated by The Hanna Mining Co.; Mahoning, operated by Pickands Mather & Co.; and McKinley, operated by Jones & Laughlin Steel Corp. Collectively, these seven mines produced more than 16.4 million tons of ore, or 75 percent of all natural iron ores produced in Minnesota. All the mines were in St. Louis County except the Plummer group, which was in Itasca County.

United States Steel Corp. continued development work at its Twin City property near Fraser which was scheduled to begin production in 1970 as part of the Sherman mine complex. Total natural ore shipments from Mesai Range mines by United States Steel in 1969 were 12.4 million tons.

The Hanna Mining Co. shipped nearly 4.0 million tons of natural ore from its Minnesota mines. Shipments from the Pierce group were a record 1,916,000 tons.

Hanna also operated its West Hill mine near Grand Rapids and made shipments from stocks at the Rabbit Lake mine on the Cuyuna Range and from the South Agnew and Douglas group on the Mesabi Range. A rescreening plant was completed by Hanna at the Pierce group.

Jones & Laughlin Steel Corp. shipped a total of 2,960,000 tons of iron ore from four Mesabi Range operations. Mines operated were the Lind-Greenway, Hill Annex, McKinley, and the Schley Group. In September, the company closed the Schley Group.

The 1969 navigation season for ports shipping Minnesota iron ores began April 4 at Superior, Wis. and ended on January 10, 1970, at Two Harbors, the latest iron ore shipping on record for a Lake Superior port. Two companies were planning to place in service much larger ore carriers than those currently used. Bethlehem Steel Corp. was constructing a 52,000-gross-ton-capacity vessel with a length of 1,000 feet and a beam of 105 feet. United States Steel Corp. was building a 45,000-ton-capacity lake carrier, 805 feet long with a 105-foot beam. The use of larger vessels had been made possible by the completion of the Poe Lock at Sault Ste. Marie, Michigan in 1968.

About 98 percent of the iron ore shipped from Minnesota was by lake vessel to lower Lake ports and thence to consuming furnaces. The remainder was transported by rail.

The 1969 Minnesota State Legislature increased the taconite production tax rate to 11.5 cents per ton of taconite concentrates produced plus 0.1 cent per ton for each percent that the iron content of the concentrate exceeds 55 percent. The previous rate was 5 cents per ton plus the same escalation for each percentage increment above 55 percent iron.

Table 5.—Crude iron ore [1] data, in 1969, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production [2]	Shipments		Stocks Dec. 31
			Direct to consumers	To concentrators	
County:					
Crow Wing	------	--------	--------	--------	----
Fillmore	------	--------	--------	--------	----
Itasca	------	25,132	--------	25,132	----
St. Louis	r 1,420	110,351	5,461	105,563	746
Total	r 1,420	135,483	5,461	130,695	746
Range:					
Cuyuna	------	--------	--------	--------	----
Mesabi	r 1,420	135,483	5,461	130,695	746
Spring Valley district	------	--------	--------	--------	----
Total	r 1,420	135,483	5,461	130,695	746

r Revised.
[1] Exclusive of ore containing 5 percent or more manganese.
[2] Entire production from open pit mines.

Table 6.—Usable iron ore [1] data, in 1969, 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	758	--------	--------	448	310
Fillmore	r 18	--------	--------	18	-----
Itasca	r 782	8,231	4,849	8,281	733
St. Louis	r 4,847	47,044	27,706	48,210	3,680
Total	r 6,405	55,275	32,555	56,957	4,723
Range:					
Cuyuna	758	--------	--------	448	310
Mesabi	r 5,629	55,275	32,555	56,491	4,413
Spring Valley district	r 18	--------	--------	18	-----
Total	r 6,405	55,275	32,555	56,957	4,723

r Revised.
[1] Exclusive of ore containing 5 percent or more manganese.

Table 7.—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]
1884–1964	66,668	2,463,124	101,839	6,612	2,638,242
1965	367	50,279	782	625	52,053
1966	1,299	51,506	704	772	54,280
1967	1,041	48,857	202	58	50,157
1968	961	51,411	---	83	52,454
1969	---	55,275	---	---	55,275
Total [2]	70,335	2,720,451	103,527	8,149	2,902,463

[1] Exclusive, after 1905, of iron ore containing 5 percent or more manganese.
[2] Data may not add to totals shown because of independent rounding.

Table 8.—Production of usable iron ore

(Thousand long tons)

Year	Direct shipping ore	Concentrates (other than agglomerates)	Agglomerates	Total		Iron content (percent)
				Usable ore [1]	Iron content	
1965	11,631	21,370	19,053	52,053	29,510	56.69
1966	12,854	19,686	21,741	54,280	30,625	56.42
1967	11,111	14,719	24,327	50,157	28,742	57.30
1968	5,002	17,197	30,255	52,454	30,597	58.33
1969	5,461	16,433	33,381	55,275	32,555	58.90

[1] Data may not add to totals shown because of independent rounding.

Table 9.—Iron ore [1] shipped from mines

(Thousand long tons)

Year	Direct shipping ore [2]	Concentrates			Total usable ore [3]	Proportion of concentrates to total usable ore (percent)
		Agglomerates	Other	Total [3]		
1965	11,579	19,039	20,255	39,294	50,873	77.24
1966	12,863	21,580	20,690	42,270	55,133	76.67
1967	11,149	23,884	14,424	38,308	49,457	77.46
1968	5,044	29,751	16,481	46,231	51,275	90.16
1969	5,461	33,693	17,802	51,496	56,957	90.41

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Includes crushed, screened, and sized ore not further treated.
[3] Data may not add to totals shown because of independent rounding.

Table 10.—Dates of first and final cargoes of iron ore at U.S. upper Great Lakes ports

Port and dock	1968		1969	
	First	Final	First	Final
Duluth, Minn.: DM & IR	Apr. 1	Dec. 14	Apr. 18	Dec. 17
Escanaba, Mich.: C & NW	Mar. 31	Dec. 19	Apr. 6	Dec. 24
Marquette, Mich.:				
Soo Line	Apr. 12	Nov. 1	Apr. 7	Dec. 1
LS & I	Apr. 10	Dec. 18	Apr. 9	Dec. 15
Silver Bay, Minn.: Reserve	Apr. 1	Dec. 5	Apr. 8	Dec. 16
Superior, Wis.:				
GN	Apr. 14	Dec. 15	Apr. 4	Dec. 19
NP—Soo Line	May 3	Sept. 28	Apr. 28	Oct. 17
Taconite Harbor, Minn.: Erie	Apr. 9	Dec. 14	Apr. 4	Dec. 18
Two Harbors, Minn.: DM & IR	Apr. 23	Jan. 3 [1]	Apr. 24	Jan. 10 [2]

[1] Jan. 3, 1969.
[2] Jan. 10, 1970.

Source: Skillings' Mining Review.

A Federal-State conference on water pollution, convening at Duluth, recommended that Reserve Mining Co. undertake further studies relating to possible alternative methods of reducing the discharge of tailings into Lake Superior and that a progress report be given in 6 months.

The University of Minnesota Mines Experiment Station continued research on the beneficiation and pelletizing of Minnesota iron ores.

At its Twin Cities Metallurgy Research Center, the U.S. Bureau of Mines continued research on iron ores, including beneficiation of nonmagnetic and low-grade iron ore by flotation and by magnetic roasting, production of low-silica iron ore concentrates and pellets, and preparation of both metallized and oxide pellets. The proposed sale of the Bureau's Iron Range Demonstration plant near Keewatin was set aside in favor of determining the feasibility of operation of the plant by private industry. W. S. Moore Co. and the Upper Great Lakes Regional Commission financed a study to determine the feasibility of producing metallized pellets at a small commercial plant.

Iron and Steel.—American Steel & Wire Division of United States Steel Corp. produced basic pig iron and steel at its Duluth facility. Only one of the company's two blast furnaces was operated during the year. North Star Steel Co. produced steel from ferrous scrap at its electric furnace in St. Paul. The company planned to double the capacity of the plant with an additional furnace that was under construction at yearend. The second furnace was scheduled to be placed in operation in 1970.

Manganiferous Ore.—Shipments of 341,000 long tons of manganiferous ore (ore containing 5 percent or more manganese, natural) from five Cuyuna Range properties in Crow Wing County, were nearly double those of 1968. Over 99 percent of the total shipments were in the form of ferruginous manganese ore (ore containing 10 to 35 percent manganese, natural). Production and shipments were reported by two companies. Pittsburgh Pacific Co. reported production from its Louise mine and made stockpile shipments from the Mangan No. 1 and Sagamore properties. The Hanna Mining Co. began production in April from its Lauretta (also known as the Gloria-Zeno) mine. Development work at the Lauretta included construction of a new crushing and screening plant. Hanna also made stockpile shipments from its Algoma property. Ore from the Cuyuna Range was transported by rail to the Northern Pacific Railway Co. ore docks at Superior.

The U.S. Bureau of Mines studied the recovery of both iron and manganese products from low-grade Cuyuna Range ores at its Twin Cities Metallurgy Research Center.

Table 11.—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)	
1965	32,935	33.99	7.27	217,695	35.47	12.75	250,630
1966	4,035	33.55	8.61	242,020	33.87	14.12	246,055
1967	-------	-------	-------	211,387	32.88	14.56	211,387
1968	1,596	39.89	6.88	169,695	33.15	14.23	171,291
1969	50	40.37	7.44	340,567	29.73	14.29	340,617

[1] Direct-shipping and beneficiated ore.

NONMETALS

Abrasive Stone.—Jasper Stone Co. produced grinding pebbles and tube-mill liners from its quartzite deposit near Jasper in Rock County. Output of tube-mill liners increased in quantity and value and that of grinding pebbles increased in quantity but decreased in value.

Cement.—Shipments of portland cement increased in quantity and value over those of 1968 due primarily to increased consumption of cement by ready-mixed concrete companies. Minnesota's only cement

plant was operated by Universal Atlas Cement Division of United States Steel Corp., at Duluth. The company operated three kilns producing types I and II (general use and moderate heat), type III (high-early-strength), portland slag, and masonry cements. Raw materials used in the manufacturing process included limestone, slag from the nearby United States Steel blast furnace, sand, gypsum, iron dust, and air-entraining compounds. Most of the shipments were to Minnesota with lesser amounts to Illinois, Michigan, Nebraska, North Dakota, Pennsylvania, South Dakota, and Wisconsin. Most of the output was shipped in bulk, and the remainder was transported in bags. Trucks were used to haul the major portion of the total shipments; the remainder was shipped by rail. Portland cement shipments into and within Minnesota were nearly 9.2 million barrels, an increase of more than 4 percent over those of 1968. Most of the shipments from other States were from plants in Iowa and Michigan, with lesser amounts from nine other States. Shipments of masonry cement into and within Minnesota decreased 1 percent to 451,000 barrels.

Clays.—Production of common clay and shale (excluding fire clay) increased more than 14 percent over that of 1968. Increased use of clay and shale in manufacturing lightweight aggregate more than offset a decrease in the amount of material consumed in brickmaking. A small amount of material was consumed in the manufacture of floor and wall tile. Production was reported from Brown, Carlton, Hennepin, Ramsey, and Redwood Counties. Goodwin Companies, a Des Moines, Iowa based subsidiary of Harsco Corp., acquired the former C. H. Klein Brick Co. plant at Chaska. In 1969, the company began mining clay and remodeling the existing facilities preparatory to beginning brick production in 1970. Fire clay consumption, all of which was used in the production of vitrified sewer pipe, continued to decrease sharply due to the increased use of Iowa clay. Fire clays of Minnesota origin consumed in 1969 were from stocks of materials mined in Goodhue County in former years.

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 principally for handmade jewelry and personal collections.

Lime.—Total output of quicklime and hydrated lime decreased 9 percent in quantity and 7 percent in value from that of 1968. Decreases in lime used for construction and agricultural purposes more than offset increases in the amount of lime used in chemical and industrial applications. American Crystal Sugar Co. produced quicklime at its plants near Chaska, Carver County; Moorhead, Clay County; and Crookston and East Grand Forks, Polk County. Shaft kilns were operated at these plants using coke for fuel. The entire output was used by the company for sugar refining. The State's only commercial lime plant was operated by Cutler-Magner Co. at Duluth. The company burned Michigan limestone in a rotary kiln, utilizing bituminous coal as fuel. Most of the lime produced was consumed in Minnesota. Nearly all the commercial output was sold for chemical and industrial purposes, mainly paper manufacturing, with the remainder used for agricultural purposes and mason's lime.

Perlite.—Zonolite Division, W. R. Grace & Co. produced expanded perlite at its Minneapolis plant from material mined outside the State. The company was the only producer of expanded perlite in Minnesota. Sales of the expanded product increased substantially over those of 1968. Material was used for plaster aggregate, concrete aggregate, insulation, horticultural purposes, paint additives, textured granules, and foundry uses.

Sand and Gravel.—Because of increased demand for road construction materials, Minnesota's 1969 sand and gravel output exceeded the previous record established in 1968 by 8 percent in quantity and 10 percent in value. About 5 percent of the Nation's 1969 sand and gravel output was produced in Minnesota.

More than 75 percent of the total sand and gravel output was used for road construction, 18 percent for building purposes, 5 percent for fill, and the remainder for other purposes, including industrial sand used for sandblasting, engine, filler, foundry, glassmaking, molding, oil (hydrafrac), and other uses. Production of industrial sands increased nearly 5 percent in

value, but the tonnage remained nearly unchanged from that of 1968. Average value of sand and gravel was $0.84 per ton in 1969 compared with $0.82 per ton in 1968. Production of sand and gravel used in road construction increased 9 percent in quantity and 13 percent in value over that of 1968. Material used for building increased 3 percent in quantity and 6 percent in value.

Production was reported from each of the State's 87 counties. Counties producing more than 1 million tons, in descending order of tonnage, were Hennepin, Washington, St. Louis, Dakota, Clay, Chisago, and Stearns. These seven counties accounted for nearly 42 percent in quantity and 43 percent in value of the total sand and gravel output. About 96 percent of the total commercial output was transported by truck and the remainder by rail and water.

Industrial sand, produced by Gopher State Silica, Inc., of Le Sueur, was shipped from Duluth-Superior to England, marking the first waterborne shipment of silica sand from that port.

Stone.—Minnesota's 1969 stone output, consisting of basalt, granite, limestone and dolomite, marl, and quartzite was more than 5.0 million tons valued at nearly $14.3 million, a new record high. Stone production in 1969 exceeded the previous quantity record established in 1966 by 3 percent and the previous high value established in 1968 by 9 percent.

Major reason for the increase was a greater demand for crushed stone, notably

Table 12.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,766	$4,189	5,008	$4,503
Paving	2,824	2,072	3,231	2,136
Fill	707	332	622	328
Railroad ballast	------	------	13	W
Other [1]	578	1,415	522	1,449
Total [2]	8,875	8,008	9,395	8,417
Gravel:				
Building	3,664	6,300	3,680	6,623
Paving	23,951	17,123	27,039	20,269
Railroad ballast	405	252	198	139
Fill	954	426	1,428	617
Other	10	12	62	60
Total [2]	28,984	24,113	32,408	27,709
Total sand and gravel [2]	37,859	32,121	41,803	36,125
Government-and-contractor operations:				
Sand:				
Paving	1,176	726	1,285	759
Fill	57	25	42	19
Other	17	8	31	14
Total	1,250	759	1,358	792
Gravel:				
Paving	5,420	3,475	4,772	3,198
Fill	142	58	159	64
Other	3	1	28	13
Total	5,565	3,534	4,959	3,275
Total sand and gravel [2]	6,815	4,293	6,318	4,066
All operations:				
Sand [2]	10,125	8,767	10,754	9,208
Gravel [2]	34,549	27,647	37,368	30,983
Total [2]	44,674	36,414	48,121	40,191

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

[1] Includes blast, engine, filler, foundry, glass, molding, oil (hydrafrac), other construction and industrial sand, and item indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 13.—Production of sand and gravel, by counties

(Thousand short tons and thousand dollars)

County	1968		1969		County	1968		1969	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Aitkin	65	W	55	$36	Martin	266	$178	402	$305
Anoka	W	W	W	W	Meeker	197	170	107	84
Becker	476	W	598	W	Mille Lacs	330	W	153	W
Beltrami	429	$258	446	281	Morrison	657	405	318	W
Benton	100	W	479	355	Mower	300	176	926	525
Big Stone	164	108	222	157	Murray	157	96	234	160
Blue Earth	602	549	905	760	Nicollett	612	W	400	W
Brown	458	W	496	W	Nobles	984	576	617	424
Carlton	673	W	828	W	Norman	76	41	281	172
Carver	487	425	408	W	Olmsted	475	383	555	W
Cass	130	92	281	202	Otter Tail	1,308	1,091	668	399
Chippewa	244	178	378	264	Pennington	20	11	404	315
Chisago	240	114	1,394	947	Pine	87	52	W	W
Clay	1,609	W	1,397	W	Pipestone	102	73	349	196
Clearwater	640	678	251	197	Polk	1,248	W	989	W
Cook	196	W	201	W	Pope	167	108	134	87
Cottonwood	141	91	111	75	Ramsey	616	535	454	W
Crow Wing	467	338	266	262	Red Lake	140	102	27	26
Dakota	3,552	2,772	2,748	2,325	Redwood	375	W	463	W
Dodge	W	W	54	41	Renville	529	W	408	W
Douglas	618	325	226	172	Rice	582	381	832	537
Faribault	158	151	95	67	Rock	912	W	217	W
Fillmore	32	W	47	W	Roseau	W	W	510	418
Freeborn	566	396	632	477	St. Louis	2,290	1,704	2,817	2,140
Goodhue	375	W	171	W	Scott	209	162	514	412
Grant	327	168	203	176	Sherburne	517	563	959	1,111
Hennepin	5,519	W	6,158	W	Sibley	189	178	W	W
Houston	------	------	18	11	Stearns	1,625	1,382	1,267	1,224
Hubbard	73	39	189	103	Steele	389	W	316	W
Isanti	W	W	74	48	Stevens	155	133	258	202
Itasca	781	442	550	356	Swift	67	36	192	114
Jackson	228	163	140	105	Todd	794	434	520	316
Kanabec	20	11	79	70	Traverse	112	57	84	59
Kandiyohi	463	545	955	1,090	Wabasha	80	82	81	W
Kittson	39	19	363	288	Wadena	136	69	129	W
Koochiching	119	108	158	126	Waseca	102	60	34	24
Lac qui Parle	119	79	422	321	Washington	2,557	W	4,285	W
Lake	263	143	321	192	Watonwan	102	69	15	8
Lake of the Woods	76	47	58	40	Wilkin	216	148	456	233
Le Sueur	750	W	955	1,541	Winona	W	W	W	W
Lincoln	251	157	225	177	Wright	715	530	790	608
Lyon	580	409	242	252	Yellow Medicine	215	192	461	289
McLeod	340	271	108	94	Undistributed [1]	1,353	16,951	690	17,496
Mahnomen	W	W	457	303					
Marshall	341	210	444	394	Total [2]	44,674	36,414	48,121	40,191

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes production for which no county breakdown is available and data indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

granite and limestone and dolomite. Output of crushed stone was nearly 5.0 million tons valued at $7.3 million, an increase of 14 percent in quantity and 17 percent in value over that of 1968. Output of dimension stone decreased 13 percent in quantity but increased nearly 2 percent in value. Nearly 79 percent of the State's 1969 output of crushed and broken stone was transported by truck with the remainder hauled by rail and water.

Table 14.—Limestone and dolomite sold or used by producers, by uses

Use	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural—thousand cubic feet	33	$151	5	$36
Other rough construction [1]—thousand short tons	1	12	2	72
Dressed architectural:				
Cut—thousand cubic feet	97	1,352	86	1,153
House stone veneer—do	123	372	89	298
Sawed—do	11	59	6	35
Flagging—do	2	10	6	29
Total approximate thousand short tons	23	[2] 1,957	18	[2] 1,624
Crushed and broken:				
Concrete aggregate and roadstone:				
Concrete aggregate—thousand short tons	299	529	381	632
Bituminous aggregate—do	211	307	229	350
Macadam aggregate—do	198	299	343	468
Dense graded road base stone—do	1,848	2,175	1,979	2,512
Surface treatment aggregate—do	673	805	561	715
Unspecified aggregate and roadstone—do	NA	NA	132	163
Total aggregate and roadstone [2]—do	3,229	4,116	3,624	4,839
Agricultural limestone—do	336	620	280	518
Railroad ballast—do	W	W	44	59
Riprap and jetty stone—do	48	62	72	91
Other [3]—do	187	409	107	278
Total crushed and broken—do	3,800	5,207	4,127	5,785
Grand total—do	3,823	7,164	4,145	7,409

NA Not available.
W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes irregular-shaped stone, rubble (1968–69), and other rough stone (1969).
[2] Data may not add to totals shown because of independent rounding.
[3] Includes stone used for other fillers or extenders (1968); asphalt filler; flux; poultry grit and mineral food; other uses; and item indicated by symbol W.

Table 15.—Granite sold or used by producers, by uses

Use	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural—thousand cubic feet	8	$32	4	$15
Rough monumental—do	13	44	6	31
Dressed architectural (cut)—do	190	3,456	195	3,918
Dressed monumental—do	60	1,313	60	1,323
Total—approximate thousand short tons	23	4,845	22	5,287
Crushed and broken:				
Aggregate and roadstone—thousand short tons	133	252	216	344
Railroad ballast—do	175	258	320	547
Riprap—do	W	W	115	128
Other [1]—do	114	169	10	106
Total [2]—do	422	679	662	1,125
Grand total [2]—do	444	5,524	684	6,412

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes granite for riprap (1968), grit, and stone sand.
[2] Data may not add to totals shown because of independent rounding.

Limestone and dolomite was produced in 15 southeastern Minnesota counties. Leading counties, in descending order of value of production, were Dakota, Blue Earth, Scott, Le Sueur, and Olmsted, which together accounted for 58 percent of the total value of Minnesota's limestone and dolomite output. Crushed stone comprised more than 99 percent in quantity and 78 percent in value of the total limestone and dolomite output. Crushed and broken limestone and dolomite production increased nearly 9 percent in quantity and more than 11 percent in value, mainly because of an increased demand for roadstone and aggregates. Production of agricultural limestone decreased 17 percent in quantity and 16 percent in value from that of 1968. Dimension limestone and dolomite was produced by four companies operating quarries and plants in Blue Earth, Le Sueur, and Winona Counties. Production decreased nearly 23 percent in quantity and 17 percent in value from that of 1968. Major decreases occurred in sales of material for house stone veneer and cut stone. In terms of value, Minnesota ranked second in output of dimension limestone and dolomite, producing 9 percent of the Nationwide total.

Eleven companies produced granite in 8 counties. Leading counties, in descending order of value of production, were Stearns, Big Stone, and Yellow Medicine. Granite comprised nearly 14 percent in quantity and 45 percent in value of all stone produced in Minnesota. Output of crushed and broken granite increased substantially in quantity and value due mainly to an increased demand for material used as aggregate and roadstone and railroad ballast. Production of dimension granite decreased 2 percent in quantity but increased 9 percent in value, compared with that of 1968. Dimension granite sold for architectural purposes increased less than 1 percent in quantity and nearly 13 percent in value. Granite sold for monumental purposes decreased nearly 10 percent in quantity and less than 1 percent in value.

Crushed and broken basalt was produced by Arrowhead Blacktop Co., near Duluth.

Table 16.—Production of stone, by counties

(Thousand short tons and thousand dollars)

County	1968		1969		Kind of stone produced in 1969 [1]
	Quantity	Value	Quantity	Value	
Beltrami	------	------	9	$23	Granite.
Big Stone	76	$623	109	396	Do.
Blue Earth	252	969	397	946	Limestone.
Cass	------	------	(2)	(2)	Marl.
Dakota	352	467	693	983	Limestone.
Dodge	182	207	W	W	Do.
Fillmore	337	522	340	537	Do.
Goodhue	199	225	168	195	Do.
Houston	288	W	236	274	Do.
Kanabec	(2)	W	------	------	
Lac qui Parle	2	441	1	330	Granite.
Le Sueur	W	W	25	787	Limestone.
Mille Lacs	1	W	1	W	Granite.
Mower	410	552	241	360	Limestone.
Nicollet	W	W	W	W	Quartzite.
Olmsted	582	684	W	W	Limestone.
Redwood	1	44	29	59	Granite.
Renville	1	W	1	W	Do.
Rice	23	26	27	32	Limestone.
Rock	W	W	W	W	Quartzite.
St. Louis	55	W	90	W	Traprock.
Scott	346	798	428	890	Limestone.
Stearns	289	3,772	347	4,801	Granite.
Steele	W	W	W	W	Limestone.
Wabasha	181	194	W	W	Do.
Wadena	4	3	7	W	Marl.
Washington	544	W	475	W	Limestone.
Winona	43	478	70	W	Do.
Yellow Medicine	74	102	186	335	Granite.
Undistributed	185	2,939	1,154	3,306	
Total [3]	4,427	13,045	5,035	14,253	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] "Limestone" used generally to include dolomite.
[2] Less than ½ unit.
[3] Data may not add to totals shown because of independent rounding.

Output increased 64 percent in quantity and 50 percent in value over that of 1968. Material was used for aggregate and riprap.

Marl was produced for agricultural purposes in Cass and Wadena Counties. Output increased nearly 73 percent in quantity and value over that of 1968.

Quartzite was produced by New Ulm Quartzite Quarries, Inc., in Nicollet County, near New Ulm, and by Jasper Stone Co., in Rock County, near Jasper. Uses for the material included poultry grit, aggregates, riprap, filter stone, stone sand, refractory purposes, and dimension stone. Total output increased in quantity.

Sulfur.—Great Northern Oil Co. and Northwestern Refining Co. recovered elemental sulfur as a byproduct from petroleum refining operations near Pine Bend, Dakota County, and St. Paul Park, Washington County, respectively. The Claus process was used to recover sulfur at the Dakota County operation and the Modified Claus process was utilized at the Washington County refinery.

Vermiculite.—Two firms in Minneapolis and one in St. Paul produced exfoliated vermiculite from crude vermiculite mined outside the State. The expanded material was used for various types of insulation, lightweight aggregate in plaster and concrete, and other uses. Sales increased 11 percent in quantity and 4 percent in value over those of 1968.

MINERAL FUELS

Peat.—Production and sales of peat were reported by seven companies operating bogs in Aitkin, Becker, Carlton, Itasca, Pine, and St. Louis Counties. In addition, one company reported production in Aitkin County but no sales. Output increased sharply due to an increased demand for material used for both general soil improvement and as an ingredient in potting soils. Production consisted mainly of moss and reed-sedge peats. A small amount of humus peat was produced in Pine County. Most of the peat sales were in packaged form; the remainder was sold in bulk.

Table 17.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone—Grinding pebbles and tube-mill liners:			
Jasper Stone Co	Box 206 Sioux City, Iowa 51102	Quarry and processing plant.	Rock.
Cement:			
Universal Atlas Cement Division United States Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	Portland and masonry, wet process.	St. Louis.
Clays and shale:			
North Central Lightweight Aggregate Co., Inc.	4901 W. Medicine Lake Dr. Minneapolis, Minn. 55427	Pit and plant	Hennepin.
Ochs Brick & Tile Co	Springfield, Minn. 56087	Pits and plant	Brown, Redwood.
Red Wing Sewer Pipe Corp	Red Wing, Minn. 55066	Processed stockpiled material.	Goodhue.
Twin City Brick Co	790 Joy Ave. St. Paul, Minn. 55118	Pit and plant	Ramsey.
Coke:			
American Steel & Wire Division United States Steel Corp.	Morgan Park Duluth, Minn. 55800	Coke ovens	St. Louis.
Koppers Co., Inc	1000 Hamline Ave. N. St. Paul, Minn. 55104	----do	Ramsey.
Iron ore:			
Cleveland-Cliffs Iron Co.:	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Canisteo and Hill Trumbull.	----------	Mines and concentrators.	Itasca.
Holman-Cliffs and Sally	----------	Stockpile shipments	Do.
Coons Pacific Co.:	2521 First Ave. Hibbing, Minn. 55746		
Coons Pacific Plant	----------	Concentrator	St. Louis.
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, Ohio 44114		
Rabbit Lake	----------	Stockpile shipments	Crow Wing.
Butler Taconite Project	----------	Mine, concentrator, and agglomerator.	Itasca.
National Steel Pellet Project.	----------	----do	Itasca and St. Louis.
Douglas Group	----------	Stockpile shipments	St. Louis.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Iron ore—Continued			
The Hanna Mining Co.—Continued	100 Erieview Plaza Cleveland, Ohio 44114		
Pierce Group and South Agnew Group.		Mines and concentrators.	St. Louis.
West Hill		Mine and concentrator.	Itasca.
Jones & Laughlin Steel Corp., Minnesota Ore Division:	Virginia, Minn. 55792		
Hill Annex and Lind-Greenway.		Mines and concentrators.	Do.
McKinley and Schley Group.		----do	St. Louis.
Oglebay Norton Co.:	Hanna Bldg. Cleveland, Ohio 44115		
Thunderbird Mine		Mine; ore treated at Fairlane Plant.	Do.
Fairlane Plant		Concentrator and agglomerator.	Do.
Pacific Isle Mining Co.:	Box 157 Coleraine, Minn. 55722		
Higgins No. 2		Stockpile shipments	Do.
Pickands Mather & Co.:	2000 Union Commerce Bldg. Cleveland, Ohio 44115		
Danube		Mine and concentrator.	Itasca.
Erie Commercial		Mine, concentrator, and agglomerator.	St. Louis.
Mahoning		Mine and concentrator.	Do.
Pittsburgh Pacific Co.:	2521 First Ave. Hibbing, Minn. 55746		
Arne, Coons, Dale, Dunwoody, Higgins No. 2 Trespass, McEwen-Onondaga, Monroe, and So. Uno N.P.		Ore treated at Coons Pacific Plant.	Do.
Julia Plant		Concentrator	Do.
Kerr West Lease, Lamberton, Leonidas, and Nelson LOSP.		Stockpile shipments	Do.
Lincoln		Ore treated at Coons Pacific and Julia Plants.	Do.
Wyoming Annex		Ore treated at Julia Plant.	Do.
Reserve Mining Co.:	Silver Bay, Minn. 55614		
Peter Mitchell		Mine and primary crushing.	Do.
E. W. Davis Works		Concentrator and agglomerator.	Lake.
Rhude & Fryberger, Inc.:	Box 66 Hibbing, Minn. 55746		
Gross Nelson and Hull-Rust Group.		Mines and concentrators.	St. Louis.
Schroeder Mining Co.:	Box 576 Chatfield, Minn. 55923		
Wright		Mine and concentrator.	Fillmore.
Snyder Mining Co.:	Box 1106 Pittsburgh, Pa. 15230		
Kosmerl Lease Area, Wanless, Whiteside, and Woodbridge.		Mines	St. Louis.
United States Steel Corp., Minnesota Ore Operations:	Box 417 Mountain Iron, Minn. 55768		
Plummer Group		Mine and concentrator.	Itasca.
Trout Lake Concentrator		Concentrator	Do.
Kosmerl		Mined by Snyder Mining Co. in conjunction with Whiteside Mine.	St. Louis.
Minntac		Mine, concentrator, and agglomerator.	Do.
Rouchleau Group		Ore treated at Julia Plant.	Do.
Sherman Group		Mine and concentrator.	Do.
Stephens Mine		Mine	Do.
Iron and steel:			
American Steel & Wire Division United States Steel Corp.	Morgan Park Duluth, Minn. 55800	Iron blast furnace and open-hearth steel furnaces.	Do.
North Star Steel Co	1400 Red Rock Road St. Paul, Minn. 55119	Electric steel furnace	Ramsey.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Secondary Lead Smelters:			
Gopher Smelting & Refining Co.	Hwy. 49 and Hwy. 55 St. Paul, Minn. 55111	Processing plant	Dakota.
National Lead Co	3650 Hampshire Ave. So. Minneapolis, Minn. 55426	do	Hennepin.
Lime:			
American Crystal Sugar Co.	Boston Bldg. Denver, Colo. 80201	Quicklime, shaft kilns	Carver, Clay, Polk.
Cutler-Magner Co	12th Ave. & Waterfront Duluth, Minn. 55802	Quicklime and hydrated lime, one rotary kiln.	St. Louis.
Manganiferous ore:			
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, Ohio 44114		
Algoma		Stockpile shipments	Crow Wing.
Lauretta		Mine	Do.
Pittsburgh Pacific Co.:	2521 First Ave. Hibbing, Minn. 55746		
Louise Mine		Ore treated at Virginia Plant.	Do.
Mangan No. 1 and Sagamore.		Stockpile shipments	Do.
Virginia Plant		Concentrator	Do.
Peat:			
Colby Pioneer Peat Co	Box 8 Hanlontown, Iowa 50444	Peat bog	Aitkin.
Northland Products Co., Inc.	Box 16 Fergus Falls, Minn. 56537	do	Becker.
Power-O-Peat Co	Gilbert, Minn. 55741	do	St. Louis.
Red Wing Peat Corp	Box 3006 Houston, Texas 77001	do	Carlton.
Expanded perlite:			
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	Processing plant	Hennepin.
Sand and gravel:			
Alexander Construction Co., Inc.	4641 Hiawatha Ave. Minneapolis, Minn. 55406	Pits and portable plants.	Dakota, Hennepin, Washington.
Anderson Aggregates, Inc.	100 N. Seventh St. Minneapolis, Minn. 55403	Pit; one stationary, one portable plant.	Hennepin.
Barton Contracting Co	10300 89th Ave. N. Osseo, Minn. 55369	Pits and stationary plants.	Carlton, Chisago, Hennepin, Ramsey, St. Louis, Scott, Sherburne, Washington, Wright.
Duininck Bros. & Gilchrist	Olivia, Minn. 56277	Pits and portable plants.	Big Stone, Carlton, Clearwater, Kandiyohi, Kittson, Marshall, Polk, Redwood, Renville, Roseau, Sherburne.
Fischer Construction Co., Inc.	County Road 42 Rosemount, Minn. 55068	Pits and portable plants.	Dakota, Hennepin, Mower, Nobles, St. Louis, Washington, Wright.
Gopher State Silica, Inc	Le Sueur, Minn. 56058	Pit and stationary plant.	Le Sueur.
W. Hodgman & Sons, Inc.	1100 Marcus St. Fairmont, Minn. 56031	Pits and portable plants.	Brown, Blue Earth, Grant, Martin, Marshall, St. Louis, Traverse.
McLaughlin & Schulz, Inc.	Box 201 Marshall, Minn. 56258	do	Big Stone, Lincoln, Lyon, Pipestone, Polk, Pope, Redwood, Rock, Swift, Wilkin, Yellow Medicine.
Mark Sand & Gravel Co	Box 396 Fergus Falls, Minn. 56537	do	Becker, Clearwater, Douglas, Mahnomen, Norman, Otter Tail, Wilkin.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Minnesota Valley Improvement Co.	Granite Falls, Minn. 56241	Pits and portable plants.	Beltrami, Benton, Blue Earth, Carlton, Chippewa, Hennepin, Lyon, Morrison, Otter Tail, Rice, Sherburne, Stevens, Wabasha, Wilkin, Wright, Yellow Medicine.
J. L. Shiely Co	1101 N. Snelling Ave. St. Paul, Minn. 55108	Pit and stationary plant.	Washington.
Ulland Brothers, Inc	Box 98 Austin, Minn. 55912	Pits and portable plants.	Freeborn, Mower, Olmsted, Steele.
Do	Box 340 Cloquet, Minn. 55720	----do	Carlton, Lake, St. Louis.
Stone:			
Granite:			
Cold Spring Granite Co.	Cold Spring, Minn. 56320	Quarries	Big Stone, Lac qui Parle, Mille Lacs, Renville.
Do	----do	Quarries and stationary plant.	Stearns.
Delano Granite, Inc	Delano, Minn. 55328	Quarries	Big Stone, Stearns, Yellow Medicine.
Do	----do	Stationary plant	Wright.
The Green Co	Granite Falls, Minn. 56241	Quarry and stationary plant.	Yellow Medicine.
Shiely-Petters Crushed Stone Co., Inc.	Box 69 St. Cloud, Minn. 56301	----do	Stearns.
Limestone and dolomite:			
The Babcock Co	Kasota, Minn. 56050	----do	Le Sueur.
Biesanz Stone Co., Inc.	116 W. 7th St. Winona, Minn. 55987	----do	Winona.
Bryan Rock Products, Inc.	Box 215 Shakopee, Minn. 55379	Quarries; stationary and portable plants.	Scott, Washington.
Hector Construction Co., Inc.	Box 410 Caledonia, Minn. 55921	Quarries and portable plants.	Houston, Winona.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577	Quarry and stationary plant.	Dakota.
Mankato Ag Lime & Rock Co.	Route 3 Mankato, Minn. 56001	----do	Blue Earth.
Mankato Stone Co	826 N. Front St. Mankato, Minn. 56001	----do	Do.
Osmundson Brothers	Adams, Minn. 55909	Quarry and portable plant.	Mower.
Quarve & Anderson Co.	Route 3, Box 27 Rochester, Minn. 55901	Quarries and portable plants.	Dodge, Goodhue, Olmsted, Wabasha, Winona.
J. L. Shiely Co	1101 N. Snelling Ave. St. Paul, Minn. 55108	Quarries and stationary plants.	Scott, Washington.
Vetter Stone Co	Route 4 Mankato, Minn. 56001	Quarries and stationary plant.	Blue Earth, Le Sueur.
Marl:			
Richard Nanik Marl Pit.	Star Route Staples, Minn. 56479	Pit	Wadena.
Sorum's Marl Service	Remer, Minn. 56672	----do	Cass.
Quartzite:			
Jasper Stone Co	Box 206 Sioux City, Iowa 51102	Quarry and stationary plant.	Rock.
New Ulm Quartzite Quarries, Inc.	New Ulm, Minn. 56073	----do	Nicollet.
Traprock (Basalt):			
Arrowhead Blacktop Co.	14th Ave. W. & Waterfront Duluth, Minn. 55802	Pit	St. Louis.
Recovered sulfur:			
Great Northern Oil Co	Box 3596 St. Paul, Minn. 55101	Elemental sulfur recovered as a byproduct of oil refining.	Dakota.
Northwestern Refining Co.	P.O. Drawer 9 St. Paul Park, Minn. 55071	----do	Washington.
Exfoliated vermiculite:			
MacArthur Co	936 Raymond Ave. St. Paul, Minn. 55114	Processing plant	Ramsey.
The B. F. Nelson Manufacturing Co.	401 Main St. NE Minneapolis, Minn. 55413	----do	Hennepin.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 01109	----do	Do.

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, Economic, and Topographical Survey for collecting information on all minerals except fuels.

By Charles J. Jirik [1] and Alvin R. Bicker [2]

The value of Mississippi mineral production increased 10.1 percent to $243.2 million, the highest ever. Mineral fuels—petroleum, natural gas, and natural gas liquids—constituted 87.6 percent of the total value, or $213 million. The increase was attributable to mineral fuels, which gained about $24 million in value. The combined value of all other minerals reported decreased $1.5 million.

[1] Petroleum engineer, Bureau of Mines, Dallas, Tex.

[2] Economic geologist, Mississippi Geological, Economic, and Topographical Survey, Jackson, Miss.

Table 1.—Mineral production in Mississippi [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	1,693	$9,075	1,703	$8,660
Natural gas—million cubic feet	135,051	22,601	131,234	23,097
Natural gas liquids:				
Natural gasoline and cycle products—thousand 42-gallon barrels	459	1,277	565	1,572
LP gases—do	518	958	538	799
Petroleum (crude)—do	58,708	164,396	64,283	187,514
Sand and gravel—thousand short tons	11,980	12,669	11,484	12,263
Stone—do	747	833	W	W
Value of items that cannot be disclosed: Cement, lime, magnesium compounds, and value indicated by symbol W	XX	9,146	XX	9,279
Total	XX	220,955	XX	243,184
Total 1967 constant dollars	XX	220,921	XX	p 233,418

p Preliminary. 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 Mississippi, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	$22,318	$23,765	Petroleum, sand and gravel, natural gas, natural gas liquids.
Alcorn	W	W	Clays, sand and gravel.
Amite	2,245	2,515	Petroleum, natural gas.
Attala	W	W	Clays.
Bolivar	144	W	Sand and gravel.
Carroll	678	904	Sand and gravel, clays.
Claiborne	6	-----	
Clarke	11,958	31,519	Petroleum, natural gas, natural gas liquids, sand and gravel.
Clay	531	563	Sand and gravel, stone, natural gas, petroleum.
Copiah	W	W	Sand and gravel.
Covington	1,413	937	Petroleum, sand and gravel, natural gas.
De Soto	W	W	Sand and gravel.
Forrest	4,193	3,883	Natural gas, sand and gravel, petroleum, clays.
Franklin	13,914	13,847	Petroleum, natural gas.
Greene	340	268	Petroleum.
Hancock	262	247	Natural gas, petroleum, sand and gravel.
Harrison	302	174	Sand and gravel.
Hinds	3,526	1,857	Petroleum, clays, sand and gravel, natural gas.
Holmes	W	348	Sand and gravel, petroleum.
Itawamba	W	722	Clays, natural gas.
Jackson	W	W	Magnesium compounds, lime, sand and gravel.
Jasper	25,917	25,875	Petroleum, natural gas liquids, natural gas, sand and gravel.
Jefferson	1,557	1,501	Petroleum, natural gas, natural gas liquids.
Jefferson Davis	5,621	6,152	Natural gas, petroleum.
Jones	11,595	10,821	Petroleum, natural gas, natural gas liquids, clays.
Lafayette	19	9	Sand and gravel.
Lamar	13,759	13,938	Petroleum, natural gas, sand and gravel.
Lauderdale	40	39	Clays, sand and gravel.
Lee	W	W	Do.
Lincoln	6,978	5,571	Petroleum, natural gas, sand and gravel, natural gas liquids.
Lowndes	481	W	Sand and gravel, clays.
Madison	2,051	1,715	Petroleum, natural gas.
Marion	7,391	7,518	Natural gas, petroleum, sand and gravel.
Marshall	409	381	Clays.
Monroe	2,774	3,187	Clays, sand and gravel, natural gas, petroleum.
Noxubee	557	631	Sand and gravel, clays.
Panola	W	W	Clays, sand and gravel.
Pearl River	1,032	1,068	Natural gas, sand and gravel, petroleum, natural gas liquids, clays.
Perry	W	196	Sand and gravel, petroleum.
Pike	6,971	4,565	Petroleum, sand and gravel, natural gas liquids, natural gas.
Pontotoc	15	W	Sand and gravel, clays.
Prentiss	9	12	Clays.
Rankin	5,915	6,140	Cement, petroleum, stone, natural gas, sand and gravel.
Scott	137	119	Petroleum, natural gas.
Simpson	3,650	2,569	Petroleum, natural gas, sand and gravel.
Smith	16,680	20,666	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Stone	269	284	Sand and gravel.
Sunflower	21	W	Clays.
Tallahatchie	-----	43	Sand and gravel.
Tate	90	59	Do.
Tippah	W	W	Clays.
Tishomingo	W	W	Sand and gravel.
Union	613	16	Do.
Walthall	4,166	4,076	Natural gas, petroleum, sand and gravel.
Warren	W	W	Cement, sand and gravel, stone.
Washington	W	823	Sand and gravel.
Wayne	9,797	15,184	Petroleum, natural gas, sand and gravel.
Wilkinson	7,198	8,386	Petroleum, sand and gravel, natural gas.
Winston	W	W	Clays.
Yalobusha	240	W	Sand and gravel.
Yazoo	7,787	7,927	Petroleum, sand and gravel, natural gas.
Undistributed	15,386	12,164	
Total	220,955	243,184	

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, Chickasaw, Choctaw, Coahoma, George, Grenada, Humphreys, Issaquena, Kemper, Lawrence, Leake, Leflore, Montgomery, Neshoba, Newton, Oktibbeha, Quitman, Sharkey, Tunica, and Webster.

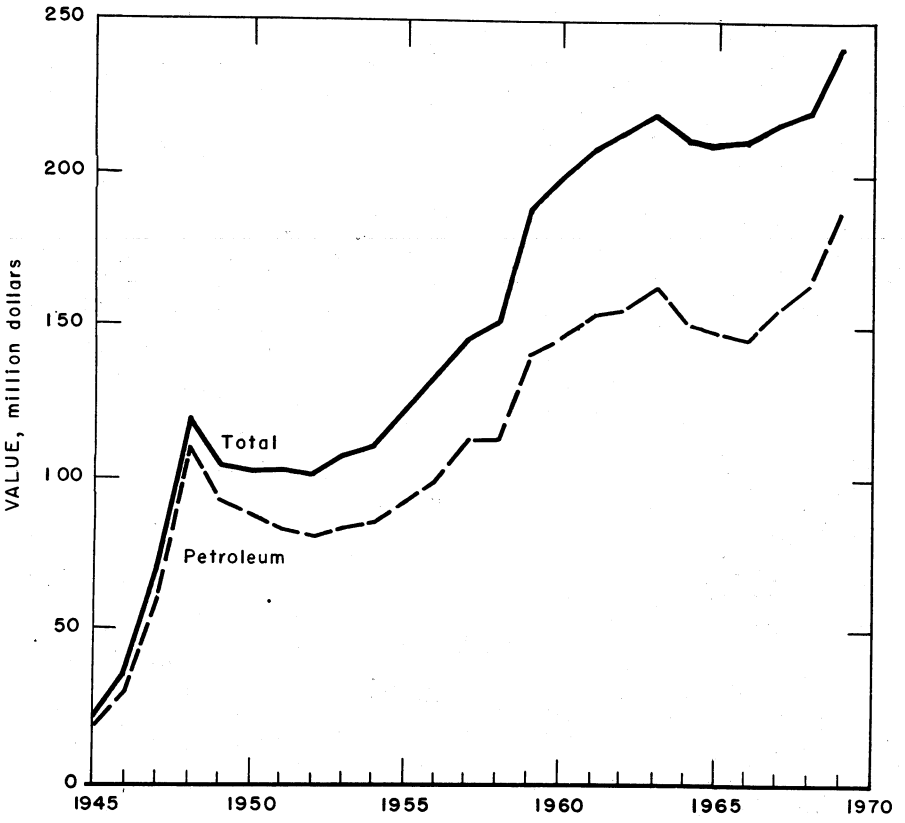

Figure 1.—Value of petroleum and total value of mineral production in Mississippi.

Construction of the Mississippi Power and Light Co.'s 750,000-kilowatt generating unit at the Baxter Wilson Steam Electric station near Vicksburg proceeded on schedule. The new unit is expected to be in operation by late 1971. South Mississippi Electric Power Association continued erection of its $23 million generating plant in Jones County. The company is also installing a 16,000-kilowatt gas turbine generating plant at Benndale in George County. The plant was prefabricated by General Electric Co. Mississippi Power Co. completed installation of a 250,000-kilowatt generating unit at Plant Jack Watson near Gulfport. The facility increased the total capacity of the plant to 512,000 kilowatts. About 3,000 tons of coal per day is used to fuel the plant expansion, with oil as the standby fuel. Natural gas is used for fuel in the remainder of the plant. Coal for the new unit is barged in via the Mississippi River and the Intracoastal Waterway.

Recent offshore seismic activity prompted the Mississippi State Mineral Commission to schedule a competitive lease sale for November 1969. However, the proposed sale, covering all of Mississippi's offshore acreage, was postponed. Although limited amounts of State offshore acreage have been leased on a negotiated basis in the past, no commercial oil or gas discoveries have been reported.

During the year a 2-million-acre leasing program in the Black Warrior Basin of eastern Mississippi and western Alabama included parts of three Mississippi counties. There have been no reported commercial oil or gas discoveries in the Mississippi counties. The most probable sediments for oil and gas production in the area are of Mississippian age.

Employment.—According to the Mississippi Employment Commission, overall average mineral industry employment increased 3.3 percent, compared with a 7.1-percent increase during 1968. Mineral industry employment remained at 1.1 percent of the total nonagricultural labor force.

Transportation.—Columbia Gulf Transmission Co. expanded capacity of its 841-mile main between Rayne, La., and Leach, Ky. Loops totaling 305 miles of 36-inch line were added, with 72 miles in Mississippi. Chandeleur Pipeline Co. is constructing 80 miles of 16-inch gas pipeline from the Main Pass Block 41 field offshore Louisiana to the Standard Oil Co. of Kentucky refinery at Pascagoula. Collins Pipe Line Co., a company formed jointly by Tenneco Oil Co. and Murphy Oil Corp., began construction of distribution facilities to move products from their refineries in Louisiana to Collins, Miss. The project includes 124 miles of 16-inch products pipeline from Chalmette and Meraux, La., to Collins to connect with the Colonial and Plantation pipeline systems.

Table 3.—Indicators of Mississippi business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total labor force (nonagricultural)	thousands	549.2	562.0	+2.3
Unemployment	do	7.3	6.9	−5.5
Employment:				
Construction	do	30.6	32.6	+6.5
Mining	do	6.0	6.2	+3.3
All manufacturing	do	175.1	178.1	+1.7
All industries [1]	do	541.9	555.1	+2.4
Factory payrolls	millions	$831.1	$878.7	+5.7
Personal income:				
Total	do	$4,878	$5,174	+6.1
Per capita		$2,077	$2,192	+5.5
Construction activity:				
Building permits, total private nonresidential	millions	$45.2	$63.6	+40.7
Cement shipments to and within Mississippi	thousand 376-pound barrels	4,371	4,427	+1.3
Farm marketing receipts	millions	$846.9	$833.6	−1.6
Mineral production	do	$221.0	$243.2	+10.0

p Preliminary.
[1] Transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; services; and government included.

Sources: Survey of Current Business, Construction Review, Farm Income Situation, Employment and Earnings and Monthly Report on the Labor Force, and Bureau of Mines.

Table 4.—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 refining of petroleum [2]
1965	4,800	710	155	2,290	5,300	380
1966	4,700	750	100	2,300	5,300	410
1967	4,904	827	151	2,193	5,100	373
1968	5,482	862	151	2,164	5,144	393
1969	5,515	864	158	2,141	5,084	417

[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 5.—Worktime 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
1968:								
Nonmetal	845	253	214	1,720	--	28	16.28	587
Sand and gravel	442	250	110	1,046	--	20	19.12	3,350
Stone	184	243	45	365	--	2	5.48	107
Total	1,471	251	369	3,131	--	50	15.97	1,454
1969: [p]								
Nonmetal	915	252	231	1,846	--	47	25.45	595
Sand and gravel	535	247	132	1,195	--	23	19.25	3,682
Stone	150	257	39	313	--	1	3.19	77
Total [1]	1,600	251	402	3,355	--	71	21.17	1,646

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The combined value of natural gas, natural gas liquids, and crude petroleum production increased $24 million, or 12.6 percent, over that of 1968. The major part of the increase, or over $23 million, was due to increased crude petroleum production, as well as an average per-barrel price increase from $2.80 in 1968 to $2.92 in 1969. The combined value of $213 million was 87.6 percent of the total value of mineral production, compared with 85.6 percent the previous year.

Mississippi continued to rank ninth as an oil-producing State. The 12 leading petroleum-producing counties in descending order were Clarke, Jasper, Adams, Smith, Wayne, Franklin, Lamar, Jones, Wilkinson, Yazoo, Lincoln, and Pike.

Total drilling activity resulted in the completion of 691 wells: 194 were oil-productive, 15 were gas productive, and 482 were dry holes. The number of wells drilled was 2.5 percent less than the number drilled during 1968. The average depth of all the wells drilled in the State was 8,395 feet, compared with the national average of 4,881 feet.

The Mississippi State Oil and Gas Board adopted wider spacing rules to encourage exploration and development of the State's deeper formations. Regulations were amended to allow 80-acre spacing for oil wells and 640-acre spacing for gas wells drilled below 3,500 feet in northeast Mississippi and below 12,000 feet elsewhere.

Twenty-two new oilfields were discovered; 11 of the discoveries were productive from the Wilcox Formation and eight from Jurassic-age reservoirs. Wilcox discoveries were East Commencement, Edgewood, Flat Lake, Linwood, Southeast Woodlands, South Sammy Creek, and Washout Bayou, all in Adams County; Chare Station and Mills Branch in Franklin County; and Coulson Bayou and Woodlawn in Wilkinson County. Jurassic (mostly Smackover) discoveries were Shubuta, Goodwater, and Watts Creek in Clarke County; Jonathan in Greene County; Paulding and West Paulding in Jasper County, and Winchester and Wolf Creek in Wayne County. The remaining fields were completed in various Cretaceous Formations.

The Mississippi Geological, Economic, and Topographical Survey published a report entitled Copiah County Geology and Mineral Resources.[3]

According to the Mississippi State Oil and Gas Board monthly bulletin, as of December 31, 1969, there were 3,424 producible wells in 366 fields that contained 383 oil pools and 58 gas pools. The number of producible wells was down 3.7 percent from the 3,556 reported at the end of 1968.

Natural Gas.—Five counties supplied 76 percent of the State's natural gas production. In descending order of production they were Jefferson Davis, Marion, Walthall, Smith, and Forrest. Natural gas reserves declined for the eigth consecutive year. However, the 1.6-percent rate was the smal-

[3] Bicker, Alvin R., Thad N. Shows, Theo H. Dinkins, Jr., and Thomas E. McCutcheon. Copiah County Geology and Mineral Resources. Mississippi Geol., Econ., and Topographical Survey Bull. 110, 1969, 172 pp.

Table 6.—Oil and gas well drilling in 1969, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Adams	35	---	50	7	---	83	175
Amite	5	---	2	---	---	11	18
Claiborne	---	---	---	---	---	1	1
Clarke	47	---	9	4	---	14	74
Forrest	---	1	5	---	---	1	7
Franklin	14	---	25	2	---	74	115
Greene	---	---	---	1	---	---	1
Hinds	---	1	---	---	1	5	7
Holmes	---	---	---	---	1	---	1
Itawamba	---	---	1	---	---	---	1
Jasper	2	---	4	2	---	8	16
Jefferson	5	1	5	---	---	28	39
Jefferson Davis	1	6	---	---	---	---	7
Jones	11	---	4	1	---	2	18
Lamar	2	---	1	---	---	---	3
Lawrence	---	---	---	---	---	2	2
Lincoln	7	---	3	---	---	---	10
Madison	2	---	1	---	---	3	6
Marion	---	1	2	---	---	---	3
Newton	---	---	---	---	---	1	1
Pike	1	---	---	---	---	1	2
Rankin	1	---	---	---	---	1	2
Scott	---	---	---	---	---	5	5
Sharkey	---	---	---	---	---	1	1
Smith	5	---	---	---	---	2	7
Stone	---	---	1	---	---	---	1
Sunflower	---	---	---	---	---	1	1
Walthall	---	3	---	---	---	3	6
Warren	---	---	1	---	---	---	1
Wayne	18	---	8	3	---	8	37
Wilkinson	16	---	27	2	1	61	107
Yazoo	---	---	2	---	---	14	16
Total:							
1969	172	13	151	22	3	330	691
1968	151	14	145	18	1	380	709

Source: Mississippi State Oil and Gas Board monthly bulletin.

lest recorded since the decline began. According to the American Gas Association, Inc. (AGA), the reserves at yearend were down 23 billion cubic feet compared with those in 1968. The AGA reserves-to-production ratio declined only slightly to 8.5:1 from the 1968 ratio of 8.8:1. Three exploratory wells discovered gas fields. They are the Learned field in Hinds County; White Castle in Wilkinson County; and Tchula Lake in Holmes County, a gas-condensate discovery.

Storage capacity in the State consists of about 1,150 million cubic feet in the Amory field in Monroe County, and about 5,750 cubic feet in reservoirs of the Jackson Dome in Rankin and Hinds Counties. Of the total 6,900 million cubic feet of storage in the State, 5,670 million cubic feet constituted the working capacity. Transcontinental Gas Pipe Line Corp. continued construction of new natural gas storage facilities at the Eminence salt dome, Covington County. Underground storage will consist of two bottle-shaped caverns leached from the salt stock with a total volume of 2 million barrels. The designed storage capacity is 2,970 million cubic feet at a maximum pressure of 3,950 pounds per square inch, absolute. The system is designed to deliver 750 million cubic feet per day. Total cost of the facilities, including a new 2,000-horsepower compressor station, is about $10 million. The first cavern is scheduled for final preparation and fill up by September 1970.

Natural Gas Liquids.—Reserves of natural gas liquids increased 467,000 barrels, according to the AGA, and constituted 0.25 percent of the national reserves. The ratio of reserves to yearly production decreased to 18:1.

The total capacity of the State's natural gas processing and cycling plants at yearend was over 300 million cubic feet per day. The average gas throughput statewide during the year was slightly over 30 percent of capacity, according to the Mississippi State Oil and Gas Board monthly bulletins.

Southwest Gas Producing Co. and Placid Oil Co. began operating a casinghead gas treating plant in the Nancy and East Nancy fields, Clark County. The plant is designed to recover about 40 barrels of condensate

per day by processing about 4 million cubic feet of casinghead gas daily from the Nancy and East Nancy fields.

According to the operators of the underground liquefied petroleum (LP) gas storage facilities in the Petal salt dome, Forrest County, there was no significant change in storage at yearend from that reported during 1968. Storage as of October 1968, according to the Oil and Gas Journal, was 3,767,000 barrels of propane; 600,000 barrels of butane; 2,240,000 barrels of LP gases.

Petroleum.—Crude oil was produced in 31 counties during 1969. Tweleve counties reported production of over 1 million barrels and accounted for 92 percent of the total in the State.

Approximately 3 barrels of salt water per barrel of crude oil was produced in 1969. The 185 million barrels of salt water produced with the crude was disposed of by dumping into surface pits and by injection into about 400 disposal wells.

The 355 exploratory wells drilled resulted in discovery of 22 oilfields, for a success ratio of 1 out of 16. Of 266 Wilcox exploratory wells, 11 were oil-productive for a success ratio of 1 out of 24. A total of 41 exploratory wells drilled to test Jurassic horizons resulted in the discovery of eight oilfields. The Goodwater field, Clarke County, appears to be the largest in area of the Jurassic discoveries. West Nancy field, Clarke County, is also a significant Jurassic discovery. The first well in the field flowed at the rate of 2,640 barrels of oil per day on the initial test through perforations from 13,845 to 13,884 feet. There is a thick oil section in the Smackover Formation with over 150 feet logged in the discovery well.

Again during 1969 there was considerable emphasis on developmental drilling in Jurassic fields. Of 82 developmental Jurassic field wells, 66 resulted in oil producers for a success ratio of 4 out of 5. Twenty-seven of the wells were dual completions, and one was a triple completion. According to the Mississippi State Oil and Gas Board, the increase in total production of about 5.6 million barrels over 1968 was due entirely to development of the deeper Jurassic zones.

According to the American Petroleum Institute (API), proved crude oil reserves at year end were 360.2 million barrels, an increase of 34.6 million barrels over those of 1968. Although there was an increase in reserves, the greater percentage increase in production resulted in an API reserve-to-production ratio decrease to 5.6:1. The API also estimated that crude oil production capacity increased from 173,000 barrels per day at the end of 1968 to 203,000 barrels per day at the end of 1969.

The four refineries in Mississippi had a crude oil processing capacity of 184,500 barrels per stream day and were operated at an average of 88.4 percent of capacity during 1969. About 21 percent of the oil processed was produced in the State, and the remainder was received from other States.

Table 7.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1968	Changes in proved reserves, due to extensions and discoveries in 1969 [1]	Proved reserves, Dec. 31, 1969	Change in proved reserves from 1968 (percent)
Crude oil—thousand barrels	325,649	50,185	360,198	+10.6
Natural gas liquids [2]—do	19,578	1,090	20,045	+2.4
Natural gas—million cubic feet	1,434,078	126,305	1,410,898	−1.6

[1] Excludes revisions.
[2] Includes condensate, natural gasoline, and LP gases.

Sources: American Gas Association and American Petroleum Institute, Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas.

Table 8.—Natural gas liquids production

(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	633	$1,606	527	$975	1,160	$2,581
1966	566	1,483	443	987	1,009	2,470
1967	427	1,167	424	1,085	851	2,252
1968	459	1,277	518	958	977	2,235
1969	565	1,572	538	799	1,103	2,371

Table 9.—Marketed production of natural gas [1]

Year	Million cubic feet	Value (thousands)
1965	166,825	$28,861
1966	156,652	27,257
1967	139,497	24,133
1968	135,051	22,601
1969	131,234	23,097

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

Table 10.—Crude petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1965	56,183	$148,437
1966	55,227	146,353
1967	57,147	155,726
1968	58,708	164,396
1969	64,283	187,514

Table 11.—Crude petroleum production, indicated demand, and stocks in 1969, by month

(Thousand 42-gallon barrels)

Month	Production	Indicated demand [1]	Stocks originating in Mississippi
January	4,988	5,064	5,129
February	4,619	4,751	4,997
March	5,327	5,190	5,134
April	5,212	4,913	5,433
May	5,421	4,632	6,222
June	5,375	6,533	5,064
July	5,628	5,308	5,384
August	5,537	5,160	5,761
September	5,401	5,808	5,354
October	5,681	6,058	4,977
November	5,452	5,317	5,112
December	5,642	5,476	5,278
Total:			
1969	64,283	64,210	XX
1968	58,708	55,822	XX

XX Not applicable.
[1] Calculated from monthly production and changes in stocks.

Table 12.—Crude petroleum produced by fields [1]

(Thousand 42-gallon barrels)

Field	1965	1966	1967	1968	1969
Baxterville	5,592	5,399	5,027	5,025	4,871
Bay Springs	970	3,487	3,931	3,680	3,311
Brookhaven	1,299	1,073	(2)	(2)	1,110
Cypress Creek and South	-----	-----	-----	-----	1,239
Eucutta	1,050	814	(2)	(2)	1,260
Heidelberg	3,904	3,830	3,891	3,822	3,775
Little Creek	4,137	2,841	1,976	1,229	-----
McComb	3,837	2,797	1,760	1,082	-----
Nancy and East	-----	-----	-----	-----	2,160
Pachuta	-----	-----	-----	-----	4,582
Quitman	-----	-----	-----	-----	2,234
Quitman Bayou	(2)	1,392	2,852	2,515	1,478
Raleigh	1,304	1,191	1,124	1,081	-----
Soso	2,070	1,939	2,129	2,002	1,493
Summerland	1,096	1,291	1,589	1,275	-----
Tallahala Creek	-----	-----	-----	1,983	2,632
Tallahala Creek East	-----	-----	-----	-----	1,456
Tinsley	2,447	2,325	2,293	2,183	2,132
Other fields [3]	28,477	26,848	30,575	32,831	30,550
Total	56,183	55,227	57,147	58,708	64,283

[1] Based on Oil and Gas Journal data adjusted to Bureau of Mines total.
[2] Included with "Other fields."
[3] Bureau of Mines data.

Standard Oil Co. of Kentucky is adding facilities to double the capacity of its refinery at Pascagoula to 290,000 barrels per day. In addition to increasing storage and loading capacity at the refinery wharf, three major refining units are being built. The major units are a two-stage crude distillation unit; a two-stage isomax plant to upgrade fuel oil into more valuable products—primarily gasoline and jet fuel; and a steam-methane reforming plant to produce hydrogen from natural gas.

During August 1969, Hurricane Camille, moving in a northerly direction east of the Mississippi Delta, struck the Mississippi coast between Pass Christian and Biloxi with estimated 30-foot tides and 190-mile-per-hour winds. Prior to the storm's passage, oil and gas operators along the Mississippi Delta and adjacent offshore areas shut in several thousand wells. Among the fields shut in was the offshore Main Pass Block 41 field, which supplies fuel gas to the Standard Oil Co. of Kentucky refinery at

Pascagoula. As a result, runs to the plant during August and September were down to 2.3 million and 3.3 million barrels, respectively, from the 4.7 million barrels delivered during July.

Petrochemicals.—General Tire and Rubber Co. is building a new unit at Columbus to expand vinyl-materials production capacity. Completion is scheduled for mid-1970.

NONMETALS

Cement.—Shipments of portland cement decreased 15 percent, while shipments of masonry cement decreased only 3 percent. The total value of portland cement shipments decreased 19.5 percent, reflecting a 5-percent decrease in the average unit price; the total value of masonry cement shipments, reflecting an average unit price decrease of nearly 10 percent, declined almost 13 percent.

Clays.—Clay output increased slightly to 1.7 million short tons, but value declined 4.6 percent, reflecting a lower average unit price. A decrease was reported in the quantity of fuller's earth sold or used; however, there was a 5-percent price increase over the 1968 price. The total tonnage of miscellaneous clay used for heavy clay products and light-weight aggregate increased 3 percent and constituted 65 percent of the State's clay production. Fire clay production decreased 15 percent, while bentonite production increased 8 percent. Ball clay continued to be produced in Panola County. International Minerals and Chemical Corp. officially opened its new $1 million bentonite mine and plant south of Aberdeen in Monroe County. The plant has about twice the capacity of the older operation in nearby Smithville and is expected to process 125,000 to 150,000 tons of bentonite per year.

Lime.—The quantity of lime sold or used increased about 36 percent.

Magnesium Compounds.—Production of magnesium compounds, used in the manufacture of refractory bricks, increased 30 percent.

Perlite.—Johns-Manville Products Corp. continued production of expanded perlite in Adams County.

Sand and Gravel.—Production was reported from 45 of the State's 82 counties. The seven leading producing counties in descending order of value were Forest, Copiah, Adams, Carroll, Washington, De Soto, and Lowndes. These counties accounted for 50 percent of the total tonnage and 52 percent of the value. There were no appreciable changes in the total quantity and value of sand and gravel production.

Stone and Shell.—Stone production and value decreased slightly. No shell production was reported during 1969.

Sulfur.—Recovery of sulfur from refinery and natural gases was reported in Lamar and Madison Counties. The average unit price for sulfur produced in the State decreased 24 percent, while the quantity of sulfur recovered was only slightly below that during 1968. Pan American Sulfur Co. and Phillips Petroleum Co. announced that further development of their joint gas and sulfur project in the Black Creek field had been discontinued.

METALS

No production of metals was reported in the State during 1969.

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
1965	280	$3,477	299	$2,570	923	$950	1,502	$6,997
1966	291	3,615	280	2,673	1,156	1,201	1,727	7,489
1967	259	3,067	306	3,306	1,089	1,479	1,654	7,852
1968	277	3,128	353	4,525	1,063	1,422	1,693	9,075
1969	299	3,525	305	3,999	1,099	1,136	1,703	8,660

Table 14.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	7,192	$7,785	1,255	$932	8,447	$8,717
1966	12,307	12,815	368	748	12,675	13,563
1967	13,575	14,299	464	1,186	14,039	15,485
1968	11,660	12,522	320	147	11,980	12,669
1969	11,140	11,811	344	451	11,484	12,263

[1] Data may not add to totals shown because of independent rounding.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,173	$2,002	2,432	$2,111
Paving	1,844	1,750	1,636	1,446
Other [1]	239	331	152	276
Total [2]	4,256	4,083	4,219	3,831
Gravel:				
Building	2,593	2,770	2,423	2,797
Paving	4,426	5,177	4,277	4,898
Other [3]	385	492	220	285
Total	7,404	8,439	6,920	7,980
Total sand and gravel [2]	11,660	12,522	11,140	11,811
Government-and-contractor operations:				
Sand: Paving	-----	-----	73	99
Gravel: Paving	320	147	271	352
Total sand and gravel	320	147	344	451
Grand total [2]	11,980	12,669	11,484	12,263

[1] Includes railroad ballast (1968), fill, industrial sand, and other construction sand.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes railroad ballast (1968), fill, other construction gravel, and miscellaneous gravel.

Table 16.—Principal producers

Commodity and company	Address	Type of activity or producing fields	County
Cement:			
Marquette Cement Mfg. Co	20 North Wacker Dr. Chicago, Ill. 60606	Plant	Rankin.
Valley Cement Ind., Inc	Box 22491 Jackson, Miss. 39205	----do	Warren.
Clay:			
American Colloid Co	5100 Suffield Ct. Skokie, Ill. 60076	Mine	Itawamba and Monroe.
Delta-Macon Brick & Tile Co., Inc	R.F.D. 3, Box 2 Macon, Miss. 39341	Mine and plant	Noxubee.
Dresser Minerals, div. of Dresser Industries, Inc.	Box 6504 Houston, Tex. 77005	----do	Attala.
Filtrol Corp	3250 East Washington Blvd. Los Angeles, Calif. 90023	----do	Itawamba and Smith.
Holly Springs Brick & Tile Co., Inc	Box 310 Holly Springs, Miss. 38635	----do	Marshall.
International Minerals & Chemical Corp.	Administration Center Old Orchard Rd. Skokie, Ill. 60076	Mine	Monroe.
Jackson Ready-Mix Concrete Co	Box 1292 Jackson, Miss. 39205	Mine and plant	Hinds.
Kentucky-Tennessee Clay Co	Box 447 Mayfield, Ky. 42066	Mine	Panola.
Oil Dri Production Co	Box 285 Ripley, Miss. 38661	----do	Tippah.
Tri-State Brick & Tile Co., Inc	Box 9787 Jackson, Miss. 39206	Mine and plant	Hinds.
Wyandotte Chemicals Corp	1609 Biddle Ave. Wyandotte, Mich. 48192	----do	Tippah.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity or producing fields	County
Lime:			
H. K. Porter Company, Inc	Box 1150 Pascagoula, Miss. 39567	Plant	Jackson.
Magnesium compounds:			
H. K. Porter, Co., Inc., Refractories Div.	Box 1150 Pascagoula, Miss. 39567	----do	Jackson.
Perlite:			
Johns-Manville Products Corp., Celite Div.	22 East 40th St. New York, N.Y. 10016	Expanding plant.	Adams.
Sand and gravel:			
American Sand & Gravel Co	Box 272 Hattiesburg, Miss. 39401	Stationary	Forrest.
J. J. Ferguson Sand & Gravel	Box 318 Greenwood, Miss. 38930	----do	Carroll.
Green Bros. Gravel Co., Inc	Rt. 4, Box 17 Franklinton, La. 70438	----do	Copiah.
Greenville Gravel Co	Box 220 Greenville, Miss. 38701	Dredge	Washington.
Memphis Stone & Gravel Co	Box 6246 Memphis, Tenn. 38111	Stationary	De Soto.
St. Catherine Gravel Co	Box 928 Natchez, Miss. 39120	----do	Adams.
Traxler Gravel Co., div. of Delta Ind., Inc.	Box 1292 Jackson, Miss. 39205	Stationary and dredge.	Copiah.
Weymouth Construction Co	Box 319 Memphis, Tenn. 38101	Stationary	De Soto.
Williams Gravel Co	Poplarville, Miss. 39470	Dredge	Pearl River.
Yazoo Valley Gravel Co	1115½ Jackson Ave. Oxford, Miss. 38655	Stationary	Panola.
Stone:			
Marquette Cement Mfg. Co	20 North Wacker Dr. Chicago, Ill. 60606	Quarry	Rankin.
Valley Cement Ind., Inc	Box 22491 Jackson, Miss. 39205	----do	Warren.
State Dept. of Agriculture and Commerce.	West Point, Miss. 39773	----do	Clay.
Oil and gas:			
Chevron Oil Company, Western Div.	Box 599 Denver, Colo. 80201	Brookhaven	Lincoln.
		South Center Ridge.	Smith.
		Cranfield	Adams and Franklin.
		Hub	Marion.
		Hub East	Do.
		Knoxo	Walthall.
		East Mallalieu	Lincoln.
		West Mallalieu	Do.
		Mize	Smith.
		Pisgah	Rankin.
		Puckett	Rankin and Smith.
		Raleigh	Simpson.
		Reedy Creek	Jones.
		Shongelo Creek	Smith.
Gulf Oil Corp	Box 1166 Pittsburgh, Pa. 15230	Baxterville	Lamar and Marion.
		Bolton	Hinds.
		Gwinville	Jefferson Davis.
		Heidelberg	Jasper.
		East Heidelberg	Do.
		West Heidelberg.	Do.
		West Mallalieu	Lincoln.
		Pistol Ridge	Forrest and Pearl River.
		Soso	Jasper, Jones, and Smith.
		East Yellow Creek.	Wayne.
Humble Oil & Refining Co	Box 2180 Houston, Tex. 77001	Alloway	Adams.
		Baxterville	Marion and Lamar.
		Beaver Branch	Adams.
		Bentonia	Yazoo.
		Bryan	Jones and Jasper.
		Chaparral	Wayne.
		Cowpen	Adams.
		East Eucutta	Wayne.
		West Eucutta	Do.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity or producing fields	County
Oil and gas—Continued			
Humble Oil & Refining Co.—Continued		East Fairview	Adams.
		Fayette	Jefferson.
		Gilliard Lake	Adams.
		Gillsburg	Amite.
		Gwinville	Jefferson Davis.
		Hub	Marion.
		Hub East	Do.
		Junction City	Clarke.
		Kelly Hill	Wilkinson.
		Knoxo	Walthall.
		Lagrange	Adams.
		North Lake Lucille.	Do.
		Loring	Madison.
		West Mallalieu	Lincoln.
		Mantua	Adams.
		Maxie	Forrest.
		Otter Lake	Adams.
		Pickens	Madison and Yazoo.
		Pistol Ridge	Pearl River.
		Sandy Hook	Marion.
		Shieldsboro	Adams.
		Sibley	Do.
		Waveland	Hancock.
		East Yellow Creek.	Wayne.
		North Yellow Creek.	Do.
		West Yellow Creek.	Do.
Meason Operating Co	Natchez, Miss. 39120	Bourbon	Adams.
		North Carthage Point.	Do.
		Clear Springs	Franklin.
		Courtland	Adams.
		Dexter	Walthall.
		Ellis Cliffs	Adams.
Pan American Petroleum Corp	Box 591 Tulsa, Okla. 74101	Clear Springs	Franklin.
		Collins	Covington.
		Diamond	Wayne.
		Dry Bayou	Franklin.
		East Fork	Amite.
		North East Fork.	Do.
		North Freewoods.	Franklin.
		Grange	Jefferson Davis.
		Hilo	Adams.
		South Ireland	Wilkinson.
		Kelly Hill	Do.
		Knoxville	Franklin.
		North Knoxville.	Do.
		Lake Mary	Wilkinson.
		Lazy Creek	Pike.
		Levees Creek	Adams.
		Little Creek	Pike.
		Locust Hill	Adams.
		Lorene	Smith.
		Morgan Town	Adams.
		Pelahatchie	Rankin.
		Pine Mount	Adams.
		West Pine Ridge.	Do.
		Quitman Bayou	Do.
		Siloam	Clay.
		Stringer	Jasper.
		Sylvarena	Smith.
		Tallahala Creek	Do.
		Thorn	Chickasaw.
		Wells Creek	Franklin.
		Zeigler Creek	Do.
Shell Oil Co	Shell Building 921 Common New Orleans, La. 70112	Pachuta Creek	Clarke.
		Goodwater	Do.
		Bay Springs	Jasper.
		Tallahala Creek	Smith.

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity or producing fields	County
Oil and gas—Continued			
Sun Oil Co	1608 Walnut Philadelphia, Pa. 19103	Baxterville	Lamar.
		Bolton	Hinds.
		Diamond	Wayne.
		West Eucutta	Do.
		East Franklin	Franklin.
		East Heidelberg	Jasper.
		Knoxo	Walthall.
		Kokomo	Do.
		Mantua	Adams.
		McComb	Pike.
		Mercer	Adams.
		Pistol Ridge	Forrest and Pearl River.
		Sandy Hook	Marion.
		Smithdale	Amite.
		East Summit	Pike.
		Tom Branch	Franklin.
		West Yellow Creek.	Wayne.

The Mineral Industry of Missouri

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

By Joseph C. Arundale [1] and James A. Martin [2]

The Missouri mineral industry continued to expand, and the value of mineral output rose sharply to a record high of $367.2 million in 1969. Missouri advanced in rank as a mineral-producing State and was one of the Nation's most rapidly growing mining and metallurgical centers. The total value of the State's mineral products gained 33 percent ($91 million) over that of 1968. More than a reflection of higher prices, the dramatic rise in mineral value resulted mostly from increased production of major mineral commodities, with several setting new records. The overall growth was due largely to increased output of lead and iron ore, with large advances also in cement, stone, copper, and zinc.

Lead, cement, stone, iron ore, and sand and gravel accounted for 80 percent of the total mineral value. The distribution of production value by mineral groups was nonmetals, 50 percent; metals, 46 percent; and mineral fuels, 4 percent.

Trends and Developments.—The Missouri Geological Survey prepared a review and forecast of Missouri's mineral resources and industry for the State Planning Agency. Publication was scheduled for mid-1970. A summary of the report, including an analysis and forecast of mineral activity by the Regional Planning Districts set up by the Missouri Department of

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[2] Chief, Economic Geology Section, Missouri Geological Survey and Water Resources, Rolla, Mo.

Table 1.—Mineral production in Missouri [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite—short tons	284,319	$4,102	304,031	$4,220
Cement:				
Portland—thousand 376-pound barrels	20,081	71,206	21,325	74,368
Masonry—thousand 280-pound barrels	405	1,312	427	1,319
Clays—thousand short tons	2,433	6,158	[2] 2,251	[2] 6,405
Coal (bituminous)—do	3,205	13,460	3,301	14,283
Copper (recoverable content of ores, etc.)—short tons	5,494	4,598	12,664	12,039
Iron ore (usable)—thousand long tons gross weight	1,648	23,585	2,622	35,826
Lead (recoverable content of ores, etc.)—short tons	212,611	56,180	355,452	105,889
Natural gas—million cubic feet	[3] 107	[3] 14	126	17
Sand and gravel—thousand short tons	10,649	14,204	10,940	14,574
Silver (recoverable content of ore, etc.)—thousand troy ounces	341	731	1,442	2,582
Stone—thousand short tons	r 38,988	r 58,743	41,977	63,251
Zinc (recoverable content of ores, etc.)—short tons	12,301	3,321	41,099	12,001
Value of items that cannot be disclosed: Other nonmetals and fuels	XX	r 18,624	XX	20,458
Total	XX	r 276,238	XX	367,232
Total 1967 constant dollars	XX	269,840	XX	p 337,567

p Preliminary. r Revised. 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."
[3] Supercedes figures given in commodity chapter.

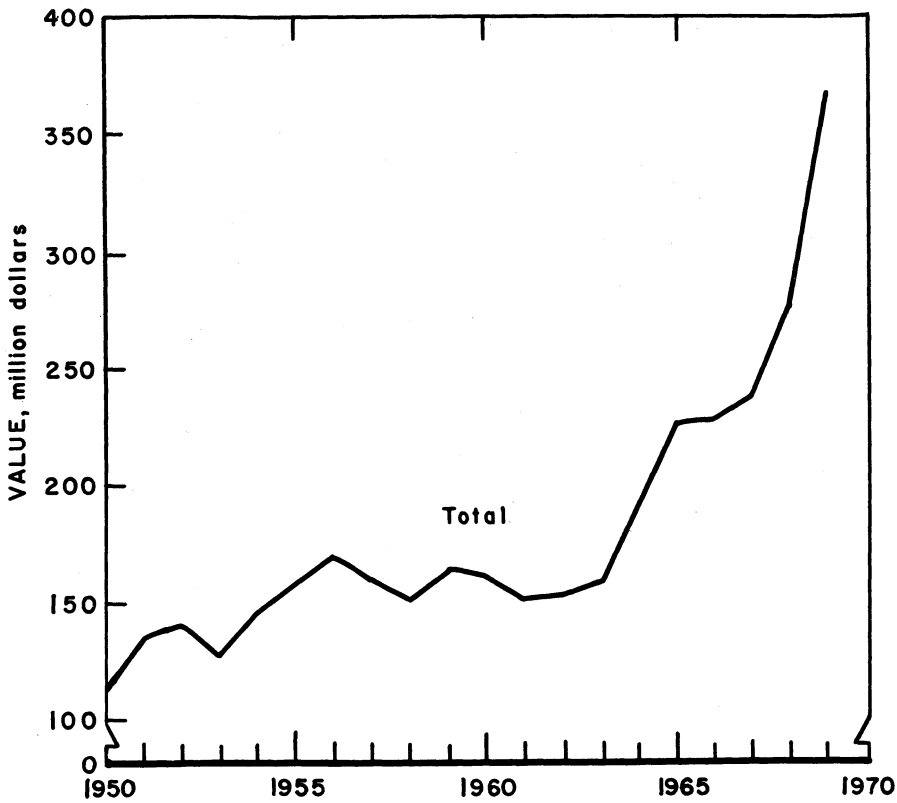

Figure 1.—Total value of mineral production in Missouri.

Table 2.—Value of mineral production in Missouri, by counties [1]

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Adair	W	W	Stone.
Atchison	$3	W	Petroleum.
Audrain	1,041	W	Clays.
Barry	W	W	Stone.
Barton	W	W	Stone, asphalt.
Bates	W	W	Stone.
Benton	6	$9	Barite.
Boone	4,082	4,321	Coal, stone, sand and gravel, clays.
Buchanan	W	412	Stone, sand and gravel.
Butler	W	W	Sand and gravel, clays.
Caldwell	287	257	Stone, natural gas.
Callaway	1,666	1,662	Clays, stone, coal, sand and gravel.
Camden	------	W	Stone.
Cape Girardeau	11,616	W	Cement, stone, clays, sand and gravel.
Cass	r 220	254	Stone, petroleum, clays.
Cedar	1	------	
Christian	747	531	Stone.
Clark	W	W	Do.
Clay	939	W	Do.
Clinton	269	285	Stone, natural gas.
Cole	407	588	Stone, sand and gravel, barite, lead.
Cooper	W	W	Stone, sand and gravel.
Crawford	4,904	5,942	Lead, copper, zinc, silver, sand and gravel.
Dade	W	111	Stone.
Dallas	40	W	Do.
Daviess	W	W	Stone, sand and gravel.
De Kalb	236	368	Stone.
Douglas	180	238	Sand and gravel.
Dunklin	90	W	Do.
Franklin	587	608	Stone, clays, sand and gravel.
Gasconade	1,603	2,317	Clays.
Gentry	W	W	Stone, sand and gravel.
Greene	3,762	4,251	Stone, lime.
Grundy	280	379	Stone, sand and gravel.
Harrison	W	W	Stone.
Henry	W	W	Coal, stone.
Hickory	42	W	Stone.
Holt	W	W	Do.
Howard	W	W	Stone, sand and gravel.
Howell	308	W	Do.
Iron	14,357	57,312	Lead, iron ore, copper, zinc, silver, stone.
Jackson	13,409	14,539	Cement, stone, sand and gravel, clays, petroleum.
Jasper	4,272	3,980	Stone, sand and gravel.
Jefferson	16,838	W	Cement, stone, sand and gravel, clays.
Johnson	W	W	Stone.
Knox	W	W	Do.
Laclede	W	W	Do.
Lafayette	W	83	Sand and gravel, stone.
Lawrence	W	W	Stone.
Lewis	W	W	Sand and gravel, stone.
Lincoln	401	567	Stone, sand and gravel, clays.
Linn	W	W	Stone.
Livingston	1,176	805	Stone, clays, sand and gravel.
Macon	W	W	Coal.
Madison	W	W	Stone.
Maries	------	W	Clays.
Marion	W	434	Lime, stone.
Mercer	466	407	Stone.
Miller	258	W	Sand and gravel, stone.
Moniteau	54	131	Stone.
Monroe	418	398	Stone, clays, sand and gravel.
Montgomery	715	883	Clays, stone, sand and gravel.
New Madrid	------	W	Sand and gravel.
Newton	139	W	Stone.
Nodaway	530	649	Stone, sand and gravel.
Oregon	W	W	Stone.
Osage	W	W	Clays.
Ozark	W	W	Stone, sand and gravel.
Pemiscot	W	W	Sand and gravel.
Perry	W	W	Stone.
Pettis	W	W	Do.
Phelps	285	268	Stone, sand and gravel, clays.
Pike	W	W	Cement, stone, clays.
Platte	269	324	Stone, clays.
Pulaski	W	W	Sand and gravel, stone.
Putnam	276	151	Coal.
Ralls	11,078	W	Cement, stone, clays, sand and gravel.
Randolph	635	1,154	Stone, coal.
Ray	651	1,321	Stone.
Reynolds	23,508	51,058	Lead, zinc, copper, silver, sand and gravel, stone.
St. Charles	1,747	2,721	Stone, sand and gravel, clays.

See footnotes at end of table.

Table 2.—Value of mineral production in Missouri, by counties [1]—Continued

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
St. Clair	W	------	
St. Francois	r$15,854	$18,234	Lead, lime, stone, copper, zinc, silver.
Ste. Genevieve	24,703	27,105	Lime, stone, sand and gravel.
St. Louis	30,516	32,923	Cement, stone, sand and gravel, clays, petroleum.
Saline	573	780	Stone.
Scotland	W	W	Do.
Scott	W	W	Stone, clays.
Shannon	W	W	Stone.
Shelby	210	W	Do.
Stoddard	W	392	Sand and gravel.
Vernon	r 337	208	Stone, coal, asphalt, petroleum, sand and gravel.
Warren	344	155	Stone, clays, sand and gravel.
Washington	36,962	43,817	Iron ore, lead, barite, zinc, copper, silver, sand and gravel.
Wayne	250	W	Stone.
Wright	W	W	Do.
Undistributed	41,691	83,900	
Total	276,238	367,232	

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 1968 or 1969: Andrew, Bollinger, Carroll, Carter, Chariton, Dent, McDonald, Mississippi, Morgan, Polk, Ripley, Schuyler, Stone, Sullivan, Taney, Texas, Webster, and Worth.

Table 3.—Indicators of Missouri business activity

	1968	1969 p	Change, percent
Employment and labor force, annual average:			
Total labor force—thousands	1,649.2	1,668.3	+1.1
Unemployment—do	24.2	25.1	+3.7
Employment—do	1,625.0	1,643.2	+1.1
Construction—do	70.9	70.2	−1.0
Mining—do	8.4	8.9	+5.9
All manufacturing—do	458.1	454.3	−.8
Factory payrolls—do	$2,912.8	$3,020.2	+3.6
Personal income:			
Total—millions	$15,065	$16,086	+6.7
Per capita	$3,268	$3,459	+5.8
Construction activity:			
Building permits, total private nonresidential—millions	$268.2	$354.5	+32.1
Cement shipments to and within Missouri thousand 376-pound barrels	9,709	9,577	−1.4
Farm marketing receipts—millions	$1,402.2	$1,507.7	+7.5
Mineral production—do	$276.2	$367.2	+32.9

p Preliminary.
Sources: Survey of Current Business, Construction Review, The Farm Income Situation, Employment and Earnings and Monthly Report on the Labor Force, and Bureau of Mines.

Community Affairs, was published in two parts.[3] Comparison of the State's mineral industry at the beginning and end of the 1959–69 period reveals some momentous developments and some notable trends. Output of minerals in Missouri in 1969 was double the value of production 10 years ago (in constant dollars) owing to such developments as the huge Viburnum Trend lead-zinc-copper district and the new cement plants along the Mississippi River.

The gap in value between metals and nonmetals—which began after World War II and peaked in 1962 with the value of nonmetals reaching 81 percent and the value of metals declining to a low of 11 percent of the total—had nearly closed as a result of new lead-zinc-copper and iron production. In 1959, nonmetals comprised 73 percent of the total value; metals 19 percent, and mineral fuels 8 percent. In 1969, metals comprised nearly half of a total value that was twice that of 1959.

Missouri's mineral industry was not only expanding, but was also diversifying. The State's first aluminum smelter was being built near New Madrid on the Mississippi

[3] Economic Geology Section, Missouri Geological Survey. History and Forecast of Mineral Production in Missouri. Mineral Industry News, v. 9, No. 7, July 1969, pp. 89–98; No. 8, August 1969, pp. 103–111.

River. Copper, zinc, and silver, as coproducts of lead production, were significant in 1969. Bentonitic clay was produced for the first time in the State. The production of sulfuric acid, recovered in lead-smelting operations, was also significant.

Prospects for the future growth of the State's mineral industry were enhanced by major exploration projects underway during 1969. American Zinc Co. began a new exploration program in southeast Missouri on about 11,000 acres of land jointly held for the past several years with Granite City Steel Co. The exploration was being done under an agreement with Getty Oil Co. Zinc, lead, copper, and iron ore have been encountered in this area in previous explorations.

Construction began on a sixth lead mine and mill complex in the Viburnum Trend, bringing the total capacity of the district to about 400,000 tons of lead metal equivalent annually. The two new lead smelters in southeast Missouri had their first full year of operation in 1969 and added to the doubled capacity of the existing smelter to achieve a record output.

An intensive program over the past several years of expanding, rebuilding, remodeling, and improving the clay-processing plants in northeast Missouri has made the area one of the largest and most modern refractories-producing centers in the country.

Labor and Employment.—According to the Division of Employment Security, Missouri Department of Labor and Industrial Relations, the mineral industry employed 8,985 workers in 1969, continuing the steady increase in employment in that industry over most of the past decade. Employment in the metal mining segment showed a substantial increase to 3,830 employees, compared with 3,555 in 1968. Employment in coal mining increased to 815, from 668 in 1968, as a result of the opening of two new open pit coal mines in the State. Employment in nonmetal mining rose slightly, to 4,210 from 4,200 in 1968.

Legislation and Government Programs.—The 75th General Assembly of the Missouri Legislature considered several bills relating to the minerals industry, but no legislation of special significance to the minerals industry was passed during the session. Bills relating to land reclamation, mine inspection, tax on limestone and barite, and severance taxes on natural resources were introduced but rejected.

Formulation of and compliance with the safety regulations under new Federal mine safety legislation were of prime concern to the Missouri mining industry during the year. The industry was making an effort to prepare for compliance with the law.

Table 4.—Exploratory drilling in Missouri
(Linear feet)

Year	Churn	Rotary	Diamond
1965	111,786	5,324	188,071
1966	133,879	4,036	292,699
1967	94,908	37,978	237,031
1968	45,272	43,011	211,493
1969	73,874	21,442	167,179

Table 5.—Worktime 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
1968:								
Coal	356	306	109	812	------	14	17.25	398
Metal	2,691	262	732	5,858	4	242	41.99	5,257
Nonmetal and native asphalt	917	236	217	1,756	------	57	32.46	770
Sand and gravel	564	240	135	1,140	------	20	17.55	774
Stone	4,138	270	1,116	9,261	3	191	20.95	2,464
Total	8,666	263	2,309	18,827	7	524	28.20	2,984
1969: [p]								
Coal	425	324	137	1,024	------	14	13.67	314
Metal	3,045	263	818	6,547	2	305	46.89	4,104
Nonmetal and native asphalt	840	231	194	1,587	------	52	32.76	810
Sand and gravel	830	238	198	1,687	------	29	17.19	507
Stone	4,280	270	1,157	9,510	4	179	19.24	3,727
Total [1]	9,420	264	2,505	20,355	6	579	28.74	3,182

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Environment.—Environmental problems and projects—many involving the mineral industry directly—were prominent in Missouri news during 1969. PPG Industries Inc., at Crystal City, Jefferson County, continued efforts to eliminate turbidity in nearby creeks caused by discharge of particulate waste composed of fine sand and clay. In an effort to stabilize the surface of old slime ponds and control windblown dust in the Old Lead Belt, St. Joseph Lead Co. started a program of revegetation in the areas. The program began with covering small test plots with several inches of soil; these were fertilized and sowed with grasses and plants. Other tests involved plantings of vines and trees directly in the finely ground stone of the settling ponds. In later experiments chemical "adhesives" and tailings stabilizers were tested.

Emissions from smokestacks were being curbed by the mineral and metallurgical industries. In St. Louis, Century Foundry was reportedly successful in an effort to control smoke and dust from its operations. National Lead Co. was building a new system for controlling air pollution from ilmenite ore digesters at the company's titanium plant in south St. Louis.

Union Electric Co. completed 700-foot-high smokestacks at its new power-generating plant on the Missouri River at Labadie, Franklin County, to abate air pollution from the coal-fired generating unit. The company also completed a $1 million facility at its Meramec generating plant in south St. Louis County for the removal of sulfur dioxide from stack gases of coal-fired steam generators; at yearend, this facility was being evaluated.

The Water Resources Research Center of the University of Missouri presented the results of its research on a wide variety of water-related projects in Missouri, ranging from hydrological problems to water law. Of special interest to the mineral industry were discussions on stream pollution in the Viburnum Trend mine and mill area. Tests showed that waters discharged from operations in the Viburnum Trend area neither approached the contaminant limits of acute toxicity to fish nor presented other significant stream pollution problems. Water quality did not deviate significantly from the standards for dissolved oxygen, alkalinity, hardness, or stream temperature. A different problem arose from organic milling reagents, which form a surface film contributing to the growth of bacteria and undesirable mats of blue-green algae in streams. Recommendations for correcting the problems included separation of mine discharge water from milling waste water; increased detention time for waste water from milling; baffling, or below-surface water withdrawal from settling ponds to retain surface films; removal of trees and heavy underbrush from settling ponds; and continued research to determine improved treatment of milling waste waters. The mining companies were implementing the recommendations, and results were being analyzed.

In the October 1969 issue of its Missouri Mineral Industry News, the Missouri Geological Survey began a regular series of "Environmental Notes" on problems involving geology and man's environment. The first environmental note presented the results of studies made by the Missouri Geological Survey at the request of the Missouri Water Pollution Board and the Department of Conservation relating to the subsurface movement of water and its relation to pollution. Environmental Note No. 2 (in the November 1969 issue) was a discussion of the environmental impact of industrial development (including mining) in the Missouri Ozarks area.

Exploration, Geologic Studies, and Mapping.—A comprehensive program of geologic mapping of much of the State by Missouri Geological Survey staff members was underway. Reconnaissance mapping was being done with the long-range goal of publishing a revised geologic map of the State in the mid-1970's. Field work was being done in south-central Missouri. Detailed mapping was in progress in rapidly expanding urban areas so that basic geologic information will be available to help guide further development. This mapping, to be published on the scale of 7½-minute topographic quadrangle maps, is concentrated in Kansas City, Springfield, Cape Girardeau, and St. Louis and in Jefferson County. Missouri's current geologic map was published in 1961 at a scale of 1 inch to 8 miles; the revised map will be more detailed and will incorporate findings of field studies made in areas where information was previously lacking. In addition, other mapping completed since 1961 will be included.

The "Proceedings of the Missouri Mining Tax Symposium", held in Rolla on Octo-

ber 17, was published by the University of Missouri-Rolla.

During the year the Missouri Geological Survey issued Information Circular 20, "Missouri Directory of Mineral Producers and Processors," which listed individual companies and included a county index, and Information Circular 22, "Index to Missouri Areal Geologic Maps 1890-1969". This latter illustrated book listed three classes of maps: geologic, reconnaissance geologic, and outcrop. The map of Missouri is divided into 17 index regions to correspond to the U.S. Geological Survey U.S. Map Series regions. These regions are further subdivided so that mapped areas can be easily identified and located. Most unpublished maps included in the index are on file at the Missouri Geological Survey in Rolla.

Nine new aeromagnetic maps covering 15-minute quadrangles in extreme southwestern Missouri were made available by the Missouri Geological Survey. The maps were published as an integral part of the Survey's continuing program of basic data collection and dissemination. Aeromagnetic mapping was initiated in 1947 by the Missouri Geological Survey in cooperation with the U.S. Geological Survey and interested mining companies. The new maps have a scale of 1:62,500 and show total magnetic intensity by contours at 10- and 50-gamma intervals.

The Missouri Geological Survey published the first in a series of special reports on the Precambrian geology of Missouri as part of its "Operation Basement" project —a concentrated effort to intensify investigations, mapping, and dissemination of basic Precambrian data. This new publication—Report of Investigations No. 44, "Exposed Precambrian Rocks in Southeast Missouri"—is based on detailed investigations made from 1931 to 1952 and on findings since then. Southeast Missouri is one of the few areas in the central United States where Precambrian rocks are exposed at the surface. The Precambrian, as a mineral exploration target, has attracted increasing interest in recent years because significant mineral deposits have been found in these rocks in Missouri. Additional knowledge of these rocks will be useful as a guide in future mineral exploration.

A special issue of Missouri Mineral Industry News[4] focused on the "problems and solutions of underground limestone mining" and summarized the transition from the "philosophy of mine and abandon" to modern "mined space" practices and the utilization of such mined-out space.

REVIEW BY MINERAL COMMODITIES

NONMETALS

The increase in production was attributed to generally high construction activity in the State. All nonmetallic mineral commodities, except clay, registered quantity and value gains; clay showed a slight decrease in quantity.

Barite.—Missouri stepped up output of barite and produced nearly one-third of the barite mined in the United States, but for the first time in several years the State dropped from first place and relinquished the lead to Nevada. Exploration continued in Washington County with the objective of extending known areas of barite occurrence.

Eleven firms reported barite production in Missouri during 1969. The bulk of the output was mined in Washington County, but small tonnages were also produced in Cole and Benton Counties in central Missouri. Much of the crude barite was ground in Missouri for use in well-drilling fluids; some was sold for chemical uses.

Table 6.—Barite sold or used by producers

Year	Short tons	Value
1965	328,585	$4,219,343
1966	337,076	4,279,770
1967	331,780	4,443,851
1968	284,319	4,101,979
1969	304,031	4,220,432

In a program funded by a special appropriation from the Missouri Legislature, the Missouri Geological Survey, in cooperation with the U.S. Bureau of Mines, was engaged in an extensive drilling program in the Washington County barite district to determine how much unrecovered barite is contained in tailings ponds. Approximately 200 test holes were drilled in selected

[4] Missouri Mineral Industry News. Mining in Kansas City. V. 9, No. 4, April 1969, pp. 25–56.

abandoned tailings ponds where large quantities of barite are believed to have been lost during processing. It is hoped that practical methods for recovering the barite can be developed if sufficient quantity is indicated.

Cement.—Missouri cement shipments rose to a record high of 21.8 million barrels valued at $76 million and ranked fifth in the Nation. Although increased consumption of cement within the State was indicated by the moderate increase in overall construction, much of the cement output was sold outside the State, which points up Missouri's favorable raw material situation and the importance of the Mississippi River as a transportation artery for such commodities.

Table 7.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1965	13,975	13,334	$46,034
1966	13,956	13,848	46,228
1967	14,888	15,044	52,119
1968	19,806	20,081	71,206
1969	20,860	21,325	74,368

Seven cement plants in Missouri operated by six companies had an estimated capacity of about 30 million barrels annually. Six of these plants are located along the Mississippi River; the seventh is on the Missouri River near Kansas City. Four of Missouri's cement plants use the wet process, two use the dry process, and one uses a combination of wet and dry. About 96 percent of cement shipments were in bulk, and 60 percent of the bulk shipments were by truck. Approximately 70 percent of all shipments were to ready-mix concrete companies, with about 22 percent of the total going to highway contractors and concrete product manufacturers.

Clays.—A decrease in the output of refractory clays in central Missouri was offset by production of bentonitic-type clays in the southeast part of the State.

Missouri is a major producer of fire clay for refractories. Other uses include the manufacture of cement and structural clay products, principally brick and tile. Thirteen companies produced fire clay from 142 pits mostly in east-central Missouri. Slightly more than 1 million tons of the total clay produced was fire clay for refractories manufacture.

Recent interest in Porter's Creek clay in southeast Missouri prompted reprinting "The Geology of Stoddard County, Missouri," published in 1937 as appendix VI of the 59th Biennial Report of the Missouri State Geologist. Because of the quality of the original report and the relatively little additional geologic data acquired in the area, it was reprinted without revision. Several recent developments indicate the interest in Porter's Creek clay. In 1965 the Mid-American Clay and Mineral Co. erected a plant south of Oran, Scott County, to process Porter's Creek clay. In 1967, the Missouri Clay Products Co. (wholly owned subsidiary of the St. Joseph Lead Co.) stripped an area and excavated trenches on its property near Aquilla, Stoddard County, preparatory to mining and processing this clay. In October 1968, A. P. Green Refractories Co. announced plans to construct a plant near Oran to calcine Porter's Creek clay.

Kaiser Refractories, Inc., installed additional dust control facilities at its Mexico works.

Lime.—Lime was produced at plants in Greene, Marion, and Ste. Genevieve Counties; dead-burned dolomite and dolomitic quicklime were produced in St. Francois County. Quicklime and hydrated lime were used chiefly for chemical and other industrial purposes. The iron and steel industries used dead-burned dolomite for refractory purposes.

Table 8.—Clay 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
1965	1,128	$4,313	1,098	$1,126	2,226	$5,439
1966	1,285	4,898	1,044	1,091	2,329	5,989
1967	1,131	4,747	1,174	1,473	2,305	6,220
1968	1,064	4,334	1,369	1,824	2,433	6,158
1969	1,040	4,968	1,211	1,437	[1] 2,251	[1] 6,405

[1] Excludes bentonite and fuller's earth.

During the year, Marblehead Lime Co. ceased both quarrying and calcining operations at its Hannibal, Marion County, plant. The company plans to hydrate quicklime and process crushed stone trucked in from its Quincy, Ill. plant and quarry.

Sand and Gravel.—The value of sand and gravel production increased nearly 3 percent and reached an alltime high in 1969; quantity also increased 3 percent over that of 1968. Sand and gravel was produced chiefly from stream deposits in 41 counties. Nearly 86 percent of total production was used as aggregate for ready-mix concrete, concrete products, and paving. Industrial sand, comprising 9 percent of total tonnage and 28 percent of total value, was produced in Jasper, Jefferson, St. Charles, and St. Louis Counties. Shipments of commercial output were 81 percent by truck, 10 percent by barge, and 9 percent by rail.

Stone.—Output of stone in Missouri continued a steady increase and reached a record high in quantity and value in 1969.

Table 9.—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
1965	11,229	$12,954	839	$781	12,068	$13,735
1966	10,454	13,283	248	257	10,702	13,540
1967	9,651	12,488	65	68	9,716	12,556
1968	10,597	14,153	52	51	10,649	14,204
1969	10,886	14,524	53	50	[1] 10,940	14,574

[1] Data do not add to total shown because of independent rounding.

Table 10.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,949	$3,581	4,500	$4,429
Paving	1,304	1,456	1,450	1,487
Fill	338	326	325	299
Other [1]	1,031	3,856	1,080	4,113
Total [2]	6,622	9,219	7,354	10,329
Gravel:				
Building	2,127	2,730	2,369	3,098
Paving	1,716	2,070	1,019	973
Fill	33	19	41	28
Other [3]	99	115	103	96
Total [2]	3,975	4,934	3,533	4,195
Total sand and gravel [2]	10,597	14,153	10,886	14,524
Government-and-contractor operations: Gravel: Paving	52	51	53	50
Grand total [2]	10,649	14,204	10,940	14,574

[1] Includes railroad ballast, other construction sand, and industrial sand (unground and ground).
[2] Data may not add to totals shown because of independent rounding.
[3] Includes miscellaneous gravel and other construction gravel.

Table 11.—Stone sold or used by producers, by uses

Use	1968		1969	
	Quantity	Value	Quantity	Value
Dimension stone—approximate short tons	43,293	$2,628,449	15,538	W
Crushed and broken:				
Riprap—short tons	3,208,038	2,909,703	2,741,505	$2,965,461
Concrete aggregate, roadstone, etc—do	r 21,472,866	r 28,948,052	24,950,003	33,402,781
Railroad ballast—do	140,465	183,577	49,474	68,529
Agricultural—do	r 4,396,026	r 7,123,960	3,832,292	6,400,850
Cement—do	5,367,073	5,367,073	5,660,180	5,660,180
Other [1]—do	r 4,359,936	r 11,582,127	4,727,709	[2] 14,753,101
Total stone—do	r 38,987,697	r 58,742,941	41,976,701	63,250,902

r Revised. W Withheld to avoid disclosing individual company confidential data.
[1] Includes stone for terrazzo, roofing granules, whiting, asphalt filler, other fillers, coal dust, filter stone, mineral foods, poultry grit, lime, refractory, flux, and miscellaneous uses.
[2] Includes dimension stone value.

Table 12.—Stone sold or used by producers, by kinds

(Short tons and thousand dollars)

Year	Granite (dimension)		Limestone		Sandstone (dimension)		Other stone [1]		Total stone	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1965	3,124	$234	34,952,692	$49,770	2,258	$52	1,289,359	$3,518	36,247,433	$53,574
1966	2,471	253	33,698,016	48,468	1,500	36	1,537,760	4,636	35,239,747	53,393
1967	2,047	246	35,496,586	49,133	1,500	36	1,084,679	4,538	36,584,812	53,953
1968	W	W	r 38,123,462	r 54,320	W	W	864,235	4,423	r 38,987,697	r 58,743
1969	W	W	41,202,515	59,213	W	W	774,186	4,038	41,976,701	63,251

r Revised. W Withheld to avoid disclosing individual company confidential data; included in total.

[1] Includes granite, marble, sandstone, and traprock.

Limestone, dolomite, granite, sandstone, marble, and traprock were produced. Limestone, produced in 76 counties, accounted for 96 percent of the quantity and about 92 percent of the total value of stone production. Crushed and dimension granite were produced in Iron County. Dimension marble was quarried in Greene, Jasper, and Ste. Genevieve Counties; crushed marble was produced in Jasper, Jefferson, and Madison Counties. Crushed sandstone was produced in Jefferson County; dimension sandstone was quarried in Shannon and Johnson Counties.

Bar-Co-Roc Asphalt Co. in Barton County and Silica Rock Asphalt Co. in Vernon County produced asphaltic sandstone for road surfacing.

Reported production of limestone for agricultural purposes totaled 3.8 million tons in 1969 compared with 4.4 million tons in 1968.

The annual need for aglime in Missouri, as estimated by the U.S. Department of Agriculture from reports by the University of Missouri, recently doubled from 5 million tons to 10 million tons. The university cited these reasons for the increased need: deeper plowing, which mixes more acidic subsoil with less acidic topsoil; development of old pasturelands, which have never been treated with limestone, for more intensive forage-livestock production; increased use of fertilizer, especially nitrogen materials, which increases acidity; and increased yields per acre.

Sulfur.—St. Joseph Lead Co.'s sulfuric acid plant at Herculaneum began operation in October, utilizing the stack gases produced in smelting lead concentrates. The $4.5 million plant produces sulfuric acid at the rate of about 300 tons per day and reduces air pollution by recovering the sulfur formerly emitted to the air.

American Metal Climax, Inc. (AMAX)-Homestake Lead Tollers operated its sulfuric acid plant at the Bixby lead smelter.

Sulfuric acid was used in fertilizer manufacture.

METALS

Metals comprised 46 percent of total value of Missouri mineral output, up from 32 percent in 1968. Completion of new facilities resulted in doubling lead output in the past 2 years; copper and zinc production also increased substantially as coproducts of the new lead facilities. Silver output, also a coproduct of the lead facilities, was about 1.4 million ounces. Iron shipments increased 59 percent as the two major mines in the State operated at near capacity.

Aluminum.—Construction of the new aluminum reduction plant by Noranda Aluminum Corp. near New Madrid in the "bootheel" area of southeast Missouri was reported behind schedule but progressing toward a completion date now estimated at 1972. An aluminum wire and rod mill adjacent to the reduction plant was completed during the year and started processing purchased aluminum metal.

Copper.—Output of copper more than doubled that of the previous year as a result of increased activity in the new lead belt, where copper is recovered as a coproduct.

Iron Ore and Steel.—The two iron ore mines and pellet plants in Missouri achieved nearly full-time operation, and output approached the designed capacity of the plants. Pilot Knob Pellet Co. had its first full year of operation in Iron County. In Washington County, Meramec Mining Co. was installing underground crushing facilities and increasing output.

Table 13.—Iron ore (usable)
(Thousand long tons and thousand dollars)

Year	Quantity	Value
1965	1,784	$24,607
1966	1,887	26,450
1967	1,871	26,673
1968	1,648	23,585
1969	2,622	35,826

Table 14.—Ferrous scrap and pig iron consumption
(Thousand short tons)

Year	Ferrous scrap	Pig iron	Total scrap and pig iron
1965	1,096	42	1,138
1966	1,063	41	1,104
1967	1,051	31	1,082
1968 r	1,049	24	1,073
1969	1,058	20	1,078

r Revised.

Lead.—A decision to develop a new $19 million mine-mill complex in Reynolds County in the Viburnum Trend was announced by St. Joseph Lead Co. (St. Joe) in 1969. The new Brushy Creek facility will have a designed capacity of 65,000 tons per year of lead concentrate with some

zinc and copper. St. Joe awarded the first contract for construction of the new mine and mill to G. L. Tarlton Contracting Co. of St. Louis. Twin shafts will be sunk to a depth of 1,600 feet. Production is expected early in 1972.

The Magmont mine, a joint venture of Cominco American, Inc., and Dresser Industries, Inc., was dedicated on September 19 about midway in its first full year of operation. The first ore from Magmont mine was milled in June 1968, and the first lead was shipped from a nearby smelter, jointly owned and operated by American Metal Climax and Homestake Mining. Since that time the Magmont mine has been producing above the designed annual capacity of 50,000 tons of lead metal equivalent. This is the successful conclusion of an effort that began with initial exploration in southeast Missouri by a subsidiary of Cominco American, Inc.—Montana Phosphate Products Co.—in 1957 and that took more than a decade of exploration and development and the expenditure of more than $18.5 million.

Zinc.—A nearly fourfold increase in the output of zinc over that of 1968 brought Missouri back to the list of major zinc-producing States. Zinc was a significant coproduct of lead mined in the Viburnum Trend operations.

Table 15.—Tenor of lead ore milled and concentrates produced in Missouri, 1969

Total material [1]	short tons	7,873,570
Concentrates produced:		
Copper	short tons	27,767
Recovery factor	percent	0.35
Lead	short tons	517,717
Recovery factor	percent	6.58
Zinc	short tons	64,610
Recovery factor	percent	0.82
Metal content of ore: [2]		
Copper	do	0.16
Lead	do	4.51
Zinc	do	0.52
Average copper content of concentrate	do	27.90
Average lead content of concentrate	do	70.80
Average zinc content of concentrate	do	53.88

[1] Based on Missouri ore (dirt), old tailings treated at mills, and barite ore containing lead shipped to smelter.
[2] Figures represent metal content of crude ore only as recovered in the concentrate; data on tailings losses not available.

Table 16.—Mine production of silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Number of mines	Material sold or treated (short tons)	Silver		Copper		Lead		Zinc	
			Troy ounces	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1965	5	5,279,420	299,522	$387	2,331	$1,650	133,521	$41,659	4,312	$1,259
1966	7	5,387,330	-------	------	3,913	2,831	132,255	39,981	3,968	1,151
1967	10	5,563,824	226,168	351	3,215	2,458	152,649	42,742	7,430	2,057
1968	9	6,356,252	340,856	731	5,494	4,598	212,611	56,180	12,301	3,321
1969	10	7,873,570	1,442,090	2,582	12,664	12,039	355,452	105,889	41,099	12,001

[1] Based on Missouri ore (dirt), old tailings treated at mills, and barite ore containing lead shipped to smelter (1969).

Table 17.—Total value of mineral production in Missouri and production and value of lead in Missouri and the United States

(Short tons and thousand dollars)

Year	Total value of Missouri mineral production	Lead production					
		Missouri				United States	
		Quantity	Value	Percent of U.S. production	Percent of world production	Quantity	Value
1965	$225,568	133,521	$41,659	44.3	4.5	301,147	$93,959
1966	227,950	132,255	39,981	40.4	4.2	327,368	98,964
1967	237,010	152,649	42,742	48.2	4.8	316,931	88,741
1968	r276,238	212,611	56,180	59.2	6.4	359,156	94,903
1969	367,232	355,452	105,889	69.8	10.1	509,013	151,635

rRevised.

MINERAL FUELS

Mineral fuels contributed 4 percent of total mineral value. Coal output increased 3 percent largely because of expanded requirements of coal-fired steam powerplants.

Coal.—Two new strip coal mines were being developed in the State, both to supply fuel for electric generating facilities.

The new Empire mine of Pittsburg & Midway Coal Mining Co. was nearing completion in Barton County. The 750,000-ton-per-year strip mine will fuel the 200,000-kilowatt Asbury powerplant of Empire District Electric Co. Raw coal will be crushed at the mine to 1¼-inch size and transported by conveyor belt to the powerplant.

Peabody Coal Co. opened a new pit in Randolph County to produce about 750,000 tons per year and supply coal to the nearby Thomas Hill electric generating plant of Associated Electric Cooperative.

Table 18.—Coal (bituminous) production [1]
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	3,564	$14,779
1966	3,582	14,834
1967	3,696	15,573
1968	3,205	13,460
1969	3,301	14,283

[1] Excludes mines producing less than a thousand short tons.

With a possible 45 billion tons of unmined bituminous coal, Missouri ranks at least ninth in the Nation in terms of reserves. Of this reserve, 31 billion tons is in areas where mining and some exploration have been done, and 14 billion tons is in relatively unexplored areas. The Missouri Geological Survey was awarded a grant from the National Center for Air Pollution Control to compile and publish maps and tonnage estimates of the quantity and quality of Missouri's coal reserves. The study was being conducted in two stages. Stage one, to be completed by June 1970, will describe Missouri's coal resources in text and tables by tonnage, seam thickness, location, quality, and sulfur content, and will include a series of maps showing distribution of coal in nine important coal seams. To date, investigations have been made in most of the potential coal-producing counties. Findings show that there are approximately 7.5 billion tons of coal in Missouri in seams over 28 inches thick, of which nearly 2 billion tons are in seams over 42 inches thick. More than 1 billion tons of thick coal is in Randolph and Macon Counties. Preliminary studies indicate that there is over a half billion tons of thick coal at depth in the north-central part of Missouri, particularly in Mercer and Harrison Counties. Stage two, to be completed by 1972, will be a more detailed study involving field investigations, outcrop sampling, and core drilling to obtain essential tonnage data in areas where control is sparse.

The U.S. Bureau of Mines conducted a study of strippable coal resources in Missouri as part of a nationwide study. Results of the work, done by the Bartlesville, Okla., Mineral Supply Field Office, are to be published later. Seam thickness, sulfur content, and resources are included for each county.

Petroleum and Natural Gas.—Petroleum was recovered from pools in Atchison, Cass, Jackson, St. Louis, and Vernon Counties. American Oil Co. operated its Sugar Creek refinery near Kansas City in Jackson County. Natural gas was produced from the Turney pool in Clinton County and the Polo pool in Caldwell County.

A packet of maps entitled "Missouri Oil and Gas Wells of Record, 1860–1969," was released by the Missouri Geological Survey. Assembled from the files of the Missouri Geological Survey and other sources, the maps show all oil and gas wells drilled in Missouri since 1860, including stratigraphic and other test wells and producing wells. A system of symbols differentiate between producing wells, stratigraphic tests, shows of oil and gas, and other wells. There are five maps in the packet: The first map is a small-scale map of the State, showing wells in low-density areas; the other four maps are larger scale and show regions with high well density.

Table 19.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt, native:			
Bar-Co-Roc Asphalt Co	P.O. Box 11 Iantha, Mo. 64753	Mine	Barton.
Silica Rock Asphalt Corp	Sheldon, Mo. 64784	----do	Vernon.
Barite:			
Dresser Minerals	P.O. Box 6504 Houston, Tex. 77005	----do	Washington.
Milchem, Incorporated	P.O. Box 22111 Houston, Tex. 77027	Mine and mill	Do.
National Lead Co., Baroid Division.	P.O. Box 1675 Houston, Tex. 77001	----do	Do.
National Lead Co., DeLore Division.	P.O. Box 2808 Carondelet Sta. St. Louis, Mo. 63111	Mill	St. Louis.
Chas. Pfizer & Co., Inc	Box 47 Mineral Point, Mo. 63660	Mine and mill	Washington.
Cement:			
Alpha Portland Cement Co	15 South Third St. Easton, Pa. 18043	Plant and quarry	St. Louis.
Dundee Cement Co	P.O. Box 317 Dundee, Mich. 48131	----do	Pike.
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606	----do	Cape Girardeau.
Missouri Portland Cement	7751 Carondelet Ave. St. Louis, Mo. 63105	----do	Jackson, St. Louis.
River Cement Co	Festus, Mo. 63028	----do	Jefferson.
Universal Atlas Cement Div. of U.S. Steel Corp.	Chatham Center, Box 2969, Pittsburgh, Pa. 15230	----do	Ralls.
Clay and shale:			
Allied Chemical Corp	Box 70 Morristown, N.J. 07960	Mine and plant	Gasconade.
Alton Brick Co	Box 1025 Maryland Heights, Mo. 63042	----do	St. Louis.
Carter-Waters Corp	2440 Pennway Kansas City, Mo. 64108	----do	Platte.
C-E Refractories Div. of Combustion Engineering.	101 Ferry St. St. Louis, Mo. 63147	----do	Audrain, Callaway, Gasconade, Monroe.
Dundee Cement Co	Dundee, Mich. 48131	----do	Pike.
A. P. Green Refractories Co.	Mexico, Mo. 65265	----do	Audrain, Franklin, Gasconade, Maries, Phelps.
Harbison-Walker Refractories Co.	2 Gateway Center, Pittsburgh, Pa. 15222	----do	Callaway, Gasconade, Lincoln, Montgomery, St. Charles, Warren.
Kaiser Refractories	P.O. Box 499 Mexico, Mo. 65265	----do	Audrain, Callaway, Franklin, Gasconade, Montgomery, Osage, Warren.
Marquette Cement Mfg. Co.	20 North Wacker Dr. Chicago, Ill. 60606	----do	Cape Girardeau.
Midland Brick & Tile Co	Box 428 Chillicothe, Mo. 64601	----do	Livingston.
Missouri Portland Cement Co.	7751 Carondelet Ave. St. Louis, Mo. 63105	----do	Jackson, St. Louis.
H. K. Porter Co., Inc	4705 Ridgewood Ave. St. Louis, Mo. 63116	----do	Callaway, Gasconade, Monroe.
Universal Atlas Cement Div., U.S. Steel Corp.	P.O. Box 2969 Pittsburgh, Pa. 15230	----do	Ralls.
Wellsville Fire Brick Co	West Highway 19 Wellsville, Mo. 63384	----do	Montgomery.
Coal:			
Clayton-Hensley Coal Co	Route 3, Fulton, Mo. 65251	Strip mine	Callaway.
Ellis Coal Co	Bronaugh, Mo. 64728	----do	Vernon.
Kirkville Coal Co., Inc	Box 332 Centerville, Iowa 52544	----do	Putnam.
Peabody Coal Co	301 North Memorial Dr. St. Louis, Mo. 63102	----do	Boone, Henry Macon, Randolph.
Veach & Haines Coal Co	Unionville, Mo. 63565	Underground mine	Putnam.

Table 19.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Copper: See Lead.			
Iodine (consumption):			
Hoffman-Taff, Inc	West Bennett Rd. Springfield, Mo. 65800	Plant	Greene.
Interstate Chemical Co., Inc.	501 Santa Fe Kansas City, Mo. 64102	----do	Jackson.
Mallinckrodt Chemical Works.	3600 North Second St. St. Louis, Mo. 63147	----do	St. Louis.
Iron ore:			
Meramec Mining Co	Route 4 Sullivan, Mo. 63080	Underground mine	Washington.
Pilot Knob Pellet Co	Box 26 Ironton, Mo. 63650	----do	Iron.
Lead:			
Cominco American, Inc	Box 430 Salem, Mo. 65560	----do	Do.
Missouri Lead Operating Co. for Amax Lead Co. and Homestake Lead Co. of Mo.	Boss, Mo. 65440	----do	Do.
Ozark Lead Co	Sweetwater, Mo. 63680	----do	Reynolds.
St. Joseph Lead Co	Bonne Terre, Mo. 63628	----do	Crawford, Iron, Reynolds, St. Francois, Washington.
Lime:			
Ash Grove Cement Co	1000 TenMain Center Kansas City, Mo. 64105	Plant	Greene.
Marblehead Lime Co	300 West Washington Chicago, Ill. 60606	----do	Marion.
Mississippi Lime Co	7 Alby Alton, Ill. 62002	----do	Ste. Genevieve.
Valley Dolomite Corp	915 Olive St. St. Louis, Mo. 63101	----do ----do	St. Francois. St. Francois.
Perlite:			
J. J. Brouk & Co	1367 South Kingshighway Blvd. St. Louis, Mo. 63110	Expanding plant	St. Louis.
Roofing Granules:			
GAF Corp	Box 278 Annapolis, Mo. 63620	Plant	Iron.
Sand and Gravel:			
Eureka Sand & Gravel Co	Rt. 1, Box 77 Eureka, Mo. 63025	Stationary	St. Louis.
Holliday Sand & Gravel Co	6811 West 63rd St. Overland Park, Kans. 66202	Dredge	Various.
Independent Gravel Co	220½ West 4th Joplin, Mo. 64801	Stationary	Jasper.
Manley Sand Division of Martin-Marietta Corp.	Rockton, Ill. 61072	----do	Jefferson.
Mississippi Sand & Matl. Co.	650 Rosedale St. Louis, Mo. 63112	Stationary and dredge	St. Louis.
Missouri Aggregates, Inc	801 South Lindberg St. St. Louis, Mo. 63100	Stationary	Do.
Missouri Gravel Co	313 16th St. Moline, Ill. 61265	Dredge	Lewis.
PPG Industries, Inc	1 Gateway Center Pittsburgh, Pa. 15219	Stationary	Jefferson.
Pennsylvania Glass Sand Corp.	Berkeley Springs, W. Va. 25411	----do	St. Louis, St. Charles.
Riverside Sand & Dredging	5000 Bussen Rd. St. Louis, Mo. 63129	Dredge	St. Louis.
St. Charles Sand Co	Rt. 1, Box 253 Bridgeton, Mo. 63042	Stationary	Do.
Simpson Material Co	15 Lookout Dr. Valley Park, Mo. 63088	Dredge	Jefferson.
Simpson Sand & Gravel Co	----do	----do	St. Louis.
Stewart Sand & Material Co.	4049 Pennsylvania Ave. Kansas City, Mo. 64111	Stationary	Jackson.
Taylor Sand & Gravel Co	Caruthersville, Mo. 63830	Dredge	Pemiscot, New Madrid.
Welton & Gray Gravel Co	Rt. 4 Ava, Mo. 65608	Portable	Douglas.
Winter Bros. Material Co	13098 Gravois Rd. St. Louis, Mo. 63127	Stationary	St. Louis.
Silver: See Lead.			
Stone:			
Brown Quarries	Washington, Mo. 68090	Quarry	Various.
Bussen Quarries, Inc	5000 Bussen Rd. St. Louis, Mo. 63129	----do	Jefferson, St. Louis.
Dundee Cement Co	P.O. Box 317 Dundee, Mich. 48131	----do	St. Louis.

Table 19.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Gordon Bros. Quarries, Inc.	Forest City, Mo. 64451	Quarry	Holt.
Mississippi Lime Co.	7 Alby St. Alton, Ill. 62002	do	Ste. Genevieve.
Missouri Portland Cement Co.	7751 Carondelet Ave. St. Louis, Mo. 63105	do	Jackson, St. Louis.
River Cement Company	Festus, Mo. 63028	do	Jefferson.
St. Charles Quarry Co.	Box 40, South River Rd. St. Charles, Mo. 63301	do	St. Charles.
Vigus Quarries, Inc.	7929 Alabama Ave. St. Louis, Mo. 63111	do	Jefferson, St. Louis.
West Lake Quarry & Material Co.	Rt. 1, Box 206 Taussig Rd. Bridgeton, Mo. 63042	do	St. Louis, Scott.
Tripoli:			
The Carborundum Co., American Tripoli Div.	Seneca, Mo. 64865	Mill	Newton.
Vermiculite:			
W. R. Grace & Co., Zonolite Div.	62 Whittemore Ave. Cambridge, Mass. 01109	Exfoliating plant	St. Louis.
Zinc: See Lead.			

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 Fred V. Carrillo,[1] Mary Anne McComb,[2] and William N. Hale [1]

In 1969, Montana mineral production was valued at $282.6 million, an increase of 24 percent compared with the 1968 value, and above the previous record value set in 1966 ($245.3 million). Both 1967 and 1968 mineral production were affected adversely by a nationwide labor dispute which idled the copper industry. The 1969 value of copper production rose 69 percent compared with the previous year. Other metals also showed significant increases in value of production: Gold (91 percent), silver (34 percent), and zinc (76 percent).

Fuels, in general, reversed last year's trends. Petroleum, after a large increase in production value in 1968, fell 5 percent in 1969. Natural gas, which declined last year, rose 139 percent. Only coal continued its trend with an increase in production value of 81 percent.

Construction materials posted strong gains as sand and gravel rose 85 percent in value of production, and stone rose 117 percent.

In November of 1968, a coal symposium was held in Billings to discuss the potentials and hazards of utilizing Montana's vast energy resource.[3]

[1] Geologist, Bureau of Mines, Albany, Oreg.
[2] Economist, Bureau of Mines, Albany, Oreg.
[3] Roys, Perry F. Coal Scrutinized. Montana Today, v. 15, No. 1, January 1970, pp. 3-4.

Table 1.—Mineral production in Montana [1]

Mineral		1968		1969	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2]	thousand short tons	30	$34	34	$63
Coal (bituminous and lignite)	do	519	1,214	1,030	2,199
Copper (recoverable content of ores, etc.)	short tons	69,480	58,151	103,314	98,219
Gem stones		NA	109	NA	109
Gold (recoverable content of ores, etc.)	troy ounces	13,385	[3] 525	24,189	[3] 1,004
Iron ore (usable)	thousand long tons, gross weight	12	W	13	W
Lead (recoverable content of ores, etc.)	short tons	1,870	494	1,753	522
Lime	thousand short tons	179	2,005	255	2,737
Manganese ore and concentrate (35 percent or more Mn)	short tons, gross weight	4,649	213	775	26
Manganiferous ore and concentrate (5 to 35 percent Mn)	do	2,063	22	------	------
Natural gas	million cubic feet	19,313	1,757	41,229	4,205
Petroleum (crude)	thousand 42-gallon barrels	48,460	124,488	43,954	118,359
Pumice	thousand short tons	93	327	134	102
Sand and gravel	do	8,762	7,754	16,595	14,383
Silver (recoverable content of ores, etc.)	thousand troy ounces	2,133	4,574	3,429	6,141
Stone	thousand short tons	3,314	4,878	7,667	10,579
Zinc (recoverable content of ores, etc.)	short tons	3,778	1,020	6,143	1,794
Value of items that cannot be disclosed: Cement, clays (bentonite), fluorspar, gypsum, natural gas liquids, peat, phosphate rock, talc, tungsten, vermiculite, and values indicated by symbol W		XX	20,566	XX	22,189
Total		XX	228,131	XX	282,631
Total 1967 constant dollars		XX	r223,063	XX	p257,898

p Preliminary. r Revised. 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 bentonite; included with "Value of items that cannot be disclosed."
[3] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

Table 2.—Value of mineral production in Montana, by counties

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Beaverhead	$716	$2,156	Stone, sand and gravel, tungsten, silver, lead, zinc, copper, gold.
Big Horn	820	1,072	Stone, petroleum, sand and gravel, lime, coal, pumice, natural gas.
Blaine	563	498	Petroleum, natural gas, coal.
Broadwater	270	369	Stone, iron ore, sand and gravel, silver, lead, zinc, gold, copper.
Carbon	7,459	7,437	Petroleum, stone, natural gas, sand and gravel.
Carter	85	153	Sand and gravel, petroleum, clays, stone.
Cascade	265	1,551	Sand and gravel, stone, clays, zinc, lead, silver.
Chouteau	173	56	Sand and gravel, stone.
Custer	W	156	Do.
Daniels	166	8	Sand and gravel.
Dawson	2,837	2,680	Petroleum, sand and gravel, stone.
Deer Lodge	1,895	2,395	Lime, stone, silver, sand and gravel, copper, gold.
Fallon	19,662	18,913	Petroleum, natural gas.
Fergus	W	W	Gypsum, sand and gravel, stone, clays.
Flathead	857	727	Sand and gravel, silver, lead, copper, zinc, stone, gold.
Gallatin	W	W	Cement, stone, sand and gravel, clays.
Garfield	-------	162	Sand and gravel.
Glacier	1,891	1,752	Petroleum, sand and gravel.
Golden Valley	31	15	Sand and gravel.
Granite	5,478	1,081	Silver, zinc, stone, sand and gravel, lead, copper, gold, clays.
Hill	125	154	Sand and gravel, natural gas, stone.
Jefferson	W	W	Cement, stone, sand and gravel, silver, lead, gold, zinc, copper, clays.
Judith Basin	14	88	Sand and gravel.
Lake	77	308	Sand and gravel, peat, stone.
Lewis and Clark	875	2,114	Zinc, sand and gravel, lead, silver, stone, gold, copper.
Liberty	1,713	1,775	Petroleum, natural gas.
Lincoln	5,325	6,561	Vermiculite, sand and gravel, stone.
McCone	2,488	1,593	Petroleum.
Madison	W	W	Talc, gold, silver, stone, copper, lead, sand and gravel, zinc.
Meagher	82	36	Sand and gravel, lead, silver, zinc, stone, gold, copper.
Mineral	200	W	Copper, silver, clays, lead, zinc, sand and gravel, gold.
Missoula	W	3,278	Sand and gravel, stone, copper, silver.
Musselshell	3,684	2,605	Petroleum, coal, sand and gravel, stone.
Park	177	191	Sand and gravel, stone, gold, copper, silver.
Petroleum	515	23	Sand and gravel.
Phillips	25	103	Sand and gravel, stone.
Pondera	54	40	Petroleum, sand and gravel.
Powder River	42,800	36,878	Petroleum, natural gas, sand and gravel, pumice, coal.
Powell	W	W	Phosphate rock, sand and gravel, gold, silver, lead, copper, zinc, stone.
Prairie	49	820	Stone, sand and gravel.
Ravalli	W	W	Fluorspar, silver, sand and gravel, lead, zinc, stone, copper, gold.
Richland	4,561	6,300	Petroleum, coal, lime, sand and gravel.
Roosevelt	5,482	5,784	Petroleum, sand and gravel, stone.
Rosebud	2,843	5,174	Petroleum, stone, coal, sand and gravel, clays.
Sanders	116	252	Sand and gravel, stone, lead, zinc, silver, gold, copper.
Sheridan	6,453	6,393	Petroleum, sand and gravel, stone.
Silver Bow	61,894	103,487	Copper, silver, gold, sand and gravel, manganese ore, clays, stone, zinc.
Stillwater	152	1,721	Stone, sand and gravel, natural gas, petroleum.
Sweet Grass	57	9	Sand and gravel.
Teton	37	105	Sand and gravel, petroleum, stone.
Toole	3,448	3,093	Petroleum, sand and gravel, natural gas.
Treasure	-------	W	Clays, stone.
Valley	67	287	Stone, sand and gravel.
Wheatland	32	136	Sand and gravel, stone.
Wibaux	14	28	Petroleum, sand and gravel.
Yellowstone	2,348	1,940	Sand and gravel, petroleum, lime, clays.
Combined counties [1]	21,978	26,387	
Undistributed [2]	17,278	23,787	
Total	228,131	282,631	

W Withheld to avoid disclosing individual company confidential data.
[1] Petroleum and natural gas production from fields underlying two or more counties.
[2] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

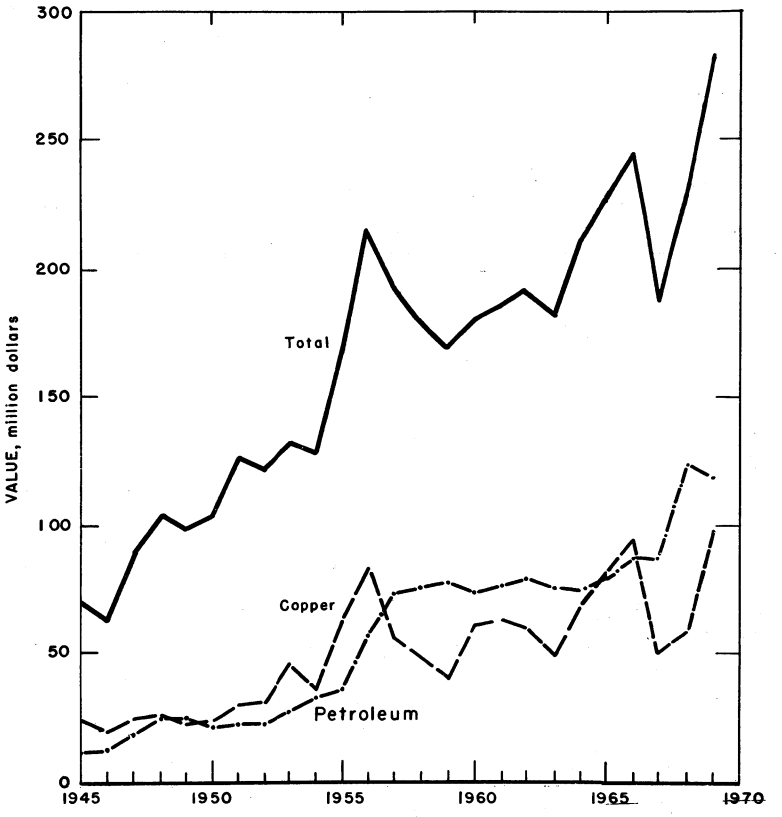

Figure 1.—Value of copper, petroleum, and total value of mineral production in Montana.

The State legislature enacted a law to which would control, but not prohibit dredge mining, which went into effect on July 1, 1969. The act, to be administered by the State Board of Health, guarantees land restoration after dredge mining, and applies to public and private land in and near stream beds. To insure compliance, miners must post bonds of $1,000 per acre. It was believed that although there had been little dredge mining in the State, this law would inhibit future dredge mining.

An article on the recycling of scrap automobiles into the steel industry was published by the University of Montana. The article was confined to the problem of the junked autos in Montana.[4]

The Anaconda Company closed its electrolytic zinc refinery at Anaconda and reactivated two units at its Great Falls refinery. About 300 workers were employed at the Anaconda plant, and most were given the option to transfer. Also, the company reopened its Anaconda copper concentrator to handle increased ore production from the nearby Butte Hill mines. This year, the city of Anaconda enjoyed the highest employment since the late 1950's.

Almost every month in 1969 showed a record high employment level, which peaked in August at 206,500 jobs. The average unemployment for the year fell to 4.5 percent from 4.7 percent in 1968. There was also an increase in the total labor force to 272,500 from 271,900 the previous year. Only the construction and government sectors had lower employment levels than in 1968.

There were no Office of Minerals Exploration contracts active during 1969.

[4] Barth, Glenn R., and H. J. Schnell. Utilization of Montana's Junked Automobiles: An Economic Analysis. Montana Business Quarterly, Winter/Spring 1969, pp. 32–40.

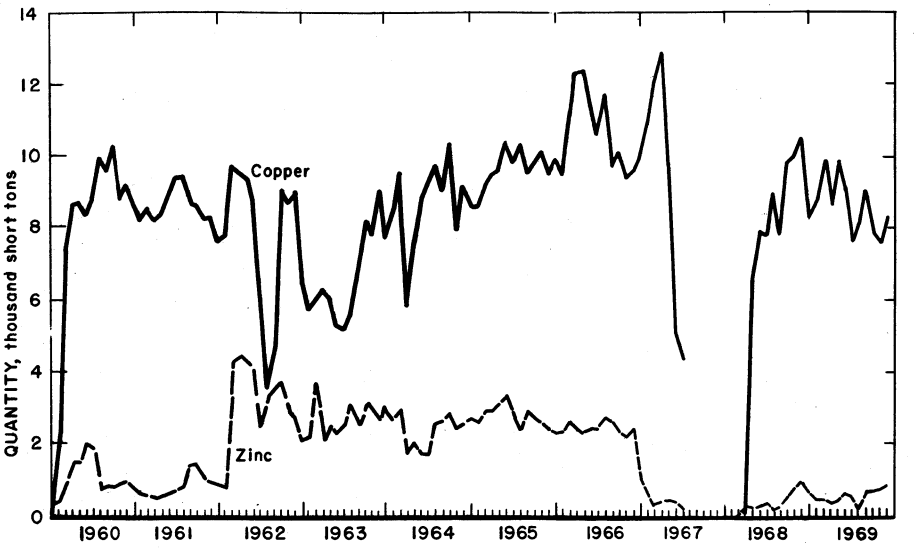

Figure 2.—Mine production of copper and zinc in Montana, by months, in terms of recoverable metals.

Table 3.—Indicators of Montana business activity

		1968	1969 p	Change, percent
Annual average employment:				
Total nonagricultural industries	thousands	194.8	196.6	+0.9
Total manufacturing	do	23.3	24.0	+3.0
Lumber and timber industries	do	8.9	8.8	−1.1
Metal-mining and primary-metal industries	do	6.0	8.0	+33.3
Contract construction	do	11.5	11.3	−1.7
Transportation and utilities	do	17.6	17.6	------
Personal income:				
Total	millions	$2,039.0	$2,168.0	+6.3
Per capita		$2,930.0	$3,124.0	+6.6
Construction activity:				
Heavy engineering awards	millions	$66.6	$114.1	+71.3
Highway construction contracts awarded	do	$39.1	$42.9	+9.7
Cement shipments to and within Montana	thousand 376-pound barrels	1,483.0	2,076.6	+40.0
Farm marketing receipts	millions	$509.5	$529.5	+3.9
Mineral production	do	$228.1	$282.6	+23.9

p Preliminary.

Sources: 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
1965	7,500	4,600	1,100	1,800	3,600	1,100
1966	7,400	4,800	1,000	1,600	3,900	1,100
1967	5,900	3,200	1,000	1,700	3,200	1,000
1968	5,500	2,300	1,000	2,200	3,700	1,100
1969 p	6,100	3,300	800	2,000	4,700	1,100

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	1965	1966	1967 [1]	1968 [2]	1969
Mining:					
Average weekly earnings	$119.12	$125.51	$131.86	$136.00	$151.62
Average weekly hours	38.8	39.1	40.2	40.0	42.0
Average hourly earnings	$3.07	$3.21	$3.28	$3.40	$3.61
Metal mining:					
Average weekly earnings	$114.39	$122.80	$129.72	$129.02	$145.60
Average weekly hours	36.9	37.9	39.1	38.4	40.9
Average hourly earnings	$3.10	$3.24	$3.32	$3.36	$3.56
Primary-metals processing:					
Average weekly earnings	$116.40	$122.25	$117.08	$128.08	$133.60
Average weekly hours	40.7	41.3	39.4	39.9	40.0
Average hourly earnings	$2.86	$2.96	$2.97	$3.21	$3.34

[1] Data for metal mining and primary-metals processing include first 7 months of year only because of strike.
[2] Data for metal mining and primary-metals processing include last 9 months of year only because of strike.

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
1965	421	7,456	$49,048	$6,578
1966	423	7,579	51,262	6,764
1967	414	7,305	52,572	7,197
1968	416	4,673	35,032	7,497
1969	440	6,146	48,736	7,930

Source: Unemployment Compensation Commission of Montana, Montana Labor Market. Industries and employment covered under unemployment insurance laws of Montana.

Table 7.—Worktime 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
1968:								
Coal and peat	67	163	11	84	--	2	23.93	203
Metal	2,960	209	617	4,946	3	75	15.77	5,151
Nonmetal	765	255	195	1,572	2	51	33.71	8,923
Sand and gravel	596	172	102	822	--	17	20.68	360
Stone	327	242	79	644	--	7	10.87	118
Total [1]	4,715	213	1,005	8,068	5	152	19.46	4,945
1969: [p]								
Coal and peat	70	171	12	90	--	2	22.16	199
Metal	2,985	279	838	6,699	2	128	19.41	3,084
Nonmetal	560	248	139	1,126	1	23	21.32	5,793
Sand and gravel	830	155	129	1,124	--	24	21.35	461
Stone	490	242	119	975	--	12	12.31	481
Total [1]	4,940	249	1,236	10,014	3	189	19.17	2,815

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

METALS

Aluminum.—Output of aluminum from the Anaconda Aluminum Co. plant at Columbia Falls surpassed 1968's record production by 47 percent. The first year of capacity production was achieved following the installation of two potlines in 1968. Shipments of alumina from Jamaica began arriving at the reduction plant in September. The raw material was routed to the Columbia Falls plant through the newly constructed unloading facilities at Everett, Wash., designed to handle 350,000 tons of alumina per year.

Cadmium.—Byproduct cadmium production from the electrolytic zinc plants at Anaconda and Great Falls was nearly 13 percent higher than that of 1968.

Copper.—Annual production of copper increased 49 percent from the 1968 total to 103,314 tons as The Anaconda Company maintained a full production schedule during the year following the 1968 strike. Anaconda company mines accounted for 103,168 tons or 99.85 percent of the total copper mined in the State. Higher prices and increased production resulted in a 69-percent increase in value to $98,219,000. Byproduct copper was produced from silver ores at the American Smelting and Refining Co. (Asarco) smelter at East Helena.

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)
1965	121	11	15,634	22,772	$797	5,207	$6,733
1966	117	5	17,645	25,009	875	5,320	6,878
1967	62	3	9,093	9,786	343	2,066	3,203
1968	143	3	10,215	13,385	525	2,133	4,574
1969	88	2	16,131	24,189	1,004	3,429	6,141
1862–1969	---	---	NA	17,824,941	408,541	865,144	667,681

Year	Copper		Lead		Zinc		Total value [3] (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	115,489	$81,766	6,981	$2,178	33,786	$9,866	$101,340
1966	128,061	92,639	4,409	1,333	29,120	8,445	110,171
1967	65,483	50,063	898	251	3,341	925	54,785
1968	69,480	58,151	1,870	494	3,778	1,020	64,764
1969	103,314	98,219	1,753	522	6,143	1,794	107,679
1862–1969	8,443,376	3,096,770	948,650	151,318	2,847,267	551,807	4,876,116

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer mines), ore milled, old tailings re-treated, and ore, old slag, and copper precipitates shipped to smelters during the calendar year indicated.
[2] Does not include gravel washed.
[3] Data may not add to totals shown because of independent rounding.

Table 9.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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 (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Ore:							
Dry gold, gold-silver, and silver [2]	57	44,207	8,465	604,620	251	1,146	266
Copper	7	16,016,931	15,420	2,555,970	181,076	-----	-----
Lead	15	2,691	264	22,803	8	683	140
Lead-zinc and zinc [2]	5	12,446	12	147,485	4	[3] 381	[3] 2,171
Total [4]	27	16,032,068	15,696	2,726,258	181,089	1,064	2,311
Other lode material:							
Silver old tailings	3	5,435	24	10,258	24	-----	-----
Copper precipitates	--	---	-----	---	25,264	-----	-----
Zinc slag	1	49,676	-----	88,178	-----	1,296	9,709
Total [4]	4	55,111	24	98,436	25,288	1,296	9,709
Total lode material	88	16,131,386	24,185	3,429,314	206,628	3,506	12,286
Total placer	2	[5]	4	-----	-----	-----	-----
Grand total [4]	90	16,131,386	24,189	3,429,314	206,628	3,506	12,286

[1] Detail will not necessarily add to total, because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual confidential data.
[3] Includes small amount of lead and zinc from copper ore.
[4] Data may not add to totals shown because of independent rounding.
[5] 48 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)
1965	7	93	161	4	1	10	11	94	171
1966	[3] 4	36	422	1	([4])	1	5	36	423
1967	[5] 3	15	141	--	--	--	3	15	141
1968	[6] 2	2	20	1	([4])	2	3	3	22
1969	[7] 1	([4])	2	1	([4])	2	2	([4])	4

[1] Combined to avoid disclosing individual confidential data.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes three dragline dredges and one power rocker.
[4] Less than ½ unit.
[5] Includes one nonfloat washing plant, one hydraulic, and one power rocker.
[6] Includes one dragline dredge and one nonfloat washing plant.
[7] Hydraulic.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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	12	--	226	$9	72,542	$130
Broadwater	4	--	W	W	7,028	13
Cascade	1	--	-------	-----	16	([1])
Deer Lodge	3	--	48	2	39,754	71
Granite	17	--	254	11	246,109	441
Jefferson	11	1	681	28	53,053	95
Lewis and Clark	5	--	88	4	97,315	174
Madison	13	--	W	W	W	W
Missoula	2	--	-------	-----	30	([1])
Park	1	--	7	([1])	19	([1])
Powell	5	--	126	5	636	1
Sanders	3	--	W	W	192	([1])
Silver Bow	5	--	15,428	640	2,563,453	4,590
Undistributed [2]	6	1	7,331	304	349,167	625
Total [3]	88	2	24,189	1,004	3,429,314	6,141

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Beaverhead	14	$13	203	$60	67	$19	$232
Broadwater	W	W	20	6	W	W	24
Cascade	-------	-------	([1])	([1])	1	([1])	([1])
Deer Lodge	2	2	-----	---	-----	-----	75
Granite	20	19	114	34	1,004	293	797
Jefferson	8	8	102	30	31	9	170
Lewis and Clark	2	2	724	216	4,859	1,419	1,815
Madison	W	W	25	7	13	4	632
Missoula	([1])	([1])	-----	---	-----	-----	([1])
Park	([1])	([1])	-----	---	-----	-----	1
Powell	([1])	([1])	4	1	([1])	([1])	8
Sanders	W	W	9	3	2	1	4
Silver Bow	103,179	98,090	-----	---	W	W	103,321
Undistributed [2]	88	84	554	165	166	48	600
Total [3]	103,314	98,219	1,753	522	6,143	1,794	107,679

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 Flathead, Meagher, Mineral, Ravalli Counties, and items indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Table 12.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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 (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Amalgamation, concentration, and smelting of concentrates [1]	15,546	2,695,841	181,183	391	2,124
Direct smelting:					
Ore	8,615	635,037	157	1,819	453
Old tailings	24	10,258	24	---	---
Precipitates	---	---	25,264	---	---
Old slag	---	88,178	---	1,296	9,709
Total	8,639	733,473	25,445	3,115	10,162
Placer	4	---	---	---	---
Grand total	24,189	3,429,314	206,628	3,506	12,286

[1] Combined to avoid disclosing individual company confidential data.

Table 13.—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			
1965	8	2	15,462	18,420	4,790
1966	5	--	17,503	21,608	4,864
1967	5	--	9,041	8,339	1,856
1968	6	--	10,089	9,782	1,466
1969	5	--	16,022	15,428	2,563
1882–1969	--	--	[2] 373,838	2,457,376	649,065

Year	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
1965	115,279	4,594	25,629	$97,373
1966	127,885	2,411	22,284	106,749
1967	65,448	64	816	53,450
1968	69,362	---	---	61,580
1969	103,179	---	W	103,321
1882–1969	8,402,961	415,425	2,406,818	4,190,009

W Withheld to avoid disclosing individual company confidential data.
[1] Does not include gravel washed.
[2] Complete data not available: 1882–1904.

The Anaconda Company announced in its annual report to stockholders that Berkeley pit ore production at Butte was increased from 43,000 tons per day to 56,000 tons per day. Total copper production for the year from the Berkeley open pit was reported to be 75,104 tons, up 57 percent from that of 1968.

The concentrator at Anaconda was reactivated to accommodate production from the Butte underground mines and the increased Berkeley pit output. Production from the underground mines remained at about 8,000 tons of ore per week. Construction began on a new ore crushing-conveying system for the Berkeley pit, estimated to cost about $6 million and described as the largest gyratory crushing plant in the American mining industry.

The announcement of two Montana properties available for immediate development was made by The Anaconda Company. The Heddleston district, north of Helena, was reported to contain a large low-grade copper-molybdenum deposit with significant silver values. Another property, in the Stillwater area near Nye, was claimed to contain large tonnages of copper-nickel ore which could be mined by open pit methods.

Exploration activity, principally in the western half of the State, continued throughout the year as the demand for copper held steady. Bear Creek Mining Co. completed a 3,000-foot exploration adit at its Spar Lake copper prospect, 20 miles south of Troy, Lincoln County. The adit was driven into the south side of Mount

Vernon to confirm mineral showings found by earlier diamond drilling from the surface. Gulf Resources & Chemical Corp. and Sun Oil Co. reported a copper discovery in Judith Basin County. A core-drilling program on Cordero Mining Co. property (a wholly owned subsidiary of Sun Oil) indicated ore-grade copper mineralization, with byproduct gold and silver.

Gold.—An increase in the average market price of gold to $41.51 per ounce and an 81-percent increase in production resulted in a 91-percent increase in value to $1,004,000. Total gold production in the State was 24,189 ounces, approximately 64 percent originating as a byproduct of copper production from the Butte area, Silver Bow County. Placer ouput declined to only 4 ounces from two operations. Ten gold mines in Granite, Jefferson, Madison, Park, Powell, and Sanders Counties contributed to the total gold production. Additional gold was obtained from nine gold-silver mines in Beaverhead, Broadwater, Jefferson, and Madison Counties.

Pacific Mines, Inc., shipped gold and silver ore from the Easton-Pacific mines in the Alder-Virginia City region of Madison County. Gold mineralization in blue shale was reported at the Miller mine in Confederate Gulch, Broadwater County.

Iron Ore.—The total State iron ore production was from the Iron Cross open pit mine of R & S Iron Co. near Radersburg. Production increased 11.6 percent to 13,067 tons of ore. The ore was used by the cement industry.

Lead.—Lead production declined nearly 6 percent from 1968 to 1,753 tons because of smaller ore shipments from the Jo Dandy, Maulden, and Sam Gaty-Franklin mines to the Asarco smelter at East Helena. Increased lead production at the Anaconda zinc fuming plant at East Helena was not sufficient to offset the decline in mine output. However, a 1.7-cent-per-pound increase in the average annual price to 14.9 cents increased the value $28,000 to $522,000. Lead production was reported from 44 operations throughout the State. The largest source was byproduct lead from the Anaconda slag fuming plant which recovered 648 tons of lead. Reported lead production at the Maulden mine in Beaverhead County was 179 tons; the Sam Gaty-Franklin mine in Lewis and Clark County yielded 75 tons. Taylor-Knapp Co. recovered 104 tons of lead from the True Fissure mine of the Taylor-Knapp Unit Area in Philipsburg, Granite County.

Manganese.—No manganese ore was mined during the year, and shipments from The Anaconda Company stockpile, totaling 775 tons, accounted for all the manganese production attributed to the State. Total shipments valued at $25,775 were 88 percent less than those of the previous year.

Nickel.—The Anaconda Company continued evaluation of a large nickel-copper deposit in the Stillwater district near Nye (Stillwater and Sweetgrass Counties). The Anaconda Company annual report stated that the properties contain what may prove to be one of the largest concentrations of copper-nickel mineralization yet found in the United States.

Silver.—Byproduct silver from the Butte mines of The Anaconda Company accounted for 2,555,000 ounces, or 75 percent of the total silver produced in the State. Total production of 3,429,000 ounces was a 61-percent increase from 1968 and reflected the increase in copper production for 1969. Because of a drop in the average annual price of silver to $1.79 per ounce, the total value for the year increased only 34 percent to $6,141,000.

Silver output came from 86 operations in 17 counties, including 38 mines classified as principally silver producers. Only Silver Bow County with 2,563,453 ounces, Granite County with 246,109 ounces, Madison County, and Flathead County had mine outputs exceeding 100,000 ounces. Significant amounts (more than 10,000 ounces) were also reported from mines in Beaverhead, Deer Lodge, Jefferson, Lewis and Clark, Mineral, and Ravalli Counties.

Interest in locating and developing silver deposits in mining regions throughout the State remained high. Rehabilitation work continued at the Nancy Lee mine near Superior, Mineral County, and surface geochemical and drilling programs were initiated. A drilling program was conducted at the Crystal mine near Basin, Jefferson County, by Utica Mines, Ltd., of Vancouver, British Columbia, Canada.

In Beaverhead County, Spokane National Mines, Inc., reported that additional reserves were developed at the New Departure and Cottontail mines near Dillon. Production at the New Departure mine was 3,255 ounces of silver from 300 tons of ore. Big West Resources, Inc., shipped 125

tons of ore containing 2,345 ounces of silver from a new discovery in the Argenta district. Midnight Mines, Inc., explored the Polaris mine with crosscutting and diamond drilling and shipped 171 tons of ore containing 4,911 ounces of silver. The Maulden mine reported 4,057 ounces of silver production from 1,720 tons of lead ore.

Several mines in the Philipsburg district of Granite County shipped ore containing significant amounts of silver. Typical among them was the Comanche Extension mine which yielded 12,309 ounces of silver from 1,450 tons of ore. The largest production in the area came from the True Fissure mine of Taylor-Knapp Co.; shipments of 11,098 tons of ore contained 115,170 ounces of silver.

Thorium.—A research paper was published by the Idaho Nuclear Energy Commission describing thorium deposits of the Lemhi Pass area.[5]

Tungsten.—No tungsten production was reported in the State during the second half of the year, resulting in a 27-percent decline in the annual production total. Tungsten production at the Calvert Creek properties in Beaverhead County was halted in June by foreclosure proceedings initiated against Minerals Engineering Co. by General Electric Co. The mine was closed, and the mill was placed on a standby basis.

Asarco acquired a lease and began surface investigations on a small group of claims on Goat Creek near Thompson Falls, reported to have tungsten and molybdenum.

Zinc.—Output continued to be derived from both byproduct production at copper mining operations and from various small lead-zinc-silver operations. Increased recovery from Anaconda's slag fuming plant at East Helena accounted for most of the 63-percent rise in the State total to 6,143 tons. Byproduct zinc from the Anaconda plant was the largest source, accounting for 4,855 tons or 79 percent of the total. Zinc production was reported from 44 operations throughout the State including two mines classified as principally zinc producers and three mines classified as principally lead-zinc producers.

The largest zinc mining operation in the State was at the Taylor-Knapp Unit Area in Granite County where 974 tons of zinc, 104 tons of lead, and 115,170 ounces of silver were recovered from 11,098 tons of ore.

The Anaconda Company closed the electrolytic zinc refinery at Anaconda in August because of insufficient foreign concentrates to continue production at both the Anaconda and the Great Falls refineries. The shutdown involved four refining units at the plant which produced over 48,000 tons of zinc in 1968. At the same time, two additional zinc units were reactivated at the Great Falls refinery. The Anaconda plant's roaster was kept in operation.

NONMETALS

Cement.—The quantity of cement shipments increased 57 percent over the 1968 total. The increase was due mainly to cement used in the concrete pour at Libby Dam, averaging 6,000 cubic yards per day toward yearend. Output was by Kaiser Cement & Gypsum Corp. at Montana City, Jefferson County, and by Ideal Basic Industries, Inc., (formerly Ideal Cement Co.) at Trident, Gallatin County. Destinations within the State accounted for 55 percent of the cement sold. Shipments also were made to Idaho (20 percent), North Dakota (10 percent), Washington (6 percent), Wyoming (5 percent), Utah (3 percent), and Oregon and Colorado (combined less than 1 percent).

Of the total cement shipped, 58 percent was transported by rail and 42 percent by truck. The ratio of bulk to packaged shipments was about 13:1. About 42 percent of the portland cement produced was distributed to firms manufacturing commercial concrete products, such as ready-mixed concrete companies (33 percent), concrete product manufacturers (4 percent), and building material dealers (5 percent). The other 58 percent was sold to highway (17 percent) and other contractors (35 percent) and to miscellaneous customers (6 percent).

The complex system of cement, fly ash, and mineral aggregate supply for concrete production at Libby Dam was the subject of a report.[6]

Clays.—Miscellaneous clay and shale sold or used by producers increased 13 percent, but bentonite output declined 16 percent

[5] Geach, Robert. Thorium Reserves in Montana. Transactions of Thorium Information Meeting, Idaho Nuclear Energy Commission, 1969.

[6] Pacific Builder & Engineer. Access at Libby Dam—Tall Trestle in Dam Axis. Published by Construction Publications/West, Inc., Sept. 19, 1969, pp. 28–30.

from the 1968 total. Miscellaneous clay and shale for making heavy clay products, mainly building brick and draintile, was dug by Lewistown Brick & Tile Co. near Lewistown, Fergus County, and by Lovell Clay Products Co. near Billings, Yellowstone County. Miscellaneous clay and shale was dug for lining a slag-run ditch by Stauffer Chemical Co. at Butte, Silver Bow County.

Clay and shale for use in lightweight aggregate came from an operation of Treasurelite Division of Treasure State Industrial Products, Inc., near Great Falls, Cascade County, and from an operation of Kanta Products, Inc., at Logan, Gallatin County. Treasure State Industrial Products, Inc., improved instrumentation of the kiln and cooler, and increased the capacity of expanded shale at its Great Falls, Cascade County, Treasurelite lightweight-aggregate plant from 3 to 8 cubic yards (about 5.4 tons) per hour. The firm planned to revamp crushing and screening facilities at the plant over the next 2 years. The operation of plant facilities was described.[7] [8]

The Montana City pit (Jefferson County) of Kaiser Cement & Gypsum Corp. and the Trident quarry (Gallatin County) of Ideal Basic Industries, Inc., were sources of clay and shale used in manufacturing cement.

Hallett Minerals Co. mined bentonite near Vananda, Rosebud County, and shipped the material to Duluth, Minn., for processing into a product suitable for use as a binder in pelletizing iron ore concentrate. The Montana State Highway Department dug bentonite in Granite and Mineral Counties for use as a ditch liner in road construction. National Lead Co. continued mining bentonite near Colony, Carter County, for use in oil-well-drilling muds.

Ashland Chemical Co., Division of Ashland Oil & Refining Co., began construction 18 miles south of Glasgow, Valley County, of a bentonitic-clay processing facility designed to make granular and pulverized material from clay dug at the Brazil Creek Bentonite Co. deposit. Construction continued on a railroad spur to serve the plant.

Bentonite deposits in Montana were described.[9]

Fluorspar.—Roberts Mining Co. mined fluorspar at the Crystal Mountain mine, Ravalli County. The material, upgraded to metallurgical-grade fluorspar by milling at a heavy-media separation plant at Darby, was marketed largely to the steel industry.

Gem Stones.—Sapphire properties in Judith Basin and Lewis and Clark Counties were the subjects of articles.[10] [11]

Gypsum.—The tonnage of gypsum mined declined 4 percent below the 1968 total. Gypsum mined by United States Gypsum Co. from the Shoemaker mine near Heath, Fergus County, was calcined and marketed as ground gypsum.

Lime.—Output of lime increased 42 percent over the 1968 total mainly because of increased consumption for metallurgical use and for water treatment. Lime used in manufacturing sugar also was above the previous year output.

Lime was manufactured at Anaconda, Deer Lodge County, by The Anaconda Company for metallurgial use and for water treatment of tailing disposal systems. Limestone for the operation came from the Browns quarry near the lime plant. Lime was manufactured for use in sugar refining at plants in Sidney, Richland County, and Harden, Big Horn County, by Holly Sugar Corp., and at Billings, Yellowstone County, by the Great Western Sugar Co.

Phosphate Rock.—The quantity of marketable phosphate rock production declined 48 percent, chiefly from continued effects of phasing out mining operations in Beaverhead, Granite, and Silver Bow Counties.

Output of phosphate rock, all from operations in Powell County, was by Cominco American, Inc., from the Anderson-Brock and Warm Springs mines and by George Relyea from the Relyea mine. The phosphate rock was of suitable grade for processing without further beneficiation and went either directly to consumers in the Rocky Mountain States or to Trail, British Columbia, Canada, for manufacturing phosphate fertilizers by the Consolidated Mining & Smelting Co. of Canada

[7] Levine, Sidney. Montana Lightweight Producer Expands to Satisfy Growing Market. Rock Products, v. 72, No. 3, March 1969, pp. 64–66.
[8] Trauffer, Walter E. Montana Lightweight Aggregate Plant Expanded. Pit and Quarry, v. 61, No. 11, May 1969, pp. 169–171, 178.
[9] Berg, R. B. Bentonite in Montana. Montana Bureau of Mines and Geology, Bull. 74, 1969, 34 pp.
[10] Yaras, Herman. Precious Yogo Sapphires Will Again Gleam Among the World's Precious Jewels. Lapidary Journal, April 1969, pp. 178–180.
[11] Young, Marjorie Williams. Sapphires on Eldorado Bar. Gems and Minerals, August 1969, pp. 29–31.

Ltd. Late in the year, Cominco American, Inc., announced that continued weakening of the fertilizer market made curtailment necessary at the Anderson and Warm Springs sections of the Brock mine, and the firm centered all remaining phosphate mining operations in Montana at the Brock mine proper near Garrison.

Stauffer Chemical Co. operated its elemental phosphorus plant at Silver Bow on rock supplied from the company strip-mining operation at Soda Springs, Idaho.

Rocky Mountain Phosphates, Inc., continued to be involved in litigation over alleged responsibility by the company for air pollution from its phosphate-rock defluorinating plant at Garrison.

Sand and Gravel.—Output of sand and gravel nearly doubled, increasing 89 percent over the 1968 total because of greater requirements by the State highway department in road construction and maintenance. The tonnage used was greater than the previous year for the U.S. Army Corps of Engineers at the Libby, Lincoln County, dam construction project.

Commercial sand and gravel firms operated 35 plants—25 stationary and 10 portable—in producing 2.1 million tons. Government-and-contractor production (largely for roads and dam construction by Federal, State, and local government agencies) totaled 14.5 million tons from 37 plants—seven stationary and 30 portable.

Sand and gravel was produced in 51 of the 56 counties in the State. Output exceeded 1 million tons in Cascade, Lincoln, Missoula, and Yellowstone Counties. The use distribution of sand and gravel output was road material, 84 percent; building, 4 percent; and miscellaneous uses, including fill and railroad ballast, 12 percent.

Stone.—Output of stone more than doubled, mainly because of increased usage at State Highway Department projects. Stone was produced in 38 counties; output exceeded 1 million tons in Jefferson and Rosebud Counties and was more than ¾ million tons in Beaverhead and Stillwater Counties.

Traprock (commonly basalt or other dark, fine-grained igneous rock), miscellaneous stone (unclassified as to type), granite, limestone, marble, sandstone, quartz, and quartzite were produced. The traprock and miscellaneous stone came from 48 quarries and was used mainly in road construction (5.4 million tons), but some (638,000 tons) was used as riprap; as fill, and as railroad ballast.

Limestone output totaling 1.4 million tons came from six quarries, and it was used for manufacturing cement, for making lime, and for metallurgical purposes. Some was used as riprap at construction projects. Limestone was produced in Broadwater, Carbon, Deer Lodge, Gallatin, and Jefferson Counties.

Table 14.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	788	$1,284	626	$1,010
Road material	1,210	1,128	1,129	1,393
Fill	222	178	158	112
Other[1]	212	296	228	339
Total	2,432	2,886	2,141	2,854
Government-and-contractor operations:				
Building	13	5	9	24
Road material	4,971	3,230	12,783	10,655
Fill	473	343	300	169
Other[1]	873	1,290	1,362	681
Total	6,330	4,868	14,454	11,529
All operations:				
Building	801	1,289	635	1,034
Road material	6,181	4,358	13,912	12,048
Fill	695	521	458	281
Other[1]	1,085	1,586	1,590	1,020
Grand total	8,762	7,754	16,595	14,383

[1] Includes special sands and sand and gravel used for railroad ballast and miscellaneous purposes.

Granite from four quarries in Carbon, Flathead, and Gallatin Counties was used as riprap in jetty construction.

Marble output from three quarries in Madison and Park Counties was crushed and sized and used for roofing granules, for poultry grit, for manufacturing cement, and for road construction.

Sandstone, quartz, and quartzite output for use as industrial silica came from 11 quarries in Beaverhead, Big Horn, Dawson, Deer Lodge, Gallatin, Jefferson, and Ravalli Counties. Quartz output from two quarries was used as dimension stone, and as riprap for jetty construction. Crushed and sized silica products were used in manufacturing cement, ferrosilicon, and for metallurgical purposes.

Sulfur.—Production of high-purity elemental sulfur from oil refinery waste gases increased over the 1968 total. Montana Sulphur & Chemical Co. recovered sulfur from hydrogen sulfide gas byproducts obtained from oil-refining operations of Continental Oil Co. and Humble Oil & Refining Co. at Billings. Farmers Union Central Exchange began operating a 28-ton-per-day elemental sulfur recovery system that was contingent upon byproduct hydrogen sulfide gas received from its oil-refining operation at Laurel, Yellowstone County.

Talc.—Production of talc increased 48 percent over the 1968 total. Talc mined by two companies, at one mine in Beaverhead County and at four mines in Madison County, was ground and sized at plants in Beaverhead and Gallatin Counties. Some was shipped out of State for grinding.

Chas. Pfizer & Co., Inc., Minerals, Pigments, and Metals Division, continued mining talc at the Smith-Dillon-Crown mine about 11 miles southeast of Dillon, Beaverhead County, and hauled the material to a company grinding mill at Barratts for processing. Talc from the firm's Regal-Keystone and Treasure State mines in Madison County also was hauled to the plant at Barratts for grinding. Some of the talc mined by the firm in Montana was shipped to a grinding plant of Pomona Tile Division, American Olean Tile Co., Pomona, Calif.

The United Sierra Division, Cyprus Mines Corp., mined talc at the Yellowstone mine in Johnny Gulch, 15 miles south of Cameron, Madison County, and at the Beaverhead mine in the Stone Creek district of the Ruby Range about 10 miles southwest of Alder, Madison County. The material was processed at a company grinding plant at Three Forks, Gallatin County. Some was trucked to a Northern Pacific Railway siding at Norris, from where it was transshipped to a company grinding plant at Grand Island, Nebr. The firm tested the grinding capability of a mill installed at Alder, Madison County.

The use distribution of talc by industry was paper, 34 percent; paint, 23 percent; ceramics, 13 percent; and exports and miscellaneous uses, including insecticides, rice polishing, textiles, toilet preparations, and some undetermined end uses, 30 percent.

Vermiculite.—Crude vermiculite production increased 6 percent over the 1968 total. The open pit mine of the Zonolite Division, W. R. Grace & Co., about 6 miles northeast of Libby, Lincoln County, continued to be the principal source of vermiculite in the United States. Crude ore was milled at the mine site, and the sized concentrate was shipped largely out of State for processing at both company and other custom exfoliating plants. Some of the processed material was exfoliated by Robinson Insulation Co. at Great Falls.

MINERAL FUELS

Coal.—Output of bituminous coal and lignite, reaching over 1 million tons, almost doubled the 1968 total. The increase was due to continued expansion of coal-mining facilities at Colstrip, Rosebud County, to meet requirements of coal-fired steam-electric plants of Montana Power Co. at Billings and of Minnesota Power & Light Co. at Cohasset, Minn. Of 12 active mines in six counties, seven were underground and five were strip-mining operations.

Coal was produced at 12 mines, seven underground and five strip-mining operations in six counties. The principal source of bituminous coal was the Colstrip mine of Western Energy Co., followed by output from the Big Sky mine of Peabody Coal Co., both near Colstrip, Rosebud County. The unit train technique of coal transportation sharply reduced the fuel costs at the coal-fired steam-electric plant and improved the competitive position of Montana coal reserves. Four unit trains of 100 cars each delivered bituminous coal each month from the Peabody Coal Co. Big Sky mine operation at Colstrip over 850 miles

Table 15.—Coal (bituminous) production [1] in 1969, by counties

(Thousand short tons and thousand dollars)

County	Number of mines by type of operation		Production total	
	Underground	Strip	Quantity	Value
Big Horn	--	1	2	$15
Musselshell	6	--	33	305
Powder River	--	1	1	7
Richland	--	1	307	(2)
Blaine and Rosebud	1	2	687	1,872
Total	7	5	1,030	2,199

[1] Excludes mines producing less than 1,000 tons.
[2] Value included with Blaine and Rosebud Counties.

to the Cohasset, Minn., steam-electric generating station of Minnesota Power & Light Co. Shipments were started under terms of a freight rate established by the Interstate Commerce Commission (ICC) at $3.65 per ton for the haul from Colstrip to Cohasset, Minn. By 1973, when Minnesota Power & Light Co. has completed construction of the coal-fired steam-electric generating plant at Cohasset and shipments of coal from Colstrip have approached 2 million tons per year, the freight rate would be reduced to $2.74 per ton. Throughout the year, bituminous coal was delivered over 100 miles by unit train from the Western Energy Co. (a subsidiary of Montana Power Co.) Colstrip mine operation at Colstrip to the Montana Power Co. coal-fired steam-electric generating plant at Billings.

Lignite was produced at two strip-mining operations in two counties. The principal source of lignite was the Knife River Coal Mining Co. Savage mine near Sidney, Richland County. Output from the Savage strip-mining operation was used as a fuel in the Montana-Dakota Utilities Co. coal-fired steam-electric generating plant at Sidney.

The Montana legislature enacted a measure supplementing a 1967 law under which surface coal mine operators were encouraged to enter into voluntary mined-land reclamation agreements with the State. Although the new law makes previous voluntary agreements attractive, it provides a credit incentive to operators whereby one-half the cost of reclamation can be applied against the State's coal mine license tax. The sociopolitical aspects related to establishment of a workable system for mined-land reclamation was the subject of a report.[12] The feasibility of developing Montana coal reserves by strip mining was analyzed.[13] A report was published on the Foster Creek coal deposit in southeastern Montana.[14]

Petroleum and Natural Gas.—Recovery of crude petroleum declined 9 percent from the 1968 alltime high of 48.5 million barrels. Petroleum represented about 42 percent of the State mineral production value. About 67 percent of the crude oil recovered came from six fields—the Bell Creek field (13.2 million barrels) in southeastern Montana Powder River Basin; the Cabin Creek (3.6 million barrels), Pine (3.6 million barrels), and Pennel fields (1.7 million barrels) in the Williston Basin; the Cut Bank field (5.0 million barrels) in northern Montana; and the Elk Basin field (2.4 million barrels) in south-central Montana.

The Bell Creek field continued as the largest source of petroleum in the State, accounting for 30 percent of total production. Cumulative production since its discovery in 1967 was estimated at 31.5 million barrels of oil and 10 billion cubic feet of gas. Following the Bell Creek field discovery in Montana, exploration for petroleum and natural gas in the Lower Cretaceous Muddy Formation spread to correlative rock units in Wyoming and North and South Dakota, but major production from reservoirs in the formation was centered in Powder River County, Mont., and Campbell County, Wyo. An estimated 12

[12] Groff, Sidney L. Voluntary Mined-Land Reclamation in Montana. Mining Congress Jounral, v. 55, No. 10, October 1969, pp. 46–50.
[13] Phelps, E. R. Recent Developments in Lignite and Subbituminous Coal in Montana. Skillings Mining Review, Mar. 15, 1969, pp. 11–12, 20.
[14] Gilmour, Ernest H., and Loren A. Williams. Geology and Coal Resources of the Foster Creek Coal Deposit, Eastern Montana. Montana Bureau of Mines and Geology, Bull. 73, June 1969, 9 pp.

to 15 million acres of petroleum leases on private and public land in the four-State area was held for exploring rock units correlating with the Lower Cretaceous Muddy formation.

Marketed production of natural gas more than doubled, reaching an alltime high for the State of 41.2 billion cubic feet (bcf). Withdrawal of natural gas was highest in the Bell Creek field, with output totaling 9.2 bcf. The Cut Bank field ranked second with production of 7.3 bcf; the Cedar Creek field, with output of 5.3 bcf, was third. Over 2 bcf came from the Keith Block field, and fields exceeding 1 bcf were Bowdoin, Cabin Creek, Lake Basin, Whitlash, and Big Coulee. Development of natural gas reserves in the Tiger Ridge gasfield, discovered by High Crest Oils, Inc., in 1967 on the north flank of the Bearpaw Mountains in north-central Montana, has awaited an outlet to major markets. Early in the year, Northern Natural Gas Co. contracted with High Crest Oils, Inc., and other field developers for natural gas reserves in the Tiger Ridge field. The firm announced plans to build a pipeline from Tiger Ridge field to Saskatchewan, Canada, to connect with a major line from Alberta, Canada, to North Branch, Minn. Announced plans for delivery during 1970 of gas from the Tiger Ridge field could more than double the natural gas production in Montana. The limits of the Tiger Ridge gasfield were extended to 215 square miles with the north and west borders of the field remaining to be delineated.

There were 806 wells drilled for oil and gas. Exploratory drilling totaled 486 wells, of which 15 were oil discoveries, five were gas wells, and 466 were dry holes. Development drilling totaled 320 wells, of which 171 were oil producers, 44 were gas producers, and 105 were dry holes. Exploratory and development drilling was most extensive in Powder River County in the vicinity of the Bell Creek field where 164 wells were drilled, including 60 oil producers and 104 dry holes. The average well depth was 5,181 feet. An estimated 135 wells were drilled in the vicinity of the Tiger Ridge

Table 16.—Oil and gas wells drilled in 1969, by counties

County	Exploratory wells			Proved field wells			Total	
	Dry	Oil	Gas	Dry	Oil	Gas	Wells	Footage
Big Horn	20	---	---	---	---	---	20	141,171
Blaine	39	---	2	5	---	9	55	138,187
Carbon	---	1	---	3	2	---	6	48,824
Carter	46	---	---	---	---	---	46	187,622
Chouteau	13	---	---	---	---	---	13	23,462
Custer	27	---	---	---	---	---	27	147,180
Daniels	5	---	---	---	---	---	5	38,726
Dawson	10	---	---	---	---	---	10	73,917
Fallon	6	1	---	1	12	---	20	150,837
Fergus	10	---	---	---	---	---	10	27,837
Garfield	7	---	---	---	---	---	7	36,489
Glacier	3	---	---	3	35	---	41	133,826
Hill	38	---	3	18	---	21	80	129,458
Lewis and Clark	1	---	---	---	---	---	1	3,728
Liberty	8	---	---	7	3	7	25	60,814
McCone	18	1	---	---	---	---	19	112,073
Meagher	1	---	---	---	---	---	1	1,841
Musselshell	10	---	---	4	2	---	16	80,292
Petroleum	2	---	---	1	3	---	6	11,930
Phillips	14	---	---	---	---	---	14	50,316
Pondera	8	---	---	6	30	---	44	142,009
Powder River	74	2	---	30	58	---	164	849,714
Prairie	6	---	---	---	---	---	6	34,452
Richland	12	4	---	4	7	---	27	288,067
Roosevelt	12	4	---	4	2	---	22	209,443
Rosebud	19	---	---	5	1	---	25	143,589
Sheridan	9	1	---	6	8	---	24	202,808
Stillwater	1	---	---	---	---	---	1	3,300
Teton	5	---	---	---	---	---	5	12,783
Toole	23	---	---	8	7	7	45	88,274
Treasure	1	---	---	---	---	---	1	6,591
Valley	6	---	---	---	---	---	6	23,302
Wheatland	1	---	---	---	---	---	1	2,320
Wibaux	5	1	---	---	1	---	7	48,936
Yellowstone	6	---	---	---	---	---	6	28,640
Total	466	15	5	105	171	44	806	3,682,758

Source: Oil and Gas Conservation Commission of the State of Montana.

gasfield in Blaine (55 wells) and Hill (80 wells) Counties. The exploratory and development drilling at Tiger Ridge field resulted in 35 gas-producing wells, 11 in Blaine County and 24 in Hill County. The average well drilling depth in Blaine County was 2,512 feet, and in Hill County, average drilling depth was 1,618 feet.

An estimated 40.4 million barrels of crude oil was processed at the nine oil refineries. Montana wells supplied 24 percent of the crude oil refined; 65 percent came from Wyoming and 11 percent came from Canadian wells.

There were 54 active secondary recovery projects; 51 were waterflooding and three were gas injection projects. Seven waterflood projects were started.

Petroleum exploration and development on Northern Pacific Railway lands (over 3 million acres in Montana and North Dakota) were described.[15]

[15] Go With Northern Pacific Railway. Oil—Black Gold. Published by Northern Pacific Railway Co., v. I, No. 4, August 1969, pp. 2–6.

Table 17.—Principal producers

Commodity and company	Address	Type of activity	County
Metals:			
Aluminum:			
Anaconda Aluminum Co	Columbia Falls, Montana 59912	Plant	Flathead.
	Great Falls, Montana 59401	Rolling mill	Cascade.
Copper:			
The Anaconda Company	Anaconda, Montana 59711	Smelter	Deer Lodge.
	Butte, Montana 59701	Mine, concentrator, precipitating plant.	Silver Bow.
	Great Falls, Montana 59401	Refinery, rolling mill.	Cascade.
Gold:			
The Anaconda Company	Butte, Montana 59701	Mine, concentrator.	Silver Bow.
Richard Arnold, Norman Boe	Boulder, Montana 59632	Mine	Jefferson.
E. L. Burns	White Sulphur Springs, Montana 59645.	Placer	Meagher.
Conda Butte Exploration, Inc	Butte, Montana 59701	Mine	Jefferson.
Maurice R. Haigh	Three Forks, Montana 59752	Placer	Do.
W. A. Hall	Helena, Montana 59601	Mine	Powell.
Pacific Mines, Inc	Virginia City, Montana 59755	----do	Madison.
John H. Patterson	Silver Star, Montana 59751	----do	Do.
John J. Rothfus	Butte, Montana 59701	----do	Jefferson.
Iron ore:			
R & S Iron Co	Radersburg, Montana 59641	----do	Broadwater.
Lead-zinc:			
American Smelting and Refining Co.	East Helena, Montana 59635	Smelter	Lewis and Clark.
The Anaconda Company	----do	Slag fuming plant.	Do.
	Great Falls, Montana 59401	Zinc plant	Cascade.
	Anaconda, Montana 59711	Smelter	Deer Lodge.
The Bunker Hill Co	Kellogg, Idaho 83837	Mine	Mineral.
John H. Byrd	Helena, Montana 59601	----do	Lewis and Clark.
Champion Oil & Mining Co	Victor, Montana 59875	----do	Ravalli.
Flathead Mines, Inc	Kalispell, Montana 59901	----do	Flathead.
John Hand	Dillon, Montana 59725	----do	Beaverhead.
Taylor-Knapp Co	Philipsburg, Montana 59858	Mine and mill	Granite.
Silver:			
The Anaconda Company	Butte, Montana 59701	Mine, concentrator.	Silver Bow.
Frank Antonioli, Joe Metesh	Butte, Montana 59701	Mine	Do.
Delbert Bullock	Basin, Montana 59631	----do	Jefferson.
The Bunker Hill Co	Kellogg, Idaho 83837	----do	Mineral.
Champion Silver Mining Co	Warm Springs, Montana 59756	----do	Deer Lodge.
Flathead Mines, Inc	Kalispell, Montana 59901	----do	Flathead.
Harold Giulio	Boulder, Montana 59632	----do	Jefferson.
William C. Montgomery	Anaconda, Montana 59711	----do	Deer Lodge.
Pacific Mines, Inc	Virginia City, Montana 59755	----do	Madison.
Taylor-Knapp Co	Philipsburg, Montana 59858	Mine and mill	Granite.
Dick Tunstill	Philipsburg, Montana 59858	Mine	Beaverhead, Granite.
Albert Walkup	Philipsburg, Montana 59858	----do	Do.
James W. Young	Philipsburg, Montana 59858	----do	Do.
Tungsten:			
Minerals Engineering Co	Glen, Montana 59732	Mine and mill	Beaverhead.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Nonmetals:			
Cement:			
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colorado 80202	Plant	Gallatin.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, California 95014	do	Jefferson.
Clay:			
Hallett Minerals Co	P.O. Box 491 Forsyth, Montana 59327	Pit	Rosebud, Treasure.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colorado 80202	Pit and plant	Gallatin.
Kanta Products, Inc	P.O. Box 96 Three Forks, Montana 59752	do	Do.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, California 95014	do	Jefferson.
Lewistown Brick & Tile Co	P.O. Box 573 Lewistown, Montana 59457	do	Fergus.
Lovell Clay Products Co	1312 Lockwood Road Billings, Montana 59101	do	Yellowstone.
National Lead Co	P.O. Box 1675 Houston, Texas 77001	Pit	Carter.
Stauffer Chemical Co	P.O. Box 3146 Butte, Montana 59701	Pit and plant	Silver Bow.
Treasurelite, Division of Treasure State Industrial Products, Inc.	P.O. Box 2750 Great Falls, Montana 59401	do	Cascade.
Van Gordon, Wesley	P.O. Box 5 Cardwell, Montana 59721	do	Jefferson.
Fluorspar:			
Roberts Mining Co	P.O. Box 365 Darby, Montana 59829	Mine and plant	Ravalli.
Gypsum:			
United States Gypsum Co	Lewistown, Montana 59457	Mine	Fergus.
Lime:			
The Anaconda Company	Butte, Montana 59701	Plant	Deer Lodge.
Phosphate rock:			
Cominco American, Inc	Garrison, Montana 59731	Mine and plant	Powell.
Relyea Mines	Garrison, Montana 59731	Mine	Do.
Sand and gravel:			
Billings Sand & Gravel	215 N. 16th St. Billings, Montana 59101	Pit and plant	Yellowstone.
Empire Sand & Gravel	Box 180 Billings, Montana 59101	do	Do.
Engebretson Gravel, Inc	1200 E. Oregon St. Kalispell, Montana 59901	do	Lincoln.
M & S Ready Mix	Missoula, Montana 59801	do	Missoula.
McElroy & Wilken, Inc	Box 35 Kalispell, Montana 59901	do	Flathead.
Midland Materials Co	Box 2521 Billings, Montana 59103	do	Yellowstone.
Pioneer Ready Mix	Box 818 Bozeman, Montana 59715	do	Gallatin.
Richardson Constr. Co	Box 449 Miles City, Montana 59301	do	Various.
Tressler Lowe Ready Mix Conc., Inc.	Box 797 Helena, Montana 59601	do	Lewis and Clark.
Western Gravel Supply	Glendive, Montana 59330	do	Dawson.
Stone:			
The Anaconda Company	Anaconda, Montana 59711	Quarry and plant.	Deer Lodge.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colorado 80202	do	Gallatin.
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, California 95014	do	Jefferson.
Morrison-Knudsen Co., Inc	603 Hoge Bldg. Seattle, Washington 98104	do	Lincoln.
Northern Pacific Railway Co	176 E. 5th St. St. Paul, Minnesota 55101	do	Missoula.
Stauffer Chemical Co	299 Park Ave. New York, New York 10017	do	Beaverhead.
Washington Constr. Co	500 Taylor Missoula, Montana 59801	do	Granite.
Sulfur:			
Farmer's Union Central Exchange, Inc.	P.O. Box 126 Laurel, Montana 59044	Plant	Yellowstone.
Montana Sulphur & Chemical Co.	P.O. Box 1084 Billings, Montana 59103	do	Do.
Sulfuric acid:			
The Anaconda Company	Anaconda, Montana 59711	do	Deer Lodge.

Table 17.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Nonmetals—Continued			
Talc and soapstone:			
Chas. Pfizer & Co., Inc	Dillon, Montana 59725	Plant	Beaverhead.
		Mine	Madison.
United Sierra Division of Cyprus Mines Corp.	Cameron, Montana 59720	----do	Do.
	Three Forks, Montana 59752	Plant	Gallatin.
Vermiculite:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Massachusetts 01109	Pit and plant	Lincoln.
Exfoliated vermiculite:			
Robinson Insulation Co	12th St. N. & River Drive Great Falls, Montana 59401	Plant	Cascade.
Mineral fuels:			
Coal:			
Divide Coal Mining Co	P.O. Box 342 Roundup, Montana 59072	Mine	Musselshell.
Knife River Coal Mining Co	Savage, Montana 59262	----do	Richland.
Milk River Coal Mine Co	Box 472 Chinook, Montana 59523	----do	Blaine.
Nies Coal Co	905 First St. W Roundup, Montana 59072	----do	Musselshell.
Peabody Coal Co	Box 235 St. Louis, Missouri 63166	----do	Rosebud.
P & M Coal Mine	Goulding Creek Route Roundup, Montana 59072	----do	Musselshell.
Rosebud Coal Sales Co	P.O. Box 724 Sheridan, Wyoming 82801	----do	Big Horn.
John H. Schoonover	P.O. Box 94 Ashland, Montana 59003	----do	Powder River.
Square Deal Coal Co	220 7th St. W. Roundup, Montana 59072	----do	Musselshell.
Western Coal Co	P.O. Box 153 Roundup, Montana 59072	----do	Do.
Western Energy Co	40 E. Broadway Butte, Montana 59701	----do	Rosebud.
Natural gas processing:			
Union Oil Co	Cut Bank, Montana 59427	Plant	Glacier.
Union Texas Natural Gasoline Corp.	Baker, Montana 59313	----do	Wibaux, Fallon.
Peat:			
Martin's Peat & Potting Soils	Swan Lake, Montana 59872	Bog	Lake.
Petroleum Refining:			
Big West Oil Co	Kevin, Montana 59454	Refinery	Toole.
Continental Oil Co	Billings, Montana 59101	----do	Yellowstone.
Diamond Asphalt Co	Chinook, Montana 59523	----do	Blaine.
Farmer's Union Central Exchange, Inc.	Laurel, Montana 59044	----do	Yellowstone.
Humble Oil & Refining Co	Billings, Montana 59101	----do	Do.
Jet Fuel Refinery	Mosby, Montana 59058	----do	Garfield.
Phillips Petroleum Co	Great Falls, Montana 59401	----do	Cascade.
Tesoro Petroleum Co	Wolf Point, Montana 59201	----do	Roosevelt.
Union Oil Co	Cut Bank, Montana 59427	----do	Glacier.

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 Clinton Knox [1] and Charles A. Koch [2]

Mineral production in Nebraska during 1969 included fuels and nonmetallics valued at $78 million, 5 percent greater than the 1968 total. Output of nonmetallics increased 13 percent in value to a record $39.6 million; fuels declined 3 percent, however, to $38.4 million, in a continuing downtrend from the 1962 peak of $75.3 million. The nonmetallic materials—mainly cement, sand and gravel, stone, lime, and clays—totaled 51 percent of the value of the State's 1969 mineral output, compared with 47 percent ($35.0 million) in 1968; petroleum, natural gas, and natural gas liquids comprised the fuels in the other 49 percent of the 1969 total, $1.2 million under their 1968 total value.

[1] Mining engineer, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Laramie, Wyo.

Table 1.—Mineral production in Nebraska [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	148	$206	149	$223
Gem stones	NA	4	NA	5
Lime—thousand short tons	28	W	35	W
Natural gas (marketed)—million cubic feet	8,129	1,423	6,989	1,209
Natural gas liquids:				
LP gases—thousand 42-gallon barrels	451	911	408	738
Natural gasoline and cycle products—do	153	456	128	387
Petroleum (crude)—do	13,183	36,781	12,106	36,075
Sand and gravel—thousand short tons	r 12,742	r 12,946	12,758	13,592
Stone—do	4,416	7,435	4,665	9,494
Value of items that cannot be disclosed: Cement, pumice, and values indicated by symbol W	XX	14,446	XX	16,307
Total	XX	r 74,604	XX	78,030
Total 1967 constant dollars	XX	r 74,268	XX	p 75,365

p Preliminary. 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).

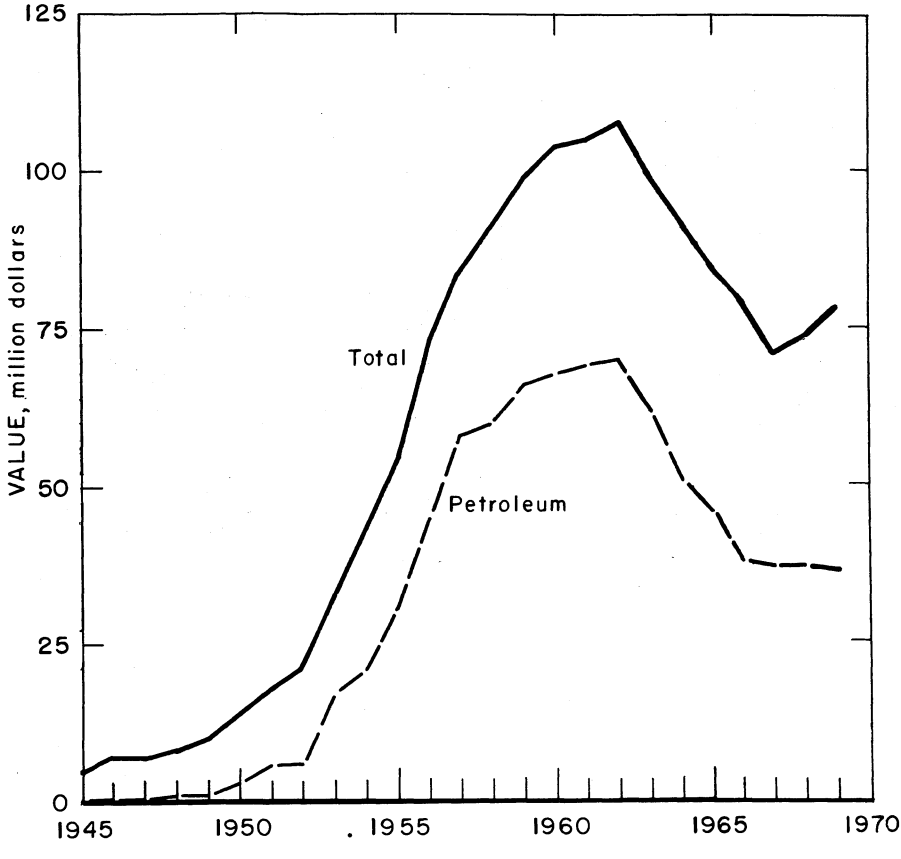

Figure 1.—Value of petroleum and total value of mineral production in Nebraska.

Table 2.—Value of mineral production in Nebraska, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	$87	$103	Sand and gravel.
Antelope	81	78	Do.
Banner	5,692	4,727	Petroleum, natural gas.
Blaine	(2)	7	Sand and gravel.
Boone	W	31	Do.
Box Butte	------	10	Do.
Boyd	31	23	Do.
Brown	W	54	Do.
Buffalo	289	355	Do.
Butler	289	327	Do.
Cass	r 16,203	18,567	Cement, stone, sand and gravel, clays.
Cedar	W	W	Sand and gravel.
Chase	22	12	Do.
Cherry	W	12	Do.
Cheyenne	7,618	7,052	Petroleum, natural gas, LP gases, sand and gravel, natural gasoline.
Clay	W	W	Sand and gravel.
Colfax	92	80	Do.
Cuming	541	560	Do.
Custer	92	54	Do.
Dakota	23	W	Do.
Dawes	6	------	Stone.
Dawson	250	342	Sand and gravel.
Deuel	279	W	Natural gas, sand and gravel.
Dixon	112	W	Sand and gravel, stone.
Dodge	r 520	559	Sand and gravel.
Douglas	r 1,831	2,349	Sand and gravel, stone, clays.
Dundy	9	12	Petroleum, sand and gravel.
Fillmore	102	56	Sand and gravel.
Franklin	54	64	Do.
Frontier	234	229	Petroleum, natural gas.
Furnas	68	W	Sand and gravel, petroleum.
Gage	377	422	Sand and gravel, stone.
Garden	37	52	Petroleum, sand and gravel.
Garfield	6	W	Sand and gravel.
Hall	997	934	Do.
Hamilton	W	W	Do.
Harlan	W	W	Petroleum, sand and gravel.
Hayes	W	W	Sand and gravel.
Hitchcock	766	689	Petroleum, sand and gravel.
Holt	94	173	Sand and gravel.
Hooker	8	3	Do.
Howard	70	44	Do.
Jefferson	W	W	Sand and gravel, clays.
Johnson	W	3	Sand and gravel.
Kearney	91	18	Do.
Keith	747	70	Do.
Keya Paha	9	6	Do.
Kimball	10,086	8,974	Petroleum, natural gasoline, natural gas, LP gases, sand and gravel.
Knox	80	113	Sand and gravel.
Lancaster	254	274	Stone, clays, sand and gravel.
Lincoln	W	98	Sand and gravel, petroleum, pumice.
Loup	21	16	Sand and gravel.
Madison	413	553	Do.
McPherson	(2)	------	Do.
Merrick	W	W	Do.
Morrill	r 1,678	2,052	Petroleum, sand and gravel, lime, natural gas.
Nance	W	W	Sand and gravel.
Nemaha	W	W	Stone.
Nuckolls	W	W	Cement, sand and gravel, stone.
Otoe	163	188	Clays, stone.
Pawnee	94	195	Stone, sand and gravel.
Perkins	29	7	Sand and gravel.
Phelps	W	W	Do.
Pierce	W	W	Do.
Platte	r 796	971	Do.
Polk	W	W	Do.
Red Willow	12,244	12,801	Petroleum, sand and gravel.
Richardson	W	304	Petroleum, stone, sand and gravel.
Rock	12	7	Sand and gravel.
Saline	W	W	Sand and gravel, stone.
Sarpy	r 807	W	Do.
Saunders	r 735	1,621	Do.
Scotts Bluff	1,866	2,597	Petroleum, lime, sand and gravel, natural gas.
Seward	W	W	Stone.
Sheridan	13	------	Sand and gravel.
Sioux	------	30	Do.
Stanton	W	W	Do.
Thayer	W	W	Sand and gravel, stone.

Table 2.—Value of mineral production in Nebraska, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Thomas	$21	W	Sand and gravel.
Valley	81	W	Do.
Washington	W	W	Stone, sand and gravel.
Wayne	1	------	Sand and gravel.
Webster	45	$105	Do.
Wheeler	17	W	Do.
York	671	166	Do.
Undistributed [3]	6,749	8,885	
Total [4]	r 74,604	78,030	

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, Burt, Gosper, Grant, Greeley, Logan, Sherman, and Thurston.

[2] Less than ½ unit.

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

[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Nebraska business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	644.7	657.6	+2.0
Employment	do	629.3	642.0	+2.0
Unemployment	do	15.4	15.6	+1.3
Agricultural employment	do	110.0	107.6	−2.2
Nonagricultural employment	do	519.3	534.4	+2.9
Mining	do	1.6	1.7	+6.2
Construction	do	23.8	25.5	+7.1
Manufacturing	do	83.2	86.0	+3.4
Government	do	94.0	96.9	+3.1
All other	do	316.7	324.3	+2.4
Payroll data:				
Agriculture	millions	$32.0	$51.0	+59.4
Mining	do	$10.0	$11.0	+10.0
Construction	do	$168.0	$191.0	+13.7
Manufacturing	do	$529.0	$585.0	+10.6
Government	do	$599.0	$641.0	+7.0
All other	do	$1,239.0	$1,331.0	+7.4
Personal income:				
Total	do	$4,661.0	$5,278.0	+13.2
Per capita		$3,208	$3,642	+13.5
Construction activity:				
Value of construction contracts	millions	$461.8	$375.9	−18.6
Residential	do	$157.8	$148.6	−5.8
Nonresidential	do	$152.1	$120.3	−20.9
Nonbuilding	do	$151.9	$107.0	−29.6
Highway construction contracts awarded	do	$38.6	$59.0	+56.9
Cement shipments to and within the State	thousand 376-pound barrels	4,427.1	4,554.6	+2.9
Business receipts:				
Retail sales	millions	$2,635.2	$2,779.0	+5.5
Farm marketing receipts	do	$1,758.0	$1,966.0	+11.8
Mineral production	do	$74.8	$78.0	+4.3
Utility production and consumption:				
Production of electric energy	million kilowatt-hours	7,692.0	7,382.7	−4.0
Natural gas consumption	billion cubic feet	177.7	194.6	+9.5

p Preliminary.

Sources: Engineering News-Record, v. 184, No. 16, Apr. 30, 1970, pp. 12–13; Nebraska Department of Economic Development; Nebraska State Railway Commission; Sales Management, Survey of Buying Power; F. W. Dodge Division, McGraw-Hill Information Systems Co.; U.S. Bureau of Mines.

The $4.6 million net increase in the value of nonmetallic output reflects mainly expanded production for lime, cement, stone, and clays; also reflected are price increases for lime, stone, clays, and sand and gravel.

Petroleum, natural gas, and natural gas liquids declined in output by 8, 14, and 11 percent, respectively; however, the net decrease in the total value of fuel production in 1969 was only 3 percent less than that of 1968 due to modest unit price rises in each.

The $3.7 million, 400-ton-per-day nitrogen solutions plant of Phillips Petroleum Co. at Hoag, Nebr. was completed.

The Nebraska Public Power District's $140 million Cooper nuclear powerplant near Brownsville with 778,000-kilowatt generating capacity and the Omaha Public Power Districts $84 million 457,000-kilowatt Fort Calhoun nuclear power stations near Fort Calhoun, both under construction, were approved for supplies of nuclear fuel.

Government Programs.—Construction contracts awarded by the State Highway Department totaled $59 million, 53 percent over those of 1968. This represents an increase of $4.6 million to $23.8 million for work on Interstate highways and of $15.8 million to $35.2 million for the State's primary and secondary systems. Maintenance contracts ($800,000 in 1968) were eliminated in 1969.[3]

Delay in implementing contracts hindered completion and opening to traffic of newly constructed mileage on the State's designated 481-mile share of the National System of Interstate and Defense Highways. Construction was in progress on 38 miles during 1969; use continued on the 373 miles that had been completed before the 1968 yearend.[4] Consequently most of the demands for cement, sand and gravel, and stone in 1969 were for heavy construction activities other than the highway programs.

Employment and Injuries.—Final statistics for 1968 and preliminary for 1969 on mineral industry employment and injuries in Nebraska are given in table 4.

[3] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1970 and Budgets for Maintenance. V. 184, No. 16, Apr. 30, 1970, pp. 12–13.

[4] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1969. Press Release FHWA–422, Feb. 9, 1970.

Table 4.—Worktime 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
1968:								
Nonmetal	14	209	3	24	------	------	------	------
Sand and gravel	832	211	176	1,651	1	24	15.15	4,195
Stone	478	281	134	1,104	------	13	11.77	606
Total	1,324	236	313	2,779	1	37	13.67	2,732
1969: p								
Nonmetal	15	205	3	25	------	1	39.46	592
Sand and gravel	925	213	197	1,829	------	26	14.21	3,783
Stone	500	295	148	1,257	------	21	16.70	309
Total [1]	1,440	241	348	3,112	------	48	15.42	2,353

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Ash Grove Cement Co. increased output at its plant in Cass County 10 percent over that of 1968. A greater percentage increase by the plant of Ideal Cement Co., a division of Ideal Basic Industries, Inc., in Nuckolls County also was a significant factor in the State's increase in cement shipments. A 13-percent increase in portland cement output was partly offset by 6 percent less masonry cement. The prices of portland and masonry cements continued virtually unchanged; however, in the relative numbers of barrels as reported, portland increased slightly to 98 percent of all cement shipped in 1969.

Clays.—Clay production from five counties was for making cement and building

brick by Ash Grove Cement Co., Endicott Clay Products Co., Omaha Brick Works, Western Brick and Aggregate Co., and Yankee Hill Brick Manufacturing Co. Output totaled 149,309 tons, only 1 percent more tonnage but valued about 8 percent over that of 1968.

Lime.—Output of lime totaled 35,300 tons manufactured in four plants in Morrill and Scotts Bluff Counties; The Great Western Sugar Co., subsidiary of Great Western United Corp., produced the commodity from high-calcium limestone shipped from its quarry in Wyoming. The 25-percent increase in production resulted from greater demands for lime in processing sugar beets and for use as a soil stabilizer in road base construction.

Pumice.—Volcanic ash was processed in the Callaway plant of LaRue Axtell Pumice Co. from its LeMasters strip mine southwest of Arnold in Lincoln County and its Carrico mine in Sweetwater County, Wyo. This pumice product is shipped mainly to makers of cleaning and scouring compounds and soaps.

Sand and Gravel.—Output reported for all 283 sand and gravel recovery operations in 75 of the 93 counties of Nebraska was about the same as that of 1968 in quantity but 5 percent higher in value, averaging nearly $1.07 per ton, an increase of 5 cents over 1968. Government-and-contractor operations declined to 42, and their tonnage dropped about 17 percent.

Table 5.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Adams	72	$87	93	$103
Antelope	100	81	93	78
Banner	72	43	------	------
Blaine	(1)	(1)	5	7
Boone	W	W	36	31
Box Butte	------	------	10	10
Boyd	25	31	23	23
Brown	W	W	55	54
Buffalo	295	289	437	355
Butler	229	289	284	327
Cass	r 431	r 336	328	291
Cedar	W	W	W	W
Chase	22	22	33	12
Cherry	W	W	11	12
Cheyenne	148	90	113	114
Clay	W	W	W	W
Colfax	109	92	88	80
Cuming	484	541	479	560
Custer	100	92	71	54
Dakota	18	23	W	W
Dawson	358	250	454	342
Deuel	61	42	W	W
Dixon	41	92	18	20
Dodge	r 698	r 520	623	559
Douglas	r 1,669	r 1,746	1,884	2,334
Dundy	1	1	------	------
Fillmore	65	102	56	56
Franklin	80	54	81	64
Frontier	W	W	------	------
Furnas	57	45	W	W
Gage	193	256	179	279
Garden	13	9	42	19
Garfield	5	6	W	W
Hall	862	997	911	934
Hamilton	W	W	W	W
Harlan	W	W	W	W
Hayes	W	W	W	W
Hitchcock	86	71	30	33
Holt	141	94	178	173
Hooker	12	8	4	3
Howard	85	70	73	44
Jefferson	214	211	290	304
Johnson	4	6	2	3
Kearney	96	91	50	18
Keith	649	747	121	70
Keya Paha	13	9	11	6

Table 5.—Sand and gravel sold or used by producers, by counties—Continued

(Thousand short tons and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Kimball	18	$18	17	$12
Knox	82	80	112	113
Lancaster	57	41	W	W
Lincoln	180	114	117	90
Loup	21	21	17	16
McPherson	(1)	(1)	------	------
Madison	283	413	390	553
Merrick	W	W	W	W
Morrill	r 144	r 139	191	198
Nance	W	W	W	W
Nemaha	3	3	------	------
Nuckolls	W	W	W	W
Pawnee	W	W	W	W
Perkins	58	29	28	7
Phelps	108	W	110	W
Pierce	W	W	W	W
Platte	r 544	r 796	663	971
Polk	W	W	W	W
Red Willow	94	96	109	103
Richardson	5	5	W	W
Rock	12	12	9	7
Saline	W	140	106	133
Sarpy	r 510	r 423	636	509
Saunders	r 827	r 735	995	1,382
Scotts Bluff	176	210	296	229
Seward	36	36	------	------
Sheridan	13	13	------	------
Sioux	------	------	30	30
Stanton	W	W	W	W
Thayer	103	113	124	143
Thomas	26	21	W	W
Valley	64	81	W	W
Washington	------	------	52	78
Wayne	1	1	------	------
Webster	77	45	119	105
Wheeler	13	17	W	W
York	603	671	152	166
Undistributed	r 1,174	r 1,230	1,316	1,377
Total [2]	r 12,742	r 12,946	12,758	13,592

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

[1] Less than ½ unit.

[2] Data may not add to totals shown because of independent rounding.

Table 6.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	r 2,488	r $2,344	2,387	$2,315
Paving	r 902	r 863	1,211	1,219
Fill	r 679	r 609	635	680
Other	15	17	2	2
Industrial:				
Blast	------	------	(1)	(1)
Unspecified	1	1	------	------
Total [2]	r 4,085	r 3,834	4,235	4,215
Gravel:				
Construction:				
Building	r 1,194	r 1,207	1,519	1,843
Paving	r 6,034	r 6,553	5,972	6,676
Railroad ballast	21	17	16	21
Fill	177	210	60	34
Other	10	11	------	------
Miscellaneous	263	271	160	151
Total [2]	r 7,699	r 8,269	7,728	8,725
Total sand and gravel	r 11,784	r 12,103	11,962	12,940
Government-and-contractor operations:				
Sand:				
Building	------	------	2	3
Paving	181	181	35	35
Fill	8	4	14	7
Total [2]	189	185	51	46
Gravel:				
Building	------	------	10	37
Paving	769	658	732	567
Fill	------	------	4	2
Total [2]	769	658	745	606
Total sand and gravel [2]	958	842	796	652
All operations:				
Sand	r 4,274	r 4,019	4,286	4,261
Gravel [2]	r 8,468	r 8,927	8,472	9,331
Total	r 12,742	r 12,946	12,758	13,592

r Revised.
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.

Stone.—Output of stone was entirely rubble and crushed and broken limestone from 32 operations in 16 of the 93 Nebraska counties. Production increased 6 percent, or 249,798 tons more than in 1968, and was 28 percent higher in value to average $2.04 per ton. The greatest use was for surface aggregate, followed in descending order with riprap, cement manufacture, concrete aggregate, road base, agricultural limestone, and other miscellaneous uses.

Talc.—The United Sierra Division, Cyprus Mines Corp., shipped talc from mines in California and Montana to be processed in its Grand Island, Nebr., plant. Nineteen percent more was processed than in 1968. The prepared talc products were exported, sold, or used for making paper, ceramics, paint, floor tile, textiles, rubber, and toilet powders.

Vermiculite.—At its Omaha plant Zonolite Division, Western Region, W. R. Grace & Co., exfoliated vermiculite shipped from its mine in Montana. Seven percent less was exfoliated than in 1968. The expanded vermiculite was sold for loose-fill insulation, concrete and plaster aggregates, soil conditioners, and fire base.

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

(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Dimension stone: Rubble	5	$27	3	$16
Crushed and broken stone:				
Riprap	1,237	1,773	977	1,413
Concrete aggregate	300	W	W	W
Dense graded roadbase	510	772	383	657
Agriculture	262	431	222	391
Other	[1] 2,103	[1] 4,432	[2] 3,081	[2] 7,017
Total [3]	4,411	7,408	4,663	9,478
Grand total [3]	4,416	7,435	4,665	9,494

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes stone used in asphalt filler, bituminous aggregate, cement, macadam aggregates, poultry grit and mineral food, railroad ballast, surface treatment aggregates, whiting, and item indicated by symbol W.
[2] Includes stone used in asphalt filler, bituminous aggregate, cement, poultry grit, surface treatment aggregates, unspecified aggregates, whiting, and item indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

MINERAL FUELS

Natural Gas.—Because of a mild winter, marketed natural gas declined 14 percent. This decline, significant when compared with the 3.8 percent decline in 1968, was in line with the 17 percent drop in 1967. The State Oil and Gas Conservation Commission records show that production of dry gas and casinghead gas each declined 1.1 billion cubic feet. Dry gas was produced in Cheyenne, Deuel, and Kimball Counties. The casinghead gas was produced in six counties; however, 73.5 percent was from Cheyenne and Kimball Counties.

Natural gas reserves declined from 56.8 billion to 56.6 billion cubic feet.[5] Extension and revisions of fields and new reserves totaled 5.8 billion cubic feet, lacking 1.5 billion cubic feet of offsetting the 1969 production.

Kansas-Nebraska Natural Gas Co., Inc., completed laying 26.4 miles of 16-inch pipe at a cost of $994,000 [6] and about 48 miles of 6-inch pipe.

Natural Gas Liquids.—Output of natural gas liquids declined 10 percent for LP gases and 16 percent for natural gasoline and cycle products. During the year, two processing plants—the Cities Service Oil Co. plant at Kimball and the Marathon Oil Co. plant in the West Sidney field—were operated, but below their combined rated daily capacity of 24.5 million cubic feet.

Estimated natural gas liquids reserves increased by 183,000 barrels to 2.3 million barrels.[7] Reserves had declined in 1967 and 1968.

Petroleum.—Because of normal depletion resulting from the 13.2 million barrel output in 1968, petroleum production declined 8 percent. An example of the steady decline is evidenced in the output from the State's largest fields. In 1968, the 25th ranking field (Minatare) yielded 97,800 barrels; however, five of the 25 fields had less than that in 1969, and the 25th field (Torgeson) yielded only 84,869 barrels.

Red Willow County again led all other counties in production as a result of the Sleepy Hollow field output. The major oil producing counties had decreases, but Dundy, Furnas, Garden, and Lincoln Counties had a slight increase in production. Significantly, Morrill County had a 12.7-percent increase.

According to the Nebraska Oil and Gas Conservation Commission, the State had 1,305 producing and 613 shut-in or temporarily abandoned wells on December 31, 1969. These figures represented a decline of 98 producing wells and an increase of 30 shut-in or temporarily abandoned wells. Kimball County with 346 producing wells, 36 under 1968, again led all other counties. Second was Red Willow County with 302 producing wells, a decline of 35. Cheyenne County had 248 wells; Banner County had

[5] Oil and Gas Journal. V. 68, No. 15, Apr. 13, 1970, pp. 44–46.
[6] Oil and Gas Journal. V. 67, No. 31, Aug. 4, 1969, pp. 152–153.
[7] Page 46 of work cited in footnote 5.

Table 8.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1968	1969	Principal fields in 1969 in order of production
Banner	2,007	1,572	Singleton, Johnson, Harrisburg, Willson Ranch.
Cheyenne	2,158	1,906	Southwest Potter, Graff, Doran, Reimers, Filon.
Dundy	3	4	Rock Canyon.
Frontier	79	77	Bed Canyon. [1]
Furnas	2	4	Southwest Wilsonville.
Garden	10	11	Richards, McCord.
Harlan	27	24	South Alma.
Hayes	1	----	
Hitchcock	249	220	Reiher.
Kimball	3,271	2,776	Sloss, Enders, Bertramson, Fernquist, Axial, Torgeson.
Lincoln	1	2	Red Willow Creek.
Morrill	504	568	Waitman, Dunlap.
Red Willow	4,354	4,261	Sleepy Hollow, Silver Creek, Ackman, Northwest Sleepy Hollow, Bed Canyon, [2] Midway.
Richardson	76	72	Falls City, Barada, Dawson.
Scotts Bluff	441	609	Cedar Valley, Minatare.
Total	13,183	12,106	

[1] Partly in Red Willow County.
[2] Partly in Frontier County.

Source: Nebraska Oil and Gas Conservation Commission.

223. These four counties, as in 1968, contained 86 percent of the producing wells.

Drilling activity increased by 98 wells over the total 285 drilled in 1968: development drilling increased by eight wells, and exploratory drilling increased by 90 wells. Although exploratory drilling increased by 46 percent, only 17 discoveries resulted, seven fewer than in 1968. Development drilling resulted in 40 producing oil wells, the same as in 1968.

Much of the exploratory drilling was in northwestern Nebraska's Box Butte, Dawes, Sheridan, and Sioux Counties. In this area the heaviest drilling concentration was in Sioux County with 47 wells, followed by Dawes County with 20 wells. No discoveries resulted, however, in these sparsely drilled counties.

Cheyenne County led the State in exploratory drilling with 58 wells, followed by Kimball County with 48 wells; Kimball County, however, had the most discoveries, seven. Primarily all of these discoveries were in the State's Denver-Julesburg basin.

Kimball County had three significant J-sand discoveries resulting in the Basin, Cable, and Knoll fields. The Basin field discovery well, No. 1 Schmid, SW¼ NE¼ sec 26, T16N, R57W, was completed by R. D. Brew and Gable Drilling, pumping 150 barrels of oil daily from the 6,783- to 6,793-foot interval. Cable field was discovered by Petroleum, Inc., at the No. 1 Leek, SE¼ SW¼ sec 34, T16N, B56W. This well was completed pumping 55 barrels of oil daily from the 6,594- to 6.598-foot interval. The Knoll field discovery well, the Bill Garber No. 1 Merideth, SW¼ SE¼ sec 21, T14N, R57W, was completed pumping 34 barrels of oil daily from the 6,954- to 6,958-foot interval.

Three significant J-sand field discoveries were in Cheyenne County: the Engelland West, Becky, and Ambage fields. The Engelland West field discovery, No. 1 Thompson, SW¼ NE¼ sec 31, T15N, R49W, was completed by Double M Oil Co. pumping 150 barrels of oil daily. Becky field was discovered by J. Paul Karcher, Ackman-Schulein & Associates, and Gable Drilling at the No. 1 Ladine, SE¼ NW¼ sec 32, T16N, R50W. The well was completed pumping 105 barrels of oil daily from the 4,922- to 4,953-foot interval. The Ambage field discovery, No. 13–29 Terman, SW¼ SW¼ sec 29, T14N, R52W, was completed by Petro-Lewis Corp. and Ackman-Schulein & Associates pumping 60 barrels of oil daily from the 5,280- to 5,282 foot interval.

The most significant discovery in the State was the Oregon field in Scotts Bluff County. Cayman Corp. and R. E. Maresh discovery well, No. 1 Ferguson, NE¼ NE¼ sec 6, T21N, R53W, was completed in September, pumping 324 barrels of oil daily from the J-sand at 4,476 to 4,483 feet.

Development drilling was most successful in Richardson County where all five wells

Table 9.—Oil and gas well drilling, by counties

County	Oil	Dry	Total	Footage
1968:				
Exploratory completions:				
Banner	8	22	30	177,042
Box Butte	---	1	1	3,919
Cheyenne	4	38	42	213,659
Dakota	---	1	1	56
Deuel	---	1	1	3,739
Dundy	---	1	1	5,238
Frontier	1	5	6	22,441
Gage	---	1	1	321
Garden	---	1	1	3,695
Gosper	---	2	2	7,239
Hitchcock	---	2	2	8,777
Holt	---	1	1	2,592
Kimball	8	35	43	272,552
Lincoln	---	2	2	8,169
Morrill	---	10	10	45,304
Nance	---	2	2	6,208
Red Willow	3	17	20	74,119
Richardson	---	6	6	17,299
Scotts Bluff	---	12	12	68,961
Sheridan	---	3	3	10,533
Sioux	---	8	8	40,693
Total	24	171	195	992,556
Development completions:				
Banner	5	18	23	140,547
Cheyenne	6	10	16	82,887
Frontier	1	---	1	4,010
Hayes	---	1	1	4,912
Kimball	20	18	38	229,926
Red willow	6	3	9	30,470
Richardson	2	---	2	4,895
Total	40	50	90	497,647
Total all drilling	64	221	285	1,490,203

County	Oil	Gas	Dry	Total	Footage
1969:					
Exploratory completions:					
Arthur	--	--	1	1	3,546
Banner	3	--	33	36	215,415
Box Butte	--	--	4	4	15,607
Chase	--	--	2	2	8,634
Cheyenne	4	--	54	58	297,444
Dawes	--	--	20	20	67,931
Deuel	--	--	2	2	7,086
Frontier	--	--	4	4	15,554
Furnas	--	--	2	2	7,188
Garden	--	--	1	1	3,403
Kimball	7	--	41	48	310,668
Lincoln	--	--	2	2	8,775
Morrill	--	--	11	11	51,275
Phelps	--	--	1	1	4,130
Red Willow	--	--	16	16	58,780
Richardson	1	--	5	6	18,224
Scotts Bluff	2	--	18	20	100,965
Sheridan	--	--	2	2	4,901
Sioux	--	--	47	47	234,977
Stanton	--	--	2	2	4,935
Total	17	--	268	285	1,439,438
Development completions:					
Banner	4	--	11	15	89,868
Cheyenne	5	1	14	20	101,181
Kimball	12	--	16	28	168,368
Red Willow	9	--	8	17	61,476
Richardson	5	--	---	5	12,116
Scotts Bluff	5	--	8	13	61,069
Total	40	1	57	98	494,078
Total all drilling	57	1	325	383	1,933,516

Source: Committee on Statistics of Drilling, American Association of Petroleum Geologists.

drilled were producers. Other counties with successes were Kimball, 12 producers in 28 wells; Red Willow, nine producers in 17 wells; and Scotts Bluff, five producers in 13 wells.

Petroleum reserves decreased by 8.5 million barrels to 46.8 million barrels.[8] Field revisions and extensions, along with new reservoirs, added 4 million barrels to the reserves—insufficient, however, to offset production.

The one crude oil refinery at Scottsbluff, operated by CRA, Inc., increased its daily crude oil capacity to 5,000 barrels, an increase of 1,000 barrels daily.[9]

METALS

No metals were mined in Nebraska. However, antimony, bismuth, gold, lead, and silver were recovered in the Omaha refinery of American Smelting and Refining Company from lead bullion and other smelter products from out of State.

[8] Page 44 of work cited in footnote 5.
[9] Oil and Gas Journal. V. 68, No. 14, Apr. 6, 1970, p. 132.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co	1000 Tenmain Center Kansas City, Mo. 64105	Wet process, 6-rotary-kiln plant.	Cass.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Wet process, 2-rotary-kiln plant.	Nuckolls.
Clays:			
Ash Grove Cement Co	1000 Tenmain Center Kansas City, Mo. 64105	Open pit mine	Cass.
Western Brick & Aggregate Co.	Box 1141 Nebraska City, Nebr. 68410	Open pit mine and plant	Otoe.
Yankee Hill Brick Manufacturing Co.	Route 1 Lincoln, Nebr. 68502	----do	Lancaster.
Lime: The Great Western Sugar Co., a subsidiary of Great Western United Corp.	Box 5308 Denver, Colo. 80217	Pot kiln at beet-sugar plant 5 pot kilns at beet-sugar plants.	Morrill. Scotts Bluff.
Natural gas and petroleum [1]			
Pumice: LaRue Axtell Pumice Co	Callaway, Nebr. 68825	Plant Open pit mine	Custer. Lincoln.
Sand and gravel (commercial):			
Central Sand & Gravel Co	Box 626 Columbus, Nebr. 68601	Dredging operation 2 dredging operations 3 dredging operations	Butler. Madison. Platte.
Christensen Sand & Gravel Co.	216 First National Bank Bldg. Fremont, Nebr. 68025	3 pits and plants Pit and plant	Dodge. Douglas.
Hank Stalp Gravel Co	Box 6 West Point, Nebr. 68788	3 dredging operations	Cuming.
Hartford Sand & Gravel Co	Box 571 Valley, Nebr. 68064	2 dredging operations	Douglas.
Luther & Maddox Gravel Co	Grand Island, Nebr. 68801	Pit and 2 plants	Hall.
Lyman-Richey Sand & Gravel Corp.	4315 Cuming St. Omaha, Nebr. 68131	Pit and plant 2 pits and plants ----do Pit and plant ----do 2 pits and plants Pit and plant	Cass. Dodge. Douglas. Morrill. Platte. Sarpy. Saunders.
McCann Sand & Gravel Co	Valley, Nebr. 68064	2 dredging operations	Douglas.
Overland Sand & Gravel Co.	22 Main St. Stromberg, Nebr. 68666	----do 4 dredging operations Dredging operation ----do	Hamilton. Merrick. Nance. Polk.
Western Sand & Gravel Co	Box 268 Lincoln, Nebr. 68501	----do 3 dredging operations	Cass. Saunders.
Stone:			
Ash Grove Cement Co	1000 Tenmain Center Kansas City, Mo. 64105	Quarry and plant	Cass.
Fort Calhoun Stone Co	1255 South St. Blair, Nebr. 68008	2 quarries and plant	Washington.
Hopper Bros. Quarries	Weeping Water, Nebr. 68463	3 quarries and plant Quarry and plant ----do ----do ----do ----do ----do ----do ----do ----do	Cass. Gage. Nemaha. Nuckolls. Otoe. Pawnee. Richardson. Saline. Saunders. Thayer.

[1] Most of the major oil and gas companies and many smaller companies operate in Nebraska, and several commercial directories contain complete lists of them.

The Mineral Industry of Nevada

This chapter has been prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, United States Department of the Interior, and the Nevada Bureau of Mines for collecting information on all minerals except fuels.

By Arthur C. Meisinger [1]

A record output value of $168.3 million was set by the mineral industry of Nevada in 1969. The output was $42 million more than the previous high figure of $126.7 million in 1956 and was 40 percent higher than that of 1968. Of the 29 metal and mineral commodities produced, 10 were metals, and 18 were nonmetals, with petroleum as the sole fuel commodity. The production value of metals as a group increased 51 percent; for the nonmetals it rose 14 percent, and for the mineral fuels it declined 11 percent. Copper and gold combined accounted for 71 percent of the value of the State's mineral production. Gold output exceeded 450,000 troy ounces for the first time since 1915. Declines in the value of iron ore and zinc production were more than offset by the increased value output of most other metals. Of the 18 nonmetals produced, only three—gypsum, perlite, and salt—decreased in output compared with that of 1968.

Substantial increases were reported in production of barite, clays, fluorspar, lithium minerals, pumice, and talc and soapstone. Increased production of cement, lime, pumice, sand and gravel, and stone reflected a higher demand for construction materials.

The record pace of mineral exploration activity in Nevada continued for the third straight year. Exploration programs reported to the Bureau of Mines totaled 77, primarily for copper, gold, and silver, in 16 counties. Exploration for crude oil declined, however, as only two well-drilling permits, compared with 17 in 1968, were issued by the Nevada Oil and Gas Conservation Commission. The two wells were drilled in Clark County, but failed to develop commercial production.

Consumption, Trade, and Markets.—Virtually all of Nevada's requirements for mineral fuels and metals, and most of its nonmetal needs other than for construction materials, were supplied by out-of-State processors.

All of the talc and fluorspar, most of the barite and perlite, and some of the gypsum and limestone produced were shipped out of State in crude form. Most of the lime output went to consumers in southern California. All petroleum production, except for a small quantity refined in Nevada, was consigned to refineries in Utah. With few exceptions, metal ores, concentrates, and precipitates were processed in mills and smelters outside the State. The one smelter (copper) in the State, at McGill, White Pine County, was dependent on Nevada ores. All usable iron ore was exported or shipped to steel plants in other States. The electrolytic manganese dioxide plant of American Potash & Chemical Corp., Clark County, operated on ore purchased from out-of-State producers, and the new tungsten carbide plant of Kennametal, Inc., Churchill County, (which went on stream in October) used concentrates purchased from various domestic and foreign producers.

Trends and Development.—Reports to the Bureau of Mines indicated that exploration activity in Nevada reached an all-time high. The 77 programs were being conducted in 16 counties for 14 different mineral commodities—nine metals and five

[1] Economist, Bureau of Mines, San Francisco, Calif.

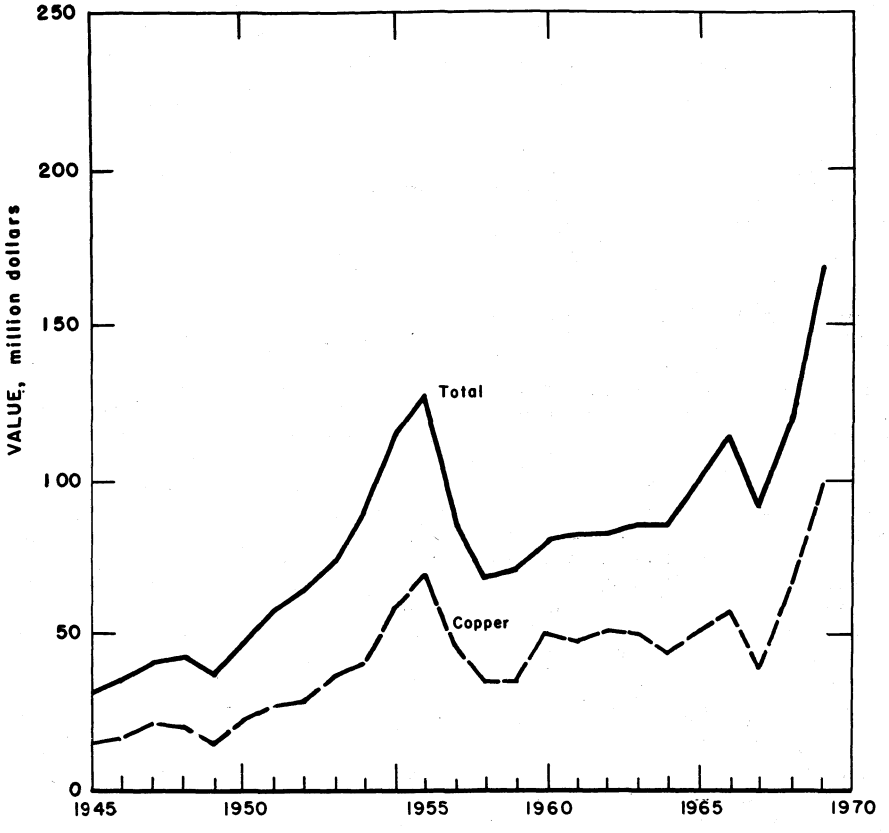

Figure 1.—Value of copper and total value of production in Nevada.

Table 1.—Mineral production in Nevada [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrates (content)—short tons	---	---	W	W
Barite (crude)—thousand short tons	216	$1,511	320	$2,275
Copper (recoverable content of ores, etc.)—short tons	77,213	64,623	104,924	99,749
Gem stones	NA	100	NA	100
Gold (recoverable content of ores, etc.)—troy ounces	317,382	[2] 12,460	456,294	[2] 18,941
Gypsum—thousand short tons	552	1,534	521	1,550
Iron ore (usable)—thousand long tons, gross weight	569	2,917	W	W
Lead (recoverable content of ores, etc.)—short tons	863	228	1,420	423
Mercury—76-pound flasks	4,780	2,560	8,165	4,124
Perlite—short tons	9,315	79	8,998	77
Petroleum (crude)—thousand 42-gallon barrels	271	W	223	W
Pumice, pumicite, and volcanic cinder—thousand short tons	62	144	83	188
Sand and gravel—do	7,812	10,442	8,447	10,834
Silver (recoverable content of ores, etc.)—thousand troy ounces	645	1,384	884	1,583
Stone—thousand short tons	1,325	2,041	1,494	2,433
Talc and soapstone—short tons	3,029	38	6,434	81
Tungsten concentrate—short tons, 60% WO_3 basis	25	58	34	69
Zinc (recoverable content of ores, etc.)—short tons	2,104	568	941	275
Value of items that cannot be disclosed: Brucite, cement, clays, diatomite, fluorspar, lime, lithium minerals, magnesite, molybdenum concentrates (content), pyrites (1969), salt, and values indicated by symbol W	XX	19,354	XX	25,593
Total	XX	120,041	XX	168,295
Total 1967 constant dollars	XX	r 112,704	XX	p 147,345

p Preliminary. r Revised. 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] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

Table 2.—Value of mineral production in Nevada, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Churchill	$406	$101	Tungsten, sand and gravel, salt, silver, gold.
Clark	12,319	13,054	Sand and gravel, lime, stone, gypsum, clays.
Douglas	W	W	Iron ore, sand and gravel, silver, zinc, lead, stone.
Elko	2,270	2,792	Sand and gravel, copper, barite, silver, lead, zinc, mercury, antimony, stone, gold.
Esmeralda	2,768	3,307	Lithium, mercury, diatomite, talc and soapstone, clays, sand and gravel, silver, copper, lead, zinc, gold.
Eureka	11,737	9,819	Gold, iron ore, sand and gravel, lead, silver, mercury, zinc, barite, copper.
Humboldt	1,614	3,005	Mercury, sand and gravel, gold, silver, antimony.
Lander	10,130	21,683	Copper, gold, barite, silver, sand and gravel, mercury, lead, zinc.
Lincoln	996	697	Fluorspar, perlite, silver, pyrite, lead, copper, sand and gravel, zinc, gold, mercury, pumicite, stone.
Lyon	37,176	53,054	Copper, cement, stone, sand and gravel, diatomite, silver, gold, clays.
Mineral	216	960	Lead, zinc, sand and gravel, silver, copper, barite, mercury, gold, stone.
Nye	2,771	3,128	Magnesite, petroleum, sand and gravel, fluorspar, mercury, brucite, volcanic cinder, clays, silver, gold, stone, copper, zinc.
Ormsby	860	139	Volcanic cinder, sand and gravel, stone, tungsten.
Pershing	4,885	5,246	Diatomite, gypsum, mercury, sand and gravel, iron ore, silver, perlite, stone, lead, gold, copper, zinc.
Storey	W	W	Diatomite, pumice.
Washoe	3,012	2,533	Sand and gravel, stone, pumicite, clays, mercury, gold, silver, lead, zinc, copper.
White Pine	24,448	44,224	Copper, gold, molybdenum, silver, lime, stone, sand and gravel, lead, zinc, clays.
Undistributed [1]	4,433	4,553	
Total	120,041	168,295	

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

[1] Includes gem stones, mercury, and tungsten that cannot be assigned to specific counties and value indicated by symbol W.

Table 3.—Indicators of Nevada business activity

	1968 r	1969 p	Change, percent
Employment and labor force, annual average:			
Total civilian work force—thousands	212.7	224.0	+5.3
Employed—do	201.8	214.0	+6.0
Unemployed—do	10.5	9.8	−6.7
Employment:			
Agriculture—do	4.6	4.6	------
Mining [1]—do	3.5	3.9	+11.4
Contract construction—do	9.2	10.9	+18.5
Manufacturing—do	7.0	7.7	+10.0
Government—do	34.1	35.8	+5.0
Other [2]—do	123.5	129.5	+4.9
Payroll data:			
Total [3]—millions	$79,080	$92,014	+16.4
Mining—do	$2,390	$2,875	+20.2
Contract construction—do	$7,875	$10,517	+33.5
Manufacturing—do	$4,603	$5,532	+20.2
All other [3]—do	$64,212	$73,090	+13.8
Personal income:			
Total—do	$1,777	$1,992	+12.1
Per capita	$3,957	$4,359	+10.2
Construction activity:			
Valuation of private authorized nonresidential construction [4]—millions	$46.7	$61.6	+31.9
Valuation of private and public-owned residential construction (permit-authorized and contract-awarded)—millions	$64.6	NA	NA
State government capital outlay for highway construction—millions	$37.6	$36.3	−3.5
Consumption of cement in Nevada, including out-of-State receipts—thousand 376-pound barrels	1,350	1,683	+24.7
Farm marketing receipts:			
Farm income—cash receipts—millions	$59.1	$63.6	+7.6
Mineral production—do	$120.0	$168.3	+40.3
Electrical energy:			
Production—thousand kilowatt-hours	402,862	466,222	+15.7
Sales—do	395,815	447,815	+13.1

r Revised. p Preliminary. NA Not available.
[1] May vary from Bureau of Mines canvass.
[2] Includes transportation (other than railroads), utilities, trade (wholesale and retail), finance, insurance, real estate, and services.
[3] Excludes Federal Government.
[4] Includes nonresidential additions and alterations.

Sources: Bureau of Mines, Construction Review, Survey of Current Business, Statistical Abstract of the United States, State Government Finances, Nevada Business Review, Nevada Employment Security Department in cooperation with the United States Department of Labor.

Table 4.—Worktime 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
1968:								
Metal	1,835	256	471	3,777	3	91	24.89	5,768
Nonmetal	748	249	186	1,492	--	41	27.48	456
Sand and gravel	605	211	128	1,014	--	20	19.73	471
Stone	322	261	84	672	1	14	22.33	9,385
Total [1]	3,510	247	869	6,954	4	166	24.44	4,205
1969: p								
Metal	2,125	310	660	5,298	4	115	22.46	5,135
Nonmetal	740	255	188	1,526	1	49	32.77	5,025
Sand and gravel	620	183	113	907	--	22	24.26	1,045
Stone	200	280	55	453	--	7	15.46	660
Total [1]	3,685	276	1,017	8,184	5	193	24.19	4,414

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

nonmetals. Silver led with 23; followed by gold, 18; copper, 10; lead and barite, five each; mercury, four, and diatomite, three. About three-fourths of the exploration projects were conducted in eight counties —Esmeralda, Eureka, Hulboldt, Lander, Lincoln, Mineral, Pershing, and White Pine.

Cortez Gold Mines held formal opening ceremonies at the Cortez gold mine, Elko County, on March 20, 1969, and announced that the first shipment of bullion had been made in February. Ruja Mining Co. placed its Ruja underground mercury mine on stream early in the year. The mine is adjacent to the Quinn River (Cordero) mine, southwest of McDermitt, Humboldt County. International Energy Co. reopened the Onetha lead-zinc mine, which it acquired after the mine had been closed when the smelters were shut down during the 1967–68 copper strike.

The State's first and the Nation's newest precious metals refinery was brought on stream in February by International Precious Metals, Inc. The refinery is located on the Lear industrial site, Reno, and is equipped to refine secondary gold, platinum metals, and silver. Also on the Lear industrial site, Titanium West., Inc., announced plans for increasing its titanium sponge melting capacity from 1,400 to 5,000 tons annually and the addition of an ingot-processing facility to make finished mill products.

U.S. Steel Corp. confirmed reports that it had located extensive iron ore deposits following exploration in the Mason Valley area, southeast of Yerington, Lyon County. Preliminary estimates indicated the presence of 250 million tons of ore containing about 40 percent iron and 0.3 percent copper. The company was acquiring a mineral patent to the claims at yearend.

Hecla Mining Co. and Bristol Silver Mines Co. conducted a joint, deep, diamond-drilling project in the Bristol mine area near Pioche, Lincoln County. At yearend, none of three test holes had reached its objective, and the drilling was to be continued in 1970. Hecla also reported that its Ruby Hill drilling project near Eureka, White Pine County, would be continued with a similar program for 1970, and that although further metallurgical research was planned in an effort to improve metal recovery of delineated ore, no immediate plans had been made to place the Ruby Hill property into production. Rehabilitation of the mine was initiated in 1966–67. Silver Ridge Mining Co. began development of its Silver Ridge (Big Horn) property near Silver Peak, Esmeralda County. Work nearing completion at yearend consisted of drilling, waste removal, and sinking of a 1,600-foot inclined shaft to intersect the old Nivloc silver-gold vein, southeast of the property. Crofoot Mines, Inc., started development at the York mercury mine in central Humboldt County, and made plans to block out ore reserves.

California Time Petroleum, Inc., purchased the Majuba Hill Mines, a 700-acre mining property 18 miles west of Imlay, Pershing County, and began exploration at yearend to determine the extent of tin, silver, and copper mineralization on the property.

The Anaconda Company was nearing completion at yearend on installation of a wet dust collection and retention system in its ore concentration plant at the Yerington mine, Lyon County. The system, when completed, was to provide effective in-plant control of dust with no visible effluent in the stacks. In addition, the company began construction of a large pilot plant to test development of a smokeless direct-reduction process for obtaining copper metal from ore.

Black Mesa Pipeline, Inc., a subsidiary of Southern Pacific Railroad, began constructing a slurry pipeline to transport powdered coal mixed with water from mines near Kayenta, Ariz., to an electric generating plant, owned jointly by Southern California Edison Co. and Nevada Power Co., in Mohave, Nev. The pipeline, 18 inches in diameter and 273 miles long, was expected to be operative by late 1970.

Legislation and Government Programs. —Public land orders by the U.S. Bureau of Land Management withdrew 63,800 acres of land in nine Nevada counties from mineral location under U.S. mining laws, of which 57,500 acres remained open to mineral leasing—24,000 acres in Elko County, 18,000 acres in Humboldt County, and 15,500 acres in seven other counties. Other land orders restored 2,900 acres to mineral entry and location in Lander, Storey, and Washoe County and 240 acres to mineral location and leasing in Elko, Mineral, and Washoe Counties. The State received U.S. Treasury checks totaling

$606,201.08 in bonuses, royalties, and rentals covering mineral leases and permits.

The Lead-Zinc Small Producers Stabilization Act of October 3, 1961 (Public Law 87-347), as amended, providing for stabilization payments to small domestic producers of lead and zinc ores and concentrates, expired December 31, 1969. In the 8-year period of the program, Nevada producers received payments totaling $39,901 on 393 tons of lead and 1,249 tons of zinc. No payments were made to Nevada producers in 1969 inasmuch as the average monthly market price for lead and zinc equalled or exceeded the statutory stabilization price of 14.5 cents per pound established by the Act for each of the metals.

The Bureau of Mines continued to provide consulting service to the Atomic Energy Commission (AEC) on preshot and postshot structural surveys of mines, tunnels, and surface installations in connection with underground nuclear tests on and adjacent to AEC's Nevada Test Site and Supplemental Test Site C, in central Nevada.

Research studies conducted at the Bureau of Mines Reno Metallurgy Research Center on the application of electrochemical techniques to hydrometallurgical processing of low-grade and refractory ores resulted in significant improvement in gold recovery from carbonaceous ores and economic recovery of mercury from cinnabar ores. Similar treatment of silver ores improved metal recovery from refractory materials. Related experiments on the chlorination of gold confirmed that the vapor transport species in chloride roasting processes is $FeAuCl_6$. Studies in electrowinning of rare earths included the production of mischmetal from bastnaesite concentrate and the preparation of rare-earth cobalt alloys with rare-earth oxides as cell feed and cobalt metal as the consumable cathode.

Investigations were also carried out using the rare-earth cobalt alloys for the preparation of high-strength permanent magnets. Rare-earth extraction and separation studies on liquid-liquid solvent systems produced 99.9 percent samarium oxide (Sm_2O_3), 99 percent gadolinium oxide (Gd_2O_3), and 99 percent Sm_2O_3 on a continuous basis. Investigations related to improving the environment included the development of a ferric chloride ($FeCl_3$) - leach process for copper sulfide ores as an alternative to the conventional method of smelting. Copper oxide ores were shown to be amenable to leaching with amino acids,

Research at the Bureau's, Boulder City Metallurgy Research Laboratory in electrorefining resulted in the production of high-purity vanadium with less than 100 parts per million of interstitial impurities. From studies on recycling metal scrap, a flowsheet was developed for cleaning titanium mill chips. A solvent extraction technique was studied for extracting columbium and tantalum from waste materials that result from chlorinating rutile in the production of titanium tetrachloride.

The Bureau of Mines San Francisco Office of Mineral Resources continued work initiated in 1968 to provide forecasts for the mineral industry in the Great Basin hydrologic region for an interagency Type I Comprehensive Framework Study. The Great Basin Region includes nearly all of Nevada, and parts of Idaho, Utah, and Wyoming.

The San Francisco Office also continued to provide liason among Federal, State, and industry groups on metallurgy research, exploration, and exploitation of the northeastern Nevada gold-bearing beds and initiated a copper resources and availability study at yearend. These activities were part of a national Mineral Deposit Investigation Program (formerly known as the Heavy Metals Program).

The Region II Field Office, Office of Minerals Exploration (OME), U.S. Geological Survey, received two new applications from persons interested in exploring for minerals in Nevada under the OME program. Three contracts were approved and four contracts were in force at yearend. The three new contracts were granted to Jack Grimm, Abilene, Tex., and Wallace McGregor, Salt Lake City, Utah, for silver exploration in Nye and Esmeralda Counties, respectively, and to P. & F., Ltd., Los Angeles, Calif., for mercury exploration on the Silver Cloud property in Elko County.

COMMODITY REVIEW

METALS

Antimony.—Small quantities of ore were produced from the Gold Creek mine, Elko County, and the Smokey claims, Humboldt County. The ore was shipped to an antimony smelter in Texas. The PA claims, Elko County, and the Last Chance mine, Lander County, inactive during the year, planned to resume production in early 1970; both properties last produced in 1967.

Copper.—Nevada copper production was 36 percent more than in 1968. The combined mine operations of the Anaconda Company, Lyon County; Kennecott Copper Corp., White Pine County; and Duval Corp., Lander County, again accounted for most of the output. The Rio Tinto mine, Elko County, also contributed significantly to the total. Lesser quantities were recovered as a byproduct from complex lead, zinc, and silver ores.

Removal of overburden at Kennecott's new Ruth pit, White Pine County, continued during the year, and mining plans were timed so that ore from the new pit will become available as ore phaseout occurs in other areas. Cerro Corp. and Big Mike Corp. (a joint venture) made feasibility studies for a mill at the Big Mike copper property in Pershing County, about 30 miles south of Winnemucca, Humboldt County.

Gold.—Gold output was 44 percent above that of 1968. It was the first time since 1915 that production in the State exceeded 450,000 troy ounces. The quantity of gold produced from eight lode gold mines represented 83 percent of the total output; the quantity of byproduct gold, primarily from copper ores, was over 16 percent, and gold from all other sources, less than 1 percent.

Cortez Gold Mines (a joint venture) began gold production at the Cortez mine, Lander County, about 30 miles southwest of Crescent Valley. Mining at the property was by open pit and the ore was processed in the company's 1,700-ton-per-day cyanide plant.

Iron Ore.—Usable iron ore production was slightly lower than in 1968. Most of the total output was exported. The remaining output was shipped as direct shipping-grade ore. Direct shipping-grade ores were produced by Nevada Barth Corp., Eureka County, and by Cooney Brothers and Nevada Iron Ore Co., Inc., both in Pershing County. The Standard Slag Co.

Table 5.—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)
1965	48	5	15,817	229,050	$8,017	507,113	$656
1966	51	10	16,229	366,903	12,842	867,567	1,122
1967	28	5	10,480	434,993	15,225	565,755	877
1968	49	4	14,209	317,382	12,460	645,192	1,384
1969	48	1	20,215	456,294	18,941	884,155	1,583
1904–1969 [4]	-----	-----	NA	17,224,091	455,186	320,415,559	223,649

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	71,332	$50,503	2,277	$710	3,858	$1,127	$61,013
1966	78,720	56,946	3,581	1,083	5,827	1,690	73,683
1967	50,771	38,815	1,500	420	3,035	840	56,177
1968	77,213	64,623	863	228	2,104	568	79,263
1969	104,924	99,749	1,420	423	941	275	120,971
1904–1969 [4]	3,343,382	1,511,189	403,997	65,749	500,272	98,277	2,354,050

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 6.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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
Churchill	1	----	150	20	$830	1,500	$2,686
Esmeralda	3	----	74	W	W	597	1,069
Eureka	3	----	798,170	W	W	24,927	44,636
Lander	6	----	2,316,804	182,414	7,572,005	499,161	893,833
Lincoln	4	----	4,823	18	747	33,798	60,521
Mineral	3	----	13,975	W	W	90,156	161,440
Nye	3	----	130	4	166	W	W
Pershing	7	----	4,705	24	996	12,903	23,105
Washoe	5	----	472	W	W	1,343	2,405
Undistributed [3]	13	1	17,075,354	273,814	11,366,020	219,770	393,536
Total	48	1	20,214,657	456,294	18,940,764	884,155	1,583,231

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Churchill	----	----	----	----	----	----	$3,516
Esmeralda	(4)	$190	W	W	(4)	$102	1,567
Eureka	W	W	W	W	W	W	W
Lander	12,099	11,501,612	W	W	11	3,052	19,984,161
Lincoln	24	22,721	108	$32,277	64	18,790	135,056
Mineral	59	56,375	873	259,977	770	224,723	W
Nye	W	W	----	----	W	W	W
Pershing	W	W	4	1,326	W	W	26,717
Washoe	W	W	W	W	W	W	9,012
Undistributed [3]	92,742	88,168,250	435	129,439	96	28,104	100,810,904
Total	104,924	99,749,148	1,420	423,019	941	274,771	120,970,933

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 rights to property.
[2] Does not include gravel washed.
[3] Includes Douglas, Elko, Humboldt, Lyon, and White Pine Counties, and counties indicated by symbol W.
[4] Less than ½ unit.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1969, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (thousand short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Dry gold	8	1,381	378,934	197	-----	-----	-----
Dry silver	19	9	264	52,947	27	125	23
Total	27	1,390	379,198	53,144	27	125	23
Copper	5	18,689	76,235	691,641	100,671	45	10
Lead and lead-zinc [2]	[3] 10	18	620	125,436	64	1,223	903
Total [4]	15	18,707	76,855	817,077	100,735	1,267	913
Other lode material:							
Gold cleanup and silver tailings [2]	[5] 5	18	190	12,302	2	3	2
Copper precipitates, copper tailings, and lead cleanup [2]	[6] 4	99	49	1,632	4,161	25	4
Total [4]	9	118	239	13,934	4,163	28	5
Total lode material [4]	48	20,215	456,292	884,155	104,924	1,420	941
Placer	1	(7)	2	-----	-----	-----	---
Total all sources [4]	49	20,215	456,294	884,155	104,924	1,420	941

[1] Detail will not necessarily add to totals shown because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] 8 lead mines and 2 lead-zinc mines.
[4] Data may not add to totals shown because of independent rounding.
[5] Silver tailings from 5 mines and gold cleanup from property not classed as a mine.
[6] Copper precipitates from 3 mines; copper tailings from 1 mine; lead cleanup from property not classed as a mine.
[7] 100 cubic yards.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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 (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Amalgamation and cyanidation: Ore	378,867	1,691	-----	-----	---
Concentration, and smelting of concentrates:					
Ore	75,360	769,493	[1] 100,250	852	817
Tailings	17	11,346	163	2	1
Total [2]	75,377	780,839	100,414	854	818
Direct smelting:					
Ore	1,826	99,037	511	541	119
Cleanup	221	1,668	([3])	25	4
Copper precipitates	-----	-----	3,999	-----	---
Tailings	1	920	([3])	1	([3])
Total [2]	2,048	101,625	4,510	567	123
Placer	2	-----	-----	-----	---
Grand total [2]	456,294	884,155	104,924	1,420	941

[1] Includes copper from heap leaching, combined to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than ½ unit.

produced iron ore in Douglas County and concentrated it for export at its Wabuska plant, Lyon County.

Lead.—Lead production was 65 percent more than in 1968. In terms of recoverable metals, silver, lead, and lead-zinc ores accounted for 95 percent of the total lead output. Although 24 lode mines in the State, five less than in 1968, contributed to the total output, only seven—four lead mines, two lead-zinc mines, and one silver mine—produced significant quantities. Three mines—one each in Lincoln, Mineral, and White Pine Counties—accounted for most of the total recoverable lead, primarily from ore shipments made from stockpiles at the mine sites.

Mercury.—Despite a drop in the average mercury price for the year to $505.04 per flask, production increased 71 percent over that in 1968. Output from the Ruja mine, Humboldt County, which came on stream early in the year, was primarily responsible for the large increase in mercury production. The total number of producers rose from 17 in 1968 to 24. Seven producers reported outputs of more than 100 flasks compared with six producers in 1968. Those producing over 100 flasks were Kollsman Mineral & Chemical Corp. (B & B mine), Esemeralda County; Advanced Mining Industries, Inc. (Cahill mine), Humboldt County; Fred H. Lenway & Co., Inc. (Quinn River/Cordero mine), Humboldt County; Ruja Mining Co. (Ruja mine), Humboldt County; LDC Mining Co. (Ione Mercury mine), Nye County; Horton Bros. Mining Co. (Horton Mercury mine), Pershing County; and Star City Mines, Ltd. (Goldbank mine), Pershing County. Fred H. Lenway, Kollsman Mineral & Chemical Corp., and Ruja Mining each produced in excess of 1,000 flasks. Eight operators, compared with three in 1968, reported outputs of less than 10 flasks.

Nine producers recovered mercury by furnace operations and 15 used retorts. Carlin Gold Mining Co. continued to produce a small quantity of byproduct mercury at its large low-grade gold mine in Eureka County. The mercury was produced by an electric retort from the final precipitate of the cyanide plant. Old West Enterprises continued a small mercury flotation plant operation at its Old West mine, south of Reno in Washoe County. Concentrates were leached with sodium sulfide followed by precipitation of mercury. Star City Mines, Ltd., installed a second condensing system at the company mill site, 4 miles west of Winnemucca. The new system increased the processing-mill capacity from 100 to 200 tons per day.

Molybdenum.—Molybdenum was recovered by Kennecott Copper Corp. as a byproduct of treating copper ores in the McGill concentrator, White Pine County. Both production and shipments were substantially higher than in 1968.

Table 9.—Mercury production, by methods of recovery

Year	Operating mines	Recovery method: Furnaced: Ore treated (short tons)	Furnaced: 76-pound flasks	Retorted: Ore treated (short tons)	Retorted: 76-pound flasks	Unclassified (76-pound flasks) [1]	Total: 76-pound flasks	Total: Value [2]
1965	42	48,197	2,877	3,575	456	-----	3,333	$1,902,310
1966	29	48,813	3,021	14,633	334	-----	3,355	1,482,306
1967	25	51,693	4,457	1,567	246	-----	4,703	2,301,460
1968	17	67,711	4,325	5,842	455	-----	4,780	2,559,977
1969	24	108,715	7,704	[3] 9,985	430	31	8,165	4,123,650

[1] Includes mercury recovered from old surface ores, dumps, and placers.
[2] Value calculated at average New York price.
[3] Includes 1,800 short tons of tailings.

The Anaconda Company continued assessment work to evaluate the economics of its development project at the Hall molybdenum property in Nye County.

Silver.—Output of recoverable silver increased 37 percent over that of 1968. Nineteen lode silver mines reported production, four more than in 1968. Copper ores yielded 78 percent of the total lode silver; lead and lead-zinc ores, 14 percent; and all other sources, 8 percent. Some of the silver was recovered from cleanup operations and treatment of old tailings.

Tungsten.—Thirteen tungsten properties, three more than in 1968, were active during most of the year. The quantity of tungsten concentrates produced was larger than in 1968, and nearly all of the output was shipped to the new tungsten carbide plant of Kennametal, Inc., in Churchill County. The new mill, about 10 miles north of Fallon, replaced the old Nevada Scheelite Division mill near Hawthorne, Mineral County, and contained improved equipment for producing tungsten carbide crystals. Several tungsten producers also shipped concentrates to the Pine Creek paratungstate plant of Union Carbide Corp. near Bishop, Calif. In Pershing County, the Fisk (Quicktung) property of the Quicktung Mining Co. was leased to Crofoot Mining Co., and scheelite ore was mined by the new operators. Also in Pershing County, Tungsten Properties, Ltd., a partnership, purchased the Tungsten Group property of the liquidated Nevada-Massachussetts Co. and produced test concentrates from the treatment of tailings. Exploration and mine maintenance were also conducted on the property by the new owners.

Zinc.—Zinc production in Nevada was 941 short tons, 55 percent less than in 1968 and the lowest output since 1964. Nearly 96 percent of the total recoverable zinc came from lead and lead-zinc ores. Twenty-two lode mines, two more than in 1968, contributed to the total zinc output. However, only three of these mines—one each in Lincoln, Mineral, and White Pine Counties—accounted for most of the recoverable metal, primarily from ore shipments made from stockpiles at the mine sites.

NONMETALS

Barite.—The quantity of primary barite sold or used by Nevada producers was 48 percent above that of 1968. Sales of ground barite, including tonnages used by producers, increased 136 percent. The major producers of crude barite ore were National Lead Co. (Rossi mine, Elko County), Dresser Minerals (Greystone/Battle Mountain mine, Lander County), FMC Corp. (Mountain Springs mine, Lander County), and Milchem, Inc. (Glidden group and Miller mine, Lander County).

National Lead Co. and Dresser Minerals ground barite in their respective plants at Dunphy, Eureka County, and Battle Mountain, Lander County. Ground barite was also produced by Milchem, Inc., in its Bateman plant near Battle Mountain. Nearly all the ground and crushed barite was sold for use in well-drilling. Crude ore from the Lander County mine of FMC Corp. was shipped to a company plant in Modesto, Calif., for use in manufacturing barite chemicals.

Cement.—Portland cement was produced by Nevada Cement Co. in a dry-process plant at Fernley, Lyon County, and bulk and bag shipments were made to customers in Nevada and California. Production capacity of the Fernley plant was increased

by the addition of a second rotary kiln and new milling equipment. Also, a bulk-storage and distribution station was established at Mina to transship products by truck to markets throughout the State. Shipments from Fernley to the distributing plants were made by rail.

Total consumption of cement in Nevada, including material received from out of State, was 1.7 million barrels, 26 percent more than in 1968.

Clays.—Clays were produced from six operations—one each in Clark, Esmeralda, Lyon, Nye, Washoe, and White Pine Counties. Bentonite was mined by Western Talc Co. from the Francis pit near Apex, Clark County; the Blanco pit near Mina, Esmeralda County; and the New Discovery pit near Beatty, Nye County. Bleaching clay was produced by Industrial Minerals & Chemical Co. at its Jupiter deposit near Weeks, Lyon County. Fire clay was mined from the McDonough clay bed near Ely, White Pine County. Common clay was obtained from a deposit near Flanigan, Washoe County by Nevada Cement Co., for use at the company cement plant in Lyon County. Clays sold or used increased 21 percent in quantity above the 1968 figure.

Diatomite.—Sales of prepared diatomite increased 7 percent in quantity and 15 percent in value compared with 1968 figures. No sales of crude materials were reported. As in 1968, four deposits were mined. Eagle-Picher Industries, Inc., remained the largest Nevada producer from its Celatom mine and filration-media plant near Lovelock, Pershing County, and Tunnel Hill mine and Clark Siding plant east of Reno, Storey County. GREFCO, Inc., the second largest producer, operated its mine at Basalt and a plant near Mina, both in Esmeralda County. United Sierra Division of Cyprus Mines Corp. supplied diatomite from its mine in Churchill County to its mill near Fernley, Lyon County. Product sales were mainly for filtration filler, and lightweight aggregate uses. Other uses included coating and fertilizer anticaking agent, insecticide carrier, insulation, and abrasive.

Expansion at the Colado plant of Eagle-Picher and the resulting increased capacity for filtration-grade products were mainly responsible for the sharp rise in product value in 1969.

Fluorspar.—Both production and shipments of fluorspar were higher than in 1968. The increase reversed a 2-year decline. J. Irving Crowell, Jr., produced and shipped ceramic and metallurgical grade fluorspar from the Crowell (Daisy) mine, Nye County. Carp Fluoride Co., formerly Wells Cargo, Inc., produced and shipped metallurgical grade fluorspar from its Carp Spar mine, Lincoln County. All shipments were made to out-of-State customers.

Gypsum.—Crude gypsum production was 6 percent less in quantity than in 1968. Output was almost 521,000 tons for use at Nevada and California plants making plaster and board products, and as retarder in portland cement.

Gypsum was mined by United States Gypsum Co. (Empire quarry) in Pershing County for use in the company plant at Gerlach, Washoe County. In Clark County, the Flintkote Co. (Blue Diamond mine) and Johns-Manville (Apex mine) mined gypsum for use at their respective Blue Diamond and Las Vegas plants and for shipment to plants in California. The three Nevada plants produced 325,000 tons of calcined gypsum, compared with 303,000 tons in 1968. The increase in calcined gypsum was attributed to demand for ½-inch and ⅝-inch wall board used in hotel and apartment building construction. Building plaster and lath outputs were lower than in 1968. Registered sales of agricultural gypsum in Nevada dropped from 4,700 tons in 1968 to 3,100 tons.

Lime.—Output of lime was 14 percent greater than in 1968 and established an alltime high. Increased shipments were made to the steel and paper industries, and sales for soil stabilization increased. Although shipments were made throughout the western States, most went to consumers in southern California.

U.S. Lime division of the Flintkote Co. operated three plants in Clark County, producing quicklime at Apex, hydrated lime at Sloan, and both quicklime and hydrated lime at Henderson. Morrison & Weatherly Chemical Products produced lime at McGill, White Pine County, primarily for use by Kennecott Copper Corp.

Lithium Compounds.—The output of lithium carbonate from the Silver Peak facility of Foote Mineral Co. in Esmeralda County increased substantially for the second consecutive year. Production was 45 percent higher than in 1968, and the com-

pany reported that investments made in improved dike construction and scalants contributed greatly to the increased production and lower costs.

Magnesite and Brucite.—Basic, Inc., produced magnesite and brucite from open pit operations near Gabbs, Nye County, and upgraded the ore in nearby processing facilities. Mine production and combined consumption and shipments of all materials were higher than in 1968. Most of the ore was used in the manufacure of refractories and special products. Some ore was sold to out-of-State customers.

Basic, Inc. reported development of an improved flotation process to treat a wider range of magnesite ore, and raw-ore beneficiation circuits in the company processing plants were redesigned and expanded to incorporate the new process.

Perlite.—As in 1968, three companies produced all of the crude perlite. Combined Metals Reduction Co. (Hollinger pit) and Delamar Perlite (Mackie claims) both operated mines in Lincoln County, and United States Gypsum Co. operated the Pearl Hill quarry in Pershing County. Most of the crude perlite output was sold to out-of-State customers. Total sales, however, declined for the 12th consecutive year.

Crude perlite from the Pearl Hill quarry was expanded by United States Gypsum Co. for use in the company wall-board plant in Washoe County.

Pumice (Volcanic Cinder).—Output of pumice, pumicite, and volcanic cinders was 34 percent higher than in 1968, primarily because of a greater demand for the materials in concrete admixtures and fill. Cind R Lite Co. mined volcanic cinders from the Cinder Cone deposit, southeast of Beatty, Nye County, for landscaping and concrete aggregate uses. Volcanic cinders (scoria) from the Cinderlite Aggregates property of Savage Construction Co., Inc., Ormsby County, was prepared for use in concrete aggregate, road construction, and fill. Pumicite from the Lory Free pit of Kemway Enterprises, Lincoln County, was prepared for concrete admixture use. Pumicite from the Naturalite group of claims of Kaiser Industries, Corp., Storey County, and pumice from the Rilite Aggregate Co. property, Washoe County, were prepared for concrete aggregate use.

Salt.—Solar-evaporated salt was harvested from a dry lakebed in Churchill County. No output was reported for the year from the Silver Peak area ponds in Esmeralda County, and as a result, Nevada salt production was considerably less than in 1968. Nearly all of the salt produced was sold for use within the State; only a small quantity was shipped out of State to users in California. Most of the output was sold for use in ice control on roads by State, county, and local agencies in Nevada. Lesser quantities were sold for use in the meatpacking, tanning, casing, and dairy industries and in feed mixers.

Sand and Gravel.—Output of sand and gravel rose from 7.8 million tons in 1968 to 8.4 million tons because of increased demand for building projects in the Las Vegas, Reno, and Lake Tahoe areas and for construction of State and county highways and facilities.

There were 91 active sand and gravel operations, 17 fewer than in 1968. Of these, 42 were classified as commercial and 49 as Government-and contractor. Three of the commercial operations produced over 500,000 tons each, nine produced between 100,000 and 500,000 tons each, and 30 produced less than 100,000 tons each.

Production of specialty sands in the Overton area, Clark County, for glass, molding, and other industrial uses was slightly lower than in 1968, owing to a decrease in output of sand for glass manufacture.

Stone.—Nearly 1.5 million tons of stone was quarried, compared with 1.3 million tons in 1968. The increase was due entirely to a larger output of limestone, used in Lyon County for the manufacture of ce-

Table 10.—Sand and gravel production in 1969, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Clark	4,077	$5,390
Elko	1,363	1,408
Esmeralda	3	3
Eureka	243	243
Humboldt	91	130
Lander	55	50
Lincoln	20	21
Lyon	166	260
Mineral	216	213
Nye	234	407
Ormsby	33	40
Pershing	235	242
Washoe	1,612	2,319
White Pine	49	56
Other counties [1]	50	52
Total	8,447	10,834

[1] Includes Churchill and Douglas counties.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Glass	W	W	W	W
Molding	W	W	W	W
Building	687	$1,441	973	$1,543
Paving	230	282	428	559
Railroad ballast	W	W	---	---
Fill	143	113	125	122
Other	145	259	8	16
Gravel:				
Building	837	1,451	1,307	2,392
Paving	1,088	1,284	1,465	1,506
Railroad ballast	W	W	---	---
Fill	358	335	350	294
Other	W	W	W	W
Miscellaneous	247	485	84	227
Undistributed sand and gravel [1]	210	926	179	863
Total sand and gravel	3,945	6,576	4,919	7,522
Government-and-contractor operations: [2]				
Sand:				
Building	---	---	23	23
Paving	88	95	1,043	1,084
Fill	8	5	6	4
Other	24	24	16	16
Total	120	124	1,088	1,127
Gravel:				
Building	---	---	19	19
Paving	3,617	3,618	1,991	1,728
Fill	36	30	371	365
Other	94	94	59	73
Total	3,747	3,742	2,440	2,185
Total sand and gravel	3,867	3,866	3,528	3,312
All operations:				
Sand	1,529	3,129	2,800	4,229
Gravel	6,283	7,313	5,647	6,605
Grand total	7,812	10,442	8,447	10,834

W Withheld to avoid disclosing individual company confidential data.
[1] Includes fire or furnace sand, other industrial (unground) sand, and items indicated by symbol W.
[2] Includes figures for State, counties, municipalities, and other Government agencies.

ment, and in Clark and White Pine Counties for the manufacture of lime. Production of all other types of stone decreased.

Limestone also was produced in Clark County for sugar refining, metallurgical flux, and other chemical and industrial uses; in Pershing County for poultry grit; and in White Pine County as a flux in the smelting of copper. Marble was quarried in Mineral County for terrazzo, and calcareous marl was quarried in Nye County for use as a mineral filler.

Public works crews and contractors produced sandstone, limestone, granite, and miscellaneous stone in several counties for use as riprap, road base, and concrete aggregate.

Sulfur and Pyrites.—Pyrites was recovered from dump material by R. J. Dalton in Lincoln County and sold to an out-of-State customer. Assessment work was conducted on the Crofoot Sulfur deposit, Humboldt County. The mine last produced in 1965.

Talc and Soapstone.—Talc and soapstone production, the largest since 1957, came from three deposits in Esmeralda County. Talc was mined from the Hideout claims near the California State line and from the Wellington group of claims near Goldfield. All the soapstone was obtained from the White Top deposit of Chas. Pfizer & Co., Inc., near Lida. Sales were more than double those of 1968, and all shipments went to out-of-State grinding mills.

MINERAL FUELS

Petroleum.—Oil production in Nevada was 18 percent lower than in 1968, continuing the decline from a high recorded in 1969. As in preceding years, production came entirely from the Eagle Springs field in Nye County. At yearend 10 wells were producing. Only two well-drilling permits, 15 less than in 1968, were issued during the year by the Nevada Oil and Gas Conservation Commission. The two wells were development wells completed as dry holes in Clark County. Drilling footage for the two development wells totaled 8,435 feet. Two other well-drilling projects stood suspended at yearend. Although drilling was at a low level during the year, oil shows were reported in the Monte Cristo well in northwestern Esmeralda County, and several seismic crews continued surveys in the east-central part of the State in areas still considered to have potential for oil discovery.

Newton Petroleum Enterprises constructed a small refinery at the Mustang airport, Tonopah, Nye County, to make fuel oil for furnaces used to heat industrial and municipal buildings in Nevada.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Antimony:			
M. E. Myers	P.O. Box 65 Mountain City, Nev. 89831	Open pit mine	Elko.
Barite:			
Baroid Division, National Lead Co.	P.O. Box 1675 Houston, Tex. 77001	do	Do.
Dresser Minerals	P.O. Box 94 Houston, Tex. 77005	do	Lander.
FMC Corp	P.O. Box 3808 Modesto, Calif. 95352	do	Do.
Milchem, Inc., Mineral Division	Box 22111 Houston, Tex. 77027	do	Do.
Brucite:			
Basic, Inc	845 Hanna Bldg. Cleveland, Ohio 44115	do	Nye.
Cement:			
Nevada Cement Co	Fernley, Nev. 89408	Dry-process, portland-cement plant.	Lyon.
Clays:			
Nevada Cement Co	Fernley, Nev. 89408	Open pit mine	Washoe.
Western Talc Co	P.O. Box 368 Yermo, Calif. 92398	do	Clark, Esmeralda, Nye.
Copper:			
The Anaconda Co	P.O. Box 1000 Weed Heights, Nev. 89443	do	Lyon.
Cliffs Copper Corp	P.O. Box 1211 Rifle, Colo. 81650	do	Elko.
Duval Corp	P.O. Box 451 Battle Mountain, Nev. 89820	do	Lander.
Kennecott Copper Corp., Nevada Mines Div.	McGill, Nev. 89318	do	White Pine.
Diatomite:			
Eagle-Picher Industries, Inc	P.O. Box 1869 Reno, Nev. 89505	do	Pershing, Storey.
GREFCO, Inc	630 Shatto Pl. Los Angeles, Calif. 90005	do	Esmeralda.
United Sierra Division, Cyprus Mines Corp.	P.O. Box 1201 Trenton, N.J. 08606	do	Churchill.
Fluorspar:			
Carp Fluoride Co	P.O. Box 536 Delta, Utah 84624	do	Lincoln.
J. Irving Crowell, Jr	P.O. Box 96 Beatty, Nev. 89003	Underground mine.	Nye.
Gold:			
Carlin Gold Mining Co	P.O. Box 672 Elko, Nev. 89801	Open pit mine	Eureka.
Cortez Gold Mines	Cortez, Nev. 89821	do	Lander.
Duval Corp	P.O. Box 451 Battle Mountain, Nev. 89820	do	Do.
Kennecott Copper Corp., Nevada Mines Division.	McGill, Nev. 89318	do	White Pine.
Gypsum:			
The Flintkote Co	P.O. Box 2678 Terminal Annex Los Angeles, Calif. 90054	do	Clark.
Johns-Manville Products Corp	215 Market Street, Rm. 916 San Francisco, Calif. 94105	do	Do.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	do	Pershing.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Iron ore:			
Nevada Barth Corp	P.O. Box 425 Carlin, Nev. 89822	Open pit mine	Eureka.
Nevada Iron Ore Co., Inc	730 14th St. Lovelock, Nev. 89419	----do	Pershing.
Standard Slag Co	Box 4400 Reno, Nev. 89501	----do	Douglas.
Lead:			
John F. Ala	P.O. Box 55 Montello, Nev. 89830	Underground mine.	Elko.
Eureka-Nevada Limited	P.O. Box 297 Eureka, Nev. 89316	----do	Eureka.
Federal Resources Corp	1370 South 3d West Salt Lake City, Utah 84115	----do	Mineral.
Hammock & Bush	P.O. Box 184 Mina, Nev. 89422	Open pit mine	Do.
International Energy Co	628 Patterson Bldg. Denver, Colo. 80202	Underground mine.	White Pine.
Lime:			
The Flintkote Co	P.O. Box 57367 Flint Station Los Angeles, Calif. 90057	Rotary kilns, batch and continuous hydrators.	Clark.
Morrison & Weatherly Chemical Products.	Box 1105 McGill, Nev. 89318	Rotary kilns	White Pine.
Lithium:			
Foote Mineral Co	Route 100 Exton, Pa. 19341	Dry Lake brines.	Esmeralda.
Magnesite:			
Basic, Inc	845 Hanna Bldg. Cleveland, Ohio 44115	Open pit mine	Nye.
Mercury:			
Advanced Mining Industries, Inc	P.O. Box 1185 Winnemucca, Nev. 89445	Underground mine.	Humboldt.
Kollsman Mineral & Chem. Corp	1441 Angelo Dr. Beverly Hills, Calif. 90210	Open pit mine	Esmeralda.
Fred H. Lenway & Co., Inc	100 California St. San Francisco, Calif. 94111	Underground mine.	Humboldt.
Ruja Mining Co	P.O. Box 31 McDermitt, Nev. 89421	----do	Do.
Star City Mines, Ltd	P.O. Box 1008 Winnemucca, Nev. 89445	Open pit mine	Pershing.
Molybdenum:			
Kennecott Copper Corp., Nevada Mines Division.	McGill, Nev. 89318	----do	White Pine.
Perlite:			
Combined Metals Reduction Co., Panacalite Division.	218 Felt Bldg. Salt Lake City, Utah 84110	----do	Lincoln.
Delamar Perlite	Pioche, Nev. 89043	Underground mine.	Do.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	Open pit mine	Pershing.
Petroleum:			
James L. Davis	21 Boyd Rd. Pleasant Hill, Calif. 94523	Producing crude-oil wells.	Nye.
North American Resources Corp	811 San Jacinto Bldg. Houston, Tex. 77002	----do	Do.
Western Oil Lands, Inc	380 Linden St. Reno, Nev. 89502	----do	Do.
Pumice:			
Kaiser Industries Corp	300 Lakeside Dr. Oakland, Calif. 94612	Open pit mine	Storey.
Rilite Aggregate Co	P.O. Box 5665 Reno, Nev. 89503	Open pit mine	Washoe.
Savage Construction Inc	P.O. Box 970 Carson City, Nev. 89701	----do	Ormsby.
Salt:			
Fallon Development Co	Harrigan Rd. Fallon, Nev. 89406	Dry lake brines.	Churchill.
Sand and gravel:			
A-1 Paving Co	3346 Ellis Las Vegas, Nev. 89102	Open pit mine	Clark.
C. M. Brown Construction Co	1770 North Leonard Lane Las Vegas, Nev. 89108	----do	Do.
Dayton Sand & Gravel Co	P.O. Box 193 Dayton, Nev. 89403	----do	Lyon.
R. Helms Construction Co	3025 Mill St. Reno, Nev. 89502	----do	Washoe.
Las Vegas Building Materials, Inc	P.O. Box 530 Las Vegas, Nev. 89101	----do	Clark.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Nevada Aggregates & Asphalt	P.O. Box 7424 Reno, Nev. 89502	Open pit mine	Washoe.
Reynolds Electrical & Engineering Co., Inc.	P.O. Box 14400 Las Vegas, Nev. 89114	do	Nye.
Simplot Silica Products	P.O. Box 308 Overton, Nev. 89040	do	Clark.
Stewart Brothers Co	P.O. Box 2775, Huntridge Sta. Las Vegas, Nev. 89101	do	Do.
Stock Mill & Supply Co	3336 Cinder Lane Las Vegas, Nev. 89103	do	Do.
Wells-Cargo, Inc	2894 West Spring Mountain Rd. Las Vegas, Nev. 89114	do	Do.
West Coast Silica Co	P.O. Box 150 Overton, Nev. 89040	do	Do.
W. M. K. Transit Mix, Inc	1606 Industrial Rd. Las Vegas, Nev. 89102	do	Do.
Silver:			
The Anaconda Co	P.O. Box 1000 Weed Heights, Nev. 89443	do	Lyon.
Bristol Silver Mines Co	P.O. Box 276 Pioche, Nev. 89043	Underground mine.	Lincoln.
Duval Corp	P.O. Box 451 Battle Mountain, Nev. 89820	Open pit mine	Lander.
Eureka-Nevada Ltd	P.O. Box 297 Eureka, Nev. 89316	Underground mine.	Eureka.
Federal Resources Corp	1370 South 3d West Salt Lake City, Utah 84115	do	Mineral.
Hammock & Bush	P.O. Box 184 Mina, Nev. 89422	Open pit mine	Do.
Kennecott Copper Corp., Nevada Mines Division.	McGill, Nev. 89318	do	White Pine.
Stone:			
Morrison & Weatherly Chemical Products.	Box 1105 McGill, Nev. 89318	Open quarry	Do.
Nevada Cement Co	Fernley, Nev. 89408	do	Lyon.
U.S. Lime Division, The Flintkote Co.	P.O. Box 57367 Flint Station Los Angeles, Calif. 90057	do	Clark.
Talc and soapstone:			
Chas. Pfizer & Co., Inc	P.O. Drawer AD Victorville, Calif. 92394	Open pit mine	Esmeralda.
H. N. Stewart	P.O. Box 176 Big Pine, Calif. 93513	do	Do.
Tungsten:			
Henry C. & John Crofoot	P.O. Box 797 Lovelock, Nev. 89419	do	Churchill.
Zinc:			
Federal Resources Corp	1370 South 3d West Salt Lake City, Utah 84115	Underground mine.	Mineral.
International Energy Co	628 Patterson Bldg. Denver, Colo. 80202	do	White Pine.

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 William Cochran [1]

Mineral production in New Hampshire was valued at $8.1 million in 1969, an 11-percent decrease from the record level of $9.2 million established the previous year. The decrease was due primarily to reduced demand for materials used in highway construction. Construction materials including sand and gravel and various types of building stone accounted for 98 percent of the total value of minerals produced in the State.

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in New Hampshire [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	41	$41	44	$40
Sand and gravel—do	7,742	5,698	6,310	5,149
Stone—do	383	3,377	320	2,888
Value of items that cannot be disclosed: Feldspar, gem stones, and mica (1969).	XX	50	XX	43
Total	XX	9,166	XX	8,120
Total 1967 constant dollars	XX	9,078	XX	p 7,906

p Preliminary. 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 New Hampshire, by counties

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Belknap	W	W	Sand and gravel.
Carroll	W	W	Sand and gravel, stone.
Cheshire	W	W	Sand and gravel, mica.
Coos	$220	$171	Sand and gravel.
Grafton	803	677	Sand and gravel, stone, feldspar, clays, mica.
Hillsboro	2,952	2,513	Stone, sand and gravel.
Merrimack	2,333	2,280	Sand and gravel, stone.
Rockingham	1,192	959	Sand and gravel, stone, clays.
Strafford	W	256	Sand and gravel, clays.
Sullivan	W	W	Sand and gravel.
Undistributed [1]	1,666	1,265	
Total	9,166	[2] 8,120	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes value of sand and gravel and gem stones not assigned to specific counties and values indicated by symbol W.
[2] Data does not add to totals shown because of independent rounding.

Table 3.—Indicators of New Hampshire business activity

	1968	1969 p	Change, percent
Employment and labor force, annual average:			
Total labor force—thousands	r 292.8	297.6	+1.6
Unemployment—percent of work force	1.8	2.3	+27.8
Employment:			
Manufacturing employment—thousands	99.7	98.0	−1.7
Durable goods—do	46.4	46.7	+0.6
Nondurable goods—do	53.4	51.3	−3.9
Nonmanufacturing employment—do	156.4	164.1	+4.9
Mining and construction—do	12.3	13.7	+11.4
Payroll-average weekly earnings:			
Manufacturing	$98.74	$103.10	+4.4
Durable goods	$103.09	$107.73	+4.5
Nondurable goods	$95.20	$99.46	+4.5
Personal income:			
Total—millions	r $2,288	$2,491	+8.9
Per capita	$3,254	$3,474	+6.8
Construction activity:			
Highway construction contracts—thousands	$17,234	$37,272	+116.3
Cement shipments to and within New Hampshire—thousand 376-pound barrels	1,036	994	−4.1
Mineral production value—thousands	$9,166	$8,120	−11.4

r Revised. p Preliminary.

Source: State of New Hampshire Department of Employment Security; Survey of Current Business; State of New Hampshire Department of Public Works and Highways.

Table 4.—Worktime 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
1968:								
Nonmetal	47	314	15	118	---	1	8.47	17
Sand and gravel	376	204	77	660	---	14	21.21	924
Stone	121	245	30	237	---	4	16.85	438
Total [1]	544	223	121	1,016	---	19	18.71	705
1969: p								
Nonmetal	50	217	11	85	---	1	11.76	235
Sand and gravel	410	191	78	725	---	14	19.32	1,037
Stone	145	242	35	281	---	12	42.69	1,131
Total [1]	600	205	123	1,091	---	27	24.75	998

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Clay from pits in Grafton, Rockingham, and Strafford Counties was used principally in manufacturing building bricks. The volume of clay produced during 1969 increased 7 percent over that of the previous year, but the value declined slightly.

Feldspar.—Bell Minerals Co. continued to operate the Ruggles mine in Grafton County. Feldspar was selectively mined, hand sorted, and shipped by truck to a central grinding mill at Paris, Maine. There was no change in unit value from the previous year, but the volume of crude ore declined. The ground feldspar was used primarily in ceramics and as an abrasive in cleaning compounds.

Gem Stones.—The many pegmatites and old mine workings in New Hampshire are

a source of mineral specimens and semiprecious gem stones. Amateur collectors as well as dealers collected specimens primarily in Carroll, Cheshire, and Grafton Counties.

Mica.—A small quantity of scrap mica was produced at two operations in Cheshire and Grafton Counties. The material was shipped to a grinding mill in Concord, Mass. The ground product was used principally in paint and as a lubricant in the manufacture of rubber products.

Perlite.—National Gypsum Co. expanded crude perlite in its Portsmouth Plant. The raw material was imported from a mine in Colorado. The volume of expanded perlite was about half of the previous year's production. The product was used principally in acoustical plaster.

Sand and Gravel.—Production of sand and gravel declined 18 percent, primarily due to a decrease in output at Government-and-contractor operations. The amount of material used for highway maintenance and construction dropped sharply for the second consecutive year; deliveries were 1.3 million tons less than in 1968 and 2.9 million tons less than in 1967 when State and interstate highway construction was at a peak. Commercial production of sand and gravel declined about 3 percent, but operators washed and screened proportionately more of their product during the year. In addition, the average value of washed material increased from $1.13 to $1.24 per ton; the average value of bank-run material decreased from $0.60 to $0.42 per ton. The number of operators reporting commercial production increased by 7, but this increase occurred mainly among operators with less than 25,000 tons per year and thus had little effect on total production. Of the 39 commercial operations in 1969, 18 had an output of less than 50,000 tons, eight produced 50,000 to 100,000 tons, and 13 produced over 100,000 tons each; the latter group accounted for over 80 percent of the commercial sand and gravel output. About 12 percent of the State's commercially produced sand and gravel was shipped by rail to the Boston area for use in ready-mix concrete.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	673	$592	697	$743
Paving	607	554	543	554
Fill	834	579	714	322
Other [1]	51	39	52	47
Total	2,165	1,764	[2] 2,004	[2] 1,667
Gravel:				
Building	822	1,108	748	1,120
Paving	1,013	1,153	793	936
Fill	156	77	479	288
Other [3]	293	248	307	323
Total	2,284	2,586	2,327	2,617
Total sand and gravel	4,449	4,350	[2] 4,330	[2] 4,285
Government-and-contractor operations:				
Sand:				
Paving	1,225	486	664	287
Fill	18	6	18	6
Total	1,243	[2] 494	682	293
Gravel: Paving	2,050	854	1,298	571
Total sand and gravel	3,293	[2] 1,350	1,980	[2] 865
All operations:				
Sand	3,408	2,258	2,686	[2] 1,961
Gravel	4,334	3,440	3,625	3,188
Grand total	7,742	5,698	[2] 6,310	5,149

[1] Includes filtration sand, engine sand, and sand for other construction and industrial uses.
[2] Data does not add to totals shown because of independent rounding.
[3] Includes miscellaneous gravel.

Stone.—Total value declined 14 percent compared with that of the previous year; comparable decreases occurred in dimension and crushed stone. Of the total 1969 value of production, 79 percent was accounted for by dimension granite. Principal products were curbing, and cut stone for architectural work. Other types of granite products, including monuments, accounted for less than 11 percent of dimension stone value. Output as well as average unit value of crushed quartz declined. The material was used primarily as exposed aggregate in decorative concrete. The volume of crushed stone, used primarily in highway construction, declined 18 percent; however, average unit value increased from $2.13 to $2.21 per ton.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clay:			
Densmore Brick Co	Lebanon, N.H. 03766	Pit	Grafton.
W. S. Goodrich, Inc	Epping, N.H. 03042	Pit	Rockingham.
The Kane-Gonic Brick Corp	Gonic, N.H. 03867	Pit	Strafford.
Feldspar (crude):			
Bell Minerals Co	West Paris, Maine 04289	Underground and open pit.	Grafton.
Gypsum (calcined):			
National Gypsum Co	325 Delaware Ave., Buffalo, N.Y. 14202	Plant	Rockingham.
Mica:			
Otto Lassman	Gilsum, N.H. 03448	Pit	Cheshire.
RPM Inc	Newport, N.H. 03773	Pit	Grafton.
Perlite (expanded):			
National Gypsum Co	325 Delaware Ave., Buffalo, N.Y. 14202	Plant	Do.
Sand and gravel:			
R. S. Audley, Inc	Rt. 3A Bow, N.H. 03302	Pit	Merrimack.
Campton Sand & Gravel, Inc	P.O. Box 2 W. Campton, N.H. 03228	Pit	Grafton.
Cold River Sand & Gravel Corp	P.O. Box 429 Bellows Falls, Vt. 05101	Pit	Cheshire.
J. J. Cronin Company	P.O. Box 176 N. Reading, Mass. 01864	Pit	Hillsboro.
Iafolla Construction Co., Inc	Peverly Hill Rd. Portsmouth, N.H. 03801	Pit	Rockingham and Strafford.
Keene Sand & Gravel, Inc	725 Main Street Keene, N. H. 03431	Pit	Cheshire.
Lebanon Crushed Stone, Inc	Plainfield Rd., W. Lebanon, N.H. 03784	Pit	Grafton.
Manchester Sand, Gravel & Cement Co., Inc.	P.O. Box 415 Hooksett, N.H. 03106	Pit	Merrimack and Rockingham.
Nashua Sand & Gravel	Route 130 Nashua, N.H. 03060	Pit	Hillsboro.
Palazzi Corp	2321 Hartford Ave. Johnston, R.I. 02900	Pit	Merrimack.
Thomopoulis Sand & Gravel Pit	Londonderry, N.H. 03053	Pit	Rockingham.
Tilton Sand & Gravel, Inc	Tilton, N.H. 03276	Pit	Belknap.
Twin States Sand & Gravel	P.O. Box 203 W. Lebanon, N.H. 03784	Pit	Grafton.
Weaver Bros. Construction Co	Rt. 3A, Box 396 Concord, N.H. 03300	Pit	Merrimack.
Stone:			
Granite, dimension:			
Kitledge Granite Corp	Oak Street Milford, N.H. 03055	Quarry	Hillsboro.
The John Swenson Granite Co., Inc.	North State Street Concord, N.H. 03301	----do	Merrimack.
Miscellaneous stone, crushed:			
Iafolla Construction Co., Inc	Peverly Hill Rd., Portsmouth, N.H. 03801	----do	Rockingham.
Lebanon Crushed Stone, Inc	Plainfield Rd., W. Lebanon, N.H. 03784	----do	Grafton.
Quartz, crushed:			
North Country Aggregates, Inc.	P.O. Box 55, S. Lyndeboro, N.H. 03082	----do	Hillsboro.

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 Stanley A. Feitler [1]

The value of New Jersey mineral production was $83.1 million, an alltime high. The total exceeded by $2.9 million (4 percent) the previous high established in 1965. As compared with 1968, the value increased 7 percent; expressed in 1967 constant dollars, the increase was 5 percent. Stone accounted for about two-thirds of the net increase in value, but the unit value of stone was 3 percent below that of 1968. Of the 11 mineral commodities in table 1, unit values were lower for six, higher for four, and unchanged for one.

Somerset County continued to be the leading mineral producing area, and was followed, in decreasing order of value, by Sussex, Cumberland, Morris, Ocean, and Passaic Counties. Mineral production was reported for all counties except Salem.

[1] Supervisory physical scientist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in New Jersey [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	373	$1,008	327	$1,123
Gem stones	NA	10	NA	10
Peat—short tons	55,786	621	46,367	551
Sand and gravel—thousand short tons	20,306	33,570	20,325	33,977
Stone—do	13,151	30,343	15,162	34,034
Zinc[2] (recoverable content of ores, etc.)—short tons	25,668	6,930	25,076	7,322
Value of items that cannot be disclosed: Lime, magnesium compounds, manganiferous residuum, greensand marl, and titanium concentrate (ilmenite)	XX	4,984	XX	6,090
Total	XX	77,466	XX	83,107
Total 1967 constant dollars	XX	76,469	XX	p 79,914

p Preliminary. 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 New Jersey, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Atlantic	$617	$516	Sand and gravel.
Bergen	W	1,941	Do.
Burlington	2,829	1,842	Sand and gravel, clays.
Camden	2,218	2,092	Do.
Cape May	W	W	Magnesium compounds, sand and gravel.
Cumberland	12,520	12,579	Sand and gravel, clays.
Essex	W	W	Stone.
Gloucester	478	560	Sand and gravel, greensand marl.
Hudson	W	W	Stone.
Hunterdon	W	W	Do.
Mercer	W	W	Do.
Middlesex	2,484	2,421	Sand and gravel, clays.
Monmouth	1,145	1,201	Sand and gravel.
Morris	6,347	7,565	Sand and gravel, stone.
Ocean	5,059	6,040	Sand and gravel, ilmenite.
Passaic	5,175	5,838	Stone, sand and gravel.
Somerset	14,505	14,706	Stone, clays.
Sussex	12,771	13,328	Zinc, stone, sand and gravel, lime, manganiferous residuum, peat.
Union	W	W	Stone.
Warren	880	938	Sand and gravel, peat, stone.
Undistributed [2]	10,436	11,543	
Total [3]	77,466	83,107	

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.
[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New Jersey business activity

		1968	1969 [p]	Change, percent
Employment and labor force, annual average: [1]				
Total work force	thousands	2,909.9	2,960.9	+1.8
Unemployment	percent of work force	4.6	4.5	−2.2
Employment	thousands	2,771.9	2,809.1	+1.3
Manufacturing	do	885.9	879.7	−.7
Durable goods	do	461.1	455.4	−1.2
Stone, clay, and glass products	do	38.8	40.6	+4.6
Primary metal industries	do	38.6	39.4	+2.1
Fabricated metals	do	66.9	67.4	+.7
Machinery (excluding electric)	do	75.5	74.9	−.8
Electrical machinery	do	129.1	125.5	−2.8
Transportation equipment	do	31.9	31.6	−.9
Instruments	do	35.5	33.3	−6.2
Other durable	do	44.8	42.7	−4.7
Nondurable goods	do	424.8	424.3	−.1
Nonmanufacturing	do	1,601.5	1,644.6	+2.7
Construction	do	114.1	112.5	−1.4
Transportation and public utilities	do	166.4	172.5	+3.7
Finance, insurance, and real estate	do	109.7	112.8	+2.8
Service	do	372.2	377.8	+1.5
Government	do	343.3	355.6	+3.6
Payroll, average weekly earnings: [2]				
Manufacturing		$125.76	$132.33	+5.2
Personal income: [3]				
Total	millions	[r] $28,047	$30,580	+9.0
Per capita		[r] $3,967	$4,278	+7.8
Construction activity:				
New housing units authorized [2]		[r] $36,546	$34,098	−6.7
Portland cement shipments to New Jersey	thousand 376-pound barrels	[r] 10,319	10,963	+6.2
Mineral production	thousands	$77,466	$83,107	+7.3

[p] Preliminary. [r] Revised.
[1] Bureau of Employment Security, New Jersey.
[2] New Jersey Economic Indicators.
[3] Survey of Current Business, New Jersey Department of Labor.

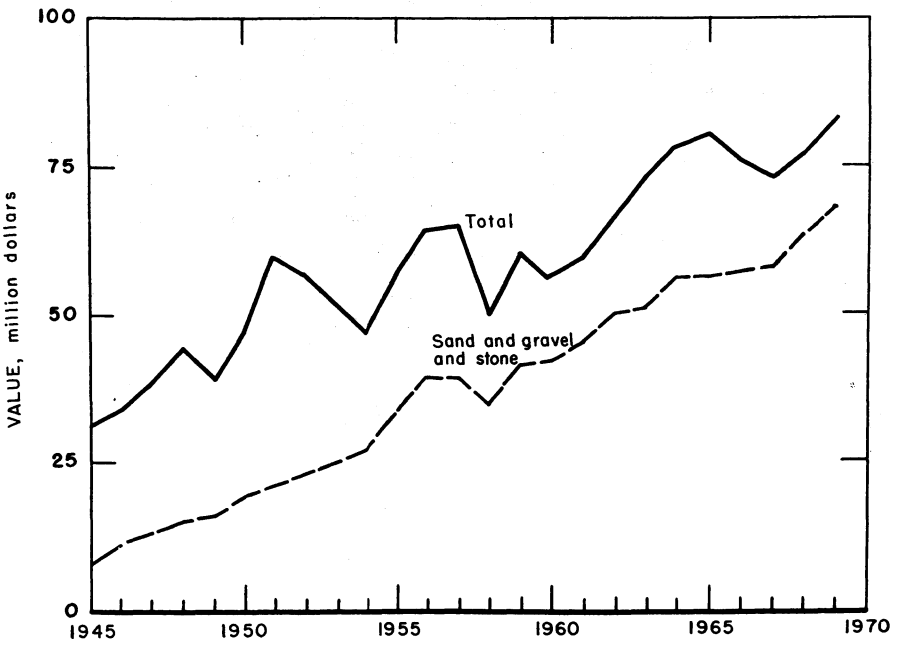

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in New Jersey.

Table 4.—Worktime 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
1968:								
Peat	21	215	5	36	-----	-----	-----	-----
Metal	174	295	51	413	1	22	55.69	15,627
Nonmetal	353	235	83	664	-----	20	30.13	568
Sand and gravel	1,044	245	255	2,104	-----	56	26.62	781
Stone	983	261	257	2,159	-----	68	31.49	1,220
Total	2,575	253	651	5,376	1	166	31.06	2,066
1969:[p]								
Peat	21	206	4	35	-----	1	28.60	343
Metal	175	265	47	379	-----	26	68.66	2,345
Nonmetal	290	273	79	634	-----	17	26.80	875
Sand and gravel	1,130	239	271	2,233	-----	63	28.22	2,857
Stone	935	269	252	2,146	1	77	36.36	4,178
Total [1]	2,555	256	653	5,426	1	184	34.09	3,095

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Portland cement shipments into New Jersey totaled 11 million 376-pound barrels, an increase of 6 percent over 1968. Five percent of the portland cement was high-early strength. Masonry cement shipments were 4 percent less than those of 1968. Most of the portland and masonry cement was manufactured in eastern Pennsylvania and eastern New York. Cement was distributed from five terminals: Two in Jersey City, and one each in Bayonne, Elizabethport, and Newark.

Clays.—The quantity of clay produced declined 12 percent as compared to that of 1968, but value was 11 percent higher. Miscellaneous clay and shale, used for building brick and heavy clay products, accounted for 75 percent of the total clay tonnage, but the total value of fire clay was slightly higher. Fire clay was used principally for fire brick, foundry clay, and refractory mortar. Quantities of fire clay were used as a vehicle for aerosols, drilling mud, wall and floor tile, whiteware, and building brick. Miscellaneous clay produced for brick was sufficient to make more than 70 million brick in 1969. Miscellaneous clay and shale were produced in Middlesex, Somerset, Camden, and Burlington Counties, in descending order of tonnage. Fire clay was mined in Middlesex and Cumberland Counties. The Tri-County Brick Corp., Bergen County, was inactive during 1969.

Gem Stones.—Mineral collectors and dealers continued to recover specimens from mineral localities, mine dumps and quarries, principally in the northern part of the State. The value of the material collected was estimated to be the same as in 1968.

Gypsum.—Crude gypsum from other States and foreign sources was calcined at four plants, two in Burlington County and one each in Bergen and Camden Counties. The quantity of gypsum processed, 383,000 tons, was 8 percent greater than in 1968. The calcined gypsum was used mainly in the manufacture of wallboard, lath, and sheathing. Gypsum plaster and Keene's cement also were produced.

Iodine.—Consumption of organic and inorganic iodine by chemical and pharmaceutical companies in the State totaled 608,000 pounds compared with 631,000 pounds in 1968. The iodine was used for medicines, sanitation products, and other chemicals.

Lime.—Production of hydrated lime increased significantly in tonnage and value compared with that of 1968. Lime produced at one plant in Sussex County was used for construction, agriculture, water purification, and sewage treatment.

Magnesium Compounds.—Production of refractory magnesia expanded 64 percent, but the unit price was lower than in 1968. The refractory magnesia was produced in Cape May County from sea water and im-

ported dolomite. J. T. Baker Chemical Co., Warren County, converted purchased materials to a variety of magnesium compounds.

Marl, Greensand.—Production of greensand marl was greater in quantity and value than in 1968. Marl, recovered by hydraulic mining from a pit in Gloucester County, was processed and used for water treatment. A quantity of crude marl was used as a soil conditioner.

Perlite.—Crude perlite mined in Colorado, Nevada, and New Mexico was expanded at four plants, two in Middlesex County and one each in Mercer and Somerset Counties. Johns-Manville Products Corp., Building Products Division, discontinued production of expanded perlite at its Manville plant, Somerset County, on March 31. Expanded perlite was used primarily in roof insulation board and acoustical plaster; other uses included aggregate for ultra-light-weight concrete, loose-fill insulation and soil conditioner, and as a lightweight filler.

Pigments.—Metal-base pigments used primarily in the manufacture of paint, were produced at a number of plants in New Jersey. Iron oxide pigments were produced by Pigments and Specialties Division, Cities Service Co. (formerly Columbian Carbon Co.) in Mercer and Middlesex Counties, and by E. I. du Pont de Nemours & Co., Inc., in Essex County. Titanium dioxide was produced by The New Jersey Zinc Co., Gloucester City, and National Lead Co., near Sayreville. National Lead Co. also manufactured lead pigments. Zinc oxide and leaded zinc oxide pigments were produced by Royce Chemical Co., Carlton Hill.

Sand and Gravel.—The total output of sand and gravel was virtually the same as in 1968, but the value increased 1 percent. Production of sand and gravel for construction increased but at a lower rate than in 1967–68; as compared with 1968, quantity and value were 1 and 3 percent higher, respectively. Average value per ton increased $0.02 to $1.17 per ton. The quantity of material used for fill was 4 percent less than in 1968. Of the 16.9 million tons of sand and gravel used for construction, 2.6 million (15 percent) was unprocessed. Output of industrial sand for all uses decreased 6 percent in quantity and 2 percent in value, reflecting an increase of $0.19 in the average value per ton. Industrial sand accounted for 16 percent of the tonnage and 41 percent of the value of all sand and gravel produced in the State. Glass and furnace sand production increased substantially, but output of sand for molding and traction decreased markedly. Most of the industrial sand was produced in Cumberland County where most operations used suction pumps mounted on barges floating on ponds fed by ground water. The sand and water slurry was pumped to processing plants for sizing, grinding, or other treatment. Many of the ponds created by removal of the sand are used for fishing and other recreational activities.

Sand and gravel was produced by 93 companies at 100 operations in 14 of the State's 21 counties. Production exceeded 1 million tons in each of eight counties. Ocean County led in tonnage with 3.9 million tons. Cumberland County ranked first in value; its industrial sand accounted for more than one-third of the total value of sand and gravel produced in the State.

Two operations produced more than 1 million tons, five produced from 500,000 to 1 million tons, and 50 were in the 100,000 to 500,000-ton bracket. The product was delivered to the point of consumption by truck, 79 percent; railway, 17 percent; and water, 4 percent.

Stone.—Increased building activity, especially highway construction, in the State's northern and northwestern counties, created increased demand for construction aggregates. Total stone production increased 15 percent in tonnage and 12 percent in value. Stone was quarried in 10 counties, led by Somerset, Passaic, Sussex, and Hunterdon Counties, in decreasing order of value. Types of stone produced, in decreasing order of tonnage, were basalt, granite, limestone, miscellaneous stone, marble, and sandstone. Basalt (traprock) continued to be the type of stone most quarried and accounted for 81 and 77 percent, respectively, of the State's total stone production and value. Output of 12.3 million tons was 10 percent higher than in 1968; average value decreased from $2.17 per ton to $2.14. Somerset County with 6.6 million tons and Passaic County with 2 million tons were the leading basalt producers. Basalt also was produced in Essex, Hudson, Hunterdon, Mercer, and Union Counties. Quantities were used for riprap, railroad ballast, and other uses, but 97 percent was sold as

Table 5.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Sand:				
Building	5,955	$6,001	6,344	$6,501
Paving	4,266	4,598	4,189	4,426
Fill	1,401	675	1,363	636
Glass	1,123	4,579	W	W
Molding	1,857	6,322	1,431	5,216
Blast	134	713	129	647
Ground	138	1,313	131	1,270
Other [1]	582	1,344	1,735	6,936
Total	15,256	25,545	15,322	[2] 25,634
Gravel:				
Building	2,785	5,142	2,595	5,092
Paving	1,713	2,271	1,832	2,489
Fill	330	256	296	245
Other [3]	222	356	280	517
Total	5,050	8,025	5,003	8,343
Total sand and gravel	20,306	33,570	20,325	33,977

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes fire or furnace, engine, filtration, oil (1969), and other sand.
[2] Data may not add to total shown because of independent rounding.
[3] Includes miscellaneous and other gravel.

aggregate for highway and building construction.

Granite, with a large increase in tonnage (55 percent) and value (63 percent), displaced limestone as the State's second leading stone based on value. Average value increased $0.10 per ton to $2.06. Produced from quarries in Hunterdon, Morris, and Sussex Counties, crushed granite was used mainly for concrete aggregate and roadstone.

Crushed limestone was produced at two quarries in Sussex County and one in Warren County. Output was 10 percent greater than in 1968 but total value was about the same, reflecting a decrease of $0.47 per ton in average value. The limestone was used for agriculture, special construction aggregate, poultry grits, filler, and other applications. Crushed miscellaneous stone (gneiss) quarried and crushed in Passaic County was used for concrete aggregate and roadstone. Output was significantly greater than that of 1968. Sandstone was quarried for flagstone at several localities in Hunterdon County. Marble for use in terrazzo was mined at a quarry in Warren County.

Sulfur.—Shipments of byproduct sulfur totaled 55,000 long tons, an increase of 9 percent. The total value was slightly lower because the average value per long ton decreased to $39.18 from $43.92 in 1968. Elemental sulfur was recovered as a byproduct of petroleum refining at five plants, two each in Gloucester and Union Counties, and one in Middlesex County. Industrial Chemicals Division, Allied Chemical Corp., discontinued recovery of sulfur at its Bayway plant in Union County during 1969. The operation of liquid sulfur storage and transshipment terminals was continued.

Vermiculite.—One plant each in Essex, Mercer, and Middlesex Counties produced exfoliated vermiculite from crude material shipped from other States or imported. The exfoliated material was used for loose fill insulation, aggregate in ultra-lightweight concrete, horticulture, acoustical plaster, packing, and a variety of industrial applications.

METALS

Ferroalloys.—Shieldalloy Corp., Newfield Gloucester County, produced ferroalloys of vanadium, titanium, boron, molybdenum, columbium, and columbium-tantalum.

Titanium—Tonnage and total value of ilmenite concentrate production increased, but the unit value was lower than in 1968. Glidden-Durkee Div. of SCM Corp. recovered ilmenite from a sand deposit about 3 miles north of Lakehurst, Ocean County. After concentration, the ilmenite was shipped to a company-owned plant at Bal-

timore, Md., for conversion to titanium dioxide pigment.

Zinc.—Manganiferous zinc ore mined at Sterling Hill, Sussex County, was crushed and shipped to a company-owned smelter at Palmerton, Pa., where zinc and manganiferous residuum were recovered. The quantity of zinc recovered was less than in 1968, but the value was greater. Shipments of manganiferous residuum were lower than in 1968.

MINERAL FUELS

Coke and Coal Chemicals.—Coke and coal chemicals were produced by Koppers Co., Inc., at its merchant oven coke plant at Kearney, Hudson County. Coal chemicals recovered included crude coal tar and crude light oil.

Natural gas.—Humble Oil and Refining Co., Union County, and Transcontinental Gas Pipe Line Corp., Bergen County, operated gas storage and distribution facilities.

Peat.—Production and sales of peat were lower than in 1968. Peat was recovered from bogs near Newton, Stanhope, and Sussex in Sussex County, and from Great Meadows in Warren County. Most of the output was used for soil improvement. A quantity was used in mushroom beds and mixed fertilizers.

Petroleum.—Six petroleum refineries were active in the State and reported total crude oil capacity of about 500,000 barrels per day. Products recovered included gasoline, asphalt, coke, lubricants, and paraffin.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Fire clay:			
Crossman Co	P.O. Box 38 South Amboy, N.J. 08879	Pit	Middlesex.
Daniel Goff Division, Jesse S. Morie & Son, Inc.	P.O. Box 35 Mauricetown, N.J. 08329	Pit	Cumberland.
A. P. Green Refractories Co. Valentine Division.	Pennval Road Woodbridge, N.J. 07095	Pit	Middlesex.
Miscellaneous clay:			
The Alliance Clay Product Co.	P.O. Box 746 Alliance, Ohio 44601	Pit	Camden.
Church Brick Co	P.O. Box 129 Bordentown, N.J. 08505	Pit	Burlington.
Glen-Gery Corp	P.O. Box 1656 East Canton, Ohio 44730	Pit	Somerset.
New Jersey Shale Brick & Tile Corp.	P.O. Box 490 Somerville, N.J. 08876	Pit	Do.
The Rosehill Corp. t/a Oschwald Brick Works.	Cliffwood, N.J. 07721	Pit	Middlesex.
Sayre & Fisher Co. & Divisions	Box 472 Sayreville, N.J. 08872	Pit	Do.
Greensand marl: Inversand Co	226 Atlantic Avenue Clayton, N.J. 08312	Pit	Gloucester.
Gypsum, calcined:			
The Celotex Corp	1500 North Dale Mabry Tampa, Fla. 33607	Plant	Bergen.
The Flintkote Co., Building Products Group-East.	480 Central Ave. East Rutherford, N.J. 07073	do	Camden.
Kaiser Gypsum Co., Inc	Delanco, N.J. 08075	do	Burlington.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	do	Do.
Ilmenite: Glidden-Durkee, Division of SCM Corp.	P.O. Box 5 Lakehurst, N.J. 08733	Pit	Ocean.
Iron oxide pigments (manufactured):			
Cities Service Co	380 Madison Ave. New York, N.Y. 10017	Plant	Mercer, Middlesex.
E.I. du Pont de Nemours & Co., Inc.	Du Pont Building Wilmington, Del. 19898	do	Essex.
Lime: Limestone Products Corp. of America.	122 Main St. Newton, N.J. 07860	do	Sussex.
Magnesium compounds:			
J. T. Baker Chemical Co	600 North Broad St. Phillipsburg, N.J. 08865	do	Warren.
Northwest Magnesite Co	2 Gateway Center Pittsburgh, Pa. 15222	do	Cape May.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Peat:			
Hyper-Humus Co	Lafayette Rd. Newton, N.J. 07860	Bog	Sussex.
Kelsey Humus Co., Partac Peat Co.	Kelsey Park Great Meadows, N.J. 07838	Bog	Warren.
Mt. Bethel Humus Co., Inc	1270 Broadway New York, N.Y. 10001	Bog	Sussex.
Netcong Natural Products	Lackawanna Drive Stanhope, N.J. 07874	Bog	Do.
Perlite (expanded):			
Coralux Perlite Corp. of New Jersey.	P.O. Box 251 Metuchen, N.J. 08840	Plant	Middlesex.
Grefco, Inc	630 Shatto Place Los Angeles, Calif. 90005	do	Do.
Johns-Manville Products Corp	22 East 40th St. New York, N.Y. 10016	do	Somerset.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass.	do	Mercer.
Petroleum refineries:			
Chevron Oil Co	1200 State St. Perth Amboy, N.J. 08861	do	Middlesex.
Hess Oil & Chemical Corp	State St. Perth Amboy, N.J. 08861	do	Do.
Humble Oil and Refining Co	Box 22, Linden, N.J. 07036	do	Union,[1] Hudson.
Mobile Oil Corp.[1]	P.O. Box 927 Philadelphia, Pa. 19105	do	Gloucester.
Texaco Inc	135 East 42d St. New York, N.Y. 10017	do	Do.
Sand and gravel:			
American Dredging Co., Sand and Gravel Division.	12 South 12th St. Philadelphia, Pa. 19107	Pit	Burlington.
Amico Sand & Gravel Co	Norman Ave. Riverside, N.J. 08075	Pit	Do.
Braen Sand & Gravel Co	Brookside Ave. Wyckoff, N.J. 07481	Pit	Bergen.
Brick-Wall Corp	Route 70 Lakehurst, N.J. 08733	Pit	Ocean.
Crossman Co	P.O. Box 38 South Amboy, N.J. 08879	Pit	Middlesex.
Fisher Bros. Sand & Gravel Co	115 Hickory Lane Bayville, N.J. 08721	Pit	Ocean.
Houdaille Construction Materials, Inc.	10 Park Place Morristown, N.J. 07960	Pit	Morris, Ocean, Warren.
Lacey Materials, Inc	Forked River, N.J. 08731	Pit	Ocean.
May's Landing Sand & Gravel Co., Inc.	Main & Central R.R. Vineland, N.J. 08360	Pit	Atlantic, Cumberland.
Jesse S. Morie & Son, Inc	P.O. Box 35 Mauricetown, N.J. 08329	Pit	Cumberland.
National Glass Sand Corp	P.O. Box 145 Millville, N.J. 08332	Pit	Do.
New Jersey Silica Sand Co	Millville, N.J. 08332	Pit	Do.
Pennsylvania Glass Sand Corp	Berkeley Springs, W.Va. 25411	Pit	Do.
George F. Pettinos, Inc	235 Bala Ave. Bala-Cynwyd, Pa. 19004	Pit	Camden.
Tri-Borough Sand & Stone, Inc	Haddonfield-Berlin Rd. Gibbsboro, N.J. 08026	Pit	Do.
United States Dredging Corp	39 Broadway New York, N.Y. 10006	Dredge	Monmouth.
Whitehead Brothers Co	60 Hanover Rd. Florham Park, N.J. 07932	Pit	Cumberland.
Smelters (copper):			
American Metal Climax, Inc	1270 Avenue of the Americas New York, N.Y. 10020	Plant	Middlesex.
American Smelting & Refining Co.	120 Broadway New York, N.Y. 10005	do	Do.
The Anaconda Co	25 Broadway New York, N.Y. 10004	do	Do.
Stone:			
Granite, crushed and broken:			
Braen Industries, Inc	Box 188, Wyckoff, N.J. 07481	Quarry	Morris.
Glen Gardner Quarry Corp	Box 344 Glen Gardner, N.J. 08826	do	Hunterdon.
Hamburg Quarry, Inc	Route 23, Hamburg, N.J. 07419	do	Sussex.
Shahmoon Industries, Inc	R.D. #1, Wharton, N.J. 07885	do	Morris.
Somerset Crushed Stone Division, Anthony Ferrante & Sons, Inc.	Route 202, Mine Brook Rd. Bernardsville, N.J. 07924	do	Hunterdon.
Tri County Asphalt Corp	Beaufort Ave. Roseland, N.J. 07068	do	Sussex.

See footnote at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone, crushed:			
Farber White Limestone Co.	Franklin, N.J. 07416	Quarry	Sussex.
Limestone Products Corp. of America.	122 Main St. Newton, N.J. 07860	do	Do.
Marble, crushed: Maryland Green Marble Corp.	Cardiff, Md. 21024	do	Warren.
Miscellaneous, crushed and broken: Passaic Crushed Stone Co., Inc.	Foot of Broad Pompton Lakes, N.J. 07442	do	Passaic.
Sandstone, dimension:			
Angelo N. Cioppi	331 Lollar Rd. Hatboro, Pa. 19040	do	Hunterdon.
H. W. Lindblad	401 Belvedere Ave. Lambertville, N.J. 08530	do	Do.
Traprock (basalt), crushed and broken:			
Samuel Braen's Sons	662 Goffle Rd. Hawthorne, N.J. 07500	do	Passaic.
Callanan Trap Rock Corp.	South Bethlehem, N.Y. 12161	do	Hudson.
Dock Watch Quarry Pit, Inc.	Box 245 Martinsville, N.J. 08836	do	Somerset.
Fanwood Crushed Stone Co.	141 Central Avenue Westfield, N.J. 07090	do	Do.
Houdaille Construction Materials, Inc.	10 Park Place Morristown, N.J. 07960	do	Hunterdon, Passaic, Somerset, Union.
M. L. Kernan Quarry	500 Tillon Rd. South Orange, N.J. 07079	do	Essex.
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, Minn. 55101	do	Somerset.
Orange Quarry Co.	318 Eagle Rock Ave. West Orange, N.J. 07050	do	Essex.
Somerset Crushed Stone Division, Anthony Ferrante & Sons Inc.	Route 202, Mine Brook Rd. Bernardsville, N.J. 07924	do	Somerset.
Trap Rock Industries, Inc.	Laurel Ave. Kingston, N.J. 08528	do	Hunterdon, Mercer, Somerset.
The Union Building & Construction Corp.	315 Howe Ave. Passaic, N.J. 07055	do	Passaic.
Warren Brothers Co., Sowerbutt-Standard District.	Planten Ave., Prospect Park Paterson, N.J. 07502	do	Do.
Sulfur:			
The Anlin Co. of New Jersey	1200 State St. Perth Amboy, N.J. 08861	Plant	Middlesex.
Freeport Sulphur Co.	161 East 42d St. New York, N.Y. 10017	do	Gloucester.
Vermiculite (exfoliated):			
Coralux Perlite Corp. of New Jersey.	P.O. Box 251 Metuchen, N.J. 08840	do	Middlesex.
Vermiculite Industrial Corp.	308 Gilligan Ave. Port Newark, N.J. 07114	do	Essex.
Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	do	Mercer.

[1] Also byproduct elemental sulfur.

The Mineral Industry of New Mexico

By Lorraine Burgin [1] and William C. Henkes [2]

Mineral production in New Mexico established a record high in 1969, reaching a total value of $935.7 million, an increase of $42 million over that of 1968. Again fuels ranked first in value of minerals produced, $631.8 million; metals second, $214.7 million; and nonmetals $89.2 million. Gains in fuels were attributed mainly to the $25.7 million rise in value of petroleum production. Increased output of copper, molybdenum, and zinc, as well as the higher prices paid for these metals, accounted for most of the rise in total value of metal production. Losses occurred in the uranium industry. With the exception of perlite, salt, lime, clay and gemstone, nonmetals declined in value; sand and gravel, potash, and cement showed the greatest dollar loss.

[1] Geologist, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1. Mineral production in New Mexico [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Carbon dioxide (natural)---thousand cubic feet	749,364	$52	902,186	$69
Clays---thousand short tons	66	89	70	89
Coal (bituminous)---do	3,429	13,507	4,471	16,376
Copper (recoverable content of ores, etc.) short tons	90,769	75,968	119,956	114,040
Feldspar---long tons	98	W	W	W
Gem stones	NA	59	NA	60
Gold (recoverable content of ores, etc.) troy ounces	6,630	[2] 260	8,952	[2] 372
Gypsum---thousand short tons	146	549	141	526
Helium, grade A---thousand cubic feet	39,100	1,355	13,000	260
Iron ore (usable) thousand long tons, gross weight	17	113	W	W
Lead (recoverable content of ores, etc.) short tons	1,363	360	2,368	705
Lime---thousand short tons	27	377	37	W
Manganese concentrate (35 percent or more Mn) short tons, gross weight	6,729	W	4,855	131
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight	50,681	379	49,146	340
Natural gas (marketed)---million cubic feet	1,164,182	156,000	1,138,133	155,924
Natural gas liquids:				
LP gases---thousand 42-gallon barrels	23,802	34,989	24,920	30,402
Natural gasoline and cycle products---do	8,868	23,104	9,053	24,388
Peat---short tons	446	4	446	4
Perlite---do	365,481	3,706	397,987	4,493
Petroleum (crude)---thousand 42-gallon barrels	128,550	378,708	129,227	404,441
Potassium salts thousand short tons K_2O equivalent	2,289	63,406	2,327	62,034
Pumice---thousand short tons	243	527	226	415
Sand and gravel---do	12,262	12,396	8,574	10,422
Silver (recoverable content of ores, etc.) thousand troy ounces	225	482	466	834
Stone---thousand short tons	2,226	3,527	2,826	3,286
Uranium (recoverable content U_3O_8) thousand pounds	12,282	[3] 95,144	11,811	[3] 69,887
Zinc (recoverable content of ores, etc.) short tons	18,686	5,045	24,308	7,098
Value of items that cannot be disclosed: Beryllium concentrate, cement, fluorspar, mica (scrap), molybdenum, salt, tin (1969), vanadium, and values indicated by symbol W	XX	23,669	XX	29,150
Total	XX	893,775	XX	935,746
Total 1967 constant dollars	XX	885,926	XX	p 890,067

p Preliminary. 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] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

[3] Value estimated based on $8 (1968) and $5.86 (1969) per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 (1968) and $6.10 (1969) per pound for commercial sales; includes value of U_3O_8 obtained from New Mexico ores processed at an out-of-State mill.

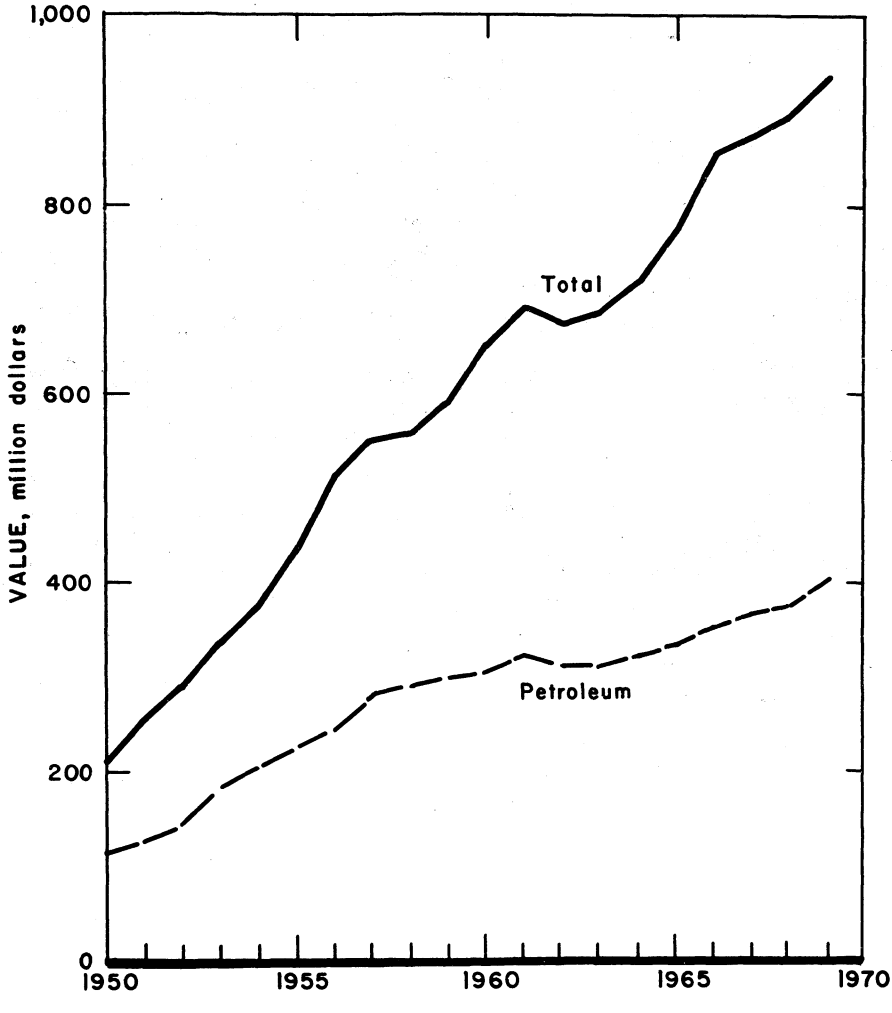

Figure 1.—Value of petroleum and total value of all mineral production in New Mexico.

Table 2.—Value of mineral production in New Mexico, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Bernalillo	$10,264	$8,675	Cement, sand and gravel, stone, clays.
Catron	W	W	Sand and gravel, stone, silver, gold, tin, copper, zinc.
Chaves	21,035	19,903	Petroleum, natural gas, sand and gravel, stone.
Colfax	W	W	Coal, sand and gravel, stone.
Curry	251	-------	
De Baca	W	W	Sand and gravel.
Dona Ana	2,255	788	Sand and gravel, pumice, clays, stone, fluorspar.
Eddy	140,990	139,758	Potassium salts, petroleum, natural gas, LP gases, salt, natural gasoline, sand and gravel, stone.
Grant	82,192	122,824	Copper, zinc, molybdenum, silver, lead, lime, manganiferous ore, gold, sand and gravel, stone.
Guadalupe	W	13	Copper, sand and gravel, silver.
Harding	192	69	Carbon dioxide.
Hidalgo	1,310	2,117	Copper, silver, gold, clays, sand and gravel, zinc, lead.
Lea	364,354	381,671	Petroleum, natural gas, LP gases, natural gasoline, stone, sand and gravel.
Lincoln	130	W	Stone, sand and gravel, pumice.
Los Alamos	17	1	Sand and gravel.
Luna	W	497	Sand and gravel, clays, stone, silver.
McKinley	72,634	54,785	Uranium, petroleum, coal, stone, molybdenum, sand and gravel, natural gas, clays.
Mora	219	734	Sand and gravel, stone.
Otero	766	326	Do.
Quay	50	35	Sand and gravel.
Rio Arriba	15,070	14,164	Natural gas, petroleum, LP gases, sand and gravel, natural gasoline, stone, pumice, feldspar.
Roosevelt	14,902	15,920	Petroleum, natural gas, LP gases, natural gasoline, sand and gravel, stone.
Sandoval	976	715	Gypsum, sand and gravel, petroleum, pumice, natural gas, peat, stone.
San Juan	109,478	115,863	Natural gas, petroleum, natural gasoline, LP gases, coal, sand and gravel, vanadium, helium, stone, uranium, pumice.
San Miguel	72	328	Sand and gravel, stone.
Santa Fe	502	2,116	Sand and gravel, stone, copper, gypsum, pumice, gold, silver, zinc.
Sierra	711	W	Sand and gravel, gypsum, copper, silver, gold.
Socorro	1,552	638	Zinc, manganese concentrate, lead, iron ore, sand and gravel, silver, stone, copper, gold.
Taos	17,821	23,639	Molybdenum, perlite, sand and gravel, stone, mica, beryllium concentrate.
Torrance	W	363	Sand and gravel, stone.
Union	W	W	Pumice, sand and gravel.
Valencia	W	20,179	Uranium, sand and gravel, perlite stone.
Undistributed [1]	36,030	9,627	
Total [2]	893,775	935,746	

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.
[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New Mexico business activity

	1968	1969 p	Change, percent
Employment and labor force, annual average:			
Total labor force—thousands	357.8	365.8	+2.2
Employment—do	339.5	347.9	+2.5
Unemployment—do	18.3	17.9	−2.2
Agricultural employment—do	25.4	23.8	−6.3
Nonagricultural employment—do	276.7	285.4	+3.1
Mining—do	16.2	17.3	+6.8
Construction—do	17.0	17.0	------
Manufacturing—do	18.2	20.1	+10.4
Government—do	84.9	86.3	+1.6
All other—do	140.4	144.7	+3.1
Payroll data:			
Agriculture—millions	$146.6	$147.0	+.3
Mining—do	$133.8	$148.4	+10.9
Construction—do	$146.9	$164.5	+12.0
Manufacturing—do	$127.4	$142.1	+11.5
Government—do	$617.4	$663.9	+7.5
All other—do	$996.9	$1,077.9	+8.1
Personal income:			
Total—do	$2,667.0	$2,876.2	+7.8
Per capita	$2,695	$2,830	+5.0
Construction activity:			
Total value of construction contracts—do	$287.4	$284.7	−.9
Residential—do	$96.1	$83.4	−13.2
Nonresidential—do	$71.7	$96.6	+34.7
Nonbuilding—do	$119.6	$104.7	−12.5
Highway construction contracts awarded—do	$36.7	$61.3	+67.0
Cement shipments to and within the State—thousand 376-pound barrels	2,909.7	2,339.6	−19.6
Business receipts: Retail sales—millions	$1,507.7	$1,489.4	−1.2
Farm marketing receipts—do	$322.4	$345.3	+7.1
Mineral production—do	$893.8	$919.1	+2.8
Utility production and consumption:			
Production of electric energy—million kilowatt hours	9,017.7	10,231.8	+13.5
Natural gas sales—billion cubic feet	1,138.2	1,111.1	−2.4

p Preliminary.

Sources: Bureau of Business Research, University of New Mexico, Albuquerque, N. Mex. 87106; Engineering News-Record, v. 184, No. 16, Apr. 30, 1970, pp. 12–13; New Mexico Public Utilities Commission; U.S. Bureau of Mines.

Almost 60 percent of the total value of mineral production of the State came from Lea, Eddy, Chaves, and Roosevelt Counties. Of the total value in the four countries, 88 percent was from natural gas, natural gas liquids (LP gases and natural gasoline), and petroleum. The second richest mineral producing area included San Jaun, McKinley, Valencia, and Rio Arriba Counties with almost 22 percent of the total value of mineral production; 60 percent of the value of output in these counties came from LP gases, natural gas, natural gasoline, and petroleum. In the third most valuable mineral area, Grant County, metals accounted for about 99 percent of the county's production, 57 percent of the State's total value of metal production, and 13 percent of the value of mineral production. About 95 percent of the value of all mineral production in the State came from the above named areas.

Employment and Injuries.—Final data for 1968 and preliminary data for 1969, compiled by the Bureau of Mines on employment and injuries in the mineral industries of New Mexico, are reported in table 4. Data on mineral fuels are excluded except for coal.

Legislative and Governmental Programs.—Under a 1-year $102,896 grant from the National Air Pollution Control Administration, the New Mexico Bureau of Mines and Mineral Resources will determine the sulfur content of near-surface strippable coal deposits in the San Juan basin of northern New Mexico and southern Colo-

Table 4.—Worktime 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
1968:								
Coal	290	224	65	518	---	19	36.71	1,148
Metal	4,162	258	1,098	8,802	4	257	29.65	3,601
Nonmetal	2,230	306	683	5,504	3	187	34.52	3,926
Sand and gravel	958	167	160	1,320	---	38	28.79	2,098
Stone	253	218	55	444	---	5	11.26	261
Total [1]	7,893	258	2,062	16,588	7	506	30.93	3,423
1969: [p]								
Coal and peat	305	231	71	553	---	17	30.75	953
Metal	4,370	273	1,198	9,606	10	409	43.62	7,356
Nonmetal	2,110	333	704	5,666	4	161	29.12	5,217
Sand and gravel	910	178	162	1,347	---	31	23.01	1,984
Stone	250	229	58	471	---	7	14.86	289
Total [1]	7,950	275	2,192	17,643	14	625	36.22	5,870

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

rado. Data already available will be assembled and specimens will be collected from coal deposits not previously examined for sulfur content.

Results of several studies on certain New Mexico mineral resources were published during the year by State and Federal agencies.[3]

Of the 998.3 miles of designated Interstate Highway system in New Mexico, 739.8 miles were open to traffic at yearend; construction was underway on 221 miles; and only 37.5 miles had no work in progress.[4] Highway contracts planned for 1970 total about $60.8 million. Contracts awarded in 1969 totaled $61.3 million for highway construction, up $24.7 million from 1968; $40.5 million was for the Interstate system.[5]

[3] Adams, Samuel S. Bromine in the Salado Formation, Carlsbad Potash District, New Mexico. New Mexico Bur. Mines and Miner. Res. and New Mexico Institute of Min. & Technol. Bull. 93, 1969, 122 pp.

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[4] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1969. Press Release FHWA–422, Feb. 9, 1970.

[5] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1970 and Budgets for Maintenance. V. 184, No. 16, Apr. 30, 1970, pp. 12–13.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of mineral fuels production increased $24.1 million or 4 percent in 1969. The total value of mineral fuels, $631.9 million, comprised 68 percent of the values of the State's mineral output.

Carbon Black.—Output of carbon black from the two plants in the State—Continental Carbon Co. and Ashland Chemical Co.—declined 12 percent. From an input of 13.6 billion cubic feet of natural gas, 38.8 million pounds of carbon black were produced.

Carbon Dioxide.—Production of carbon dioxide from Harding County increased 20 percent in quantity and 33 percent in value; quantity was up 152.8 million cubic feet and value, $17,000. R. W. Adams, Schwartz Carbonic Co., and S.E.C. Corp. were the only producers.

Coal.—The highest recorded annual yield of bituminous coal in the State was achieved by yearend. Production climbed to nearly 4.5 million tons valued around $16.4 million, an increase of 30 percent in amount and 21 percent in value over 1968. Only in 1917 and 1918 did coal output even reach the 4-million-ton mark. Increased consumption of coal by the electric utilities accounted for the dramatic rise in the use of coal.

Largest operation in the State was the Navajo strip mine of Utah Construction & Mining Co., which supplied coal for the nearby Four Corners powerplant of Arizona Public Service Co. The plant consists of three generating units with a total 575-megawatt capacity. According to the company annual report, coal shipments from the Navajo mine increased from 2.3 million tons to 3.1 million tons during the year. The mine is located south of Fruitland, San Juan County on approximately 31,000 acres of land leased from the Navajo tribe; the area, extending about 25 miles south of the San Juan river, averages 1 mile wide. Occurring in the Fruitland formation (Cretaceous), the main coal seam is a bed 12 feet thick, which dips 1.5° to the east and is covered by a sandstone and shale overburden ranging from 10 to 120 feet deep. Reportedly, the subbituminous coal has a heating value of about 9,000 Btu per pound, with an average 22 percent ash content, 12 percent moisture content, and 0.7 percent sulfur content.[6] The coal is blended to maintain quality control for delivery to the powerplant.

Under construction at the Four Corners plant were two new generating units, with 755-megawatt capacity. These two units are owned by six member utilities belonging to WEST (Western Energy Supply & Transmission) Associates: Southern California Edison Co. (48 percent); Arizona Public Service Co. (15 percent); Public Service Company of New Mexico (13 percent); Salt River Project (10 percent); Tucson Gas & Electric Co. (7 percen); El Paso Gas & Electric Co. (7 percent). The fourth generating unit went into operation in August 1969, but had not yet reached full capacity by yearend. Scheduled for completion by mid-1970 is the fifth generating unit, bringing the total generating capacity at the plant to 2,085 megawatts. The plant is expected to require 8.5 million tons of coal per year at full capacity.

Improved techniques for drilling and blasting with the development of the large scale strip mining methods required at the Navajo mine were delineated.[7] The company announced a method of collecting fly ash from the new generating units and of fly ash disposal in the valleys of the overburden piles.

Public Service Company of New Mexico and Tucson Gas & Electric Co. of Tuscon Ariz., applied at yearend for permission to build a new generating facility, 9 miles north of the Four Corners powerplant, to be known as the San Juan Generating Station. The plant will consist of three coal fired generating units; construction of the first 300-megawatt unit is to begin in mid-1970, with completion mid-1973. Total cost of the unit is estimated at $53 million with equal participation by both companies.

Coal-bearing formations in the western part of the San Juan basin of New Mex-

[6] Buell, Elton H. A Look at Coal-Produced Power in the Southwest. Min. Cong. J., v. 55, No. 11, November 1969, pp. 31–35.

[7] Amerman, Richard W. Drilling and Blasting Techniques at the Navajo Mine. Paper presented at the SME Fall Meeting, AIME, Salt Lake City, Utah, Sept. 17–19, 1969. Preprint No. 69–F–315, 9 pp.

ico, some coal operations, and economic potential of the area were described.[8]

Most coal production came from seven coal mines—three in Colfax County and two each in McKinley and San Juan Counties. Besides the Navajo mine, strip mine production also came from the McKinley mine of The Pittsburg & Midway Coal Mining Co. (a subsidary of Gulf Oil Corp.) west of Gallup, McKinley County, and the Sundance mine of Sundance Coal Co., also near Gallup. Underground coal production included the York Canyon mine, Kaiser Steel Corp., about 30 miles west of Raton; Frank's No. 1 mine, Julius Seidel, operator; Genta mine, Sisneros Brothers, all in Colfax County; and the Hogback No. 13 mine, Hogback Coal Co. in San Juan County.

Coking Coal has been shipped since 1966 by unit train from the York Canyon mine of Kaiser Steel Corp. to its steel plant at Fontana, Calif. The transportation of about 700,000 tons of coal was reported economically feasible because of the high-quality, new highly mechanized mine, and loading and turn around time of 2 hours for an 84-car train of 8,400-ton capacity.[9] A bulk core sample from the York Canyon mine showed 35.7 percent volatile matter; 54.9 percent fixed carbon; 8.8 percent ash; 0.6 percent sulfur; and a 14,340-Btu content.[10]

Helium.—Output of helium from the Shiprock plant of Air Reduction Co. (Airco) declined 66.8 percent in quality and 80.8 percent in value. The decline was attributable partly to the closing of the plant in September when Airco returned it to the owners, the Navajo Indian Tribe.

Natural Gas.—Marketed natural gas was down 26.0 billion cubic feet, 2.2 percent, to 1.1 trillion cubic feet; value was down slightly—$76,000—to $155.9 million. Data compiled by the State Oil Conservation Commission show that San Juan County, the leading source, had a decline in output of 8.4 percent, which was not offset by increases in Lea and Eddy Counties. San Juan County accounted for 43.3 percent of production, Lea 37.8, and Eddy 12 percent; cumulatively, the three produced 93.0 percent of the State total gas output.

At yearend 9,100 gas wells were producing from 200 pools, compared with 8,754 wells and 188 pools at yearend 1968. Casinghead gas, comprising 26 percent of the total, was produced from many of the oilfields.

Natural gas reserves estimates by the American Gas Association, Inc. (AGA) and the American Petroleum Institute (API) gave the State proved reserves, as of Dec. 31, 1969, of 14.3 trillion cubic feet, a decrease of 861.7 billion cubic feet. New fields and pools added 47.3 billion cubic feet; extensions and revisions of existing fields added 182.8 billion cubic feet.[11]

Royalty and taxes received by the State from gas production amounted to $12.8 million, of which taxes represented $8.9 million.[12] These figures do not include receipts from the State's share (37.5 percent) for royalities paid on production from public domain, nor bonuses and rentals paid for leases on State lands.

Eleven gas discoveries were completed during the year, the same number as during 1968. Five were in Lea County, four in Eddy, and two in San Juan County. In initial potential, the most significant discovery was that of Texas American Oil Corp. in Eddy County. The well, Todd-Federal No. 1, SW¼NE¼ sec 26, T23S, R31E, was completed late in the year for a daily calculated open flow gage of 75 million cubic feet of gas from the Atoka formation (Pennsylvanian) from the perforated interval 13,679 to 13,907 feet. Total depth was 16,486 feet in Devonian rocks.

A Lea County gas discovery, Pennzoil United, Inc., Mescalero Ridge Unit No. 1, SW¼SW¼ sec 20, T19S, R34E, was completed in the Morrow formation (Pennsylvanian) for an initial daily flow gage of 8.9 million cubic feet from the interval 13,219 to 13,485 feet. The field was unnamed at yearend.

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[8] Beaumont, Edward C. Coal-Bearing Formations in the Western Part of the San Juan Basin of New Mexico. New Mexico Geological Society, Guidebook, Nineteenth Field Conference, San Juan-San Miguel-LaPlata Region. Sept. 19–21, 1968, pp. 33–40.

[9] Averitt, Paul. Unit Trains, Slurry Pipelines and Supercargo Carriers to Save Money on Long Distance Coal Shipments. Min. Eng., v. 21, No. 3, October 1969, p. 76.

[10] Pillmore, C. L. Geology and Coal Deposits of the Raton Coal Field, Colfax County, New Mexico. Mountain Geologist, v. 6, No. 3, July 1969, pp. 125–142.

[11] American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada and United States Productive Capacity as of Dec. 31, 1969. V. 24, May 1970, p. 120.

[12] New Mexico Oil and Gas Accounting Commission. Oil and Gas Accounting Report for Calendar year 1969. Mar. 10, 1970.

Also in Lea County, the Avance Oil & Gas Co. and Imperial American Co., State "ETA" No. 2, NE¼SE¼ sec 8, T16S, R35E, discovered gas in the Morrow formation. The well was completed for an initial daily gage of 6.9 million cubic feet of gas from the 11,770 to 11,786 foot interval.

El Paso Natural Gas Co. completed its pipeline construction, which includes 670 miles of pipeline and two compressor stations, to increase natural gas supply to southern California. Transwestern Pipeline Co. also completed 281 miles of 30-inch loop on its mainline from the Permian basin to southern California. Natural Gas Pipeline Company of America was building 94 miles of 30-inch gas pipeline in Lea and Roosevelt Counties and in Texas; completion was scheduled for November 1969.

Tests continued at the Project Gasbuggy nuclear-stimulation site. Early in the year, some comparative figures on the project were released. Since the reentry of the test hole in January 1968, 167 million cubic feet of gas had been produced; another well 400 feet from the Gasbuggy hole had yielded 85 million cubic feet from the same formation during a 9-year period.

Natural Gas Liquids.—Production of natural gas liquids was 4.0 percent higher in quantity and 5.7 percent lower in value than that of the previous year. The decline in value resulted from a sharp drop in value of LP gases. A total of 1,026.7 billion cubic feet of natural gas was processed in 41 extraction plants. Of the total, 911.1 billion cubic feet were returned to pipelines as marketable gas; 2.6 billion were reinjected in reservoirs.

Estimates as of January 1, 1970, by API and AGA gave the State proved reserves of 599.7 million barrels of natural gas liquids, a decline of 4.5 million barrels. The decline occurred in the San Juan basin where reserves dropped 12.9 million barrels, offsetting the gain of 8.4 million barrels in the Permain basin. Again, more than half the reserves, 53 percent, were in the San Juan basin.[13]

Peat.—From a humus deposit near San Ysidro, Sandoval County, T. L. Fox continued shipping a peat, which was again used experimentally in mixed fertilizers. Production was 446 tons.

Petroleum.—Output of petroleum, although increasing less than 1 percent, established a record high for the sixth successive year. The 3.4 million-barrel increase in Lea County more than offset decreases in Chaves, Eddy, and San Juan Counties. Lea County was again the leading oil-producing county with 72 percent of the output. In addition to Lea County, McKinley, Roosevelt, and Sandoval Counties had increased production.

According to the State Oil Conservation Commission, 17,088 wells in 703 reservoirs were yielding oil at yearend, an increase of 185 wells and 30 pools. There were 2,518 injection wells in secondary-recovery or pressure-maintenance projects. The Permian basin continued to be the principal oil area with 93 percent of the output and over 90 percent of the wells and oil-pools.

Direct revenues to the State from petroleum production totaled $47.8 million, an increase of 6 percent. Royalties amounted to $23.8 million with the balance divided among school, severance, conservation, and ad valorem taxes. The $47.8 million represented 12 percent of the value of crude oil sales during the year.

As reported by API and AGA,[14] proved reserves of crude oil declined 3 percent to 839.9 million barrels, as of Jan. 1, 1970. Additions to reserves from new fields and new pools totaled 7.5 million barrels; extensions and revisions of existing fields added 88.3 million barrels. Depletion of reservoirs by production more than offset the additions to reserves. Additional reserves available by fluid injection were estimated to be 80.1 million barrels, a sharp drop from the 213.2 million quoted for the previous year.

Overall drilling activity increased by 218 wells, 22 percent, compared with that of 1968. Most of the increase was in development drilling, up 24.5 percent compared with 9.2 percent for exploratory drilling. Development drilling in San Juan County increased 37.4 percent; that in Lea County was up 24.9 percent.

Success ratio for wildcat drilling was 16.9 percent, considerably below the 23.7 percent of the previous year. For development drilling, the success ratio was 81.5 percent, also below the figure for 1968. Lea County, again leading in drilling activity, contained 53 percent of the discovery wells.

[13] Work cited in footnote 10, p. 123.
[14] Work cited in footnote 10, pp. 26–27.

Table 5.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1968	1969	Principal fields (producing more than 1 million barrels) in 1969
Chaves	6,751	5,848	Caprock Cato.
Eddy	17,916	17,249	Empire, Grayburg, Loco Hills.
Lea	89,282	92,679	Bagley, Crossroads, Drinkard, Eunice, Hobbs, Inbe, Justis, Langlie, Maljamar, Monument, Pearl, Vacuum, Vada.
McKinley	482	822	
Rio Arriba	1,298	1,297	
Roosevelt	4,196	4,402	Chaveroo.
Sandoval	4	43	
San Juan	8,621	6,887	Horseshoe.
Total	128,550	129,227	

Source: New Mexico Oil Conservation Commission. 1969 Oil & Gas Statistics.

Table 6.—Oil and gas well drilling, by counties

County	Oil	Gas	Dry	Total	Footage
1968					
Exploratory completions:					
Catron	--	--	1	1	7,900
Chaves	4	1	29	34	168,888
Colfax	--	--	1	1	5,204
Curry	--	--	2	2	6,613
Eddy	4	4	11	19	139,470
Guadalupe	--	--	3	3	3,328
Harding	--	--	2	2	4,321
Lea	17	3	38	58	525,913
McKinley	--	--	10	10	17,746
Rio Arriba	--	--	1	1	2,517
Roosevelt	3	--	9	12	55,317
Sandoval	--	--	3	3	4,680
San Juan	2	3	18	23	74,180
San Miguel	--	--	2	2	7,774
Torrance	--	--	1	1	2,858
Union	--	--	1	1	4,190
Total	30	11	132	173	1,030,899
Development completions:					
Chaves	53	3	15	71	259,470
De Baca	--	--	1	1	2,030
Eddy	36	6	10	52	176,236
Lea	309	5	60	374	3,160,893
McKinley	10	--	3	13	16,869
Rio Arriba	1	78	9	88	581,587
Roosevelt	56	1	4	61	276,637
Sandoval	--	3	5	8	16,098
San Juan	31	94	30	155	550,243
Total	496	190	137	823	5,040,063
Total all drilling	526	201	269	996	6,070,962

County	Oil	Gas	Dry	Total	Footage
1969					
Exploratory completions:					
Chaves	4	--	26	30	160,390
Colfax	--	--	1	1	5,810
De Baca	--	--	1	1	4,065
Eddy	4	4	21	29	229,757
Harding	--	--	1	1	2,108
Lea	12	5	53	70	665,637
Lincoln	--	--	2	2	9,675
McKinley	--	--	11	11	17,840
Mora	--	--	2	2	14,730
Quay	--	--	2	2	2,887
Roosevelt	--	--	12	12	77,561
Sandoval	--	--	1	1	1,280
San Juan	1	2	22	25	47,699
Santa Fe	--	--	1	1	1,058
Torrance	--	--	1	1	1,910
Total	21	11	157	189	1,242,407
Development completions:					
Chaves	43	2	13	58	215,047
Eddy	29	4	16	49	198,918
Harding	--	1	--	1	2,110
Lea	359	10	98	467	3,603,322
McKinley	18	4	10	32	41,718
Rio Arriba	10	100	3	113	620,650
Roosevelt	52	1	13	66	471,166
Sandoval	6	11	9	26	80,968
San Juan	31	154	28	213	580,673
Total	548	287	190	1,025	5,814,572
Total all drilling	569	298	347	1,214	7,056,979

Sources: Committee on Statistics of Drilling, American Association of Petroleum Geologists (Eastern New Mexico); Petroleum Information Corp., 1968 and 1969 Résumés, Oil and Gas Operations in the Rocky Mountain Region, pp. C–1–4, C–1–5 (Western New Mexico).

Table 7.—Principal oil and gas discoveries in 1969

County and field	Well	Operator	Location			Producing formation	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range			Barrels of oil per day	Thousand cubic feet of gas per day		
Chaves County:											
Sieste	No. 1 Federal	H. L. Brown, Jr	17	8 S	31 E	San Andres	3,850	156	------	[1]Nov. 14 1968.	Flowing.
Eddy County:											
Carlsbad, South	No. 1–12 Mobil-Federal	Pennzoil United, Inc	12	23 S	26 E	Atoka	12,735	---	2,625	[1]Nov. 25 1968.	Do.
						Morrow	------	---	1,220		
Esperanza	No. 1 Tracy	Union Oil Company of Calif.	10	22 S	27 E	Delaware	10,693	206	------	Aug. 3	Do.
Red Lake	No. 1 Federal "10"	Pennzoil United, Inc	10	17 S	28 E	Cisco	11,040	313	------	Mar. 3	Flowing, New pay.
Revelation	No. 1 Miller Ranch	Marathon Oil Co	18	22 S	25 E	Delaware	8,135	163	------	[1]Dec. 12 1968.	Flowing.
Wildcat	No. 1–21 Allied-Federal	Pennzoil United, Inc	21	24 S	26 E	Morrow	11,528	---	2,700	Mar. 11	Do.
Do	No. 1 Todd-Federal	Texas American Oil Corp.	26	23 S	31 E	Atoka	16,486	---	75,000	Dec. 12	Do.
Lea County:											
Arena Roja	No. 1–P Mexico-Federal	Skelly Oil Co	21	26 S	35 E	----do	22,926	---	2,823	[2]Jan. 1	Do.
Cormac	No. 1 T. P. State	Corinne Grace	17	10 S	33 E	San Andres	4,524	136	------	Feb. 9	Do.
Dickinson	No. 1 Granny	Tom L. Ingram	1	11 S	36 E	Atoka	12,347	100	------	July 1	Flowing, New pay.
Morton, East	No. 1 Owens	Union Oil Company of Calif.	34	14 S	35 E	Pennsylvanian	10,649	452	------	May 6	Flowing.
Sawyer, West	No. 1 Santa Fe	Coastal States Gas Producing Co.	33	9 S	37 E	San Andres	5,056	169	------	Jan. 14	Pumping.
Shoe Bar, East	No. 1 State "B-2330"	Jake L. Hamon	31	16 S	36 E	Cisco	13,055	206	------	June 25	Flowing, New pay.
Spencer	No. 1–DS State	Aztec Oil & Gas Co	24	17 S	36 E	San Andres	11,253	190	------	July 21	Pumping, New pay.
Wildcat	No. 2 State "ETA"	Avance Oil & Gas Co. Imperial American Co.	8	16 S	35 E	Morrow	10,537	---	6,891	Sept. 22	Flowing.
Do	No. 5 Harry Leonard NCT–E.	Gulf Oil Corp	16	21 S	37 E	Montoya	8,220	---	226	Sept. 30	Pumping.
Do	No. 1 Mescalero Ridge Unit.	Pennzoil United, Inc	20	19 S	34 E	Morrow	13,953	---	8,900	---do---	Flowing.
Do	No. 1 State	R. K. Petroleum Corp	27	13 S	32 E	----do	12,510	483	------	Sept. 29	Do.
San Juan County:											
Wildcat	No. 1 Middle Canyon	Aztec Oil & Gas Co	14	32 N	15 W	Dakota	3,496	122	------	[3]	Pumping.

[1] Well completed in 1968, but data not available until 1969.
[2] Completed as shut-in gas well.
[3] Not available.

On the basis of initial potential, the most significant discovery was the of R. K. Petroleum Corp., in Lea County. The well, State No. 1; NW¼NE¼ sec 27, T13S, R32E, was completed for a daily flow gage of 483 barrels of 51° API oil from the Morrow formation (Pennsylvanian) from the 10,593 to 11,049 foot interval.

Union Oil Company of California discovered the East Morton field, Lea County, with its Owens No. 1 well, SW¼NE¼ sec 34, T14S, R35E. The well was completed from an open-hole section of Pennsylvanian rocks from 10,630 to 10,649 feet; initial potential flowing was 452 barrels of oil per day.

Also in Lea County, the Gulf Oil Corp., Harry Leonard No. 5 SE¼NE¼ sec 16, T21S, R37E, was completed as a new field discovery. Initial daily potential was 226 barrels of oil from the Montoya formation (Ordovician) through perforations from 7,295 to 7,333 feet.

In Eddy County, Union Oil Company of California discovered the Esperanza field in August. The discovery well, Tracy No. 1, NE¼NW¼ sec 10, T22S, R27E, was completed for an initial daily flow gage of 206 barrels of oil from the Delaware Mountain group (Permian) from the interval of 3,417 to 3,424 feet.

Runs of crude oil to stills in the State's five refineries amounted to 14.3 million barrels, all from New Mexico production. Out-of-State shipments totaled 115 million barrels. Principal destinations were Texas, 49.8 million barrels; Illinois, 21.0 million; and Indiana, 20.6 million.

The former Artesia refinery of Continental Oil Co. was sold to Navajo Refining Co. for approximately $12 million. The sale was the culmination of attempts by Continental to divest itself of the refinery in compliance with a court order resulting from antitrust litigation.

Work continued on the petrochemical plant of Mercury Chemical & Petroleum, Inc., at Dayton, neat Artesia; a revised completion date is set for mid-1970. The plant has a designed annual capacity of 264,000 tons of methanol and 100 million pounds of formaldehyde.

METALS

Metal production was valued at $214.7 million, a $21.3 million gain over that of 1968. The 11-percent increase was attributed to the first full year of production since the copper strike; new and increased production from several mines; and the higher prices for copper, molybdenum, lead, zinc, gold, and vanadium.

In the metals group copper production ranked as the most valuable, followed by uranium, molybdenum, zinc, silver, lead, vanadium, manganese, gold, iron, tin, and beryllium. With the output from the new Tyrone operation of Phelps Dodge Corp. and increased output from four other major copper mines, the value of copper production climbed $38.1 million, a 50-percent increase to a record $114 million. Uranium placed second even though the value dropped $25.2 million, or 27 percent, to $69.9 million. The loss was due, in part, to a decrease in production and also to a decline in prices paid by the AEC and commercial users. The value of molybdenum production rose 34 percent, with the increased output coming from the major molybdenum operation and as a byproduct of copper production. All metals increased in value of output except uranium, manganese, iron ore, and beryllium.

Beryllium.—A small amount of hand-cobbed beryllium mineral concentrate was shipped from the Harding mine by Pennsylvania Glass Sand Corp., a subsidary of International Telephone & Telegraph Corp. The mine is located in the Picuris mining district, southcentral Taos County.

A description of beryllium mineralization near the west end of Monticello Canyon, Socorro County was published during the year.[15] Mineralized breccia was found to contain from 0.05 to 2.5 percent beryllium oxide.

Copper.—New Mexico copper production reached an alltime high of 119,956 tons of recoverable copper, valued at about $114 million—a 32-percent gain in amount and a 50-percent gain in value over that of 1968. The significant increase was attributed to the startup of Phelps Dodge Corp.'s new Tyrone operation, added output of the other major producers, and higher copper prices.

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[15] Hillard, Patrick D. Geology and Beryllium Mineralization Near Apache Warm Springs, Socorro County, New Mexico. New Mexico Bur. Mines and Miner. Res. Circ. 103, 1969, 16 pp.

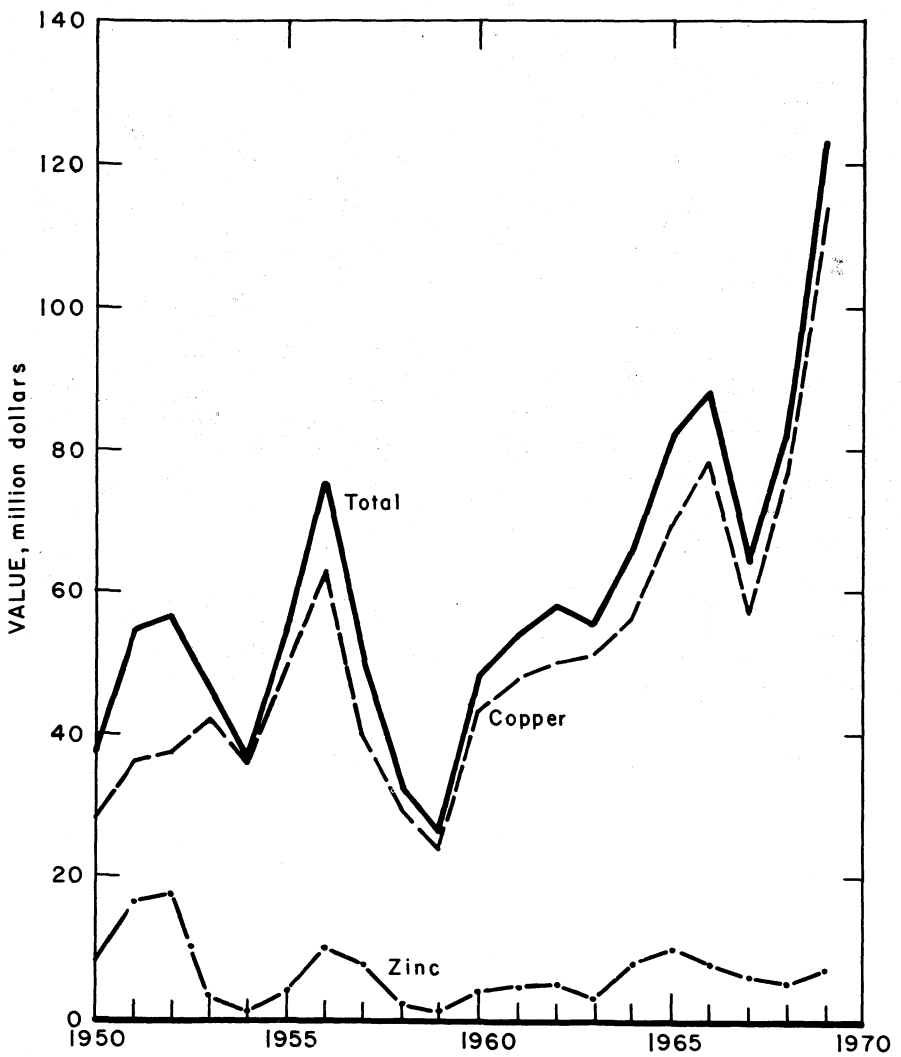

Figure 2.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico. The value of gold, silver, and lead produced annually has been relatively small.

Table 8.—Mine production of gold, silver, copper, lead, and zinc, in terms of recoverable metals [1]

Year	Mines producing		Lode 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)
1965	34	2	9,006	9,641	$337	288	$372
1966	36	---	9,438	9,295	325	243	314
1967	24	2	4,807	5,188	182	157	244
1968	24	2	7,011	6,630	260	225	482
1969	29	1	12,835	8,952	372	466	834
1848–1969	NA	NA	NA	2,296,830	53,810	74,802	60,570

	Copper		Lead		Zinc		Total value [3] (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	98,658	$69,850	3,387	$1,057	36,460	$10,646	$82,262
1966	108,614	78,571	1,596	482	29,296	8,496	88,189
1967	75,008	57,345	1,827	512	21,380	5,919	64,202
1968	90,769	75,968	1,363	360	18,686	5,045	82,116
1969	119,956	114,040	2,368	705	24,308	7,098	123,048
1848–1969	3,084,669	1,507,205	349,597	50,785	1,427,150	285,882	1,958,252

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.
[2] Does not include gravel washed or tonnage of precipitates shipped.
[3] Data may not add to totals shown because of independent rounding.

Table 9.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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
Catron	1	--	[3] 43,630	[3] 1,344	[3] $55,789	[3] 30,924	[3] $55,375
Grant	15	1	12,708,737	6,663	276,582	378,846	678,388
Guadalupe	1	--	1,500	---	---	23	41
Hidalgo	3	--	71,303	917	38,065	35,118	62,885
Luna	1	--	1	---	---	93	167
Santa Fe	2	--	(3)	(3)	(3)	(3)	(3)
Sierra	4	--	28	2	83	201	360
Socorro	2	--	9,820	26	1,079	20,386	36,504
Total:							
1969	29	1	12,835,019	8,952	371,598	465,591	833,720
1968	24	2	7,011,421	6,630	260,294	224,866	482,248

	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Catron	[3] 218	[3] $207,486	------	------	[3] 1	[3] $395	[3] $319,045
Grant	117,616	111,814,799	1,976	$588,770	23,636	6,901,770	120,260,309
Guadalupe	8	7,225	------	------	-------	---------	7,266
Hidalgo	2,104	2,000,326	5	1,370	6	1,883	2,104,529
Luna	-------	----------	------	------	-------	---------	167
Santa Fe	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Sierra	(4)	380	------	------	-------	---------	823
Socorro	10	9,554	387	115,287	664	193,888	356,312
Total:							
1969 [5]	119,956	114,039,770	2,368	705,427	24,308	7,097,936	123,048,451
1968	90,769	75,968,207	1,363	360,159	18,686	5,045,219	82,116,127

[1] Operations at plants leaching runoff water and old mill and miscellaneous cleanups not counted as producing mines.
[2] Does not include tonnage of precipitates shipped or gravel washed.
[3] Production of Catron and Santa Fe Counties combined to avoid disclosing individual company confidential data.
[4] Less than ½ unit.
[5] Data may not add to total shown because of independent rounding.

Table 10.—Mine production of gold, silver, copper, lead, and zinc, in 1969, by class of ore or other source material, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Dry gold-silver	4	1,287	502	26,322	3	2	3
Dry silver	3	52	------	796	2	------	------
Total [2]	7	1,339	502	27,118	4	2	3
Copper	12	12,557,358	8,163	324,204	86,087	(3)	663
Lead-zinc	5	54,683	102	81,924	200	2,124	6,428
Zinc	3	221,563	182	32,225	178	243	17,216
Total	20	12,833,604	8,447	438,353	86,465	2,367	24,307
Other "lode" material:							
Copper cleanup	(4)	76	2	120	12	------	------
Copper precipitates	[5] 2	41,458	------	------	33,476	------	------
Total	2	41,534	2	120	33,488	------	------
Total "lode" material [2]	29	12,876,477	8,951	465,591	119,956	2,368	24,308
Placer	1	----------	1	------	------	------	------
Total all sources	30	12,876,477	8,952	465,591	119,956	2,368	24,308

[1] Detail may not add to total because some mines produce more than one class of material.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than ½ unit.
[4] From properties not classed as mines.
[5] Operations at plants leaching runoff water not counted as producing mines.

Table 11.—Mine production of gold, silver, copper, lead, and zinc, in 1969, by method of recovery and type of material processed, in terms of recoverable metals

Method of recovery and type of material processed	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Concentration and smelting of concentrates:					
Ore	8,421	437,878	86,391	2,367	24,307
Direct smelting:					
Ore	528	27,593	76	2	3
Copper precipitates	------	------	33,476	------	------
Cleanup	2	120	12	------	------
Total	530	27,713	33,564	2	3
Placer	1	------	------	------	------
Grand total [1]	8,952	465,591	119,956	2,368	24,308

[1] Data may not add to totals shown because of independent rounding.

Located in the Burro Mountain mining district 10 miles southwest of Silver City, Grant County, the new Tyrone mine went on stream July 17. By the end of August, all 12 ball miles were operating, and near capacity production was achieved in September. The company annual report noted output in 4 months operation was 16 million tons of ore and waste mined, 3 million tons of ore mined, and 16,951 tons of copper produced. Total cost of the project, which began in 1967, was approximately $118 million including preoperating mine development expense of about $13.3 million before applicable income tax benefits. About $36.6 million of the company's 1969 capital expenditures were spent at Tyrone for completing the concentrator, the water-supply system, and the tailings dams.

Conversion of the company's old underground mine to an open pit began in 1967 after years of exploration and planning. From 1949 through 1958, 727 churn drill holes totaling 434,000 feet were sunk on 200-foot centers. The grade of ore was based on 10 foot interval assays of cuttings from these holes; further verification was obtained from raises driven from older un-

derground headings. The drilling program, followed by economic and engineering studies and acquisition of necessary land and water rights, resulted in the 1966 decision to develop the mine.

Preliminary stripping of 99 million tons of overburden from May 1967 to August 1969 required six 10-cubic-yard electric shovels, 27 electric wheel-driven 85 ton trucks and four electric rotary drills. Mining will advance with 50 foot benches, the highest bench at an elevation of 6,450 feet and the lowest at 5,750 feet. Ultimately the pit may reach a depth of 1,300 feet and extend 1.75 miles north-south and 1.25 miles east-west.

The 25,000-ton-per-day mill was designed to permit expansion up to 40,000 tons per day without interrupting production. For the present, the mill does not have a molybdenum circuit.

Additional facilities included the Bill Evans dam for fresh water; numbers 1, 2, and 3 tailings dams; diversion dam for surface water; an especially constructed leach dump system; and a powerplant consisting of eight 200-horsepower dual fuel (diesel and natural gas) engines connected with eight 3,000 kilowatt generators. Two 2,000 kilowatt generators were converted to standby units for emergencies.[16]

According to the company annual report, Chino Mines Division, Kennecott Copper Corp., produced 95,816 net tons of copper metal, a 1,082 tons increase; ore mined, milled, and treated increased from 6 million to 7.9 million net tons. The grade of ore mined dipped from a 0.968 percent copper in 1968 to 0.900 percent copper in 1969. The Albuquerque Journal reported on August 10, 1969 that 600 employees at Chino mines had completed 2 years of work—1.6 million manhours—without a lost-time accident.

The U.S. Bureau of Mines, New Mexico Institute of Mining and Technology, and Kennecott continued their cooperative research project to determine whether additional copper could be extracted from previously leached, compacted, and relatively impervious copper-bearing waste dumps resulting from open pit mining operations. Brief descriptions of some studies on Kennecott's Chino J dump were included in published abstracts of papers to be presented at the 1970 AIME annual meeting.[17]

A progress report covered the results of chemical, physical, and biological studies pertaining to dump leaching processes and discussed certain features to improve such operations.[18]

The United States Smelting, Refining & Mining Co. (USSR&M Co.) stated in its annual report that its New Continental copper-zinc mine, at Fierro, Grant County, yielded 460,000 tons of ore-grade material and 670,000 tons of marginal grade ore from the open pit mine and 502,000 tons ore-grade material from the underground mine. Mining was done by lessee and contractor. Ore from the open pit and underground mine was treated by flotation at the 3,000-ton-per-day Continental mill. After startup problems in 1968 were resolved, the fully autogenous, two-stage copper sulfide ore mill was operated at capacity with minimum difficulty during 1969. Beginning in April, over 75,000 tons of magnetite concentrate assaying 58 percent iron were recovered from the mill tailings. Plans were announced for constructing a new flotation mill to process approximately 4,000 additional tons per day of copper ore. The $10 million expansion was scheduled for completion in 1971.

Copper-zinc ore from the company's Continental No. 1 mine at Fierro was processed at the 400-ton-per-day Bayard flotation mill (Bullfrog mill) at Vanadium and a small amount at the Continental mill at Fierro. The Continental No. 1 mine is operated under lease to L. A. Patten & Associates.

Federal Resources Corp. continued to ship from the Bonney-Miser's Chest and "85" mines in the Lordsburg mining district, Hidalgo County. The company annual report noted full 450-ton-per-day production was delayed because of an acute shortage of skilled labor and because of water conditions on the 2,000 foot level at the Bonney mine. A new pumping complex was scheduled for completion to facilitate development of the ore body.

Goldfield Corp. began milling between 220 and 250 tons of copper ore per day at

[16] Caldwell, A. Blake. Phelps Dodge's New Tyrone Copper Complex. Min. Eng., v. 21, No. 12, pp. 29–36.
Pay Dirt. No. 365, Nov. 24, 1969, pp. 3–7.
[17] Mining Engineering. V. 21, No. 12, December 1969, pp. 57–58.
[18] Bhappu, Roshan B., P. H. Johnson, J. A. Brierley, and D. H. Reynolds. Theoretical and Practical Studies on Dump Leaching. Soc. of Min. Eng., Trans. AIME, v. 244, 1969, pp. 307–320.

the old San Pedro mine near Golden, Santa Fe County. The low-grade ore was obtained from sulfate dumps and stock piles at the mine.

Copper was recovered from 25 producing mines and 10 leaching operations in Grant, Hidalgo, Santa Fe, Socorro, Guadalupe, Catron, and Sierra Counties. All mining operations recovered one or more of the byproducts or coproducts—gold, silver, lead, and zinc metals.

Kerr-McGee Corp. continued exploratory drilling in the Hanover Mountain area of Grant County.

Earth Resources Co. announced plans to develop a sulfide copper deposit near Cuba, Sandoval County. According to the company annual report, open pit mineable reserves were placed at aproximately 5 million tons of 0.90 percent copper; the total copper-bearing material in the sulfide zone is approximately 10 million tons containing 0.67 percent copper. Parsons-Jurden Corp. was retained for design and engineering of the 3,000-ton-per-day flotation mill to be constructed at the site of the open pit mine. Cost of the mine-mill complex is estimated at $10 million with a 5-year operating life. Full production is anticipated late in 1971.

Gold.—Production of gold increased 35 percent; value increased 43 percent. The $372,000 value is the highest since 1942; the amount of gold produced, however, was not as high as that in 1965. The rise in value of gold output was due, in part, to an increase in price—from $39.26 to $41.51 per troy ounce. Gold was recovered mainly as a byproduct from the treatment of copper ores and, to a lesser extent, from lead, zinc, and silver ores. Principal production came from the Continental and Chino mines in Grant County; the Bonney-Miser's Chest and "85" mines in Hidalgo County; the Continental No. 1 in Grant County; and the Bearup mine of Thomas Consolidated Mines, Inc., Catron County. One placer operation reported production: The Pine Grove placer of C. J. Anderson in the Pinos Altos mining district, Grant County. Sixteen mines in Grant, Hidalgo, Santa Fe, Carton, Socorro, and Sierra Counties were sources of gold in the State.

Iron Ore.—Magnetite ore was shipped directly for use in cement by Dotson Minerals Corp. from the Jones open pit iron mine, Socorro County.

Lead.—Lead output increased 73 percent, and the value of production gained 95 percent mainly owing to the reopening of the Groundhog mine of American Smelting and Refining Co. (Asarco), and to the increase in the price for lead.

Closed since 1965, the Groundhog mine located a half mile southeast of Vanadium, Grant County, became the State's principal producer of lead as well as a major producer of silver and zinc. According to the company 1969 annual report, 44,667 tons of ore were mined and milled, producing 14,204 tons of concentrates from which 6,125 tons of zinc, 1,673 tons of lead, 155 tons of copper, and 66,419 ounces of silver were recovered.

Other production continued from The New Jersey Zinc Co., a subsidary of Gulf & Western Industries, Inc., which operated or leased four mines. Lead was recovered as a coproduct or byproduct of the company's operations at the Linchburg mine (L. A. Patten, lessee) and the Kelly mine (A. B. Baca, lessee) in the Magdalena district, Socorro County, the Hanover, and Oswaldo (leased from Kennecott Copper Corp.) mines in the Central mining district, Grant County. Output at the Princess mine of USSR&M Co. (Frank Van Cleave, lessee) declined. (See zinc.) Lead was obtained from 10 mines in Grant, Socorro, and Hidalgo Counties.

Manganese Concentrate and Manganiferous Ore.—Manganese production decreased in amount and value. Ore was obtained by Goret & Aguilar, Inc., from the Nancy-Tower underground mine in the Socorro mining district. The company upgraded the ore to a 48-percent-manganese concentrate at its Black Canyon mill near Socorro, Socorro County. A ferruginous manganese ore containing 5 to 25 percent manganese continued to be mined at the open pit Luck mine at Boston Hill outside of Silver City, Grant County. The Luck Mining Co. mined and shipped the ore to the CF&I Steel Corp. plant at Pueblo, Colo.

Molybdenum.—An increase of 27 percent in amount and 34 percent in value of molybdenum production was attributed mainly to the gain in output from the Questa mine, Molybdenum Corporation of America (Molycorp) and also to an in-

crease in copper production, which resulted in a rise in the recovery of byproduct molybdenum at Chino. As uranium production in the State dipped, so also did molybdenum recovered as a byproduct from various uranium ores in the Ambrosia Lake area, McKinley County.

Located on 15,000 acres near Questa in Taos County, the Questa mine of Molycorp achieved a record output of 10.9 million pounds of molybdenum contained in molybdenum concentrates. Mining operations were increased to remove large quantities of overburden and to provide ore for expanded mill facilities, which were completed in November. By yearend, mining operations reached 170,000 tons per day, and ore milling was at the planned rate of 16,500 tons per day. According to the annual report, exploration during the year increased proven and probable ore reserves from 276 million pounds to 333 million pounds of molybdenum within the main ore body. In a separate deposit on the "Log Cabin" claims about 6 miles southwest of the pit, reserves were estimated to contain 106 million pounds of molybdenum.

Other construction included a $600,000 truck shop for servicing 33 diesel electric trucks and three 50-ton diesel trucks; a third pipeline to the tailings pond; extension of the tailings line to a new disposal area; and the addition of a fifth ball mill. Supporting equipment planned for the mill included a fifth power-generating unit of 4,300 kilowatts and increased capabiltiy of four existing generators from 3,750 to 4,300 kilowatts. Equipment for mining included 18 85-ton diesel-electric trucks; 15 100-ton diesel-electric trucks; three 50-ton diesel rear dump trucks; two 9-inch diesel-electric rotary drills; two 9-inch electric rotary drills; two 15-inch diesel-electric rotary drills; four diesel-electric generators for four 10-yard shovels, and two 17-yard shovels; one 5-yard shovel; five 290-horsepower rubber tired bulldozers; five 300-horsepower bulldozers; one 235-horsepower crawler tractor D–8; one 385-horsepower crawler tractor D–9; and two large motor graders.[19] The company annual report noted additional mining equipment needed for the expansion of mining activity would require annual lease payments of a maximum of $1.2 million for approximately 8 years.

Molybdenum concentrates were shipped by rail to Washington, Pa., where the Molycorp plant utilizes two roasting furnaces to convert molybdenum disulfide (MoS_2) to molybdenum oxide (MoO_3). Some concentrates were shipped to Gulf ports for export. A pilot plant was also constructed at Questa to test a new process for converting lower quality MoS_2 concentrate to high-purity MoO_3, with the additional advantage of avoiding air and water pollution.

Silver.—Silver production reached 465,591 troy ounces a 107-percent increase over that of the previous year and the highest level since 1952. The value of silver output climbed to its highest point since 1941, $833,720, a 73-percent increase over that of 1968. The dramatic gain was due to new production from Tyrone and Groundhog mines and from the Continental mine. Other major output came from the Bonney-Miser's Chest and "85", Chino, Bearup, and Linchburg mines. Most silver was obtained as a byproduct from the treatment of copper ore and from the complex lead-zinc, and zinc ores and from gold-silver and silver ores. The metal was recovered from the ores of 27 mines in the eight counties of Grant, Hidalgo, Catron, Socorro, Santa Fe, Sierra, Luna, and Guadalupe.

Tin.—A small amount of placer tin was recovered by G. L. Getman in the Taylor Creek mining district, Catron County, near the Sierra County border on the edge of the Black Range primitive area. The ore was processed with a jig.

Uranium.—New Mexico ranked first among the States in uranium production, although output dipped 4 percent from 12.3 million to 11.8 million pounds of recoverable uranium oxide in uranium concentrates. Value dropped 27 percent from $95.1 million to $69.9 million. The slowdown is attributed to lower prices, lower power reactor sales, reduction in Atomic Energy Commission (AEC) purchase contracts, and the fact that private uranium sales commitments already made will fill estimated requirements until early 1975. As the result of the lower prices paid for uranium ores under the "stretch out" contracts of AEC, several New Mexico com-

[19] Thomas, David A. Molybdenum Corporation of America Expands its Plant Near Questa and Increases Production. Rocky Mountain Construction, v. 30, No. 11, June 3, 1969, pp. 28, 30, 38.

panies requested cancellation of contracts for the delivery of uranium oxide to the Commission. Four mills, three in New Mexico and one in Colorado, sold to AEC uranium concentrates containing 8.2 million pounds of U_3O_8 which originated in New Mexico. The State supplied 66 percent of the total 12.4 million pounds of U_3O_8 purchased by the agency. The number of uranium operations in the State dropped from 56 to 36 in three counties—San Juan, Valencia, and McKinley. McKinley County accounted for 33 of the operations.

Uranium exploration continued high throughout the year. Drilling increased from 4.5 to 5.6 million feet in 1969, representing 18.9 percent of the total 29.9 million feet drilled in the United States. At yearend, AEC announced that New Mexico estimated uranium reserves were increased to 34.9 million tons of ore, averaging 0.25 percent U_3O_8 and containing 86,000 tons U_3O_8. Reserves ranked first in the Nation with 42 percent of the total 204,000 tons U_3O_8 estimated recoverable at $8 or less per pound according to AEC.

The Anaconda Company continued to operate the Jackpile-Paguate open pit mine and Bluewater mill in Valencia County. Located on the Laguna Indian Reservation, the mine employed about 165 people, 90 percent being Indian. A safety record was set in April, when the mine reported 3 years had passed since the last lost-time injury. The mine has operated 18 years without fatal or permanent total injury.

The company annual report showed production of uranium oxide (U_3O_8) was 3,042,564 pounds in 1969, compared with 3,134,546 in 1968. One-half of the uranium sales were delivered to AEC; the balance went to commercial users for fuel in nuclear powerplants. A joint program was started with National Lead Co. to determine the feasibility of Anaconda's participation in nuclear fuel production and other phases of the fuel cycle, particularly dual fabrication and chemical reprocessing of spent fuels.

In the Ambrosia Lake area, McKinley County, major production came from the underground mines of Kerr-McGee Corp. called Section 17, Section 22, Section 24, Section 30, and Section 33. A new shaft and auxiliary facilities were completed; late in the year, production was started from Section 30 West mine. Section 35 mine shaft, in the same general area, was also finished, and production is scheduled for early 1971. Work was begun on the Section 19 mine shaft with a special 16.5-foot-diameter hard-rock drilling bit designed for the project by Hughes Tool Co. A twin-mastered drill rig was used to handle the 75,000-pound bit. Plans were to line the shaft with sections of 14-foot-diameter steel casing to a 775-foot depth.

Exploration by Kerr-McGee in the northeast Church Rock area delineated a minable uranium ore body on Navajo Reservation lands. Production is planned to begin in 1973. In other developments, the company made an agreement with Uranium King Corp. for exploration on 15,000 acres of land held by Uranium King in the Rio Puerco area of Sandoval, Bernalillo, and Valencia Counties. Kerr-McGee already held a lease of 18,000 acres on a nearby area.

Kerr-McGee operated a diesel-hydraulic drive train in a mine locomotive, which allowed a system of dynamic braking that eliminated brake shoes and conventional mechanical linkage, thus reducing maintenance and wheel wear. The company operated five underground mines in which 14 8-ton locomotives hauled an average of 40-ton load per trip, a distance of 2,500 to 5,000 feet to the shaft bottom. Electric locomotives previously hauled 25 tons.[20]

The Ambrosia Lake mill, operating at a daily rate of 5,000 to 6,000 tons of ore, was tested successfully to a capacity of 7,000 tons per day. Yellow cake (uranium concentrate) produced in the State is scheduled to go to the company's Sequoyah Facility in Oklahoma for processing into enriched uranium hexafluoride (UF_6). Kerr-McGee contracted to sell the UF_6 for $16.7 million to Metropolitan Edison Co. of Reading, Pa., for ultimate use in its power reactor. During the year, the company terminated its contract with AEC for delivery of 3 million pounds of U_3O_8 in 1970; sales contracts were made with private utilities for the 1970 and 1971 shipment of the material previously scheduled for delivery to the AEC. Orders were also se-

[20] Engineering Mining Journal. Add Diesel to Hydraulic. . .Get Dynamic Braking for Safe Hauling. V. 170, No. 10, October 1969, p. 83.

cured in European and Japanese markets. The company held contracts or orders for delivery of 51,147,000 pounds of U_3O_8.

United Nuclear Corp. operated the Ann Lee, Section 27 West and Section 27 East mines in the Ambrosia Lake area in McKinley County and the San Mateo mine in Valencia County. United Nuclear-Homestake Partners (70 percent owned by United Nuclear) operated five underground mines, Section 15, 23, 25, 29, and 32, all in the Ambrosia Lake district; and Mac 1 and Mac 2 mines in the Smith Lake area in McKinley County. The Partnership's uranium concentrate mill was operated at a feed rate of approximately 100,000 tons per month at yearend. United Nuclear's new Church Rock mine shaft, northeast of Gallup, was completed at a depth of 1,793 feet, and development work conducted at depths of 1,500 feet and 1,700 feet. Construction of the Church Rock mill was postponed until 1972 or 1973 because of the cancellation of deliveries to the AEC and a change in certain commercial deliveries. The millsite had been acquired, and engineering design work for the mill completed.

Exploration by United Nuclear continued under management of its wholly owned subsidiary, Teton Exploration Drilling Co.; additional land was acquired in the Laguna-Rio Puerco area east of Grants.

According to the Homestake Mining Co. annual report, United Nuclear-Homestake Partners completed final deliveries to AEC under the government-procurement program. A total of 605,250 tons of ore was shipped during 1969 from the Partnership's mines to the mill, where 2.2 million pounds of U_3O_8 were recovered, compared with 810,187 tons processed with a recovery of 2.6 million pounds in 1968. Under tolling arrangements for the individual partners, 537,000 tons of additional ore were processed. The company disclosed agreements for sale of uranium concentrates for use as fuel for electric powerplants. Firms included Westinghouse Electric Corp. in 1971, Flordia Power Corp. in 1970, and Yankee Atomic Electric Co. for delivery in 1969 or 1970.

In addition to the Anaconda, Kerr-McGee, United Nuclear, and United Nuclear-Homestake Partners operations, several additional uranium mines were active —in McKinley County, Magna Oil Corp., Cliffside mine; DeVilliers Nuclear Corp. and National Energy Corp. joint venture, DeVilliers No. 1 mine; Spry & Rowe Mining, Evelyn mine; Four Corners Exploration Co., Dog and Flea mines; in San Juan County, Ray L. Williams Mining Co., Enos Johnson mine.

A number of discoveries as the result of exploration activities were announced.

Gulf Mineral Resources Co., a subsidary of Gulf Oil Corp., reported drilling indicated a commercial deposit of uranium on Indian-alloted land leases in the Mariano Lake area, McKinley County.

Based on 107 completed drill holes in the Smith Lake area, Western Nuclear, Inc., and New Mexico & Arizona Land Co. estimated a deposit of 38,460 tons of ore with an average grade of 0.355 percent uranium oxide. The deposit is located in the Brushy basin member of the Morrison formation at depths of 260 to 300 feet. About 150 more holes were expected to be drilled. New Mexico and Arizona land has the right to a 40-percent participation in developing and mining operations or reserving an 18-percent nonparticipation royalty interest on the mineral value of the crude ore.

Exploration drilling in the Ambrosia Lake area by Magna Oil Corp. located an ore deposit of approximately 44,000 tons, containing about 300,000 pounds U_3O_8; further drilling indicated an additional 127,000 tons, or 722,000 pounds of uranium oxide.

In a joint venture, Ranchers Exploration and Development Corp. (50 percent), Houston Natural Gas Corp. (25 percent), Combustion Engineering, Inc. (25 percent) continued exploration on the uranium discovery announced in 1968. According to Ranchers annual report, the ore deposit, located on sec 7, T13N, R8W, at the eastern end of Ambrosia Lake, occurs in two layers of the Westwater Canyon member of the Morrison formation at a depth of about 1,370 feet. The upper layer ranges 1 to 5 feet thick, and ore grades up to 1.4 percent U_3O_8; the lower layer, up to 17 feet thick, has a lower average grade. Reserves were estimated at about 215,000 tons of ore with an average grade 0.50 percent U_3O_8, or about 2,150,000 pounds U_3O_8. The report states ore has been intersected in widely separated parts of the

section; minable ore, however, is confined to the northwest quarter of the 640-acre tract.

Keradamex Inc., the U.S. exploration subsidary of Kerr Addison Mines Ltd. (Canada), continued exploration on the Fernandez Ranch joint venture in the Ambrosia Lake area, Sandoval and McKinley Counties. Skillings Mining Review, November 22, 1969, p. 20, reported 190 drill holes (a total of 365,000 feet) had been drilled by October. Forty wide-spaced holes were completed in the Main Ranch area, with 17 having ore-grade intersections. A joint venture of Amarada Hess Corp. (49 percent), Noranda Mines (25 percent), and Keradamex Inc. (26 percent) the project, including exploration, is managed by Keradamex.

DeVilliers Nuclear Corp., in joint venture with Standard Oil Co. of Ohio (Sohio), reported discovery of two uranium ore bodies, one in the Ambrosia Lake area, another on the east flank of Mount Taylor. Drilling was also done in northeast New Mexico, but a project to the south near San Ysidro was abandoned. Drilling on leases, which extended over 2,240 acres in the Ambrosia Lake area, reportedly indicated reserves of more than 2 million pounds of uranium concentrate. The leases are owned 80 percent by Sohio and 20 percent by DeVilliers.

Enerdyne Corp. announced discovery of mineralization on the Rainbow claims in sec 31, T14N, R8W, at the eastern end of the Ambrosia Lake trend. The claims are adjacent to the Cliffside mine in section 36. Of 10 holes drilled, three contained uranium mineralization of ore grade and thickness; three others contained mineralization. About 17,000 feet of hole had been drilled. In sec 19, T13N, R9W, drilling encountered an area of strong mineralization in the Todilto limestone.

Vanadium.—Vanadium production increased about sixfold in quantity and about ninefold in value. Union Carbide Corp, in Colorado recovered vanadium from sludge shipped from the Shiprock mill of Foote Mineral Co. The Shiprock mill, which remained closed in 1969, had, in previous years, treated vanadium-bearing uranium ores and vanadium-rich liquids recovered at uranium mills not having vanadium-recovery circuits.

Zinc.—Reopening of the Groundhog mine —together with some increased zinc output mainly from the Oswaldo, Hanover, and the Continental mines—accounted for the 30-percent increase in zinc production to 24,308 tons and for the 41 percent ($2 million) gain in value to $7.1 million. The higher average price of zinc also contributed to the dollar gain.

The New Jersey Zinc Co. continued to lead the State with output from the Hanover and Oswaldo mines in Grant County and the Linchburg mine in Socorro County. The Linchburg mine was closed the end of August 1969. Yield from the Princess mine declined; according to the annual report of USSR&M Co., the mine was gradually phased out during the year. Exploration, however, continued by means of drifting and diamond drilling. Zinc was recovered from the ores of 13 mines located in Grant, Socorro, Hidalgo, Catron, and Santa Fe Counties.

NONMETALS

The value of nonmetals produced declined to the lowest figure in more than a decade, $89.2 million, a drop of 4 percent below that of 1968. Sand and gravel sustained the largest dollar decrease with a loss of almost $2 million; potassium salts next, down $1.4 million; and cement third, down $1.0 million. Production of potassium salts increased 2 percent but lost $1.4 million in value because of continued price erosion; this decrease, however, was much less than the $27.7 million loss suffered by the industry in 1968.

Cement.—Shipments of portland and masonry cements decreased in amount and value. The value of portland cement shipments dropped almost $1 million. Finished portland cement was used by ready-mix concrete companies, concrete-product manufacturers, highway contractors, building-material dealers, and other contractors; small amounts were used by various Federal, State, and local government agencies. Principal markets for cements were in New Mexico; however, shipments were made to Colorado, Oklahoma, Arizona, Texas, and New Jersey. The State's only cement plant is located at Tijeras, east of Albuquerque, Bernalillo County, and is operated by Ideal Cement Co., a division of Ideal Basic Industries, Inc.

Clay.—Although shipments of clay increased slightly, 6 percent, the value re-

mained the same. Bernalillo County led production in the State. Output came from Ideal Cement Co. at Tijeras, where clay is used in the preparation of cement; Kinney Brick Co., Inc., near Albuquerque, mined clay and shale for building brick. El Paso Brick Co., in Dona Ana County, also mined clay and shale for building brick. In McKinley County clay and shale used for rotary drilling mud shipped by U.S. Mining Corp., and fire clay was mined by Gallup Brick & Tile Co. Mathis & Mathis, in Luna County, continued production of clays for saggers and pins.

Feldspar.—All reported feldspar production came from Los Compadres Mica Co., which shipped a small quantity of mill tailings from the Joseph mine near Ojo Caliente, Rio Arriba County.

Fluorspar.—Although fluorspar production was down 83 percent, a small amount continued to be shipped from the Bishops Cap mine, Dona Ana County, by the North Star Mining & Milling Corp. The ore is used as a fluxing gravel in steel manufacture. Plans were announced by Uranium Investment Corp. to develop and work a fluorspar-barite deposit located near Socorro, Socorro County.

Gypsum.—Again gypsum output from five mines in three counties dipped slightly, 3 percent in quantity and 4 percent in value.

White Mesa Gypsum Co. continued to mine gypsum from its White Mesa open pit mine near San Ysidro, Sandoval County. The material was calcined for use in manufacturing wallboard at the American Gypsum Division plant of the Susquehanna Corp., Albuquerque. Kaiser Gypsum Co., Inc., mined gypsum at Rosario, south of Santa Fe for its nearby wallboard plant. Duke City Gravel Products Co. obtained gypsum from an open pit at San Felipe near Bernalillo, Sandoval County, for use as a portland cement retarder by Ideal Cement Co. A small amount of gypsum was produced in Sierra County for agricultural purposes by Associated Materials Co. of Las Cruces and Charles Swank of Truth or Consequences.

Calcined gypsum is used primarily for manufacturing wallboard, lath, and sheathing; crude or uncalcined gypsum is used as a set retarder in portland cement and for soil conditioning.

Lime.—A limestone for manufacturing high-calcium lime was quarried by Chino Mines near its mill at Hurley, Grant County. Lime is used for metallurgical control at the copper concentrating plant; with the gain in copper production, lime output increased 37 percent.

Mica.—Shipments of scrap mica dropped 1 percent and value 3 percent. Mineral Industrial Commodities of America, Inc., continued to mine scrap mica from its Tojos open pit in Taos County. At the Pojoaque dry-grinding plant north of Santa Fe, the company prepared mica for use in paints and roofing. At Las Vegas, San Miguel County, Sunshine Mica Co. ground dry mica for use in roofing.

New Mexico Bureau of Mines and Mineral Resources published results of tests and evaluations of several ground mica products in the State. Investigation was essentially limited to muscovite mica; however, ground products from sericite were also assessed.[21]

Perlite.—Perlite maintained its steady growth since production started in 1948. Output of crude perlite increased 9 percent in quantity and 21 percent in value. The State continued to lead the Nation with 84 percent of the total production.

Table 12.—Crude perlite sold or used by producers

Year	Short tons	Value (thousands)
1965	331,011	$2,905
1966	343,334	3,423
1967	346,586	3,424
1968	365,481	3,706
1969	397,987	4,493

Principal producing mines are located in northwestern Taos County at No Agua Mountain, 7 miles north of Tres Piedras; near the Cerro de la Olla area 10 miles north and 14 miles east of Tres Piedras; and another in Valencia County, East Grants Ridge about 8 miles northeast of Grants. In Taos County mine-mill operations included at No Agua Mountain, the El Grande mine of Grefco, Inc., Dicalite Division (a subsidary of General Refractories Co.), and the Seven Hills mine of Johns-Manville Perlite Corp. (a subsidiary of Johns-Manville Corp.); and in the

[21] Horst, William E. and Roshan B. Bhappu. Evaluation of Ground Mica Products From New Mexico Pegmatites. New Mexico Bur. Mines and Miner. Res. Circ. 105, 1969, 27 pp.

Cerro de la Olla area, the Silbrico Corp. (a subsidiary of Susquehanna Corp.) known until October as United Perlite Corp. In Valencia County, United States Gypsum Co. shipped from the Hill No. 7 quarry. Taso County operations shipped a mined and sized material to loading and blending facilities 20 to 36 miles north of Antonito.

Expanded perlite, the processed material, is used for insulation board, building-plaster aggregates, concentrate aggregates, filter aids, horticultural aggregates, and fillers.

Potash.—Production of marketable potassium salts in New Mexico increased to 2.3 million tons K_2O equivalent in 1969, a 2-percent rise. The value, however, dipped to $62 million, a drop of $1.4 million or 2 percent. The State produced 83 percent of the Nation's total.

An investigation by the U.S. Treasury Department found that large quantities of potassium chloride were being dumped in the United States by companies in Canada, France, and West Germany. The matter was then referred to the U.S. Tariff Commission for independent study. The Commission in a 4-to-2 decision ruled in November 1969 that the United States industry was being injured by these imports, and that the imports were being sold at less than fair value in the United States and at a level below its domestic selling price. The Tariff Commission noted the price of standard grade potassium chloride f.o.b. mine at Carlsbad dropped steadily from $22.26 per ton in February 1966 to $18.96 in 1967, to $13.98 in 1968, to $11.70 in February 1969 and near $10 per ton by November.[22] As a result of the findings, the Commission announced potassium muriate imports from the three countries would be subject to special dumping duties retroactive to June 11, 1968.

The Provincial Government of Saskatchewan, Canada, announced late in the year a plan to curb overproduction and establish some degree of price stability. Beginning January 1, 1970, the Saskatchewan Potash Conservation Board would set quarterly production rates to limit each Canadian plant to a fixed percentage of its capacity and would require exporters to obtain a license to ship potash from the province. New price schedules set a minimum of $18.75 per ton, effective after disposal of the 1969 inventory. These regulations were expected to reflect an improvement in the New Mexico potash industry later in 1970.

The annual report of American Metal Climax, Inc., announced the formation of Amax Fuels and Chemicals Group of the corporation and the inclusion of Southwest Potash Division in that group. The Division would be responsible for mining, manufacturing, and marketing agricultural

[22] U.S. Tariff Commission. Potassium Chloride (Muriate of Potash) From Canada, France, and West Germany; Determination of Injury in Investigation Nos. AA1921–58, 59, and 60 Under the Antidumping Act, 1921, as Amended. TC Publication 303, Washington, D.C., November 1969, 32 pp.

Table 13.—Crude potassium salts produced, and marketable salts produced and sold or used

(Thousand short tons and thousand dollars)

Period	Crude salts [1]		Marketable potassium salts					
	Mine production		Production			Sold or used		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value [2]	Gross weight	K_2O equivalent	Value
1968:								
January–June	7,290	1,333	2,008	1,126	$32,638	2,456	1,386	$40,274
July–December	7,801	1,403	2,043	1,163	30,767	1,970	1,124	29,924
Total [3]	r 15,092	r 2,737	4,051	2,289	63,406	4,425	2,511	70,198
1969:								
January–June	7,962	1,472	2,117	1,194	31,742	2,591	1,466	37,641
July–December	7,558	1,389	2,014	1,133	30,293	1,842	1,055	27,222
Total [3]	15,519	2,861	4,131	2,327	62,034	4,433	2,521	64,863

r Revised.
[1] Sylvite and langbeinite.
[2] Derived from reported value of "Sold or used."
[3] Data may not add to totals shown because of independent rounding.

and industrial chemicals. The Southwest Potash mine and mill are located about 10 miles north of U.S. Highway 62 and 180 on State Highway 360. Although deliveries of muriate of potash totaled 897,000 tons, an increase of 5 percent over that of 1968, sales revenues were reported lower in 1969.

U.S. Potash and Chemical Co., a subsidiary of Continental American Royality Co., continued production at its Carlsbad properties, which were purchased in 1968 from the United States Borax & Chemical Corp. According to the company annual report, U.S. Potash invested $245,000 during the year for capital expenditures to provide for increased operating efficiency and production output. The company reported higher product recoveries with the installation of new flotation equipment. New heat processing equipment was designed, engineered, and constructed by U.S. Potash to provide for an increase of over 25 percent in the production capacity for chemical-grade potash. To provide access to the No. 2 bed ore with reserves of over 200 million tons of commercial sylvinite, new mining areas were opened. The company now has over 53,000 acres of potash bearing properties under long-term leases.

National Potash Co., a wholly owned subsidiary of Freeport Sulphur Co., reported continuing depressed earnings because of oversupply and price weakness in the fertilizer industry. The company annual report noted operating profits were only marginal despite a strong November and December. Potash was mined entirely from the Eddy mine, 15 miles east of Carlsbad, and treated at the processing plant in Lea County.

Potash Company of America, a division of Ideal Basic Industries, Inc., noted in the company annual report that production at its Carsbad plant was somewhat below target because of operational problems. The company estimated reserves at Carlsbad to be adequate for 10 years at the current rate of production; reserves at the Saskatoon, Saskatchewan, plant were unlimited.

In 1969 International Minerals & Chemical Corp. (IMC) completed its new $2 million refinery, designed to treat mixed sylvite and langbeinite ores. The company facilities are located 25 miles east of Carlsbad, Eddy County. According to the annual report, IMC tonnage during fiscal 1969 dropped to 3.6 million tons of potash product from 3.8 million tons in fiscal 1968. Overseas, the company reported an 8-percent tonnage increase in potash. For its excellent safety performance during 1968, IMC was awarded the National Safety Council Award of Merit.

To consolidate nonfuel mining and milling facilities into a single organizational entity, the Kerr-McGee Corp. established a nonfuel minerals division, which included the Hobbs potash facility. According to the company annual report, the Hobbs plant, 40 miles southwest of Hobbs, Eddy County, produced 480,580 tons of murite of potash during the year; shipment from the mill exceeded production by 58,000 tons. Adjacent to a 138,000-ton storage building was a compaction plant, completed in December, to increase output of granular potash. The price for granular potash was noted as better than other grades of potash.

Duval Corp., a subsidary of Pennzoil United, Inc., continued to operate the Nash Draw and Saunders mines at a reduced rate. The work force was cut back in July approximately 100 employees; a modification of the carlsbad facilities was expected, however, to reemploy some workers and others were transferred to other operations. The company had under construction modifications and improvements to its washed langbeinite and potassium sulphate processing facilities. The approximately $1 million expansion scheduled for completion January 1, 1970, will increase productive capacity for washed langbeinite. Increased mining operations at the Nash Draw langbeinite mine will supply additional ore for the new facilities. Duval mined and processed sylvite ores at the Saunders mine 1 mile north of U.S. Highway 62 and 180 and 12 miles northeast of Carlsbad; langbeinite ores were mined at the Nash Draw mine 13 miles to the south and shipped to the Saunders for processing.

Further developments in the industry included a field test by Continental Oil Co. in which potash was obtained by solution mining a thin-bedded sylvinite ore in the

Carlsbad Potash Basin. A two-well mining system was used for the test.[23]

Pumice.—New Mexico ranked fifth in the country in the production of pumice. Shipments of pumice and pumiceous materials decreased 7 percent, and value dropped to $415,113, a 21-percent decrease, the lowest level since 1945. Twelve operations in seven counties compared with 15 in eight counties in 1968. Tabulated statistics designated "pumice" include such volcanic material as scoria, volcanic cinders, and pumice.

Pumice operations included the General Pumice Corp. Cullum mine near Espanola, Rio Arriba County; Utility Block Co., Inc., Esquire claims near Ponderosa, Sandoval County; and Copar Pumice Co., Inc., Santa Fe County, but near Espanola. Volcanic cinder was mined in San Juan County by Garcia & Son near Framington and in Dona Ana County by American Pozzolan Corp., at its Santo Tomas mine near El Paso, Tex; Associated Materials Co., Black Bear Mountain mine near Berino; Morton Bros., Volcano 1 mine and Volcanic Cinder Co., Klinker claim, both near Las Cruces. Scoria output came from Twin Peaks Products Co., Lava Pit mine, near Carrizozo, Lincoln County; Los Compadres Mica Co., BLM lease, Rio Arriba County; Crego Block Co., Inc., La Cienega mine near Sanat Fe, Santa Fe County; and Twin Mountain Rock Co., Twin Mountain Rock mine near Des Moines, Union County.

Pumice and volcanic cinders are used mainly in concrete aggregate. Additional uses include pumice in cleaning compounds, for roofing, landscaping, and as an insulating medium. Volcanic cinders are utilized in concrete admixtures, landscaping, roofing, and driveway gravel. The main uses for scoria are in roofing, ballast, concrete aggregate, landscaping, and running-track material.

Salt.—Salt shipments reached an alltime high, increasing 14,000 tons or 15 percent, and $278,000 or 21 percent. All output came from Eddy County where the salt was recovered as a byproduct of potash operations. Leading shippers of rock salt and pressed blocks were the Salt Supply Co., Inc., and New Mexico Salt Co., both of Carlsbad. Pioneer Water Co., Inc., of Eunice recovered brine from potash operations. Principal markets for rock salt were feed dealers, political subdivisions (States, counties, etc.) for icy roads, feed mixers, oil refiners, water-softener manufactures, and service companies. Some brines were used in New Mexico oil and gas well drilling and exploration and oil refining. Rock salt, used mainly in New Mexico and Texas, was also shipped to Arizona, Alabama, Colorado, Oklahoma, and Arkansas.

Sand and Gravel.—Shipments of sand and gravel decreased 30 percent and value dropped 16 percent, from 12.3 million tons valued at $12.4 million in 1968 to 8.6 million tons valued at $10.4 million. Sand and gravel operations in 30 counties totaled 155, compared with 158 operations in 31 counties in 1968. Government and contractor operations accounted for 5.3 million tons, 62 percent of the 8.6 million ton output; commercial operators shipped the remainder. Of the total amount of sand and gravel sold or used, 7.6 million tons, 89 percent, were processed by washing, screening, or otherwise treated. The rest was sold unprocessed. The material was processed in 56 portable plants, 36 stationary plants, and two companies had both stationary and portable plants.

Of the 6.8 million tons of gravel, 5.5 million tons were used by commercial and government-and-contractor operations for road construction and about 1.1 million tons for building construction. The remainder was used for fill and other purposes. Of the 1.8 million tons of sand, a total of 956,000 tons was used by all operations for building, 709,000 tons for road construction, and 101,000 tons for fill. Small amounts were used for railroad ballast and other uses. Fifty-eight percent of the 77 commercial sand and gravel operations in the State produced 12.8 percent, or 417,000 short tons with an annual production less than 25,000 tons. Only two operators had production over 400,000 tons.

Stone.—Stone shipments increased 27 percent in tonnage but decreased 7 percent in value. Fifty-four quarries in 23 counties were in operation during the year.

Operators reporting production of crushed and broken stone during the year were List & Clark Construction Co., sandstone used for dam construction and riprap and jetty stone in Santa Fe County; Ideal Cement Co., limestone for cement in Bern-

[23] Davis, J. G. and D'Arcy A. Chock. Solution Mining of Thin Bedded Potash. Paper presented to Society of Mining Engineers of AIME, February 1969, Preprint 69–AS–15, 12 pp.

alillo County; Lea County Highway Dept., other stone for roadbase stone and surface treatment aggregates in Lea County; New Mexico State Highway Commission, other stone for roadbase stone in Lea and Roosevelt Counties and limestone for roadbase stone in Lincoln and Otero Counties; Kennecott Copper Corp., limestone for lime, flux stone, and surface treatment aggregates in Grant County; Rose Gravel Co., limestone for concrete aggregate in Eddy County; Hamilton Bros., Inc., traprock for roadbase stone in McKinley County; Schultz & Lindsay Construction Co., other stone for surface treatment aggregates in San Miguel County; U.S. Bureau of Indian Affairs, limestone for roadbase stone in Rio Arriba County and other stone for roadbase stone in San Juan County; U.S. Forest Service, granite in San Miguel County and traprock for concrete aggregate in Taos County.

Table 14.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Bernalillo	1,967	$2,787	1,666	$2,239
Catron	276	233	105	129
Chaves	109	130	183	215
Colfax	60	91	1,340	1,675
De Baca	W	W	W	W
Dona Ana	2,976	2,083	622	623
Eddy	102	51	84	106
Grant	180	177	174	206
Guadalupe	39	49	5	6
Harding	108	140	------	------
Hidalgo	413	291	3	4
Lea	W	W	40	72
Lincoln	27	14	70	84
Los Alamos	12	17	1	1
Luna	1,483	982	715	490
McKinley	240	308	86	127
Mora	177	219	374	466
Otero	653	763	238	225
Quay	37	50	29	35
Rio Arriba	251	257	419	554
Roosevelt	W	W	W	W
Sandoval	402	521	155	191
San Juan	433	511	564	725
San Miguel	55	68	160	220
Santa Fe	164	273	630	865
Sierra	633	705	11	10
Socorro	377	455	48	69
Taos	95	131	126	160
Torrance	352	216	290	363
Union	14	21	35	47
Valencia	366	450	283	313
Undistributed	261	403	118	202
Total	12,262	12,396	8,574	10,422

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

Table 15.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	708	$909	729	$1,005
Paving	448	518	429	464
Railroad ballast	2	1	13	13
Fill	30	21	76	42
Industrial:				
Blast	1	2	(1)	(1)
Engine	3	2	------	------
Total	1,192	1,453	1,247	1,524
Gravel:				
Construction:				
Building	915	1,496	860	1,429
Paving	1,374	1,847	1,076	1,376
Fill	27	16	45	29
Other	1	1	------	------
Miscellaneous	14	17	17	44
Total [2]	2,331	3,379	1,999	2,877
Total sand and gravel [2]	3,523	4,832	3,246	4,402
Government-and-contractor operations:				
Sand:				
Building	65	65	227	294
Paving	73	93	280	364
Fill	------	------	25	12
Other	3	2	2	2
Total [2]	141	160	533	673
Gravel:				
Building	124	155	197	248
Paving	8,440	7,229	4,374	4,943
Fill	29	16	201	134
Other	5	3	23	22
Total	8,598	7,403	4,795	5,347
Total sand and gravel [2]	8,739	7,564	5,328	6,020
All operations:				
Sand	1,333	1,613	1,781	2,197
Gravel	10,929	10,782	6,794	8,225
Total [2]	12,262	12,396	8,574	10,422

[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.

Table 16.—Stone sold or used by producers, by counties

County	1968		1969	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Bernalillo	W	W	W	W
Catron	7,727	$13,522	42,000	$46,000
Chaves	37,957	28,462	371	482
Colfax	325,423	606,270	6,927	9,006
Curry	118,660	250,520	---------	---------
Dona Ana	128	224	981	1,275
Eddy	W	W	W	W
Grant	63,247	W	93,666	W
Hidalgo	W	W	---------	---------
Lea	266,388	260,469	249,195	312,744
Lincoln	W	W	191,762	252,589
Luna	5	120	1,011	2,925
McKinley	103,067	206,134	80,147	160,294
Mora	---------	---------	206,091	267,918
Otero	5,000	3,500	94,536	100,580
Rio Arriba	129,955	248,575	49,577	78,929
Roosevelt	---------	---------	67,753	69,539
Sandoval	---------	---------	889	1,156
San Juan	640	1,280	26,066	57,026
San Miguel	244	4,418	75,964	108,487
Santa Fe	61,544	75,000	1,094,700	775,512
Sierra	1,572	2,751	---------	---------
Socorro	4,553	16,956	1,225	11,050
Taos	25	250	47,025	58,650
Torrance	W	W	22	29
Valencia	22,675	58,700	1,813	2,574
Undistributed	1,077,303	1,749,852	494,079	969,197
Total	2,226,113	3,527,003	2,825,800	3,285,962

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

Table 17.—Stone sold or used by producers, by kinds
(Thousand short tons and thousand dollars)

Kind of stone	1965		1966		1967		1968		1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dolomite and limestone	1,452	$2,084	1,479	$2,089	649	$919	1,637	$2,657	956	$1,444
Dolomite	NA	NA	NA	NA	NA	NA	W	W	W	W
Limestone	NA	NA	NA	NA	NA	NA	1,637	2,657	956	1,443
Granite	3	17	W	W	(1)	16	(1)	3	9	28
Marble	W	W	W	W	W	W	1	23	-----	-----
Quartz, quartzite, and sandstone	(1,2)	[2] 2	325	493	75	132	189	320	1,098	779
Quartz and quartzite	NA	NA	NA	NA	NA	NA	W	W	W	W
Sandstone	NA	NA	NA	NA	NA	NA	189	320	1,098	777
Traprock	84	248	136	275	[3] 69	[3] 110	W	W	340	490
Other stone	371	668	712	1,199	598	1,226	398	523	422	547
Total [4]	1,911	3,020	2,652	4,056	1,391	2,403	2,226	3,527	2,826	3,286

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Other stone."
[1] Less than ½ unit.
[2] Excludes crushed sandstone; included with "Other stone."
[3] Excludes dimension traprock; included with "Other stone."
[4] Data may not add to totals shown because of independent rounding.

Dimension stone was shipped by Mathis & Mathis who produced dolomite in Grant County; New Mexico Granite Corp., granite, San Miguel County; Rocky Mountain Stone Co., other stone, Socorro County; Sanchez Stone Co. sandstone, Bernalillo, Socorro, Taos, and Valencia Counties; and William H. Thomas Stone Quarries, sandstone, Luna County.

Crushed and broken limestone quarried in Bernalillo, Chaves, Dona Ana, Eddy, Grant, Lincoln, Luna, Otero, Rio Arriba, San Juan, Santa Fe, Taos, and Torrance Counties was used mainly for cement, roadbase stone, concrete aggregate, riprap and jetty stone, surface-treatment aggregate, lime, flux stone, and macadam aggregate. Crushed and broken sandstone quarried in Colfax, Sandoval, and Santa Fe Counties was used for dam construction, and for riprap and jetty stone. Traprock obtained in Bernalillo, Catron, Colfax, McKinley, Mora, Sandoval, Taos, and Valencia Counties were broken for use as a roadbase, surface-treatment aggregate, concrete aggregate, and riprap and jetty stone. Quartzite from Rio Arriba County was used for terrazzo and roofing aggregate. Dimension stone was quarried in Bernalillo, Grant, Luna, San Miguel, Socorro, Taos, and Valencia Counties.

Prices for crushed and broken stone ranged from $0.64 to $16.25 per ton, and for dimension stone from $8 to $141.67.

Sulfur.—All sulfur production came as a byproduct in the liquid purification of gas at four natural gas processing plants in two counties. Of the 25,651 long tons of "recovered" sulfur produced, 19,702 long tons were shipped at a total value of $518,214. Shipments in 1968 were 24,914 long tons with a total value of $973,863.

Because of the difficulty in determining the State of origin of byproduct sulfur recovered at natural gas plants and petroleum refineries, particularly on the eastern seaboard and at the gulf ports, the quantity and value of sulfur recovered from these sources are not included in mineral production statistics in table 1.

The modified Claus process was used to recover the high-purity sulfur at the Indian Basin plant of Marathan Oil Co. and the Empire Abo plant of Pan American Petroleum Corp., both of Artesia, Eddy County. The Artesia plant, Eddy County, of Phillips Petroleum Co. used the standard Claus process as did the Cities Service Oil Co. in its Bluitt plant near Milnesand, Roosevelt County.

Vermiculite.—Vermiculite exfoliated at the Southwest Vermiculite Co. Albuquerque plant was used in concrete aggregate, block insulation, loose-fill insulation, and plaster aggregate. Sales of the material increased.

Table 18.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium: Pennsylvania Glass Sand Corp.	Berkeley Springs, W. Va. 25411	Underground mine	Taos.
Carbon dioxide (natural):			
Schwartz Carbonic Co	Box 9737 El Paso, Tex. 79987	Well and extraction plant.	Harding.
S. E. C. Corp	do	do	Do.
Cement: Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Dry process, 2-rotary-kiln plant.	Bernalillo.
Clays:			
El Paso Brick Co	Box 12336 El Paso, Tex. 79912	Open pit mine	Dona Ana.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	do	Bernalillo.
Kinney Brick Co., Inc	Box 1804 Albuquerque, N. Mex. 87103	do	Do.
Coal:			
Kaiser Steel Corp	Box 1107 Raton, N. Mex. 87740	Underground mine, crushing plant, dense media-froth flotation cleaning plant.	Colfax.
The Pittsburg & Midway Coal Mining Co.	10 Main Center Kansas City, Mo. 64105	Strip mine, crushing plant, chemical and water treatment plant.	McKinley.
Utah Construction & Mining Co	Box 155 Fruitland, N. Mex. 87416	Strip mine, crushing plant, dust suppression detergent treatment plant.	San Juan.
Copper:			
Federal Resources Corp	1370 South Third West Salt Lake City, Utah 84115	3 underground mines and mill.	Hidalgo.
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	Open pit mine, flotation mill, precipitation plant, smelter, and refinery.	Grant.
Phelps Dodge Corp., Tyrone Branch.	Tyrone, N. Mex. 88065	Open pit mine and mill.	Do.
United States Smelting Refining and Mining Co.	136 East South Temple St. Salt Lake City, Utah 84111	Underground mine, open pit-underground mine, and flotation mill.	Do.
Feldspar: Los Compadres Mica Co	Box 475 Ojo Caliente, N. Mex. 87549	Tailings dump	Rio Arriba.
Fluorspar: North Star Mining & Milling Corp.	Box 1177 Las Cruces, N. Mex. 88001	Open pit mine	Dona Ana.
Gold:			
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	*See* Copper	Do.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	do	Do.
Gypsum: White Mesa Gypsum Co	124 Jackson NE Albuquerque, N. Mex. 87108	Open pit mine	Sandoval.
Helium: Navajo Indian Tribe (Air Reduction Co., operator).	Shiprock, N. Mex. 87420	Extraction plant	San Juan.
Iron ore: Dotson Minerals Corp	Box 115 Socorro, N. Mex. 87801	Magnetic upgrading plant.	Lincoln.
Do		Open pit mine	Socorro.
Lead:			
American Smelting and Refining Co.	120 Broadway New York, N.Y. 10005	*See* Zinc	Grant.
New Jersey Zinc Co	2045 City Line Road Bethlehem, Pa. 18017	do	Socorro.
Lime:			
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	Rotary-kiln plant	Grant.
Manganese concentrates: Goret & Aguilar, Inc.	Box 282 Socorro, N. Mex. 87801	Underground mine and jigging plant.	Socorro.
Manganiferous ore: Luck Mining Co	215 Market St. San Francisco, Calif. 94105	Open pit mine	Grant.
Mica:			
Mineral Industrial Commodities of America, Inc.	Box 2403 Santa Fe, N. Mex. 87501	do Dry grinding plant	Taos. Santa Fe.
Molybdenum:			
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	*See* Copper	Grant.
Molybdenum Corporation of America, Questa Division.	280 Park Ave. New York, N.Y. 10017	Open pit mine and flotation mill.	Taos.
Natural gas and petroleum: [1]			
Peat: T. L. Fox	506 Rosemont NE Albuquerque, N. Mex. 87107	Humus bog	Sandoval.

See footnote at end of table.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Perlite:			
Grefco, Inc., Dicalite Division	333 North Michigan Ave. Chicago, Ill. 60601	Open pit mine; crushing, screening, and air-separation plant.	Taos.
Johns-Manville Perlite Corp	2500 Miguelito Road Lompoc, Calif. 93436	----do----------	Do.
Potash:			
Duval Corp., Potash Division	Box 511 Carlsbad, N. Mex. 88220	2 underground mines and refinery.	Eddy.
International Minerals & Chemical Corp.	Box 71 Carlsbad, N. Mex. 88220	Underground mine and refinery.	Do.
Kerr-McGee Corp., Hobbs Potash Operations.	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	----do----------	Do.
National Potash Co	Box 731 Carlsbad, N. Mex. 88220	----do----------	Do.
Potash Company of America, a division of Ideal Basic Industries, Inc.	Box 31 Carlsbad, N. Mex. 88220	----do----------	Do.
Southwest Potash Corp	Box 279 Carlsbad, N. Mex. 88220	----do----------	Do.
Pumice:			
General Pumice Corp	Box 449 Santa Fe, N. Mex. 87501	Open pit mine and crushing and screening plant.	Rio Arriba.
Twin Mountain Rock Co	Box 1009 Sheridan, Wyo. 82801	----do----------	Union.
Volcanic Cinder Co	Box 9977 El Paso, Tex. 79990	----do----------	Dona Ana.
Salt:			
New Mexico Salt Co	Box 303 Carlsbad, N. Mex. 88220	Potash tailing recovery and plant.	Eddy.
The Salt Supply Co., Inc	Drawer SS Carlsbad, N. Mex. 88220	----do----------	Do.
Sand and gravel (commercial):			
Albuquerque Gravel Products Co	Box 1352 Albuquerque, N. Mex. 87103	Pit and stationary crushing and screening plant.	Bernalillo.
Burn Construction Co., Inc	Box 670 Las Cruces, N. Mex. 88001	3 pits and 2 portable crushing and screening plants.	Dona Ana.
Do	----------	Pit and portable crushing and screening plant.	Otero.
Springer Corp	Box 572 Albuquerque, N. Mex. 87103	Pit and stationary crushing and screening plant.	Bernalillo.
Silver:			
American Smelting and Refining Co.	120 Broadway New York, N.Y. 10005	*See* Zinc----------	Grant.
Federal Resources Corp	1370 South 3d West Salt Lake City, Utah 84107	*See* Copper----------	Hidalgo.
Kennecott Copper Corp	Hurley, N. Mex. 88043	----do----------	Grant.
The New Jersey Zinc Co	2045 City Line Road Bethlehem, Pa. 18017	*See* Zinc----------	Socorro.
Phelps Dodge Corp., Tyrone Branch.	Tyrone, N. Mex. 88065	*See* Copper----------	Grant.
Thomas Consolidated Mines, Inc	637 Peyton Bldg. Spokane, Wash. 99201	Underground mine	Catron.
United States Smelting Refining and Mining Co.	136 East South Temple St. Salt Lake City, Utah 84111	*See* Copper----------	Grant.
Stone:			
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Quarry and plant	Bernalillo.
J. W. Jones Construction Co	Box 8038, Station C Albuquerque, N. Mex. 87108	----do----------	Colfax.
		----do----------	Lincoln.
		----do----------	Mora.
		----do----------	San Juan.
Lea County Highway Dept	Lovington, N. Mex. 88260	----do----------	Lea.
List & Clark Construction Co	6811 West 63d St. Kansas City, Kans. 66103	----do----------	Santa Fe.
New Mexico State Highway Commission.	Box 1149 Santa Fe, N. Mex. 87501	----do----------	Lea.
		----do----------	Lincoln.
		----do----------	Otero.
		----do----------	Roosevelt.

See footnote at end of table.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Uranium:			
The Anaconda Company, New Mexico Operations.	Box 638 Grants, N. Mex. 87020	Open pit mine and acid-leach process mill.	Valencia.
Kerr-McGee Corp	Box 218 Grants, N. Mex. 87020	6 underground mines and acid-leach process mill.	McKinley.
		5 underground mines	Do.
United Nuclear Corp	Box 199 Grants, N. Mex. 87020	Underground mine	Valencia.
United Nuclear-Homestake Partners.	Box 98 Grants, N. Mex. 87020	9 underground mines and alkaline-leach process mill.	McKinley.
Zinc:			
American Smelting and Refining Co.	120 Broadway New York, N.Y. 10005	Underground mine and mill.	Grant.
The New Jersey Zinc Co	2045 City Line Road Bethlehem, Pa. 18017	Open pit-underground mine, underground mine, flotation mill.	Do.
Do		2 underground mines	Socorro.
United States Smelting Refining and Mining Co.	136 East South Temple St. Salt Lake City, Utah 84111	*See* Copper	Grant.

[1] Most of the major oil and gas companies and many smaller companies operate in New Mexico and several commercial directories contain complete lists of them.

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 Robert G. Clarke [1]

The value of New York's mineral production increased 1 percent and was the highest on record, largely due to increases in natural gas, salt, and stone production. Commodities declining substantially in quantity and value of output were petroleum, sand and gravel, and zinc. The quantity and value of clays, garnet, emery, and ilmenite also decreased. Cement, iron ore, lead, and wollastonite increased in both quantity and value. The State maintained its ranking of first nationally in production of garnet, talc, and wollastonite, and continued to be a major producer of zinc, cement, gypsum, salt, sand and gravel, and stone. Construction activity was slightly greater than in 1968 although new family units decreased substantially.

Trends and Developments.—Top priority in programs and studies was centered on the State's water resources. The State Water Resources Commission established 10 regional water resources planning boards to work cooperatively with the U.S. Geological Survey for a State-wide water inventory. Other State agencies shared programs with the U.S. Army Corps of Engineers. A new Division of Mineral Resources was created in the Conservation Department to regulate the State's mineral industries and to establish safety and anti-pollution standards for these industries.

The major salt companies continued development work in underground and well field operations. International Salt Co. and Morton Salt Co. have also bought acreage

[1] Ceramic engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in New York [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	1,675	$1,790	1,623	$1,783
Gem stones	NA	10	NA	10
Gypsum—thousand short tons	570	2,925	492	2,945
Lead (recoverable content of ores, etc.)—short tons	1,396	369	1,686	502
Lime—thousand short tons	1,086	10,154	1,055	10,224
Natural gas—million cubic feet	4,632	1,390	4,861	1,458
Peat—short tons	14,888	153	14,352	178
Petroleum (crude)—thousand 42-gallon barrels	1,532	7,093	1,256	5,683
Salt—thousand short tons	5,218	42,488	5,582	45,561
Sand and gravel—do	43,439	45,812	39,806	42,518
Silver (recoverable content of ores, etc.) thousand troy ounces	28	59	32	57
Stone—thousand short tons	35,441	63,510	37,561	66,839
Zinc (recoverable content of ores, etc.)—short tons	66,194	17,872	58,728	17,149
Value of items that cannot be disclosed: Abrasive garnet, cement, emery, iron ore, talc, titanium concentrate, and wollastonite	XX	106,011	XX	107,432
Total	XX	299,636	XX	302,339
Total 1967 constant dollars	XX	295,274	XX	p 293,865

p Preliminary. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

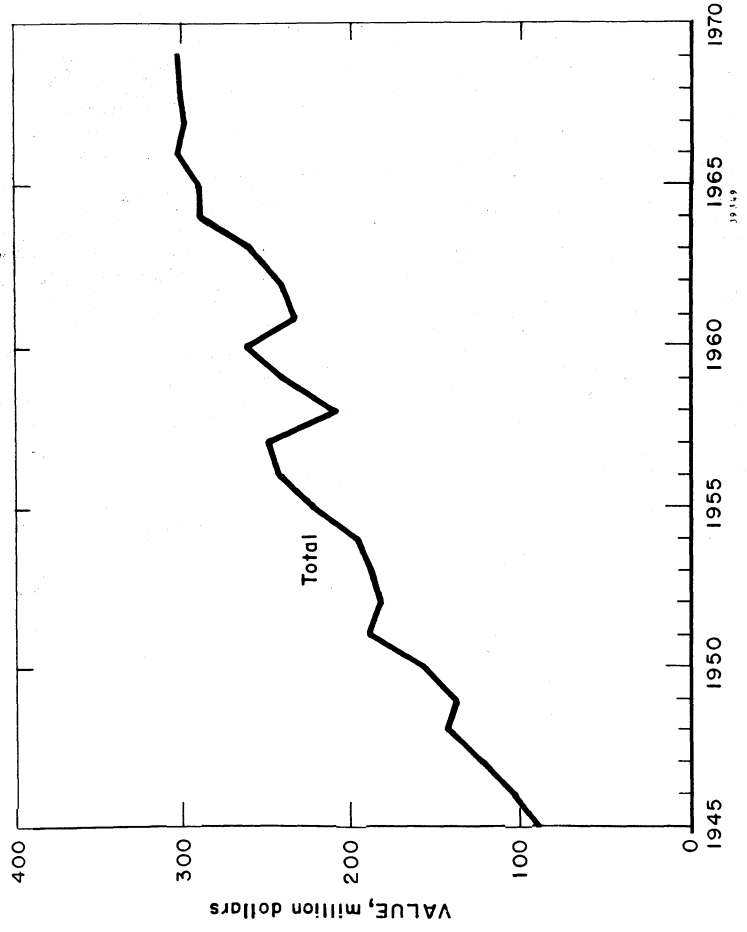

Figure 1.—Total value of mineral production in New York.

to extend their reserves and to prolong the lives of their properties in Livingston and Yates Counties.

Oil and gas companies increased their exploratory and development work. Land use conflicts restricted mineral extraction activities in urban areas. Molybdenum Corp. of America contracted with Republic Steel Co. for rights to concentrate heavy rare earths from residual materials at the latter's Mineville iron ore property near Port Henry, Essex County.

Table 2.—Value of mineral production in New York, by counties [1] [2]
(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Albany	W	W	Cement, stone, clays, sand and gravel.
Allegany	W	W	Sand and gravel.
Broome	$2,162	$1,616	Sand and gravel, stone, clays.
Cattaraugus	2,954	2,675	Sand and gravel, peat.
Cayuga	W	W	Stone, sand and gravel.
Chautauqua	W	W	Sand and gravel.
Chemung	W	W	Do.
Chenango	W	W	Do.
Clinton	W	W	Stone, sand and gravel.
Columbia	W	W	Cement, stone, sand and gravel, clays.
Cortland	608	W	Sand and gravel.
Delaware	W	1,390	Stone, sand and gravel.
Dutchess	W	W	Do.
Erie	13,583	13,850	Stone, cement, lime, sand and gravel, gypsum, clays.
Essex	W	W	Iron ore, ilmenite, wollastonite, stone, sand and gravel, stone.
Franklin	W	W	Sand and gravel, stone.
Fulton	W	192	Sand and gravel.
Genesee	3,217	3,339	Stone, gypsum, sand and gravel.
Greene	18,599	21,553	Cement, stone.
Herkimer	W	W	Stone, sand and gravel.
Jefferson	W	W	Do.
Lewis	W	947	Do.
Livingston	W	W	Salt, sand and gravel, stone.
Madison	735	838	Stone, sand and gravel.
Monroe	5,256	4,272	Stone, sand and gravel, gypsum.
Montgomery	W	W	Stone, sand and gravel.
Nassau	4,442	4,768	Sand and gravel, clays.
Niagara	4,525	4,663	Lime, stone, sand and gravel.
Oneida	2,377	2,439	Sand and gravel, stone.
Onondaga	W	20,190	Salt, lime, stone, cement, sand and gravel, clays.
Ontario	1,817	1,919	Sand and gravel, stone, peat.
Orange	1,459	1,963	Do.
Orleans	W	W	Stone, sand and gravel.
Oswego	536	W	Sand and gravel.
Otsego	W	W	Do.
Putnam	W	W	Do.
Rensselaer	1,258	1,158	Sand and gravel, stone.
Richmond	W	W	Sand and gravel.
Rockland	10,419	9,452	Stone, sand and gravel.
St. Lawrence	38,249	36,291	Zinc, iron ore, talc, stone, lead, sand and gravel, silver.
Saratoga	1,106	1,357	Stone, sand and gravel.
Schenectady	W	545	Sand and gravel.
Schoharie	W	W	Cement, stone, clays, sand and gravel.
Schuyler	W	W	Salt, sand and gravel.
Seneca	W	279	Stone, peat.
Steuben	847	1,080	Sand and gravel, stone.
Suffolk	4,221	4,153	Sand and gravel.
Sullivan	W	W	Stone, sand and gravel.
Tioga	841	442	Sand and gravel.
Tompkins	W	W	Salt, stone, sand and gravel.
Ulster	17,052	W	Cement, stone, clays, sand and gravel.
Warren	6,394	W	Cement, garnet, stone, sand and gravel.
Washington	980	1,302	Stone, sand and gravel.
Wayne	658	W	Do.
Westchester	787	809	Stone, emery, sand and gravel, peat.
Wyoming	W	W	Salt.
Yates	6	3	Sand and gravel.
Undistributed [3]	154,553	158,853	
Total [4]	299,636	302,339	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Bronx, Hamilton, Kings, New York, and Queens 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, petroleum, sand and gravel, and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.
[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New York business activity

	1968	1969p	Change, percent
Employment and labor force, annual average: [1]			
Total labor force—thousands	r 8,115.0	8,305.0	+2.3
Unemployment—percent of labor force	3.5	3.5	-----
Employment:			
Manufacturing—thousands	7,001.7	7,180.9	+2.6
Durable goods—do	r 1,879.0	1,873.6	−0.3
Nondurable goods—do	r 996.3	989.9	−0.6
Mining—do	r 8.4	8.1	−3.6
Contract construction—do	r 260.4	262.4	+0.8
Earnings—average weekly: [1]			
Manufacturing	$121.48	$128.30	+5.6
Durable goods	$134.55	$141.66	+5.3
Nondurable goods	$111.36	$117.66	+5.7
Personal income: [2]			
Total—millions	r $75,049	$80,989	+7.9
Per capita	r $4,127	$4,421	+7.1
Construction activity:			
Portland cement shipments to and within New York—thousand 376-pound barrels	r 17,691	17,626	−0.4
Mineral production—thousands	$299,636	302,339	+1.0

p Preliminary.
r Revised.
[1] New York State Department of Labor.
[2] Survey of Current Business.

Table 4.—Worktime 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
1968:								
Peat	10	202	2	16	--	1	61.94	3,097
Metal	1,312	258	356	2,844	1	34	12.31	2,661
Nonmetal	2,189	263	576	4,660	--	120	25.75	1,038
Sand and gravel	2,234	209	467	3,820	1	88	23.30	2,088
Stone	3,365	255	859	7,066	1	109	15.57	1,701
Total [1]	9,110	246	2,260	18,407	3	352	19.29	1,763
1969: p								
Peat	13	169	2	17	--	1	57.53	805
Metal	1,305	273	358	2,862	--	57	19.92	1,947
Nonmetal	2,050	266	545	4,429	1	146	33.19	2,390
Sand and gravel	2,220	215	477	3,969	--	79	19.90	559
Stone	3,215	269	864	7,082	1	80	11.44	1,262
Total [1]	8,800	255	2,246	18,359	2	363	19.88	1,489

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

The U.S. Bureau of Mines and the State of New York executed a cooperative contract for the joint investigation of New York's mineral resources.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—The Carborundum Co. and General Abrasives Co. in Niagara County operated electric furnaces for fused aluminum oxide and silicon carbide. The finished products were used in abrasives and in refractories and other nonabrasives.

Metallic abrasives consisting of chilled iron shot and grit, annealed iron shot and grit, and cut wire shot, were produced by Fanner Mfg. Co. and Pellets, Inc., in Erie County.

Cement.—Shipments of all types of cement increased 1 percent in quantity and 3 percent in value. Cement ranked first in

value among the State's mineral commodities. Among the cement-producing States, New York ranked fifth in quantity and sixth in value. Portland cement accounted for 98 percent of the cement value; the average price of portland cement increased $0.04 to $2.59 per barrel. Shipments of masonry cement decreased in quantity and the average price increased to $2.36 per barrel.

Eleven plants were in operation of which nine were in eastern and two in western New York. Four plants produced portland cement exclusively; six produced portland and masonry; and one produced masonry only. Cement production was reported from eight counties; in quantity, Albany County ranked first, followed by Greene, Ulster, and Columbia Counties.

Cement rock and limestone comprising 7.4 million tons were the principal raw materials for manufacturing portland cement. Other raw materials included clay and shale (348,000 tons), gypsum (223,000 tons), sand (33,000 tons), and iron-bearing materials (17,000 tons). A total of 658 million kilowatt-hours of electrical energy was consumed, all of which was purchased.

Forty-one percent of the combined portland and masonry cement shipped was consumed within the State; 38 percent was shipped to New England, and 8 percent was shipped to Florida.

Ready mixed concrete companies purchased 63 percent of portland cement shipped. Other large customers included concrete product manufacturers, building material dealers, and highway and other contractors. Cement was shipped by truck (74 percent), railroad (14 percent), and boat (12 percent). Bulk shipments were 95 percent of the total; the balance was shipped in packaged containers.

Most of the portland cement produced was the non-air entrained general-use type although 1.5 million barrels of air-entrained general use type and 1 million barrels of high-early strength portland cement were produced. Wet process plants accounted for more than eighty percent of the output. Yearend stocks of portland cement were 30 percent less than in 1968.

The following quarry operations of cement producers received citations from the National Safety Competition for having an outstanding safety record in 1969: Alsen Quarry, Lehigh Portland Cement Co., Cementon, Greene County; Catskill Quarry, Alpha Portland Cement Co., Cementon, Greene County; Catskill Quarry, Marquette Cement Mfg. Co., Catskill, Greene County; Glens Falls Cement Rock Quarry, Flintkote Co., Glens Falls, Warren County; Howes Cave 6-H Quarry, Penn-Dixie Cement Corp., Howes Cave, Schoharie County; and Hudson Plant, Universal Atlas Cement Division, U.S. Steel Corp., Hudson, Ulster County.

Clays.—Clay production decreased 3 percent in quantity and 1 percent in value. Beacon Brick Corp. in Dutchess County closed. Decreases in clay output for use in lightweight aggregate and portland cement contributed to the overall decrease. Special clays for pottery and abrasive bonding amounted to about the same as 1968 output and together accounted for less than 0.5 percent of the total clays produced. Leading counties in decreasing order of tonnage were Ulster and Albany in the East, and Erie in the West.

The Nytralite Plant of New York Trap Rock Corporation, Nytralite Aggregate Division, at Kingston, Ulster County, received an award for its safety record in 1969 in the Open-Pit Group, National Safety Competition.

Emery.—Production for the entire United States was from two open pit mines, DeLuca Emery Mine, Inc. and Di-Rubbo American Emery Co., in Westchester County. The output decreased less than 1 percent in quantity and was 2 percent less in value. Uses were mainly as aggregate for heavy-duty nonslip floors and pavements, and for general abrasive purposes.

Garnet.—The quantity of abrasive garnet decreased 2 percent and the value decreased 1 percent. Garnet from an open pit mine in Warren County operated by Barton Mines Corp. was sold for precision uses in coated abrasives, glass grinding and polishing, and metal lapping. Garnet recovered as a byproduct of wollastonite mining by Interpace Corp. in Essex County was sold for use in sandblasting and for general abrasive purposes.

Gem Stones.—The collection of gem stones and mineral specimens was principally by amateurs.

Graphite (Manufactured).—Manufactured graphite from petroleum coke and

other materials was produced at Niagara Falls, Niagara County, and Queens County, by various corporations. The principal uses were shapes: Anodes, electrodes, electric motor brushes, crucibles, and other refractories. Synthetic graphite powder was used as a carbon raiser in steelmaking, an additive in nonferrous metallurgy, foundry facings, and lubricants (alone and in greases).

Gypsum.—Output of gypsum decreased 14 percent in quantity but increased 1 percent in value. The average value per ton increased $0.86 to $5.99. Production came from four underground mines, two 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 materials. Eight calcining plants located in Bronx, Erie (2), Genesee, Monroe, Richmond, Rockland, and Westchester Counties were in operation. Uses for calcined gypsum other than in building materials included manufacturing plate glass, pottery, molding, and art coating plasters. Some crude gypsum was used as a retarder in portland cement.

The Akron Mine, Georgia-Pacific Corp., Akron, Erie County, received an award for its outstanding record in 1969 in the Underground Nonmetals Group, National Safety Competition.

Table 5.—Crude gypsum production

(Thousand short tons and thousand dollars)

Year	Active mines	Quantity	Value
1965	5	662	$3,511
1966	5	559	2,998
1967	5	570	3,118
1968	5	570	2,925
1969	4	492	2,945

Lime.—Production of lime in Erie, Niagara and Onondaga Counties decreased 3 percent in quantity but the value increased almost 1 percent. The lime plant of the Bethlehem Steel Corp. was operated to supply quicklime for the basic oxygen furnaces at Lackawanna. All other quicklime was captive production by chemical companies. Quicklime accounted for about 90 percent of the lime output. Most hydrated lime was used for chemical processing; some was used for construction. New York ranked seventh in quantity and ninth in value among the lime-producing States.

Perlite.—Crude perlite mined in Western States was expanded at seven plants, three in Erie County, and one each in Bronx, Genesee, Richmond, and Rockland Counties. The most important use was in acoustical building plaster. Other uses included loose fill insulation, soil conditioning, lightweight concrete aggregate, and filtering.

Salt.—The output of salt increased 7 percent in both quantity and value. Rock salt and brine salt increased in quantity and value, whereas evaporated salt remained constant. The overall value per ton increased slightly. By tonnage, most evaporated salt was used for food processing and seasoning. Another large use for evaporated salt was for manufacturing chlorine and other chemicals. The principal use for rock salt was for ice control on highways in the Northeastern States. Other important uses for rock salt were in the chemical and food industries. Salt in brine was used mainly for the manufacture of soda ash; some salt in brine was used for the manufacture of chlorine and other chemicals. Salt for chemical manufacture was used mainly in New York. Rock salt was mined in Livingston and Tompkins Counties, and salt was produced from wells in Onondaga, Schuyler, and Wyoming Counties. The State ranked fourth in quantity and third in value among the salt-producing States.

Table 6.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	5,002	$35,771
1966	4,980	36,203
1967	5,320	41,568
1968	5,218	42,488
1969	5,582	45,561

Sand and Gravel.—Production of sand and gravel decreased 8 percent in quantity and 7 percent value. The average value per ton increased by $0.02 to $1.07. There were 285 commercial operations and many other locations operated by construction companies and government operators working on various Federal, State, county, and local government contracts. Two operations had production in excess of 1 million tons and four had production between 500,000

and 1 million tons. Production from these six large operators comprised 23 percent of the commercial output. Bank-run (unprocessed) sand and gravel amounted to 20 percent of the total output. More than 1 million tons each was reported from Nassau, Suffolk, Cattaraugus, Dutchess, Ontario, Oneida, and Erie Counties in decreasing order of tonnage. Levon Properties Corp., Suffolk County, shipped sand and gravel to D. J. Carton Co., Devon, Conn.

Table 7.—Sand and gravel sold or used by producers, by classes of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	9,630	$12,211	9,786	$12,637
Paving	3,216	4,326	3,143	4,279
Fill	1,113	439	1,522	1,059
Molding	145	707	166	764
Filtration	42	63	W	W
Other	684	701	806	877
Undistributed[1]	39	87	76	162
Total	14,869	18,534	15,499	19,778
Gravel:				
Building	4,693	7,166	4,787	7,238
Paving	4,531	5,234	3,832	4,599
Fill	2,541	1,545	1,845	1,163
Undistributed[2]	793	863	657	832
Total	12,558	14,808	11,121	13,832
Total sand and gravel	27,427	33,342	26,620	33,610
Government-and-contractor operations:[3]				
Sand:				
Building	98	146	43	65
Paving	690	474	290	202
Fill	3,070	1,280	3,171	1,589
Other	692	333	721	332
Total	4,550	2,233	4,225	2,188
Gravel:				
Paving	6,552	7,143	5,530	4,837
Fill	4,853	3,072	3,364	1,820
Other	57	22	68	63
Total	11,462	10,237	[4] 8,961	6,720
Total sand and gravel	16,012	[4] 12,469	13,186	8,908
All operations:				
Sand	19,419	20,767	19,724	21,966
Gravel	24,020	25,045	20,082	[4] 20,551
Total	43,439	45,812	39,806	[4] 42,518

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes engine sand, foundry sand, and other sand.
[2] Includes railroad ballast and other gravel.
[3] Includes data for State, counties, municipalities, and other government agencies.
[4] Data does not add to total shown because of independent rounding.

Table 8.—Sand and gravel production by Government-and-contractor operation, by counties

(Thousand short tons)

County	1968	1969	County	1968	1969
Allegany	31	33	Oneida	149	172
Broome	175	70	Onondaga	185	53
Cattaraugus	81	17	Ontario	43	42
Cayuga	14	30	Orange	93	80
Chautauqua	244	263	Orleans	8	10
Chemung	32	26	Oswego	80	57
Chenango	68	70	Otsego	62	83
Clinton	34	237	Rensselaer	------	99
Columbia	7	10	St. Lawrence	161	295
Cortland	20	------	Saratoga	51	62
Delaware	14	17	Schoharie	------	2
Dutchess	------	147	Schuyler	27	13
Essex	33	114	Steuben	148	143
Franklin	123	164	Suffolk	17	16
Fulton	24	12	Sullivan	5	2
Genesee	34	67	Tioga	1	1
Herkimer	33	40	Warren	------	46
Jefferson	250	325	Washington	21	11
Lewis	80	284	Wayne	119	83
Livingston	9	11	Yates	18	8
Montgomery	13	292	Undistributed [1]	13,501	9,678
Niagara	4	------	Total	16,012	[2] 13,186

[1] Includes data unspecified by counties.
[2] Data does not add to total shown because of independent rounding.

Stone.—Total stone production increased 6 percent in quantity and 5 percent in value. Stone was the second most valuable mineral commodity produced in the State. Increases in both quantity and value were reported for trap rock (basalt), carbonate rock (limestone and dolomite), granite, and miscellaneous stone. Dutchess County ranked first in value among the State's 39 stone-producing counties, followed by Rockland, Ulster, and Onondaga. Seventeen counties had stone industries with output valued in excess of $1 million. Crushed limestone and dolomite, considered together as carbonate rock, were predominant in the State, accounting for 89 percent of the tonnage and 83 percent of the value of all stone produced. Limestone and dolomite were mined in 31 counties of which nine reported output exceeding 1 million tons each.

The chief uses for crushed dolomite and limestone were as an aggregate material in various construction applications and for the manufacture of cement and lime. Other uses were agricultural stone, railroad ballast, riprap, asphalt filler and fluxing stone. A small quantity of dimension limestone was produced in Onondaga County.

The following limestone quarry operations received citations from the National Safety Competition for having an outstanding safety record in 1969: Callanan Road Improvement Co. Plant No. 1, South Bethlehem, Albany County; Federal Crushed Stone Quarry, Buffalo Slag Co., Cheektowaga, Erie County; Jamesville Quarry, Allied Chemical Corp., Jamesville, Onondaga County; Norwood Quarry, Allied Chemical Corp., Norwood, St. Lawrence County; South Lansing Quarry, Cayuga Crushed Stone, Inc., South Lansing, Tompkins County; and Hudson Falls Quarry, Tri-County Stone Co. Inc., Hudson Falls, Washington County.

Basalt (traprock) ranked second and was produced only in Rockland County. Compared with that of 1968, the tonnage increased 26 percent. The chief uses were for concrete aggregate and road metal.

Sandstone, which includes quartzite, was quarried as dimension stone and as crushed stone. Sandstone ranked third in tonnage and value in the State, quantity and value of sandstone decreased about 5 percent each. The chief uses of dimension sandstone were for curbing and flagging and for architectural applications. Crushed sandstone was used for concrete aggregate and road metal. Production was reported from seven counties, led by Delaware and Sullivan in value.

Marble was quarried in St. Lawrence and Westchester Counties. The marble was crushed and ground for a variety of uses,

mostly concrete aggregate, road metal, and agriculture.

Slate was quarried and prepared for use as flagstone, roofing, structural, and sanitation stone in Washington County. Tonnage of slate produced was 9 percent less than that of 1968 and value decreased 6 percent. Granite was quarried and dressed in Essex and Westchester Counties mostly for building stone. Crushed granite from Essex, Warren, and Westchester Counties was used for concrete aggregate, road metal, and railroad ballast. Dimension granite decreased in both quantity and value compared with 1968. Crushed granite increased in both quantity and value. Miscellaneous stone reported from Rensselaer County increased 22 percent in both quantity and value; it was used for construction aggregate and road metal.

Table 9.—Crushed and broken limestone and dolomite sold or used by producers by uses

(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Riprap	167	$337	187	$431
Construction aggregates [1]	22,054	41,461	23,826	43,471
Agricultural	357	1,043	306	1,139
Railroad ballast	W	W	412	681
Cement	6,476	5,572	6,980	6,969
Miscellaneous uses, including fluxing stone, and lime	3,146	4,596	1,745	3,053
Total	32,200	53,009	33,456	55,744

W Withheld to avoid disclosing individual company confidential data; included with "Miscellaneous uses."
[1] Includes concrete, bituminous, macadam, surface treatment aggregates, dense graded road base stone, and unspecified construction aggregates (1969).

Talc and Soapstone.—The output of talc increased less than 1 percent and the value decreased less than 1 percent. New York continued to be the leading talc-producing State. Gouverneur Talc Co. and International Talc Co. mined talc from two underground mines and one opencut mine in St. Lawrence County. Crude talc was ground in company-owned mills and marketed principally for use in ceramics and as a mineral filler in paints. Small quantities were used as a mineral filler in floor and wall tiles, rubber, and miscellaneous products.

Vermiculite.—Crude vermiculite mined in other States was exfoliated at the Zonolite Div. plant of W. R. Grace Co., Weedsport, Cayuga County. The expanded vermiculite was used for loose fill insulation, soil conditioning, ultra-lightweight concrete aggregate, and building plaster aggregate.

Wollastonite.—Crude wollastonite was mined and beneficiated at the Willsboro Mine in Essex County now operated by Interpace Corp. The refined wollastonite was used as a filler in paints and plastics and as an ingredient in ceremic products.

METALS

Aluminum.—Production of primary aluminum from the Massena plants, St. Lawrence County, of Aluminum Co. of America and Reynolds Metals Co. increased in both tonnage and value. The State ranked fifth in aluminum production.

Iron Ore.—Mine production of magnetite iron ore increased 1 percent from an underground mine operated by Republic Steel Corp. in Essex County; and two open pit mines, one operated by National Lead Co. in Essex County and one operated by Jones & Laughlin Steel Corp. in St. Lawrence County. All of the ore was beneficiated. Production of concentrates decreased and mill concentrate stocks increased. Most of the concentrates were agglomerated before shipment. Principal uses for shipments were in the manufacture of pig iron and steel and some in the manufacture of cement, for heavy media separation, and for ballast.

Lead.—Lead was recovered as a byproduct of zinc mining at the Balmat mine of the St. Joseph Lead Co. in St. Lawrence County. Quantity increased 21 percent and the value increased 36 percent. Lead recovery varies from year to year depending on the proportion of ore coming from that section of the Balmat mine where the vein has a higher lead content. The lead concentrate was shipped to the company lead smelter at Herculaneum, Mo.

Silver.—The quantity of silver recovered from lead concentrates shipped from the Balmat mine, St. Joseph Lead Co., in St. Lawrence County was 14 percent more than that of 1968 but the value decreased 3 percent. Silver recovery usually reflects the demand for silver-free lead rather than the silver content of the concentrate. The average value of silver decreased from $2.11 per ounce in 1968 to $1.79 per ounce in 1969.

Titanium Concentrate.—Ilmenite concentrate was recovered by National Lead Co. as a coproduct of magnetite from an open-cut titaniferous-magnetite deposit near Tahawus, Essex County. Shipments and value were 15 percent less than those of 1968. The output was used principally in the manufacture of titanium dioxide pigment.

Zinc.—New York continued to rank second to Tennessee in U.S. zinc production for both quantity and value. Production, all from the Balmat and Edwards mines of the St. Joseph Lead Co. in St. Lawrence County, decreased 11 percent in quantity and 4 percent in value from 1968. St. Joseph Lead Co. reported that the No. 4 shaft at Balmat bottomed at 3,225 feet and that production is scheduled to begin in 1972 from the new mine facility.

Table 10.—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)	
1965	2	788,961	11,441	$15	601	$188	69,880	$20,405	[1] $20,607
1966	2	818,408	21,590	28	1,097	332	73,454	21,302	[1] 21,661
1967	2	808,749	31,103	48	1,653	463	70,555	19,534	20,045
1968	2	785,109	27,615	59	1,396	369	66,194	17,872	18,300
1969	2	740,825	31,755	57	1,686	502	58,728	17,149	17,708

[1] Data does not add to total shown because of independent rounding.

Table 11.—Mine production of silver, lead, and zinc, in 1969, by months, in terms of recoverable metals

Month	Silver (troy ounces)	Lead (short tons)	Zinc (short tons)
January	2,720	145	5,008
February	2,620	137	4,680
March	2,790	151	5,332
April	3,042	157	4,998
May	3,400	168	5,186
June	2,440	178	4,797
July	2,730	151	4,980
August	2,627	135	4,608
September	2,706	125	4,917
October	2,379	119	5,413
November	2,054	100	4,346
December	2,247	120	4,463
Total	31,755	1,686	58,728

MINERAL FUELS

Natural Gas.—According to the Geological Survey, New York State Museum and Science Service, the production of natural gas increased 5 percent to 4.9 billion cubic feet. Estimated crude recoverable reserves of natural gas at yearend, according to the American Gas Association, were 121 billion cubic feet, of which 98 billion cubic feet was in underground storage reservoirs. Reserves were 3 percent less than at yearend 1968.

Table 12.—Marketed production of natural gas

(Million cubic feet and thousand dollars)

Year	Quantity	Value	Average value (cents per thousand cubic feet)
1965	3,340	$1,029	30.8
1966	2,699	837	31.0
1967	3,837	1,201	31.3
1968	4,632	1,390	30.0
1969	4,861	1,458	30.0

Peat.—Sales of peat decreased 4 percent in quantity but increased 17 percent in value. The value per ton increased to $12.42. The peat was used mainly in general soil improvement although some was used for potting. Orange County was the leading producing area; output was also reported from Cattaragus, Ontario, Seneca, and Westchester Counties. Bulk shipments accounted for 30 percent of production.

Petroleum.—Production of crude oil decreased 18 percent from that of 1968. Wells in the Cattaraugus field, Cattaraugus County, yielded 60 percent of the total; the remainder came from the Allegany field in Allegany County, and the Busti pool in Chautauqua County. Proved reserves of crude oil at yearend were 11.8 million barrels according to estimates of the American Petroleum Institute.

Table 13.—Petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value	Average value per barrel
1965	1,632	$7,246	$4.44
1966	1,735	7,925	4.57
1967	1,972	9,026	4.58
1968	1,532	7,093	4.63
1969	1,256	5,683	4.52

Table 14.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1969

	Drilling								Geophysical crew-weeks	
	Proved field wells			Exploratory wells			Total		Reflection seismograph method [1]	Gravity meter method
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage		
Allegany	39	---	---	---	---	---	39	50,874	---	---
Cattaraugus	41	---	1	---	---	---	42	51,940	---	---
Cayuga	---	2	---	---	---	---	2	6,225	---	---
Chautauqua	32	---	---	---	---	2	34	27,309	---	---
Chemung	---	---	1	---	---	---	1	3,311	---	---
Erie	---	8	1	---	---	1	10	15,572	---	---
Genesee	---	1	1	---	---	---	2	3,048	---	---
Steuben	---	---	1	---	1	---	2	8,847	---	12
Wayne	---	---	---	---	---	1	1	4,050	---	---
Wyoming	---	---	---	---	---	1	1	5,718	---	---
Total	112	11	5	---	1	5	134	176,894	27	12

[1] Geophysical prospecting by seismograph was done in Cattaraugus, Orange, Steuben, and Sullivan Counties.
Sources: Drilling from American Association of Petroleum Geologists. Geophysical crew-weeks from N.Y. State Museum and Science Service.

Table 15.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Artificial:			
The Carborundum Co., Electro Mineral Div.	P.O. Box 423 Niagara Falls, N.Y. 14302	Plant	Niagara.
General Abrasive Co., Div. of U.S. Industries, Inc.	Niagara Falls, N.Y. 14302	----do	Do.
Metallic:			
Cleveland Metal Abrasive Co., Div. of Fanner Mfg. Co.	Brookside Park Cleveland, Ohio 44109	----do	Erie.
Pellets, Inc	533 S. Niagara St. Tonawanda, N.Y. 14150	----do	Do.
Cement:			
Alpha Portland Cement Co.[1]	15 South Third St. Easton, Pa. 18043	----do	Greene.
Alpha Portland Cement Co		----do	Onondaga.
Atlantic Cement Co., Inc.[1]	P.O. Box 3 Ravena, N.Y. 12143	----do	Albany.
Century Cement Mfg. Co., Inc	Rosendale, N.Y. 12472	----do	Ulster.
Glens Falls Portland Cement Co.[2] Div. of Flintkote Co.	313 Warren St. Glens Falls, N.Y. 12801	----do	Warren.
Hudson Cement Division[2] Colonial Sand & Stone Co., Inc.	1740 Broadway New York, N.Y. 10019	----do	Ulster.
Lehigh Portland Cement Co	718 Hamilton St. Allentown, Pa. 18105	----do	Erie.
Lehigh Portland Cement Co.[2]		----do	Greene.
Marquette Cement Mfg. Co.[3]	20 N. Wacker Dr. Chicago, Ill. 60606	----do	Do.
Penn Dixie Cement Corp.[1]	P.O. Box 152 Nazareth, Pa. 18064	----do	Schoharie.
Universal Atlas Cement Div.,[1] U.S. Steel Corp.	Chatham Center Pittsburgh, Pa. 15230	----do	Columbia.

See footnotes at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays (miscellaneous):			
Binghamton Brick Co., Inc	P.O. Box 1256 Binghamton, N.Y. 13902	Pit	Broome.
Hudson Lightweight Stone Div., Colonial Sand & Stone Co., Inc.	1740 Broadway New York, N.Y. 10019	Pit	Ulster.
Hudson Valley Lightweight Aggregate Corp.	P.O. Box 9138 Richmond, Va. 23227	Pit	Do.
Jova Brick Mfg. Corp	Kingston, N.Y. 12401	Pit	Do.
Nassau Brick Co., Inc	635 Round Swamp Rd. Old Bethpage, L.I., N.Y. 11804	Pit	Nassau.
Nytralite Aggregate, Inc., Div. New York Trap Rock Corp.	162 Old Mill Rd. W. Nyack, N.Y. 10994	Pit	Ulster.
Powell & Minnock Brick Works, Inc.	Coeymans, N.Y. 12046	Pit	Albany.
Emery:			
DeLuca Emery Mine, Inc	926 Constant Ave. Peekskill, N.Y. 10566	Pit	Westchester.
DiRubbo American Emery Co	Locust Ave. Peekskill, N.Y. 10566	Pit	Do.
Garnet: Barton Mines Corp	North Creek, N.Y. 12853	Pit	Warren.
Graphite (synthetic):			
Airco Speer Electrodes & Anodes, Div. of Air Reduction Co., Inc.	Packard Rd. Niagara Falls, N.Y. 14302	Plant	Niagara.
The Carborundum Co., Graphite Products Div.	2050 Cory Dr. Sanborn, N.Y. 14132	----do	Do.
Great Lakes Carbon Corp., Graphite Products Div.	299 Park Ave. New York, N.Y. 10017	----do	Do.
Space Age Materials Corp	235 East 42d St. New York, N.Y. 10017	----do	Queens.
Union Carbide Corp., Carbon Products Div.	270 Park Ave. New York, N.Y. 10017	----do	Niagara.
Gypsum:			
Crude:			
GAF Corporation,[4] Bldg., Indust. & Floor Prod. Div.	140 West 51st Street New York, N.Y. 10020	Underground	Monroe,
Georgia-Pacific Corp.,[5] Gypsum Div.	900 S.W. 5th Portland, Oregon 97204	----do	Erie.
National Gypsum Co.[5]	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Westchester.
United States Gypsum Co.[5]	101 S. Wacker Dr. Chicago, Ill. 60606	----do	Erie.
		----do	Genesee.
Calcined:			
National Gypsum Co.[6]	325 Delaware Ave. Buffalo, N.Y. 14202	Plant	Bronx.
United States Gypsum Co.[6]	101 S. Wacker Dr. Chicago, Ill. 60606	----do	Richmond.
United States Gypsum Co		----do	Rockland.
Iron ore:			
Jones & Laughlin Steel Corp	Star Lake, N.Y. 13690	Pit	St. Lawrence.
Republic Steel Corp.[7]	1629 Republic Bldg. Cleveland, Ohio 44101	Underground	Essex.
Lime:			
Bethlehem Steel Corp	701 E. Third St. Bethlehem, Pa. 18016	Plant	Erie.
Industrial Chemicals Div., Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	----do	Onondaga.
Peat:			
George Dobbs	Clifton Springs, N.Y. 14432	Bog	Ontario.
Sterling Forest Peat Co., Inc	P.O. Box 608 Tuxedo, N.Y. 10987	Bog	Orange.
Stone Age Humus Corp	Armonk, N.Y. 10504	Bog	Westchester.
Sue Peat Co	Allegany, N.Y. 14706	Bog	Cattaraugus.
Perlite (expanded): Buffalo Perlite Corp.	100 Sugg Rd. Buffalo, N.Y. 14225	Plant	Erie.
Petroleum:			
Refineries:			
Mobile Oil Corp	Buffalo, N.Y. 14221	----do	Do.
Frontier Oil & Refining Co., Div. of Ashland Oil & Refining Co.	Tonawanda, N.Y. 14150	----do	Do.
Salt:			
Evaporated:			
International Salt Co	Clarks Summit, Pa. 18411	Well	Schuyler.
Morton Salt Co	110 N. Wacker Dr. Chicago, Ill. 60606	----do	Wyoming.
The Watkins Salt Co., Inc.[8]	Box 150 Watkins Glen, N.Y. 14891	----do	Schuyler.
Rock:			
Cayuga Rock Salt Co., Inc	191 Portland Pt. Rd. Myers, N.Y. 14866	Underground	Tompkins.
International Salt Co	Clarks Summit, Pa. 18411	----do	Livingston.

See footnotes at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Salt—Continued			
Brine: Industrial Chemicals Div.,[9] Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	Well	Onondaga.
Sand and gravel:			
Barney & Dickenson, Inc	R.D. 1, Vestal, N.Y. 13850	Pit	Broome.
Colonial Sand & Stone Co., Inc	1740 Broadway New York, N.Y. 10019	Pit	Nassau, Dutchess.
Country Side Sand & Gravel, Inc	South Dayton, N.Y. 14138	Pit	Cattaraugus.
Elmira Transit Mix, Inc	Box 231, Easton, Pa. 18042	Pit	Cattaraugus, Chemung.
Levon Properties Corp	R.D. 1, Box 161 Riverhead, N.Y. 11901	Pit	Suffolk.
Bob Murphy, Inc	Vestal, N.Y. 13850	Pit	Broome.
Penn Industries, Inc	136 East 57th St. New York, N.Y. 10022	Pit	Nassau.
Pine Hill Concrete Mix Corp	2255 Bailey Ave. Buffalo, N.Y. 14200	Pit	Erie.
Roanoke Marbro Sand & Gravel Corp.	P.O. Box 172 Riverhead, L.I., N.Y. 11901	Pit	Suffolk.
Don C. Russo Sand & Gravel Co	Bushnell's Basin, N.Y. 14534	Pit	Monroe.
West Hills Silica Sand Mining Corp.	P.O. Box 722 Melville, N.Y. 11746	Pit	Suffolk.
Smelters (aluminum):			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, Pa. 15222	Plant	St. Lawrence.
Reynolds Metals Co	6601 Broad Street Rd. Richmond, Va. 23215	do	Do.
Stone:			
Basalt (crushed):			
Appalachian Stone Div. Martin Marietta Corp.	Box 120 Mercersburg, Pa. 17236	Quarry	Rockland.
New York Trap Rock Corp	162 Old Mill Rd. W. Nyack, N.Y. 10994	do	Do.
Rockland Materials Corp	P.O. Box 57, Suffern, N.Y. 10901	do	Do.
Granite (dimension):			
Di Rienzo Brothers	107 Main St. Tuckahoe, N.Y. 10707	do	Westchester.
Frank Baratta, P. D'Amato & Angelo Cucchiella, T/A Dunwoodie Stone Quarry, Inc.	941 Midland Ave. Yonkers, N.Y. 10707	do	Do.
Lake Placid Granite Co	St. Cloud, Minn. 56301	do	Essex.
Lake Street Granite Quarry, Inc.[10]	Lake Street E. White Plains, N.Y. 10600	do	Westchester.
Granite (crushed): Northern Materials, Inc.	Route 9, Chestertown, N.Y. 12817	do	Warren.
Limestone (dimension): Brickyard Falls Farm.	R.D. 2, Manlius, N.Y. 13104	do	Onondaga.
Limestone and dolomite (crushed and broken):			
Appalachian Stone Division Martin Marietta Corp.	Box 120 Mercersburg, Pa. 17236	do	Rockland.
Buffalo Crushed Stone Co	10 Park Place Morristown, N.J. 07960	do	Erie.
The Buffalo Slag Co., Inc. Federal Crushed Stone Div.	111 Great Arrow Ave. Buffalo, N.Y. 14216	do	Do.
The Callanan Road Improvement Co.	So. Bethlehem, N.Y. 12161	do	Albany.
The Callanan Road Improvement Co.	----------	do	Ulster.
Dolomite Products Co.[11]	1150 Penfield Rd. Rochester, N.Y. 14625	do	Monroe.
Eastern Rock Products, Inc.[11]	404 Court St., Utica, N.Y. 13504	do	Oneida.
Frontier Stone Products, Inc	Box 376, Lockport, N.Y. 14094	do	Niagara.
The General Crushed Stone Co	712 Drake Bldg. Easton, Pa. 18042	do	Onondaga.
Industrial Chemicals Div., Allied Chemical Corp.	P.O. Box 70 Morristown, N.J. 07960	do	Do.
Niagara Stone Div. of Great Lakes Color Printing Corp.	Quarry Road Niagara Falls, N.Y. 14304	do	Niagara.
Marble (crushed):			
Balducci Crushed Stone Co	Box 158 Gouverneur, N.Y. 13642	do	St. Lawrence.
Universal Marble Products Corp.	Thornwood, N.Y. 10594	do	Westchester.
Miscellaneous (crushed):			
Fitzgerald Bros. Construction Co., Inc.	504 Broadway, Troy, N.Y. 12180	do	Rensselaer.
Sandstone (dimension):			
Adirondak Stone Quarries, Inc.	P.O. Box 184 Malone, N.Y. 12953	do	Franklin.

See footnotes at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sandstone (dimension)—Continued			
Downsville Stone Co.[12]	1 Dock St. Stamford, Conn. 06902	Processor	Delaware.
Finger Lakes Stone Co., Inc.	Box 401, Ithaca, N.Y. 14850	Quarry	Tompkins.
Willis Hankins	Hancock, N.Y. 13783	do	Delaware.
Heldeberg Bluestone & Marble, Inc.	East Berne, N.Y. 12059	Quarry	Albany.
Johnston & Rhodes Bluestone Co.	East Branch, N.Y. 13756	do	Delaware.
W. R. Strong & Son	43 Wheeler St. Deposit, N.Y. 13754	Processor	Do.
Paul Tompkins Estate	Hancock, N.Y. 13783	do	Do.
Sandstone (crushed and broken):			
Corbisello Quarries	Ingraham Hill Rd. Binghamton, N.Y. 13900	Quarry	Broome.
Steuben Crushed Div., A. L. Blades & Sons, Inc.	County Route #10 Bath, N.Y. 14810	do	Steuben.
Sullivan Highway Products Corp.	P.O. Box 392 Monticello, N.Y. 12701	do	Sullivan.
Slate (dimension):			
Darius Slate Products	Middle Granville, N.Y. 12849	do	Washington.
A. A. Hadeka Quarry	49 South St. Poultney, Vt. 05764	do	Do.
McCullen Slate Co	R.D. 1 Granville, N.Y. 12832	do	Do.
The A. B. Potter Slate Co., Inc.	Poultney, Vt. 05764	do	Do.
Ritchie Brothers Slate Co	Middle Granville, N.Y. 12849	do	Do.
Sheldon Slate Products Co		do	Do.
Vermont Structural Slate Co., Inc.	Prospect St. Fair Haven, Vt. 05743	do	Do.
Western Slate Co	Box 104 Granville, N.Y. 12832	do	Do.
Williams Bros. Slate Co	Middle Granville, N.Y. 12849	do	Do.
Talc:			
Gouverneur Talc Co., Inc	Gouverneur, N.Y. 13642	Underground	St. Lawrence.
International Talc Co., Inc	420 Lexington Ave. New York, N.Y. 10006	do	Do.
Titanium concentrate: Ilmenite:			
National Lead Co.[13]	100 Chevalier Ave. So. Amboy, N.J. 08879	Pit	Essex.
Vermiculite (exfoliated): Zonolite Division, W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Cayuga.
Wollastonite: Interpace Corp.[14]	Willsboro, N.Y. 12996	Underground	Essex.
Zinc: St. Joseph Lead Co.[15]	250 Park Ave. New York, N.Y. 10017	do	St. Lawrence.

[1] Also crushed limestone and shale. [2] Also crushed limestone.
[3] Also crushed limestone and clay. [4] Also calcined gypsum.
[5] Also calcined gypsum and expanded perlite. [6] Also expanded perlite. [7] Also crushed granite.
[8] Also brine. [9] Also evaporated salt and crushed limestone. [10] Also crushed.
[11] Also sand and gravel. [12] % MSR, Inc. [13] Also iron ore. [14] Also garnet.
[15] Also lead and silver.

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 Monford P. Turner [1] and Stephen G. Conrad [2]

The mineral industry of North Carolina continued to grow in 1969, contributing $90.5 million to the State's economy, an increase of about $7.6 million or 9 percent over the 1968 contribution. Stone was the leading mineral commodity produced, contributing 53 percent of the total mineral production value. Other mineral commodities mined, in order of value, were sand and gravel, phosphate rock, feldspar, lithium minerals, clays, mica, and talc and pyrophyllite. Leading mineral producers were Superior Stone Co., Ideal Cement Co., Vulcan Materials Co., and Texas Gulf Sulphur Co.

North Carolina ranked first among the States in the production of feldspar, mica, and lithium minerals, and second in olivine.

Most of the important economic indicators showed gains in 1969. Indicators with the greatest increases were factory payrolls, personal income, farm marketing receipts, consumption of electric energy, and export trade. Employment increased more than the labor force, resulting in 4.4-percent reduction in unemployment. Construction activity, as measured by value of building permits and contracts awarded by the State Highway Commission during 1969, decreased considerably; however, employment in construction was up 7.4 percent from that of 1968.

[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.
[2] State geologist, North Carolina Department of Conservation and Development, Division of Mineral Resources, Raleigh, N. C.

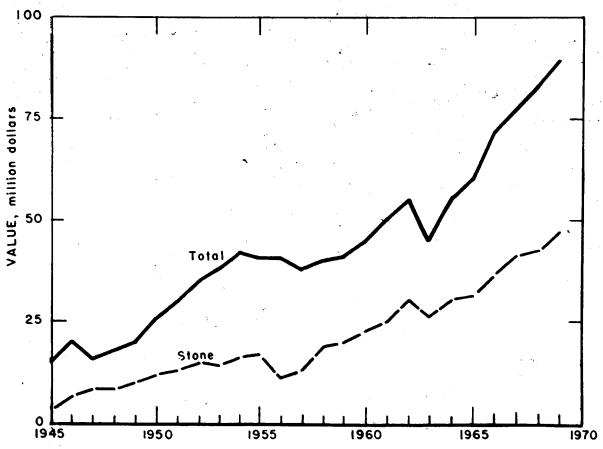

Figure 1.—Value of stone and total value of mineral production in North Carolina.

Table 1.—Mineral production in North Carolina [1]

Mineral		1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Clays [2]	thousand short tons	3,310	$2,148	3,342	$2,610
Feldspar	long tons	316,862	4,340	W	W
Gem stones		NA	20	NA	20
Mica:					
Scrap	short tons	69,054	1,640	67,214	1,513
Sheet	pounds	15,000	W	W	3
Sand and gravel	thousand short tons	10,771	11,178	10,562	11,437
Stone	do.	24,543	42,429	26,812	47,829
Talc and pyrophyllite	short tons	100,030	520	105,728	586
Value of items that cannot be disclosed: Asbestos, barite (1968), cement, clays (kaolin), iron ore (1969), lithium minerals, olivine, phosphate rock, and values indicated by symbol W		XX	20,544	XX	26,459
Total [3]		XX	82,819	XX	90,455
Total 1967 constant dollars		XX	82,237	XX	p 88,327

p Preliminary. 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 kaolin; included with "Value of items that cannot be disclosed."
[3] Data may not add to totals shown because of independent rounding.

Table 2.—Value of mineral production in North Carolina, by counties [1]

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Alamance	W	W	Granite, miscellaneous clay, pyrophyllite.
Alexander	$17	$18	Sand and gravel.
Alleghany	W	------	
Anson	W	W	Sand and gravel.
Ashe	40	W	Granite.
Avery	W	1,178	Sand and gravel, iron ore, mica, kaolin, miscellaneous clay, granite.
Beaufort	W	W	Phosphate rock, sand and gravel.
Bertie	71	W	Sand and gravel.
Bladen	147	101	Do.
Brunswick	35	16	Do.
Buncombe	W	W	Granite, sand and gravel.
Burke	W	W	Do.
Cabarrus	W	W	Traprock, granite, miscellaneous clay, sand and gravel.
Caldwell	410	815	Granite, sand and gravel.
Camden	4	4	Sand and gravel.
Carteret	3	3	Do.
Caswell	W	W	Granite, sand and gravel.
Catawba	W	W	Do.
Chatham	963	W	Granite, miscellaneous clay.
Cherokee	W	W	Marble, talc, sand and gravel.
Chowan	2	5	Sand and gravel.
Clay	43	178	Granite, sand and gravel.
Cleveland	W	W	Lithium minerals, limestone, granite, feldspar, mica, sand and gravel.
Columbus	12	60	Sand and gravel.
Craven	W	W	Limestone, sand and gravel.
Cumberland	W	W	Sand and gravel, miscellaneous clay.
Currituck	16	11	Sand and gravel.
Dare	22	16	Do.
Davidson	505	1,239	Slate, traprock, sand and gravel, miscellaneous clay.
Davie	16	W	Granite, sand and gravel.
Duplin	W	19	Sand and gravel.
Durham	W	W	Traprock, miscellaneous clay.
Edgecombe	175	173	Sand and gravel.
Forsyth	W	W	Granite, sand and gravel.
Franklin	16	12	Sand and gravel.
Gaston	W	W	Lithium minerals, sand and gravel.
Gates	5	7	Sand and gravel.
Graham	------	W	Do.
Granville	W	W	Granite, pyrophyllite, sand and gravel.
Greene	13	W	Sand and gravel.
Guilford	W	W	Granite, traprock, miscellaneous clay.
Halifax	W	W	Granite, miscellaneous clay, sand and gravel.
Harnett	W	W	Sand and gravel, miscellaneous clay.
Haywood	W	W	Sand and gravel, granite.

See footnotes at end of table.

Table 2.—Value of mineral production in North Carolina, by counties [1]—Continued

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Henderson	$689	W	Limestone, granite.
Hertford	10	W	Sand and gravel.
Hoke	21	$30	Do.
Hyde	2	2	Do.
Iredell	1,221	W	Granite, miscellaneous clay, sand and gravel.
Jackson	W	W	Granite, sand and gravel.
Johnston	W	W	Traprock, sand and gravel, miscellaneous clay.
Jones	7	W	Limestone, sand and gravel.
Lee	W	W	Miscellaneous clay, sand and gravel.
Lenoir	W	W	Sand and gravel.
Lincoln	W	W	Granite, sand and gravel.
Macon	W	233	Granite, mica.
Madison	W	42	Feldspar.
Martin	9	1	Sand and gravel.
McDowell	W	113	Do.
Mecklenburg	W	W	Granite.
Mitchell	4,403	4,161	Feldspar, mica, sand and gravel, quartz.
Montgomery	W	W	Quartz, sandstone, miscellaneous clay, sand and gravel, slate.
Moore	1,005	883	Sand and gravel, pyrophyllite, granite, miscellaneous clay.
Nash	W	W	Granite, sand and gravel.
New Hanover	W	W	Cement, limestone, miscellaneous clay, sand and gravel.
Northampton	W	6	Sand and gravel.
Onslow	W	W	Limestone, sand and gravel.
Orange	W	W	Pyrophyllite, granite.
Pamlico	1	(2)	Sand and gravel.
Pasquotank	8	24	Do.
Pender	44	47	Do.
Perquimans	22	3	Do.
Person	1	1	Do.
Pitt	W	W	Granite, sand and gravel.
Polk	W	7	Sand and gravel.
Randolph	W	W	Granite.
Richmond	56	107	Granite, sand and gravel.
Robeson	219	123	Sand and gravel.
Rockingham	W	W	Granite, miscellaneous clay, sand and gravel.
Rowan	W	W	Do.
Rutherford	W	W	Granite, sand and gravel.
Sampson	62	40	Sand and gravel, miscellaneous clay.
Scotland	21	43	Sand and gravel.
Stanly	W	W	Miscellaneous clay.
Stokes	209	181	Miscellaneous clay, sand and gravel.
Surry	2,502	3,185	Granite, traprock, sand and gravel.
Swain	116	W	Limestone, granite.
Transylvania	W	123	Granite.
Union	W	W	Traprock, miscellaneous clay, granite, sand and gravel.
Vance	W	W	Granite.
Wake	W	W	Granite, sand and gravel.
Washington	17	6	Sand and gravel.
Watauga	W	W	Do.
Wayne	122	139	Do.
Wilkes	W	W	Granite, sand and gravel.
Wilson	W	W	Do.
Yadkin	W	7	Sand and gravel.
Yancey	W	W	Mica, olivine, sand and gravel, asbestos.
Undistributed	69,536	77,093	
Total [3]	82,819	90,455	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] The following counties are not listed because no production was reported: Tyrrell and Warren.
[2] Less than ½ unit.
[3] Data may not add to totals shown because of independent rounding.

Table 3.—Selected indicators of North Carolina business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	2,132	2,225	+4.4
Unemployment	do	68	65	−4.4
Employment	do	2,064	2,160	+4.7
Construction	do	94	101	+7.4
All manufacturing	do	694	722	+4.0
Total nonfarm wage and salary	do	1,658	1,750	+5.5
Payrolls, factory	millions	$3,158	$3,488	+10.4
Personal income:				
Total	do	r $13,642	$15,045	+10.3
Per capita		r $2,659	$2,890	+8.7
Construction activity:				
Value of new units authorized in permit-issuing places	millions	$355	$331	−6.8
State Highway Commission:				
Value of contracts awarded	do	$136	$116	−14.7
Cement shipments to North Carolina	thousand 376-pound barrels	7,684	8,526	+11.0
Farm marketing receipts	millions	$1,257	$1,464	+16.5
Mineral production	do	$83	$90	+9.2
Consumption of electric energy	thousand kwh	32,363	35,501	+9.7
Export trade	millions	$179	$193	+7.8
Import trade	do	$209	$203	−2.9

r Revised. p Preliminary.
Source: U.S. Department of Commerce.

Table 4.—Worktime 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
1968:								
Metal	4	10	(1)	(1)	-----	-----	-----	-----
Nonmetal	1,960	258	505	4,082	1	122	30.13	2,525
Sand and gravel	896	228	204	1,798	1	39	22.25	3,725
Stone	1,973	234	461	3,807	2	50	13,66	7,567
Total [2]	4,833	242	1,171	9,687	4	211	22.19	4,729
1969: p								
Metal	15	290	5	37	-----	2	53.77	2,016
Nonmetal	1,925	257	503	4,060	2	103	25.86	3,737
Sand and gravel	760	232	177	1,646	2	33	21,26	7,690
Stone	1,925	251	484	4,116	2	64	16.03	3,754
Total [2]	4,630	251	11,168	9,859	6	202	21,10	4,398

p Preliminary.
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.

Trends and Developments.—Restoration of the old tungsten operations (Tungsten Queen mine, formerly the Hamme tungsten mine) near Townsville, Vance County, was scheduled to be completed by August 1, 1970. A new mill with an initial capacity of 600 tons of ore per day, was being constructed at the mine. A total of 250 men will be employed when the mine and mill are operating at capacity.

North Carolina Lime, Inc., a new company began quarrying limestone near Comfort, Jones County, for agriculture limestone use. This is the first such operation in eastern North Carolina. Reserves are estimated to be approximately 22 million tons. At present, the company is delivering by truck, but it plans to barge to points along the Intracoastal Waterway.

A nuclear generating plant costing $431 million, which will increase Duke Power Co.'s generating power by nearly 35 percent, will be built on Lake Norman in Mecklenburg County. The plant will have two nuclear reactors with a large portion of the equipment underground. The first

generating unit is scheduled for operation by late 1975, the second by early 1977. The new plant is part of the company's program to double the rate of power generated by 1975.

A 720,000-kw, coal-fired generating unit is scheduled for construction by Carolina Power & Light Co. at its Roxboro plant. The addition will cost approximately $90 million and is scheduled for operation in 1973.

Carolina Power & Light Co. has rescheduled two nuclear units, of 820,000-kw each, at its proposed Brunswick plant near Southport. The rescheduling, from 1973 to 1976 for the first and from 1974 to 1976 for the second was partly due to delays by Carolina Power & Light Co. in acquiring property and obtaining necessary approvals from regulatory authorities.

Legislation and Government Programs.—The North Carolina State Board of Water and Air Resources, exercising for the first time the right to control water usage (granted it by the 1967 State Legislature) voted to control water usage in an eight-county area of eastern North Carolina. The 5,500 square miles declared a "capacity use area" by the Board included all of Beaufort, Pamlico, and Washington Counties, and portions of Carteret, Craven, Hyde, Martin and Tyrrell Counties. Water withdrawals exceeding 100,000 gallons a day cannot be extracted from the ground-without a permit issued by the Board. The Board has made it clear that the two phosphate firms would not be permitted to withdraw more than a combined total of 54 million gallons of water a day for consumptive use. The Board adopted the regulations because it fears serious salt-water intrusion into fresh-water aquifers in the area.

The State Legislature passed the Mines Registration Act of 1969, which created the position of State Mining Engineer. It further required that all companies, firms, and individuals register their mining operations with the State mining engineer prior to March 31, 1970; directed the N.C. Mining Council to develope additional recommendations for a State mine land reclamation program for consideration by the 1971 General Assembly.

A U.S. Army Corps of Engineers Survey has ruled out digging ship channels across Pamlico Sound to serve the phosphate mining operations in Beaufort County; instead they recommended deepening and enlarging Big Ship Harbor at Morehead City. The latter project would be attempted under procedures designed to minimize damage to the natural environment, including dumping of dredged sand either at sea or on coastal beaches, rather than in existing soundside disposal areas.

At yearend, 472.01 miles of North Carolina's Interstate Highway System was open to traffic. Work was in progress on an additional 315.19 miles, and work had not yet started on the remaining 51.61 miles of designated total.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Asbestos.—Amphibole asbestos was mined by Powhatan Mining Co. near Burnsville, Yancey County. Output increased slightly above that of 1968.

Cement.—Production of portland cement at the Castle Hayne plant of Ideal Cement Co., New Hanover County, increased substantially over that of 1968. Three types of portland cement were produced; general use, moderate heat, and high-early strength. Of the total shipments, 56 percent was within the State, 33 percent was to Florida, 6 percent to Virginia, 4 percent to South Carolina, and the remaining 1 percent to other States and foreign countries. Eighty-one percent of the masonry cement was shipped within the State, 11 percent to South Carolina, and the remaining 8 percent to other States. Bulk shipments moved 67.4 percent by truck, 32.2 percent by railroad, 0.4 percent by water. Sales of portland cement were to ready-mix concrete companies (63 percent), concrete product manufacturers (15.6 percent), highway contractors (15.4 percent), and others (6 percent).

Clays.—Production of miscellaneous clay increased 1 percent in tonnage and 22 percent in value. Miscellaneous clay was mined by 25 companies from 35 mines in 22 counties for use in manufacturing brick, lightweight aggregate, and other clay products.

Table 5.—Miscellaneous clay sold or used by producers, by counties

County	1968			1969		
	Number of mines	Short tons	Value	Number of mines	Short tons	Value
Cabarrus	1	100,000	$68,000	1	W	W
Chatham	3	W	W	3	405,519	$298,524
Cumberland	1	36,000	24,500	1	W	W
Davidson	1	W	W	1	60,000	24,000
Guilford	3	178,044	111,000	3	92,034	59,323
Harnett	1	W	W	1	14,000	9,100
Lee	4	470,000	314,380	4	513,868	345,264
Rowan	3	223,328	151,900	3	282,031	183,320
Sampson	1	50,054	34,000	1	28,313	18,403
Stokes	1	217,015	147,600	1	212,706	104,226
Union	1	180,000	90,000	1	185,748	371,496
Undistributed [1]	14	1,855,591	1,206,170	15	1,548,247	1,195,705
Total	34	3,310,032	2,147,550	35	3,342,466	2,609,861

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Alamance, Avery (1969), Durham, Halifax, Iredell, Johnston, Montgomery, Moore, New Hanover, Rockingham, and Stanly Counties, and counties indicated by symbol W.

Harris Mining Co., Avery County, remained the sole producer of kaolin; both tonnage and value were lower than in 1968. The kaolin was used principally for refractories.

Feldspar.—Production of feldspar increased 7 percent in quantity and 6 percent in value. Mixed feldspar was the predominant type mined, with some potash type also produced.

Ground feldspar shipments increased both in quantity and value in response to greater demand for feldspar in the glass industry. Ground feldspar was also used for pottery with a small amount used in paint manufacture. Shipments of ground feldspar were made to Ohio (26 percent), Illinois (11 percent), Oklahoma (7 percent), Tennessee (7 percent), West Virginia (6 percent), Texas (4 percent), Pennsylvania (4 percent), Indiana (3 percent), and other States (32 percent).

Lithium Minerals.—Spodumene production in Cleveland and Gaston Counties decreased slightly in both tonnage and value. Part of the spodumene concentrate was used by the ceramic industry, and some was converted to lithium chemicals at Lithium Corporation of America's Bessemer City plant, Gaston County.

Mica.—Production of scrap mica was 67,000 tons, a decrease of 3 percent from that of 1968; value also decreased. Production of sheet mica decreased 43 percent in quantity and 40 percent in value. Nine companies reported production from 13 mines in Avery, Cleveland, Macon, Mitchell, and Yancy Counties. Ground mica output increased 5 percent in quantity and 9 percent in value. Seven companies ground mica at nine plants in 1969; six plants used dry methods, two used wet methods, and one used both wet and dry methods. Ground mica was used for roofing (42 percent), paint (17 percent), rubber (9 percent), and other uses (32 percent).

Olivine.—Production of olivine increased 7 percent in quantity and 6 percent in value. The material was used for molding sand and refractory products. Two mines were active one each in Jackson County and Yancy County.

Perlite.—Carolina Perlite Co., Inc, expanded perlite at Gold Hill, Rowan County, using crude material from other States. Quantity decreased 18 percent and value decreased 6 percent.

Phosphate Rock.—Production of phosphate rock at the Lee Creek fertilizer complex, Beaufort County, increased 11 percent in quantity and 5 percent in value. Production has increased each year since the mine opened in April 1966, and the mine and plant are approaching the design capacity of 3.0 million tons per year.

Texas Gulf Sulphur Co. exercised their State option on 992 acres of phosphate lands in Beaufort County.

Sand and Gravel.—Sand and gravel continued as the second leading mineral commodity produced in the State. Tonnage decreased 2 percent but value increased 2 percent from that of the previous year. Sand and gravel was produced in 82 of the State's 100 counties. Commercial sand and gravel comprised 72 percent of the total; the remainder was government-and-contractor production. There were 53 commercial

Table 6.—Ground mica sold or used by producers, by uses

Use	1968			1969		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Roofing	21,494	$717,030	$33.36	W	W	W
Paint	9,591	1,353,461	141.12	9,490	$1,439,585	$151.69
Rubber	4,905	690,572	140.79	4,955	761,103	153.60
Wallpaper	549	78,288	142.60	W	W	W
Plastics	548	77,850	142.06	460	W	W
Other uses [1]	15,731	748,742	47.60	40,631	1,784,414	43.92
Total	52,818	3,665,943	69.41	55,536	3,985,102	71.76

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes textile coating, well drilling and other uses, and uses indicated by symbol W.

and 71 government-and-contractor operations. Commercial operations provided all the sand and gravel used for building purposes and railroad ballast, 48 percent of that used for paving and 38 percent of that used for fill. Four of the 53 commercial operations produced 54 percent of the commercial sand and gravel. Transportation of commercial sand and gravel was 57 percent by truck and 43 percent by railroad.

Stone.—Stone was again the principal mineral commodity produced in the State in terms of both tonnage and value, comprising 53 percent of the total output value. Total tonnage increased 9 percent and value 13 percent.

Crushed stone accounted for 99 percent of the tonnage and 93 percent of the value of production. Crushed granite, the leading stone product, increased 14 percent in quantity and 16 percent in value; crushed limestone decreased slightly in tonnage but increased 4 percent in value; crushed marble and traprock decreased in tonnage but increased in value, while crushed sandstone decreased in both tonnage and value.

Table 7.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Alexander	1	42	$17	1	39	$18
Anson	4	1,986	2,832	3	W	W
Avery	3	229	297	3	W	W
Beaufort	1	134	38	1	142	105
Bertie	2	79	71	3	W	W
Bladen	1	216	147	1	135	101
Brunswick	1	50	35	1	22	16
Buncombe	4	450	657	3	W	W
Caldwell	2	166	247	4	198	W
Camden	1	6	4	1	5	4
Carteret	1	10	3	1	10	3
Caswell	1	4	4	1	8	8
Catawba	1	49	20	2	W	W
Cherokee	--	--	--	1	W	22
Chowan	1	8	2	1	21	5
Clay	--	--	--	1	100	60
Columbus	1	17	12	1	81	60
Currituck	1	23	16	1	15	11
Dare	1	31	22	1	21	16
Davidson	1	380	190	1	342	171
Davie	1	25	16	1	29	20
Duplin	2	W	W	2	26	19
Edgecombe	3	179	175	3	190	173
Forsyth	2	83	141	2	W	W
Franklin	1	16	16	1	12	12
Gaston	2	W	W	2	W	33
Gates	1	7	5	1	10	7
Granville	1	4	5	1	5	7
Greene	1	47	13	2	53	W
Halifax	1	45	23	1	77	29
Hertford	1	41	10	2	W	W
Hoke	1	30	21	1	40	30
Hyde	1	7	2	1	7	2

See footnotes at end of table.

Table 7.—Sand and gravel sold or used by producers, by counties—Continued

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Iredell	1	251	$ 375	1	48	$ 22
Johnston	1	95	87	1	109	102
Jones	1	24	7	1	20	5
Lincoln	1	46	23	1	34	20
Macon	1	16	W	--	--	--
Martin	1	34	9	1	6	1
McDowell	3	W	W	4	W	113
Mitchell	3	387	302	2	W	W
Montgomery	1	18	7	1	13	6
Moore	5	427	281	5	440	313
Nash	--	--	--	1	17	14
New Hanover	1	20	8	1	8	6
Northampton	2	W	W	1	26	6
Onslow	1	32	22	1	17	13
Pamlico	1	2	1	1	1	--
Pasquotank	1	33	8	1	32	24
Pender	1	63	44	1	64	47
Perquimans	1	31	22	1	4	3
Person	1	1	1	1	1	1
Pitt	3	196	96	3	W	92
Polk	1	16	7	1	18	7
Richmond	1	16	11	1	14	11
Robeson	1	323	219	1	165	123
Rockingham	1	2	2	1	W	W
Rowan	1	39	20	1	35	18
Rutherford	1	131	46	1	133	50
Sampson	1	30	28	1	30	22
Scotland	1	45	21	1	53	43
Stokes	1	94	61	1	110	77
Surry	1	3	4	1	(1)	(1)
Union	1	22	16	1	16	12
Wake	1	5	4	1	2	2
Washington	1	67	17	1	23	6
Wayne	2	W	122	3	144	139
Wilkes	1	18	22	1	3	3
Wilson	3	76	86	2	W	W
Yadkin	1	1	2	1	4	7
Undistributed [2]	25	3,843	4,156	23	7,387	9,198
Total [3]	121	10,771	11,178	124	10,562	11,437

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Less than ½ unit.
[2] Includes Burke, Cabarrus, Cleveland, Craven, Cumberland, Graham (1969), Harnett, Haywood, Jackson (1969), Lee, Lenoir, Transylvania (1968), Watauga, and Yancey Counties, and counties indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

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

(Thousand short tons and thousand dollars)

Use	1968			1969		
		Value			Value	
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Sand:						
Paving	3,067	$2,255	$0.74	2,596	$2,054	$0.79
Structural	2,868	2,676	.93	3,521	3,343	.95
Fill	385	287	.75	530	443	.84
Other sands [1]	590	242	.41	518	192	.37
Total	6,910	5,460	.79	7,164	6,031	.84
Gravel:						
Paving	2,080	2,396	1.15	1,542	1,639	1.06
Structural	1,172	2,057	1.76	1,223	2,221	1.82
Other gravel [2]	609	1,265	2.08	634	1,546	2.44
Total	3,861	5,718	1.48	3,398	5,406	1.59
Total sand and gravel [3]	10,771	11,178	1.04	10,562	11,437	1.08

[1] Includes railroad ballast, blast (1968), filtration, and other sands.
[2] Includes railroad ballast, fill, miscellaneous gravel, and other gravel (1968).
[3] Data may not add to totals shown because of independent rounding.

Table 9.—Crushed granite sold or used by producers, by counties

County	1968			1969		
	Number of quarries	Short tons	Value	Number of quarries	Short tons	Value
Ashe	1	W	$40,000	1	W	W
Cabarrus	1	79,435	121,500	1	71,015	$112,900
Caldwell	1	106,251	162,600	2	W	W
Clay	--	--	--	1	78,914	118,371
Guilford	4	W	W	4	2,380,569	3,919,614
Jackson	1	38,000	61,700	1	113,400	151,125
Macon	1	111,415	139,269	1	171,000	223,475
Orange	1	6,590	11,530	2	W	W
Richmond	1	30,000	45,000	1	66,371	96,238
Transylvania	1	W	162,956	1	77,000	123,000
Undistributed [1]	52	16,113,857	25,877,155	49	15,898,527	26,098,604
Total	64	16,485,548	26,621,710	64	18,856,796	30,843,327

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Alamance, Anson (1968), Buncombe, Burke, Caswell, Catawba, Chatham, Cleveland, Davie (1969), Forsyth, Granville (1969), Halifax, Haywood, Henderson, Iredell, Lincoln, Mecklenburg, Moore, Nash, Pitt, Polk (1968), Randolph, Rockingham, Rowan, Rutherford, Surry, Union, Vance, Wake, Wilkes, Wilson, and Yadkin (1968) Counties, and counties indicated by symbol W.

Dimension granite increased 5 percent in quantity and 9 percent in value; dimension marble increased 19 percent in quantity and 14 percent in value, and dimension slate increased significantly in both quantity and value.

Thirty-six companies were engaged in stone production during the year. The total of 99 active commercial quarries is as follows: Granite, 72; limestone, nine; traprock, nine; sandstone, four; quartz, two; slate, two; marble, one. The State Highway Department crushed granite at four quarries.

The major uses for crushed stone were as road base material, concrete, and bituminous aggregate. Dimension stone was used for monumental, structural stone, curbing, paving blocks, and flagging.

Transportation of stone was predominantly by truck (91.2 percent), followed by railroad (8.4 percent), and by waterway (0.4 percent).

Talc and Pyrophyllite.—Talc and pyrophyllite production increased 6 percent in quantity and 13 percent in value. Talc was sawed into crayons (6 percent) and was ground for use in toilet preparations (61 percent), textiles (28 percent), and drugs (5 percent). Pyrophyllite was ground for use in refractories (36 percent), ceramics (28 percent), insecticides (20 percent), paint (2 percent), rubber (3 percent), and other products (11 percent).

Vermiculite.—W. R. Grace & Co. operated an exfoliating plant at High Point, Guilford County, and Carolina Wholesale Florist, Inc. operated an exfoliating plant at Sanford, Lee County; both companies used crude vermiculite shipped into the State. Principal uses for the finished product were as concrete aggregate (29 percent), loose-fill insulation (57 percent), and other uses (14 percent).

METALS

Iron ore.—Cranberry Magnetite Corp. reopened the Cranberry iron mine in Avery County, last operated in 1963. A new mill was constructed at the mine. Production was 1,000 tons of high quality magnetite per month. The company shipped magnetite from its Cranberry mine for use in coal preparation, high density concrete, water pollution control, nuclear shielding, and iron powder for diversified metallurgical uses.

Tungsten.—The Tungsten Queen mine, formerly the Hamme tungsten mine, was reopened by Ranchers Exploration and Development Corp., Albuquerque, New Mex. No ore or concentrate was shipped during the year. All ore is presently being stockpiled until a new mill under construction is completed.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum: Aluminum Company of America	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Smelter	Stanly.
Asbestos: Powhatan Mining Co	6721 Windsor Mill Road Baltimore, Md. 21207	Open-pit mine	Yancey.
Cement: Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	Plant	New Hanover.
Clay:			
Kaolin: Harris Mining Co	Box 628 Spruce Pine, N.C. 28777	Open-pit mine and plant	Avery.
Miscellaneous:			
Boren Clay Products Co	Pleasant Garden, N.C. 27313	5 open-pit mines and plants	Chatham, Guilford, Sampson.
Carolina Solite Corp	Box 9138 Richmond, Va. 23227	Open-pit mine and plant	Stanly.
Pine Hall Brick and Pipe Co	Box 4325, North Station Winston-Salem, N.C. 27105	----do	Stokes.
Sanford Brick Corp	Box 38 Gulf, N.C. 27256	3 open-pit mines and plant	Chatham, Lee, Stanly.
Statesville Brick Co	Statesville, N.C. 28677	2 open-pit mines and plant	Iredell, Rowan.
Virginia Solite Corp	Box 9138 Richmond, Va. 23227	Open-pit mine and plant	Rockingham.
Feldspar:			
The Feldspar Corp.[1]	Spruce Pine, N.C. 28777	3 open-pit mines and 2 plants	Mitchell.
Foote Mineral Co	Box 792 Kings Mountain, N.C. 28086	Open-pit mine and plant	Cleveland.
International Minerals & Chemical Corp.[1]	Old Orchard Road Skokie, Ill. 60079	Open-pit mine and 2 plants	Mitchell.
Kings Mountain Mica Co., Inc	Box 709 Kings Mountain, N.C. 28086	2 open-pit mines and 2 plants	Cleveland.
Lawson-United Feldspar and Mineral Co.[1]	Minpro, N.C. 28777	Open-pit mine and plant	Mitchell.
Iron ore: Cranberry Magnetite Corp	Box 63 Greenback, Tenn. 37742	Underground mine and plant	Avery.
Lithium minerals:			
Foote Mineral Co	Box 792 Kings Mountain, N.C. 28086	Open-pit mine and plant	Cleveland.
Lithium Corp. of America, Inc	Box 428 Bessemer City, N.C. 28016	----do	Gaston.
Mica, scrap:			
Deneen Mica Co., Inc	Newdale, N.C. 28714	Open-pit mine and plant	Yancey.
The Feldspar Corp	Box 220 Spruce Pine, N.C. 28777	2 open-pit mines and 2 plants	Mitchell.
Harris Mining Co	Box 628 Spruce Pine, N.C. 28777	3 open-pit mines and 2 plants	Avery, Mitchell.
Kings Mountain Mica Co., Inc	Box 709 Kings Mountain, N.C. 28086	2-open-pit mines and 2 plants	Cleveland.
United States Gypsum Co	101 South Wacker Drive Chicago, Ill. 60606	Open-pit mine	Cleveland.
Mica, sheet: Eugene Owenby	Route 4 Franklin, N.C. 28734	Open-pit mine	Macon.

Mica grinders:			
Deneen Mica Co	Newdale, N.C. 28714	Open-pit mine and plant	Yancey.
Diamond Mica Co	Box 648 Spruce Pine, N.C. 28777	2 plants	Mitchell, Yancey.
The English Mica Co	Ridgeway Center Bldg. Stamford, Conn. 06905	Plant	Cleveland.
Franklin Mineral Products Co	Box O Wilmington, Mass. 01887	----do	Macon.
Harris Mining Co	Box 628 Spruce Pine, N.C. 28777	3 open-pit mines and 2 plants	Avery, Mitchell.
Olivine:			
Harbison-Walker Refractories Co	Gateway #2 Pittsburgh, Pa. 15222	Open-pit mine	Jackson.
Northwest Carolina Olivine, Inc	Box 672 Spruce Pine, N.C. 28777	Open-pit mine and plant	Yancey.
Perlite, expanded: Carolina Perlite Co., Inc	Box 741 Hillside, N.J. 07205	Plant	Rowan.
Phosphate rock: Texas Gulf Sulphur Co	200 Park Avenue New York, N.Y. 10017	Open-pit mine and plant	Beaufort.
Sand and gravel:			
Becker Sand & Gravel Co	Box 848 Cheraw, S.C. 29520	3 open-pit mines	Cumberland, Harnett, Moore.
W. R. Bonsal Co., Inc	Box 38 Lilesville, N.C. 28091	Open-pit mine	Anson.
Grove Stone and Sand, Branch of B. V. Hedrick Gravel and Sand Co	Swannanoa, N.C. 28778	----do	Buncombe.
Lessees of B. V. Hedrick Gravel and Sand Co	Lilesville, N.C. 28901	----do	Anson.
Nello L. Teer Co	Box 1131 Durham, N.C. 27702	----do	Harnett.
Stone:			
Granite, crushed:			
Central Rock Co., Inc	Box 510 Greensboro, N.C. 27409	Quarry	Guilford.
Foote Mineral Co	Box 792 Kings Mountain, N.C. 28086	Open-pit mine	Cleveland.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	24 quarries	Alamance, Catawba, Chatham, Cleveland, Guilford, Halifax, Iredell, Lincoln, Mecklenburg, Moore, Pitt, Randolph, Rockingham, Rowan, Union, Wake.
Nello L. Teer Co	Box 1131 Durham, N.C. 27702	4 quarries	Nash, Wake, Wilson.
Vulcan Materials Co	Box 7506, Reynolds Station Winston-Salem, N.C. 27106	15 quarries	Buncombe, Caldwell, Caswell, Davie, Forsyth, Granville, Guilford, Haywood, Henderson, Iredell, Surry, Vance, Wilkes.

See footnote at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Granite, dimension:			
Comolli Granite Co	Elberton, Ga. 30635	2 quarries	Rowan.
Crystal Pink Granite Co	Box 245 Faith, N.C. 28041	----do	Rowan.
Harris Granite Quarries Co	P. O. Box 1038 Salisbury, N.C. 28144	4 quarries	Cabarrus, Rowan.
North Carolina Granite Corp	Box 151 Mt. Airy, N.C. 27030	Quarry	Surry.
Troitino and Brown, Inc	Box 5595 Asheville, N.C. 28803	----do	Avery.
Limestone, crushed:			
Fletcher Limestone Co., Inc	Box 98 Fletcher, N.C. 28732	Quarry	Henderson.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	----do	New Hanover.
North Carolina Lime, Inc	Box 638 Greenville, N.C. 27834	----do	Jones.
Nantahala Talc and Limestone Co	Box 220 Andrews, N.C. 28901	----do	Swain.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	4 quarries	Cleveland, Craven, New Hanover, Onslow.
Marble, crushed and dimension:			
Moretti-Harrah Marble Co	Box 330 Sylacauga, Ala. 35150	Quarry	Cherokee.
Quartz, crushed:			
Southern Aggregates, Inc	Box 1198 Roanoke, Va. 24006	----do	Montgomery.
Thomas & Woody Mining Co	Box 315 Spruce Pine, N.C. 28777	----do	Do.
Slate, dimension: Jacob's Creek Stone Co., Inc	P. O. Box 608 Denton, N.C. 27239	2 quarries	Davidson.
Sandstone, crushed:			
International Minerals & Chemical Corp	Old Orchard Road Skokie, Ill. 60079	Open-pit mine	Mitchell.
The Feldspar Corp	Spruce Pine, N.C. 28777	2 open-pit mines	Do.
Sandstone, dimension: Jacob's Creek Stone Co., Inc	P.O. Box 608 Denton, N.C. 27239	Quarry	Montgomery.
Traprock, crushed:			
Ararat Rock Products Co	223 Willow Street Mt. Airy, N.C. 27030	Quarry	Surry.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	4 quarries	Davidson, Guilford, Union.
Nello L. Teer Co	Box 1131 Durham, N.C. 27702	2 quarries	Durham, Johnston.
Young Stone Co	Box 11424 Charlotte, N.C. 28209	Quarry	Cabarrus.
Talc and pyrophyllite:			
Pyrophyllite:			
Boren & Harvey, Inc	Box 7247 Greensboro, N.C. 27407	Open-pit mine	Granville.

General Minerals Co	Box 6868 Greensboro, N.C. 27405	4 open-pit mines and plant	Alamance, Moore.
Piedmont Minerals Co., Inc	P.O. Box 7247 Greensboro, N.C. 27407	Open-pit mine and plant	Orange.
Standard Minerals Co., Inc	Robbins, N.C. 27325	----do	Moore.
Talc: Hitchcock Corp	Box 35 Murphy, N.C. 28906	Underground mine and plant	Cherokee.
Vermiculite, expanded:			
Carolina Wholesale Florists, Inc	Box 537 Sanford, N.C. 27330	Plant	Lee.
W. R. Grace & Co	62 Whittemore Avenue Cambridge, Mass. 02140	----do	Guilford.

[1] Also feldspar grinding.

The Mineral Industry of North Dakota

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

By Franklin H. Persse [1] and Charles A. Koch [2]

The total value of minerals produced in North Dakota during 1969 was $91 million, a 7-percent decrease from the 1968 value. In 1967 constant dollars, the decrease in production value amounted to 11 percent. As shown in table 1, the value of total fossil fuel production declined the greatest amount, although coal (lignite) output gained 5 percent in quantity and 9 percent in value. Nonmetallics decreased 24 percent in value, mainly because the quantities of sand and gravel and stone declined 35 and 56 percent, respectively. With no uranium mining in the State, value of metal output was zero.

Legislation and Government Programs.—The 1969 legislative assembly of North Dakota enacted a bill to provide for reclaiming strip mined lands. Beginning January 1, 1970, all surface mining operations requiring overburden removal in excess of 10 feet in depth must comply with this act, administered by the State Coal Mine Inspector. Also in 1969, a comprehensive air pollution law was enacted. Under this law, which received Federal Government approval, air quality and emission standards were developed. These standards become effective July 1, 1970. Statewide water quality standards, authorized by the 1967 Water Pollution Act, were completed in 1969, when standards for the Red River of the North drainage area were approved.

[1] Mining engineer, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Laramie, Wyo.

Table 1.—Mineral production in North Dakota [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Coal ——thousand short tons	4,487	$7,986	4,704	$8,696
Gem stones	NA	1	NA	1
Natural gas (marketed) ——million cubic feet	41,023	6,769	33,587	5,441
Natural gas liquids:				
LP gases ——thousand 42-gallon barrels	2,156	3,622	1,951	2,868
Natural gasoline and cycle products —do	558	1,479	508	1,346
Petroleum (crude) ——do	25,040	66,106	22,703	63,568
Sand and gravel ——thousand short tons	10,839	10,159	7,039	7,274
Stone ——do	165	326	72	99
Value of items that cannot be disclosed: Clays, lime, peat (1968), salt, and uranium [2] (recoverable content U_3O_8)	XX	1,588	XX	1,755
Total	XX	98,036	XX	91,048
Total 1967 constant dollars	XX	98,814	XX	p87,057

p Preliminary. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] 1968 only; value estimated based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales.

Table 2.—Value of mineral production in North Dakota, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	$98	$48	Coal (lignite).
Barnes	257	387	Sand and gravel.
Benson	397	291	Do.
Billings	6,516	5,779	Petroleum, natural gas, stone.
Bottineau	6,613	7,678	Petroleum, sand and gravel, natural gas.
Bowman	2,205	2,129	Petroleum, coal (lignite), sand and gravel, natural gas.
Burke	9,487	8,122	Petroleum, coal (lignite), natural gas, LP gases, natural gasoline, sand and gravel.
Burleigh	502	540	Sand and gravel.
Cass	148	94	Do.
Cavalier	211	31	Do.
Dickey	14	128	Sand and gravel, stone.
Divide	1,169	838	Petroleum, natural gas, sand and gravel, clays.
Dunn	147	50	Petroleum, natural gas.
Eddy	260	383	Sand and gravel.
Emmons	212	227	Do.
Foster	89	W	Do.
Golden Valley	54	268	Sand and gravel, petroleum, stone, natural gas.
Grand Forks	494	451	Sand and gravel.
Grant	77	74	Sand and gravel, coal (lignite).
Griggs	237	83	Sand and gravel.
Hettinger	2	5	Do.
Kidder	26	30	Do.
LaMoure	153	1	Do.
Logan	12	24	Do.
McHenry	268	246	Sand and gravel, petroleum, natural gas.
McIntosh	169	129	Sand and gravel.
McKenzie	18,440	15,197	Petroleum, natural gas, sand and gravel, stone.
McLean	388	209	Coal (lignite), sand and gravel.
Mercer	5,671	5,355	Do.
Morton	223	160	Clays, sand and gravel, coal (lignite).
Mountrail	3,022	2,556	Petroleum, natural gas, sand and gravel.
Nelson	253	326	Sand and gravel.
Oliver	312	986	Coal (lignite), sand and gravel.
Pembina	661	805	Lime, sand and gravel.
Pierce	46	92	Sand and gravel.
Ramsey	368	39	Do.
Ransom	135	183	Do.
Renville	5,667	5,114	Petroleum, natural gas, sand and gravel.
Richland	175	200	Sand and gravel.
Rolette	127	139	Do.
Sargent	16	1	Sand and gravel, stone.
Sheridan	15	29	Sand and gravel.
Sioux	106	13	Do.
Slope	289	224	Petroleum, natural gas, sand and gravel.
Stark	4,543	4,641	Petroleum, coal (lignite), sand and gravel, natural gas, clays.
Steele	111	98	Sand and gravel.
Stutsman	432	369	Sand and gravel, stone.
Towner	82	W	Sand and gravel.
Traill	701	110	Do.
Walsh	149	318	Do.
Ward	1,715	2,179	Petroleum, coal (lignite), sand and gravel, natural gas, stone.
Wells	216	72	Sand and gravel.
Williams	24,355	23,376	Petroleum, LP gases, natural gas, natural gasoline, salt, sand and gravel, coal (lignite).
Undistributed [1]	1	221	
Total	98,036	91,048	

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.

Table 3.—Indicators of North Dakota business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	249.6	251.3	+ .7
Employment	do.	239.4	241.6	+ .9
Unemployment	do.	10.2	9.7	— 4.9
Agricultural employment	do.	63.5	60.8	— 4.3
Nonagricultural employment	do.	175.9	180.8	+ 2.8
Mining	do.	1.9	1.8	— 5.3
Construction	do.	8.0	8.0	-----
Manufacturing	do.	8.9	9.0	+ 1.1
Government	do.	45.6	48.9	+ 7.2
All other	do.	111.5	113.1	+ 1.4
Payroll data (January-March):				
Agriculture	millions	$.3	$.3	-----
Mining	do.	$3.5	$3.7	+ 5.7
Construction	do.	$10.5	$9.2	—12.4
Manufacturing	do.	$11.1	$11.8	+ 6.3
Retail trade	do.	$26.1	$27.8	+ 6.5
Services	do.	$19.9	$21.5	+ 8.0
All other	do.	$39.4	$42.1	+ 6.9
Personal income:				
Total	do.	$1.7	$1.9	+11.8
Per capita		$2,743.0	$3,011.0	+ 9.8
Construction activity:				
Highway construction contracts awarded	millions	$27.1	$41.0	+51.3
Cement shipments to and within the State	thousand 376-pound barrels	958.1	1,253.0	+30.8
Value of building permits:	millions	$49.6	$52.7	+ 6.2
Residential	do.	$28.0	$33.0	+17.9
Nonresidential	do.	$21.6	$19.7	— 8.8
Business receipts:				
Retail sales	do.	$1,056.6	$1,094.8	+ 3.6
Farm marketing receipts	do.	$860.6	$934.7	+ 8.6
Mineral production	do.	$98.0	$91.0	— 7.1
Utility production and consumption:				
Production of electric energy	million kilowatt-hours	691.1	682.8	— 1.2
Natural gas sales	billion cubic feet	16.7	18.1	+ 8.4

p Preliminary.
Sources: North Dakota Business and Industrial Development Commission; Engineering News-Record, v. 184, No. 16, Apr. 30, 1970, pp. 12–13; U.S. Bureau of the Census; U.S. Bureau of Mines.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1968:								
Coal and peat	270	227	61	474	1	15	33.74	13,212
Nonmetal	37	260	10	77	-------	7	90.81	1,155
Sand and gravel	842	160	135	1,259	-------	23	18.26	390
Stone	95	170	16	129	-------	1	7.74	108
Total [1]	1,244	178	222	1,940	1	46	24.23	3,536
1969: p								
Coal	280	238	67	506	-------	14	27.69	498
Nonmetal	60	189	12	92	1	20	227.18	69,627
Sand and gravel	665	170	113	1,032	1	18	18.41	6,139
Stone	5	221	1	7	-------	-------	-------	-------
Total [1]	1,010	190	192	1,637	2	52	32.98	7,954

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

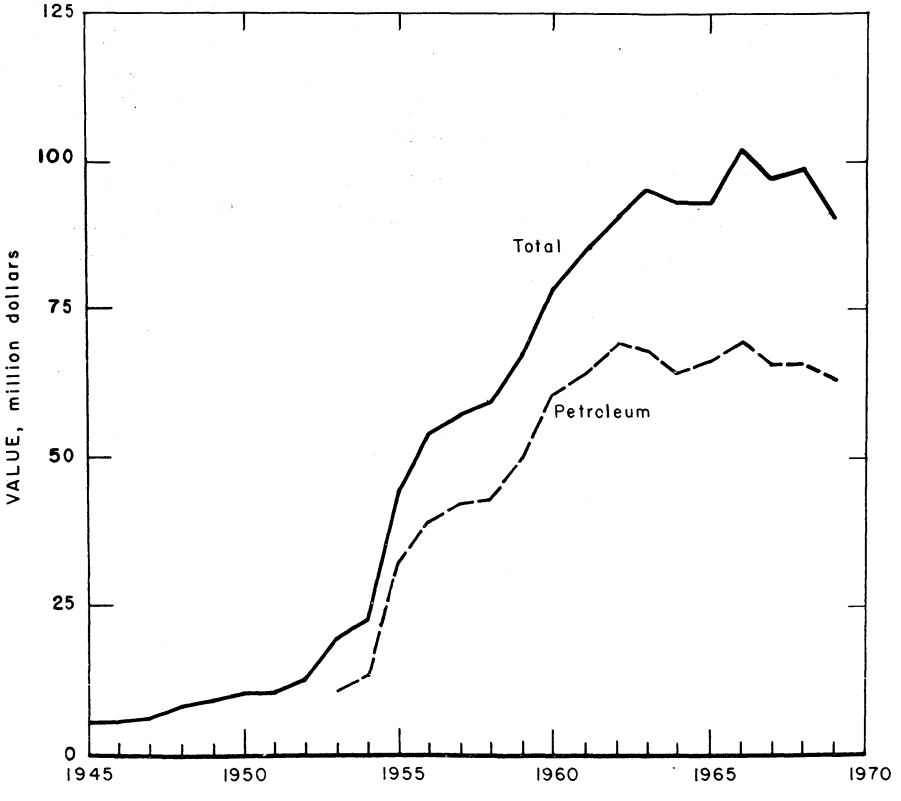

Figure 1.—Value of petroleum and total value of mineral production in North Dakota.

Contracts for highway construction and maintenance in the amount of $45.5 million were awarded by the State Highway Department. Work on the Interstate system accounted for $26 million, primary and secondary highways for $15 million and maintenance by contractors and State forces for $4.5 million.[3]

This represented an increase of $19.9 million over the amount awarded in 1968 for Interstate, primary, and secondary highways, but a $1.5 million decrease in the amount awarded for maintenance. Interstate highway mileage open to traffic increased 23.6 miles during the year; at year-end 78.05 miles were under construction.[4]

Issued during 1969, Federal and State Government publications that could be of interest to the mineral industry include three U.S. Bureau of Mines Report of Investigations,[5] two water-supply papers by the U.S. Geological Survey,[6] and seven publications by the North Dakota Geological Survey.[7]

Employment and Injuries.—Statistics of employment and injuries in the mineral industry, exclusive of the petroleum industry, are presented in table 4. Information for 1968 is final data; that for 1969 is preliminary.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Lignite).—Although the number of operating strip mines was reduced from 22 in 1968 to 20 in 1969, the quantity and value of lignite increased: output was 4.7 million tons valued at $8.7 million.

Again this year four companies at six operations—Baukol-Noonan, Inc., one operation; Knife River Coal Mining Co., two operations; Lignite Division, The North American Coal Corp., one operation; and Western Division, Consolidation Coal Co., two operations—mined over 94 percent of the lignite. Based on the demand for coal-fired, steam-generated electric power, this upward trend is expected for at least the next decade. Late in 1970 the new mine-mouth 227-megawatt plant of Minnkota Power Co-Operative, Inc., near Center, will begin using lignite supplied by Baukol-Noonan, Inc. Later in the decade, Consolidation Coal will increase output from its Glenharold mine from the present 6,000 to 17,000 tons per day to supply the 400-megawatt addition to Basin Electric Power Cooperative plant at Stanton. An operational target of 1976 was announced by United Power Association for a 500-megawatt addition to its Station plant. When this addition becomes fully operational, lignite consumption will be approximately quadruple that of the present plant.

Lignite uses, other than for electric power generation, included domestic and industrial fuel, and briquetting. Sugar refineries were among the industries using lignite as fuel; briquets are manufactured by Husky Briquetting, Inc., near Dickinson.

Because strip coal mines are the only strip operations in the State where more than 10 feet of overburden is removed, they are the only mines affected by the new laws governing reclamation of strip mined

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[3] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1970 and Budgets for Maintenance. V. 184, No. 16, Apr. 30, 1970, pp. 12–13.

[4] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1969. Press Release FHWA-422, Feb. 9, 1970.

[5] Abernethy, R. F., M. J. Peterson, and F. H. Gibson. Major Ash Constituents in U.S. Coals. BuMines Rept. of Inv. 7240, 1969, 9 pp.
———. Spectrochemical Analyses of Coal Ash for Trace Elements. BuMines Rept. of Inv. 7281, 1969, 30 pp.
Aresco, S. J., and J. B. Janus. Analyses of Tipple and Delivered samples of Coal Collected During Fiscal Year 1968. BuMines Rept. of Inv. 7219, 1969, 31 pp.

[6] U.S. Geological Survey. Surface Water Supply of the United States 1961–65—part 6, Missouri River Basin—Volume 1, Missouri River Basin Above Williston, N. Dak. Water-Supply Paper 1916, 1969, 800 pp. (plate in pocket).
———. Surface Water Supply of the United States 1961–65—part 6, Missouri River Basin—Volume 2, Missouri River Basin From Williston, N. Dak. to Sioux City, Iowa. Water-Supply Paper 1917, 1969, 560 pp. (plate in pocket).

[7] Armstrong, C. A. Geology and Ground Water Resources of Burke and Mountrail Counties, Ground Water Basic Data Part II. N. Dak. Geol. Survey Bull. 55, 1969, 282 pp.
Bluemle, Mary E. Geologic Field Trip From Grand Forks, North Dakota to Kenora, Ontario. N. Dak. Geol. Survey Misc. Series 40, 1969, 15 pp.
Carlson, Clarence G. Bedrock Geologic Map of North Dakota. N. Dak. Geol. Survey. MM–10, 1969.
Folsom, Clarence B., Jr. North Dakota Crude Oil Inventory as of Jan. 1, 1969. N. Dak. Geol. Survey Misc. Series 38, 1969, 15 pp.
Frye, Charles I. Stratigraphy of the Hell Creek Formation in North Dakota. N. Dak. Geol. Survey Bull. 54, 1969, 65 pp.
Moore, Walter L., and Frank R. Karner. Magnetic Anomalis in Pembina County, North Dakota. N. Dak. Geol. Survey Rept. of Inv. 49, 1968, 8 pp.
Pederson, Darryll T., and John R. Reid. Geology of Northeastern North Dakota. N. Dak. Geol. Survey Misc. Series 39, 1969, 30 pp.

Table 5.—Coal (lignite) sold or used,[1] by counties

County	1968		1969	
	Number of mines operating (all strip)	Short tons	Number of mines operating (all strip)	Short tons
Adams	1	11,355	1	17,603
Bowman	1	131,008	1	141,506
Burke	3	426,086	2	495,865
Grant	3	11,839	2	9,528
McLean	2	28,891	2	[2] 531,612
Mercer	3	3,318,947	3	3,052,199
Morton	2	10,720	2	9,023
Oliver	1	116,587	1	([2])
Stark	3	120,722	3	131,291
Ward	2	306,347	2	310,693
Williams	1	4,000	1	5,000
Total	22	4,486,502	20	4,704,320

[1] Excludes mines producing less than 1,000 short tons.
[2] McLean and Oliver Counties combined to avoid disclosing individual company confidential data.

lands. Many of the strip mine operators, however, had been reclaiming stripped land for a number of years. For example, Knife River Coal Mining Co., since starting its organized study of reclamation in 1963, has planted over a quarter of a million trees and shrubs, and hundreds of acres of grasses and legumes on strip mined land within the State. In 1969 Knife River Coal Mining Co. also stocked 2,300 trout in a lake formed by its mining operation.

Natural Gas.—Marketed natural gas decreased 18 percent, from 41 billion cubic feet in 1968 to 33.6 billion cubic feet in 1969. Dry natural gas production continued to decline, but the number of gas wells increased from 19 to 33. Although two of the eight discoveries were in the dry gas producing area, neither was classified as a gas discovery. Primarily because of revisions in the size of fields, proved reserves decreased by 218.2 billion cubic feet, compared with only a 15.3-billion-cubic-foot drop in 1968.[8]

Natural gas from the three processing plants was sold to Montana-Dakota Utilities Co.

Natural Gas Liquids.—Production of natural gas liquids decreased by 9.5 percent for liquid petroleum gases and by 9 percent for natural gasoline and cycle products, and the values decreased 21 percent and 9 percent, respectively. The three natural gas processing plants—Hunt Industries at North Tioga, Signal Oil and Gas Co. at Tioga, and Texaco Inc. at Lignite —continued processing casinghead gas. Sulfur is also a product of the Signal plant.

Peat.—Peat Products Co. was unable to operate during 1969 because the bog deposits in Bottineau County were too wet; peat output for the State was zero.

Petroleum.—Because of normal depletion of reservoirs, petroleum production declined for the third consecutive year; output was down 9 percent from the 25 million barrels in 1968. Throughput at the two refineries, American Oil Co. Division, Standard Oil Co. (Indiana), and Westland Oil Co., decreased 2.6 percent.

Based on present technical knowledge, recoverable reserves (primary and secondary) decreased 1.5 percent to 653.6 million barrels at yearend.[9]

The decrease was attributed to fewer discoveries and a decline in new secondary recovery projects. Over 91 percent of the recoverable reserves are from geologic formations of three ages: 53.5 percent from Mississippian, 29.5 percent from Devonian, and 8.4 percent from Ordovician. Reserves in the Mississippian formation decreased 27 percent, to 350.2 million barrels; reserves in the Devonian formation increased 163 percent, to 193.2 million barrels. Slight increases in reserves were noted in both the Ordovician and the Permian-Pennsylvanian formations; decreases in reserves were noted in both the Silurian and the Triassic formation.

Three new secondary recovery projects were begun during the year, bringing the total to 27 projects. The new projects, in

[8] Oil and Gas Journal. V. 68, No. 15, Apr. 13, 1970, pp. 44–46.
[9] Folsom, Clarence B., Jr. North Dakota Crude Oil Inventory as of Jan. 1, 1970, North Dakota Geol. Survey, Misc. Ser. No. 41, 1970, p. 1

Mississippian reservoirs, added 4.9 million barrels to the secondary reserves.

At yearend, 118 pools in 94 fields were yielding oil. In these fields, 2,006 wells had oil production capability: 609 stripper wells had daily capacity of 10 barrels of oil or less per well.

With gains in development and exploratory drilling, activity increased 16 percent above the 183 wells drilled in 1968. The State received reports of 213 well completions; 51 were completed as producing oil wells. Interest in the Muddy Formation (Cretaceous) continued, with multiwell

Table 6.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1968	1969	Principal fields in 1969 in order of production
Billings	2,292	1,958	Fryburg, Medora, Rocky Ridge.
Bottineau	2,305	2,645	Newburg, South Westhope, Wiley, Haas, Mohall, Landa.
Bowman	643	632	Cedar Creek, Horse Creek.
Burke	2,426	1,992	North Tioga, Rival, Northeast Foothills, Black Slough.
Divide	293	272	North Tioga, Stoneview.
Dunn	18	18	Lost Bridge.
Golden Valley	-----	37	Square Butte.
McHenry	32	24	Pratt.
McKenzie	5,929	4,658	Antelope, Blue Buttes, Hawkeye, North Charlson, Clear Creek.
Mountrail	1,004	848	Tioga, White Earth, East Tioga.
Renville	2,089	1,801	Sherwood, Glenburn, Mouse River Park.
Slope	88	68	Eleven Bar.
Stark	1,402	1,451	Dickinson, West Dickinson.
Ward	215	371	Lone Tree.
Williams	6,304	5,928	Beaver Lodge, Tioga, Capa, Grenora.
Total	25,040	22,703	

Source: North Dakota Geological Survey.

Table 7.—Oil and gas well drilling, by counties

County	Oil	Dry	Total	Footage
1968:				
Exploratory completions:				
Billings	--	5	5	47,151
Bottineau	1	5	6	25,893
Bowman	--	24	24	126,248
Burke	--	5	5	33,582
Burleigh	--	1	1	7,303
Divide	--	6	6	40,447
Dunn	--	3	3	20,370
Golden Valley	--	6	6	56,075
McHenry	--	3	3	11,825
McKenzie	--	1	1	10,272
Mercer	--	1	1	5,250
Mountrail	--	1	1	7,909
Pierce	--	1	1	3,035
Renville	--	7	7	34,940
Rolette	--	1	1	2,935
Slope	--	36	36	192,716
Stark	1	3	4	30,267
Ward	2	6	8	43,200
Williams	1	1	2	22,929
Total	5	116	121	722,347
Development completions:				
Billings	2	---	2	18,726
Bottineau	2	5	7	26,570
Burke	11	4	15	97,873
Divide	--	1	1	7,050
McKenzie	--	1	1	8,945
Renville	17	5	22	108,412
Stark	5	---	5	40,055
Ward	2	1	3	19,397
Williams	5	1	6	55,314
Total	44	18	62	382,342
Total all drilling	49	134	183	1,104,689

Table 7.—Oil and gas well drilling, by counties—Continued

County	Oil	Dry	Total	Footage
1969:				
Exploratory completions:				
Adams	--	1	1	4,310
Barnes	--	4	4	6,763
Billings	1	1	2	17,588
Bottineau	1	20	21	83,820
Bowman	2	3	5	49,508
Burke	--	5	5	34,402
Burleigh	--	2	2	10,982
Cavalier	--	3	3	5,360
Divide	--	2	2	13,556
Dunn	--	3	3	25,114
Golden Valley	1	9	10	61,417
Grand Forks	--	10	10	7,991
Grant	--	1	1	4,426
Griggs	--	4	4	7,787
McKenzie	1	6	7	63,783
Mercer	--	1	1	4,981
Mountrail	--	2	2	16,253
Nelson	--	9	9	16,332
Ramsey	--	6	6	16,629
Renville	1	16	17	101,415
Slope	--	2	2	18,716
Stark	1	6	7	48,197
Towner	--	1	1	1,638
Ward	--	6	6	37,865
Williams	--	5	5	61,322
Total	8	128	136	720,155
Development completions:				
Billings	--	2	2	16,455
Bottineau	16	3	19	68,335
Bowman	3	3	6	47,782
Burke	1	3	4	26,658
Divide	--	2	2	13,680
Golden Valley	2	2	4	36,732
McHenry	1	---	1	4,215
McKenzie	2	1	3	21,414
Renville	6	6	12	57,954
Stark	6	7	13	105,873
Ward	3	3	6	38,943
Williams	3	2	5	50,395
Total	43	34	77	488,436
Total all drilling	51	162	213	1,208,591

Sources: Committee on Statistics of Drilling, American Association of Petroleum Geologists (1968); adapted from Committee on Statistics of Drilling, American Association of Petroleum Geologists and Petroleum Information Corp., 1969 Résumé, Oil and Gas Operations in the Rocky Mountain Region (1969).

programs in both the eastern and western parts of the State. One operator reported a show of oil in an eastern North Dakota wildcat; however, no oil production was reported. Most of the exploratory and development drilling was in the north-central part of the State, with Bottineau and Renville Counties leading the way with 69 wells. Only four new fields were discovered during the year, one less than in 1968.

Setting a record for depth of production in the Williston basin, perhaps the most significant discovery was the Red River (Ordovician) well by Consolidated Oil & Gas, Inc., and Miami Oil Producers, Inc. The discovery well No. 23–1 FLB et al, SE¼ NE¼ sec 23, T151N, R101W, McKenzie County was completed in October, flowing 518 barrels of oil daily from the 13,543- to 13,635-foot interval. Nearest production is from Montana's Fairview field, 28 miles west.

Golden Valley County was added to the list of counties with oil production when Mule Creek Oil Co. discovered the Square Butte field. The discovery well, No. 1–449 Government-Taylor, SE¼ SE¼ sec 9, T139N, R103W, was completed in May, pumping 122 barrels of oil and 24 barrels of water daily from the Madison Formation (Mississippian) at 9,185.5 to 9,186 feet.

Two Red River discoveries were re-

corded in a sparsely drilled area of Bowman County. The Horse Creek field well No. 1. Holecek, NE¼ NE¼ sec 17, T129N, R104W, discovered by Golden Eagle Refining Co., Inc., and Mutex Exploration in February was flowing 450 barrels of oil daily from the interval 9,328 to 9,340 feet. Four and a half miles north of Horse Creek, International Nuclear Corp. discovered the Coyote Creek field in July. The discovery well, No. 1–62 Miller et al, SW¼ NE¼ sec 21, T131N, R104W was completed flowing 278 barrels of oil daily from the 9,776- to 9,806-foot interval.

Other wildcat drilling resulted in extensions of existing fields. In Billings County, Shell Oil Co. extended Heath (Mississippian) production in Rocky Ridge field 2½ miles southeast with a well in sec 36, T137N, R100W, that pumped 488 barrels of oil daily. Another Heath pool extension was the Monsanto Co. well in sec 11, T139N, R99W, Stark County, which extended the Zenith field 3 miles to the southwest. Stratigraphic Oil Co. extended the Eden Valley field a mile southeast with a well, No. 1 Shong, NE¼ SW¼ sec 23, T163N, R84W, completed in the Mission Canyon (Mississippian) at 4,172 to 4,178 feet.

Bottineau County led in development drilling with 16 of 19 wells completed as producers. Development of the Midale (Mississippian) pool in the Landa field was the most successful; eight of nine wells were producers. The Landa program renewed interest in the Midale formation in the area. Next active development drilling was in Renville County where six of 12 wells were completed as producers.

Matador Pipeline Co. solved a 15-year problem with the completion of a 68-mile insulated pipeline from Fryburg field to the Halliday station of Service Pipeline in Dunn County. The pipeline was designed with two heating stations which will heat the high-pour-point Heath crude oil to 280° F. Fields which will be serviced by the pipeline are the Dickinson, West Dickinson, Fryburg, Medora, Rocky Ridge, and Zenith.

NONMETALS

Clays.—Two new clay mines—Dic-Lite Co., mining common clay for lightweight aggregate, and Dakota Industries, Inc., producing bentonite for absorbent animal litter and absorbent floor sweeping compound—were opened in Stark County, bringing the State's total to five; irrespective of the added operations, production declined 7 percent. In Divide and Morton Counties, Baukol-Noonan, Inc., continued producing shale used for lightweight aggregate. Richter Construction Co. of Hebron mined clay in Morton County for Hebron Brick Co.

Lime.—Production and value of quicklime from the plant of American Crystal Sugar Co. at Drayton continued to increase, 5 and 8 percent, respectively.

Salt.—The State's only salt producer, Dakota Salt & Chemical Co., near Williston, shipped 9 percent more salt than in 1968. The major market was livestock feed dealers and mixers. One-half of the shipments were intrastate; the remainder went to bordering States and Canada.

Sand and Gravel.—Sand and gravel was produced in all counties except Adams, Billings, and Dunn. The greatest output was in Burleigh County, 473,000 tons, followed by 429,000 tons in Grand Forks County and 400,000 tons in Eddy County. The total output for the State decreased 35 percent to 7 million tons; the number of operations also decreased, from 359 in 1968 to 270 in 1969. The large decline was attributed mainly to decreased use of sand and gravel for road construction and maintenance. Although the dollar value of contracts awarded in 1969 by the State Highway Department was almost double that of 1968, many projects had not progressed sufficiently to require large quantities of sand and gravel for road metal.

Stone.—Shipments of stone, 72,091 tons, decreased in quantity and value 56 and 70 percent, respectively. The decline was mainly because of a decreased demand for road metal and because no projects which required riprap were constructed. Only 36,000 tons of crushed rock was used by the State Highway Department, compared with 88,000 tons used in 1968. Riprap was used only for repair and maintenance of existing projects.

Sulfur.—Natural gas processing plants, operated by Texaco Inc. in Burke County and by Signal Oil and Gas Co. in Williams County, recovered elemental sulfur as a byproduct. The output of sulfur increased 4 percent; however, the value of the sulfur shipped declined 33 percent. Inventory at yearend was more than double the amount on hand at the end of 1968. This commod-

ity is not included in the total mineral producton value of North Dakota (table 1).

Vermiculite.—Vermiculite shipped from outside the State was exfoliated and sold by Robinson Insulation Co., Minot. The greatest use was for insulation; other uses, in order of importance, included concrete and plaster aggregate, poultry litter, and soil conditioner.

Table 8.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	355	$423	473	$589
Paving	206	189	161	162
Fill	166	179	162	120
Other	2	3	5	6
Total	729	794	801	877
Gravel:				
Construction:				
Building	441	899	411	821
Paving	2,131	2,375	2,613	2,630
Railroad ballast	174	59	133	58
Fill	126	98	109	70
Miscellaneous	60	66	32	32
Total	2,932	3,497	3,298	3,611
Total sand and gravel [1]	3,661	4,291	4,100	4,488
Government-and-contractor operations:				
Sand:				
Paving	3,314	3,039	1,183	1,160
Fill	5	5	----	-----
Total	3,319	3,044	1,183	1,160
Gravel:				
Building	28	28	3	2
Paving	3,830	2,795	1,746	1,619
Fill	1	1	9	4
Total [1]	3,859	2,824	1,756	1,626
Total sand and gravel	7,178	5,868	2,939	2,786
All operations:				
Sand	4,048	3,838	1,984	2,037
Gravel [1]	6,791	6,321	5,055	5,237
Total	10,839	10,159	7,039	7,274

[1] Data may not add to totals shown because of independent rounding.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Baukol-Noonan, Inc	Noonan, N. Dak. 58765	Open pit mine and plant	Divide.
		do	Morton.
Hebron Brick Co	Hebron, N. Dak. 58638	Open pit mine	Do.
Coal:			
Baukol-Noonan, Inc	Noonan, N. Dak. 58765	Strip mine; thermal drying, crushing, and oil treatment plant.	Burke.
Consolidation Coal Co., Western Division.	111 North Wabash Ave. Chicago, Ill. 60602	Crushing and oil treatment plant.	Mercer.
		Strip mine	Oliver.
		Strip mine; thermal drying, crushing, and oil treatment plant.	Ward.
Knife River Coal Mining Co.	Bismarck, N. Dak. 58501	Strip mine, crushing and oil treatment plant.	Bowman.
		Strip mine, crushing and wax oil treatment plant.	Mercer.
The North American Coal Corp., Lignite Division.	12800 Shaker Blvd. Cleveland, Ohio 44120	Strip mine, crushing and oil treatment plant.	Do.
Lime: American Crystal Sugar Co.	600 Boston Bldg. Denver, Colo. 80202	Shaft kiln at beet-sugar refinery.	Pembina.
Natural gas and petroleum:			
Amerada Hess Corp	Box 2040 Tulsa, Okla. 74102	Crude oil wells: Fryburg field.	Billings.
		Crude oil wells: Antelope, Blue Buttes, and Charlson fields.	McKenzie.
		Crude oil wells: Beaver Lodge field.	Williams.
American Oil Co	910 South Michigan Ave. Chicago, Ill. 60680	Refinery	Morton.
Chevron Oil Co., Western Division.	1700 Broadway Denver, Colo. 80202	Crude oil wells: Glenburn field.	Renville.
Chandler & Associates, Inc.	1401 Denver Club Bldg. Denver, Colo. 80202	Crude oil wells: Sherwood field.	Renville.
Hunt Oil Co. (Hunt Industries).	1401 Elm Dallas, Tex. 75202	Crude oil wells: North Tioga field and gas processing plant.	Burke.
Marathon Oil Co	539 South Main St. Findley, Ohio 45840	Crude oil wells: Glenburn field.	Renville.
Pan American Petroleum Corp.	Box 591 Tulsa, Okla. 74102	Crude oil wells: Black Slough and Rival fields.	Burke.
Petroleum, Inc	300 West Douglas Wichita, Kans. 67202	Crude oil wells: Sherwood field.	Renville.
Shell Oil Co	50 West 50th Street New York, N. Y. 10020	Crude oil wells: Cedar Creek field.	McKenzie.
The Signal Companies, Inc.	1010 Wilshire Blvd. Los Angeles, Calif. 90017	Crude oil wells: Tioga field.	Mountrail.
		Crude oil wells: Beaver Lodge field and gas processing plant.	Williams.
The Superior Oil Co	First City National Bank Bldg. Houston, Tex. 77002	Crude oil wells: Medora field.	Billings.
Tenneco Oil Co	Box 2511 Houston, Tex. 77051	Crude oil wells: Glenburn field.	Renville.
Texaco Inc	Box 52332 Houston, Tex. 77052	Crude oil wells: Blue Buttes and Charlson fields.	McKenzie.
		Gas processing plant	Burke.
Union Oil Company of California.	Box 7600 Los Angeles, Calif. 90017	Crude oil wells: Sherwood field.	Renville.
Westland Oil Co	Box 1549 Minot, N. Dak. 58701	Refinery	Williams.
Salt: Dakota Salt & Chemical Co.	General Carbon Bldg. West Haven Road Lawrenceville, Ill. 62439	Well and plant	Williams.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel (commercial):			
Badinger Sand & Gravel	Dickinson, N. Dak. 58601	Pit and 2 plants	Burleigh.
		Pit and plant	Stark.
Bradshaw Gravel Supply	Arvilla, N. Dak. 58214	Pit and 2 plants	Grand Forks.
		Pit and plant	Walsh.
Ehley & Frisch Gravel Co.	Ashley, N. Dak. 58413	10 pits and plant	Emmons.
		10 pits	McIntosh.
Mahrer Construction Co.	Hankinson, N. Dak. 58041	Pit and plant	Richland.
Roy Scheffler, Inc	Box 906	2 pits	Bottineau.
	Fargo, N. Dak. 58102	Pit	Grand Forks.
		Pit	Hettinger.
		Pit	McKenzie.
		Pit and plant	McLean.
		Pit	Nelson.
		Pit	Oliver.
		Pit and plant	Renville.
		2 pits	Williams.
Sheyenne Sand & Gravel, Inc.	Box 178 Sheyenne, N. Dak. 58374	Pit and plant	Eddy.
Stone:			
Fisher Sand & Gravel	Dickinson, N. Dak. 58601	Quarry and plant	Billings.
McKenzie County Highway Dept.	Watford City, N. Dak. 58854	----------do	McKenzie.

The Mineral Industry of Ohio

By Joseph Krickich [1]

For the eighth consecutive year, value of mineral production in Ohio increased, establishing a record high of $580.7 million and exceeding that of 1968 by 8 percent. Record high production of bituminous coal, lime, salt, and sand and gravel helped set this record. Increases were reported for nearly every major mineral commodity. Continuing highway and building construction programs aided in maintaining the great demand for aggregate materials. Accelerated activity in the steel, chemical, and other industries were contributing factors for greater demand for Ohio minerals.

Mineral production was reported in all of the State's 88 counties except Fulton. Belmont and Harrison Counties with mineral output values of $60.3 million and $47.9 million, respectively, were the State's leading mineral-producing areas. Values in excess of $10 million were recorded for 17 other counties.

[1] Supervisory mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Ohio [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	15,222	$49,814	15,100	$50,071
Masonry—thousand 280-pound barrels	1,063	3,155	1,123	3,527
Clays—thousand short tons	4,750	15,216	4,587	11,693
Coal (bituminous)—do	48,323	191,427	51,242	210,082
Gem stones	NA	3	NA	3
Lime—thousand short tons	3,701	49,367	4,159	60,975
Natural gas—million cubic feet	42,673	10,540	49,793	12,837
Peat—short tons	6,506	94	10,848	116
Petroleum (crude)—thousand 42-gallon barrels	11,204	35,722	10,972	36,098
Salt—thousand short tons	5,713	43,172	5,844	43,519
Sand and gravel—do	46,734	57,671	49,160	63,361
Stone—do	[2] 48,054	[2] 78,772	51,792	86,570
Value of items that cannot be disclosed: Abrasive stone, gypsum, and dimension limestone and dolomite (1968)	XX	1,945	XX	1,815
Total	XX	536,898	XX	580,667
Total 1967 constant dollars	XX	531,626	XX	[p] 554,779

[p] Preliminary. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes dimension limestone and dolomite; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Ohio, by counties [1] [2]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	$1,378	$1,629	Stone.
Allen	W	2,059	Stone, sand and gravel.
Ashland	258	W	Sand and gravel, clays.
Ashtabula	W	W	Lime, sand and gravel.
Athens	1,732	W	Stone, sand and gravel, coal.
Auglaize	W	W	Stone, sand and gravel, clays.
Belmont	50,790	60,279	Coal, stone.
Brown	W	129	Sand and gravel, stone.
Butler	3,302	3,620	Sand and gravel.
Carroll	W	W	Coal, clays, sand and gravel, stone.
Champaign	W	W	Sand and gravel, peat.
Clark	W	W	Sand and gravel, lime, stone.
Clermont	5	W	Stone, sand and gravel.
Clinton	W	W	Stone, sand and gravel.
Columbiana	W	5,097	Coal, clays, sand and gravel.
Coshocton	W	W	Coal, stone, sand and gravel, clays.
Crawford	W	W	Stone, sand and gravel.
Cuyahoga	W	W	Salt, lime, sand and gravel, clays, peat.
Darke	W	W	Sand and gravel, clays, peat.
Defiance	W	W	Sand and gravel.
Delaware	2,471	2,309	Stone, lime, clays.
Erie	6,982	7,804	Stone, lime, sand and gravel.
Fairfield	W	W	Sand and gravel.
Fayette	1,124	615	Stone.
Franklin	W	W	Sand and gravel, stone, lime, clays, peat.
Gallia	1,072	970	Stone, sand and gravel, coal.
Geauga	W	3,444	Sand and gravel, stone.
Greene	W	W	Cement, stone, sand and gravel, clays.
Guernsey	1,642	351	Coal, stone.
Hamilton	4,938	5,675	Sand and gravel.
Hancock	1,231	1,257	Stone, lime, clays.
Hardin	W	W	Stone.
Harrison	44,956	47,863	Coal, stone, clays.
Henry	117	83	Sand and gravel, clays.
Highland	W	W	Stone, sand and gravel.
Hocking	683	W	Sand and gravel, coal, clays, stone.
Holmes	1,696	1,623	Coal, clays, sand and gravel, stone.
Huron	214	272	Sand and gravel, stone, peat.
Jackson	4,894	5,215	Coal, clays, stone, sand and gravel.
Jefferson	W	W	Coal, clays.
Knox	W	W	Sand and gravel, stone.
Lake	W	28,000	Salt, lime, stone, sand and gravel.
Lawrence	9,584	9,127	Cement, coal, stone, clays, sand and gravel.
Licking	W	788	Sand and gravel.
Logan	616	708	Stone, sand and gravel, peat.
Lorain	W	W	Stone, sand and gravel, abrasives.
Lucas	W	8,104	Cement, stone, sand and gravel, clays.
Madison	594	789	Stone, sand and gravel.
Mahoning	7,545	7,508	Stone, coal, clays, peat.
Marion	2,416	1,569	Stone, sand and gravel, clays.
Medina	W	W	Sand and gravel, clays.
Meigs	1,871	W	Sand and gravel, stone, salt, coal.
Mercer	W	W	Stone.
Miami	W	W	Stone, sand and gravel.
Monroe	W	W	Coal, stone, sand and gravel.
Montgomery	4,297	W	Sand and gravel, stone.
Morgan	3,681	W	Coal, sand and gravel, stone.
Morrow	49	65	Sand and gravel.
Muskingum	W	W	Coal, cement, stone, sand and gravel, clays.
Noble	8,629	10,326	Coal, stone, clays.
Ottawa	8,977	10,208	Stone, lime, gypsum.
Paulding	W	W	Cement, stone, clays.
Perry	W	17,007	Coal, sand and gravel, clays, stone.
Pickaway	W	W	Sand and gravel, stone.
Pike	925	961	Do.
Portage	W	W	Sand and gravel, peat.
Preble	W	W	Lime, stone, sand and gravel.
Putnam	512	769	Stone, lime, clays, sand and gravel.
Richland	W	W	Sand and gravel, clays, peat.
Ross	W	W	Sand and gravel, stone.
Sandusky	23,205	27,074	Lime, stone, sand and gravel.
Scioto	2,654	2,292	Stone, sand and gravel, clays.
Seneca	W	W	Lime, stone, clays.
Shelby	W	W	Sand and gravel, stone.
Stark	12,735	W	Cement, sand and gravel, stone, coal, clays, peat.
Summit	W	W	Salt, lime, stone, cement, sand and gravel, coal, clays.
Trumbull	W	W	Sand and gravel, peat.
Tuscarawas	15,618	14,409	Coal, clays, sand and gravel, stone.
Union	W	436	Stone, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Ohio, by counties [1] [2]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Van Wert	$844	$1,010	Stone, clays.
Vinton	W	W	Coal, stone, clays.
Warren	1,711	1,727	Sand and gravel.
Washington	W	W	Sand and gravel, coal, stone.
Wayne	W	W	Salt, sand and gravel, stone, clays, coal.
Williams	W	W	Sand and gravel.
Wood	2,364	1,904	Stone.
Wyandot	W	W	Stone, lime, sand and gravel, clays, peat.
Undistributed [3]	298,586	285,594	
Total	536,898	[4] 580,667	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Fulton County is not listed because 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, gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.
[4] Data does not add to total shown because of independent rounding.

Table 3.—Indicators of Ohio business activity

	1968	1969 p	Change, percent
Employment and labor force, annual average: [1]			
Total labor force—thousands	4,348.6	4,478.0	+3.0
Unemployment—percent of work force	2.9	2.7	−6.9
Employment:			
Manufacturing—thousands	1,430.9	1,468.0	+2.6
Durable goods—do	1,019.8	1,050.1	+3.0
Stone, clay, and glass products—do	69.2	72.0	+4.0
Primary metal industries—do	179.3	185.4	+3.4
Fabricated metal products—do	157.2	161.5	+2.7
Machinery, except electrical—do	221.8	229.0	+3.2
Electrical equipment—do	149.4	156.1	+4.5
Transportation equipment—do	166.6	166.8	+0.1
Instruments—do	16.0	17.3	+8.1
Nondurable goods—do	411.1	417.9	+1.7
Nonmanufacturing—do	2,319.9	2,423.0	+4.4
Mining—do	19.1	19.9	+4.2
Contract construction—do	166.9	179.5	+7.5
Payroll average weekly earnings: [1]			
Manufacturing	$142.58	$152.10	+6.7
Durable goods	$146.09	$155.82	+6.7
Nondurable goods	$132.99	$141.17	+6.2
Personal income: [2]			
Total—millions	$37,151	$40,587	+9.2
Per capita	$3,501	$3,779	+7.9
Construction activity:			
Cement shipments to and within Ohio—thousand 376-pound barrels	19,972	20,263	+1.5
Mineral production—thousands	$536,898	$580,667	+8.2

p Preliminary.
[1] Division of Research and Statistics, Ohio, Bureau of Employment Services.
[2] Survey of Current Business, U.S. Department of Commerce.

Table 4.—Worktime 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
1968:								
Coal	7,576	244	1,852	14,793	13	423	29.47	7,085
Peat	16	116	2	12	------	------	------	------
Nonmetal	2,338	269	634	5,053	1	112	22.36	1,621
Sand and gravel	2,284	240	548	4,570	2	75	16.85	3,061
Stone	5,471	275	1,504	12,261	7	191	16.15	4,007
Total	17,685	256	4,540	36,689	23	801	22.46	4,800
1969: p								
Coal	7,900	247	1,957	15,627	13	490	32.25	6,531
Peat	18	118	2	15	------	------	------	------
Nonmetal	2,110	270	570	4,594	1	96	21.11	1,837
Sand and gravel	2,325	239	555	4,655	7	87	20.19	9,646
Stone	5,590	282	1,576	12,941	4	205	16.15	2,968
Total [1]	17,970	259	4,660	37,832	25	878	23.89	5,123

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

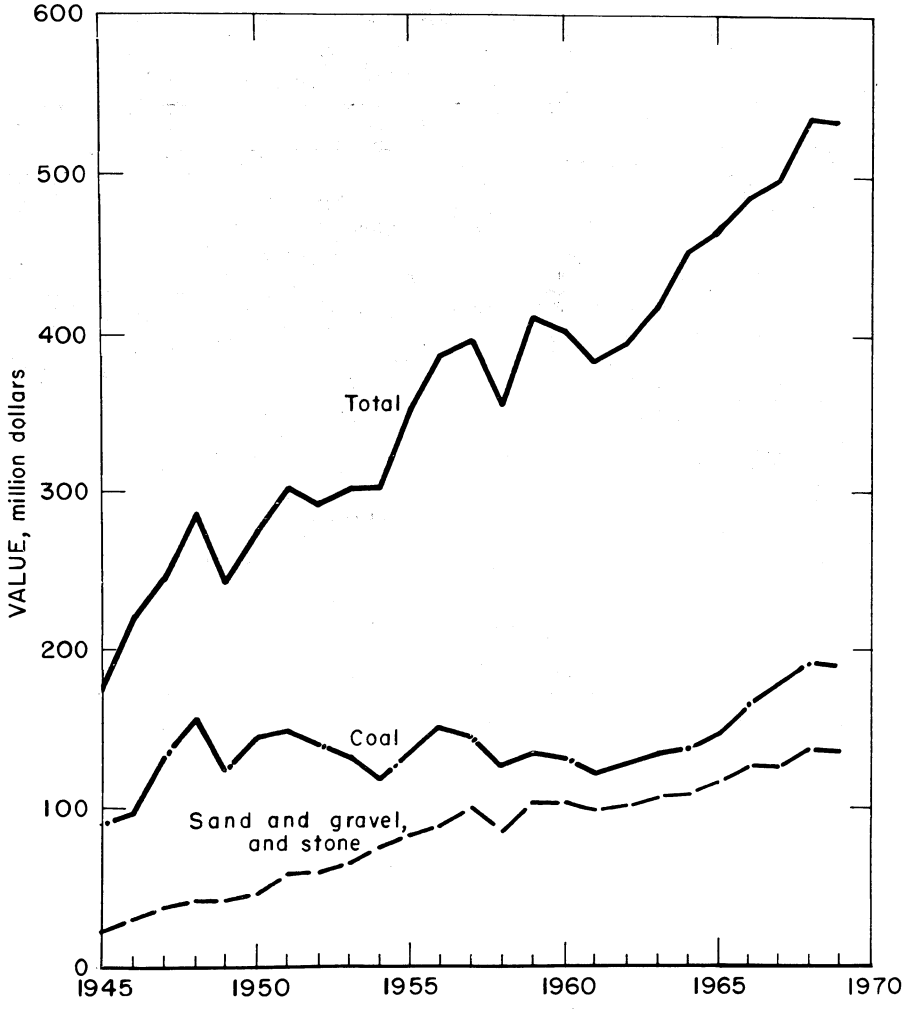

Figure 1.—Value of coal, sand and gravel, and stone, and total value of mineral production in Ohio.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stones.—Reversing a downward trend of recent years, production and value of abrasive stone (grindstone) were greater than that of 1968. Output was from one operation in Lorain County as a byproduct of sandstone quarrying at Amherst.

Cement.—Production and shipments of portland cement decreased, but value increased slightly compared with that of 1968. Production, shipments, and value of masonry cement were greater than that of 1968. The average value per barrel of portland cement rose from $3.27 in 1968 to $3.32; average value of masonry cement increased $0.17 to $3.14. Companies operated at 74 percent of capacity compared with 75 percent in 1968. Yearend stocks were 58,000 barrels higher than at the end of 1968. In terms of value of shipments, Greene, Paulding, and Muskingum were the leading cement-producing counties. Apparent cement consumption in the State totaled 20.2 million barrels of portland cement and 1.6 million barrels of masonry cement. Ohio cement producers supplied 52 percent of the portland and 47 percent of the masonry cement consumed. Of the total cement shipments, 8 percent of the portland cement and 5 percent of the masonry cement went to Michigan. Indiana received 8 percent of the portland cement and 11 percent of the masonry shipments, and West Virginia received 7 percent of the portland and 8 percent of the masonry cement. Lesser quantities of both types of cement were shipped into Kentucky and western Pennsylvania.

Distribution of portland cement shipments by types of customers was as follows: Ready-mix concrete companies, 9.0 million barrels; concrete product manufacturers, 2.5 million barrels; and highway and other contractors, 2.0 million barrels. The remainder went to building material dealers and miscellaneous customers. Over 12.5 million barrels of portland cement was shipped by truck, and the remainder was shipped by rail, or consumed at the plants. Bulk shipments predominated; only 5 percent was shipped in containers, mainly paper bags. Cement companies used 3.9 million tons of limestone and cement rock, 545,000 tons of clay and shale, 125,000 tons of gypsum, and 98,000 tons of sand as primary raw materials. Quantities of mill scale, iron ore, and fluorspar also were used. Fuel consumed in producing portland cement was predominantly bituminous coal but quantities of natural gas and fuel oil also were consumed. Producers used 390.1 million kilowatt-hours of electrical energy, of which 24 percent was generated by the producer and 76 percent was purchased from public utility companies.

Portland cement was produced at five plants using the wet process and four plants using the dry process. The largest kiln operation in the four plants using the dry process was 425 feet long. Three 450-foot-long kilns were in operation in plants using the wet process. A total of 28 kilns, ranging in size from 100 to 450 feet in length, were in operation during the year. PPG Industries was awarded Certificates of Achievement in Safety for two of its operations in the Underground Nonmetal Group of National Safety Competition. Both mines operated in 1969 without any lost-time injuries.

Clays.—Total clay production (fire clay and miscellaneous clay and shale) decreased 3 percent from that of 1968. Of the total, 56 percent was miscellaneous clay and shale used chiefly for manufacturing heavy clay products and cement, and the remainder was fire clay used mainly in refractories and heavy clay products. Clays used in manufacturing heavy clay products were below that of 1968. Clay output for refractories increased 27,000 short tons

Table 5.—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	
1965	9	14,599	14,786	$47,499	1,600
1966	9	15,755	15,181	48,740	2,271
1967	9	14,773	14,726	46,860	2,224
1968	9	14,891	15,222	49,814	1,766
1969	9	14,698	15,100	50,071	1,824

to 858,000 tons; clay used for manufacturing cement increased by 6,000 tons to 720,000 tons. Production of clay and shale used for manufacturing lightweight aggregate and floor and wall tile was less than that of 1968. Other uses of Ohio clay included pottery and stoneware and as rotary drilling mud. Of the 14 fire clay-producing counties, Tuscarawas, Columbiana, Jackson, and Stark Counties were the leading areas, accounting for 76 percent of the fire clay tonnage. Among the 34 miscellaneous clay and shale producing areas, Tuscarawas, Cuyahoga, Greene, and Stark Counties led in production.

Gem Stones.—Gem and mineral specimen collectors were active at mines and quarries throughout the States. Value remained the same as that of 1968. Specimens collected included calcite, celestite, flint, and jasper. Flint, the State's official gem stone, was recovered chiefly at Flint Ridge in southeastern Licking County and the adjacent area of Muskingum County.

Graphite (Synthetic).—Quantities of synthetic graphite were produced from petroleum coke at the Cleveland plant of the Ohio Carbon Co. The graphite was shaped for use in electrical motor brushes.

Gypsum.—Output of crude gypsum increased but value declined because of lower reported unit prices. Production from one underground mine and one open pit in Ottawa County was calcined at nearby plants for use in manufacturing building products. National Gypsum Co. at Lorain also calcined gypsum from crude material shipped from outside the State. In National Safety Competition, the underground gypsum mine of United States Gypsum Co. worked 56,583 man-hours without any disabling injuries and was awarded a Certificate of Achievement in Safety.

Lime.—Output of lime continued its upward trend as production reached a new high of 4.2 million tons and exceeded the previous high year 1966 by 301,000 tons. Production was 12 percent above that of 1968; value was 24 percent greater. Increased demand for chemical and industrial, refractory, and agricultural lime more than offset the decline for construction lime. The average unit value for all major uses increased. Ohio continued as the leading lime-producing State, accounting for 21 percent of the National output. Fifty-nine percent of the total lime production was captive tonnage or was marketed in Ohio. Other leading marketing areas for Ohio lime were Pennsylvania (409,000 tons), Michigan (226,000 tons), New York (203,000 tons), Indiana (202,000 tons), West Virginia (194,000 tons), and Illinois (134,000 tons). Quantities also were exported to Canada and other countries. Quicklime manufacture was predominately by means of shaft-type kilns. Hydrated lime producers used both batch and continuous hydrators. Fuels used by producers included bituminous coal, coke, natural gas, and fuel oil. Sandusky County continued as the leading area for lime production accounting for nearly 1.2 million tons valued at $19 million.

Perlite (Expanded).—Crude perlite shipped from Western States was processed and expanded at four plants, one each in Cuyahoga, Hamilton, Lorain, and Ottawa Counties. The expanded perlite was used as plaster and concrete aggregate, insulation, soil conditioning, and other industrial uses.

Salt.—Production of salt increased for the 11th consecutive year and established a new high of 5.8 million tons as output rose 2 percent above that of 1968. Value increased $347,000 to $43.5 million. Production of rock and evaporated salt as well as brine was greater than that of the previous year. Rock salt recovered from underground mines in Cuyahoga and Lake Counties was sold mainly for controlling

Table 6.—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
1965	27	$410	327	$6,425	2,387	$27,905	1,090	$18,468	3,831	$53,208
1966	17	253	299	5,490	2,574	28,740	968	16,514	3,858	50,997
1967[1]	16	234	257	5,672	2,550	28,548	812	14,364	3,636	48,817
1968[1]	14	221	245	5,464	2,633	29,833	810	13,848	3,701	49,367
1969	16	274	236	5,474	3,027	39,391	880	15,836	4,159	60,975

[1] Data may not add to totals shown because of independent rounding.

icy highways and in chemical applications. Evaporated salt produced in Cuyahoga, Meigs, Summit, and Wayne Counties was sold for a wide variety of uses; some was marketed as pressed block. Evaporated salt producers used both the vacuum-pan and open-pan processes for recovering the salt. Lake County with two operations continued to rank first in output. Ohio continued as a leading area for salt production, ranking third in national output.

Sand and Gravel.—Production of sand and gravel increased 5 percent above that of 1968. Value was 10 percent greater and totaled $63.4 million. Output was 2.4 million tons above that of the previous high year, 1968. Commercial sand and gravel used in building and highway construction totaled 40.7 million tons, 921,000 tons greater than in 1968. Production and value of industrial sand increased. Output totaled 1.6 million tons valued at $6.4 million; average value decreased from $4.31 per ton in 1968 to $3.93. Most of the industrial sand was marketed for molding, glass manufacture, and furnace construction and repair.

Sand and gravel was produced in 69 counties, one less than in 1968. Franklin, Hamilton, Montgomery, Portage, and Butler Counties, each with output in excess of 3 million tons, were the leading areas. In addition, 11 other counties had production exceeding 1 million tons. Commercial producers processed 86 percent of the total tonnage by washing, screening, sizing, or crushing. Over 47 million tons of sand and gravel was shipped to consumers by truck and the remainder by rail or water. Commercial operations totaled 422. Of the total, 148 operations produced less than 25,000 tons and accounted for 3 percent of the commercial tonnage. Five operations had output exceeding 1 million tons and eight operations produced from 500,000 to 1 million tons.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	7,061	$8,446	7,905	$9,585
Paving	9,520	9,797	8,837	9,982
Fill	1,478	1,141	1,670	1,066
Molding	432	2,017	525	2,282
Other [1]	1,226	3,873	1,396	4,422
Total	19,717	25,274	20,333	[2] 27,336
Gravel:				
Building	8,301	10,141	8,699	11,299
Paving	14,930	19,412	15,292	20,213
Fill	2,163	1,362	3,700	2,827
Other [3]	1,051	1,215	1,108	1,665
Total	26,445	32,130	[2] 28,800	36,004
Total sand and gravel	46,162	57,404	49,133	63,340
Government-and-contractor operations:				
Sand:				
Paving	198	70	3	2
Fill	26	9	------	------
Total	224	79	3	2
Gravel:				
Paving	235	141	22	19
Fill	[4] 113	[4] 47	2	1
Total	348	188	24	[2] 19
Total sand and gravel	572	267	27	21
All operations:				
Sand	19,941	25,353	20,336	27,338
Gravel	26,793	32,318	[2] 28,823	36,023
Grand total	46,734	57,671	[2] 49,160	63,361

[1] Includes fire or furnace sand, glass, blast, engine, filtration, ground, and other sands.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes railroad ballast, miscellaneous, and other gravel.
[4] Includes other gravel.

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

(Thousand short tons and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Ashland	W	W	268	$243
Ashtabula	111	$126	145	158
Auglaize	343	429	287	353
Butler	2,881	3,302	3,272	3,620
Clark	1,181	1,201	1,325	1,433
Clermont	5	5	W	W
Clinton	53	49	51	45
Columbiana	232	205	150	180
Coshocton	695	768	551	640
Crawford	90	125	W	W
Cuyahoga	652	816	510	640
Fairfield	W	W	312	W
Franklin	6,266	7,564	5,427	7,313
Gallia	W	W	127	W
Geauga	1,044	1,593	1,543	W
Greene	993	1,118	1,116	1,122
Hamilton	4,484	4,932	5,052	5,675
Highland	W	W	15	17
Jackson	3	3	1	2
Knox	914	2,245	1,092	2,633
Lake	274	343	130	140
Licking	857	906	746	788
Logan	131	152	160	W
Lorain	W	W	296	W
Lucas	713	613	688	314
Marion	307	262	297	309
Medina	685	803	641	769
Miami	863	965	1,029	1,278
Montgomery	3,350	3,178	3,620	4,056
Morrow	49	49	66	65
Portage	2,717	3,891	3,405	5,035
Preble	150	156	188	233
Putnam	20	14	W	W
Richland	652	680	690	722
Ross	775	738	638	747
Scioto	W	W	317	550
Shelby	405	444	426	516
Stark	1,669	2,462	1,562	2,418
Summit	1,456	1,300	1,652	1,364
Tuscarawas	1,451	2,031	1,410	1,805
Union	198	153	W	W
Warren	1,487	1,711	1,479	1,727
Washington	459	530	443	536
Wayne	555	683	508	612
Williams	W	W	265	W
Wyandot	363	341	290	333
Undistributed [1]	7,201	10,785	6,968	14,969
Total	46,734	57,671	[2] 49,160	[2] 63,361

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

[1] Includes Allen, Athens, Brown, Carroll, Champaign, Darke, Defiance, Erie, Henry, Hocking, Holmes, Huron, Lawrence, Madison, Meigs, Monroe, Morgan, Muskingum, Ottawa (1968), Perry, Pickaway, Pike, Sandusky, and Trumbull Counties, some sand and gravel unspecified by county, and data indicated by symbol W.

[2] Data does not add to total shown because of independent rounding.

Stone.—Output of stone increased for the fifth consecutive year, reflecting the continuing high level of activity in all phases of highway and building construction. Greater demand for crushed limestone (including dolomite) used as aggregate was the major contributing factor for the increase. Production of crushed limestone was 7 percent above that of 1968 and accounted for most of the State's total stone output. Miscellaneous uses of crushed limestone included filter beds, stone sand, glass and alkali manufacture, asphalt and other fillers, acid neutralizer, and for dust abatement in coal mines. Production of dimension limestone (including dolomite) increased, but value declined compared with 1968. Output was used mainly as rubble and some was sold as dressed architectural stone. Output was from quarries in Allen, Lucas, Miami, and Seneca Counties. Of the 57 limestone-producing counties (the same as in 1968), Sandusky County continued as the leading area with output of 4.9 million tons. Ottawa, Wyandot, Erie, and Mahoning Counties also were important limestone-producing areas.

Table 9.—Crushed and broken limestone and dolomite sold or used by producers, by uses
(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Riprap	306	$496	351	$574
Construction aggregate [1]	29,065	40,766	31,406	45,961
Fluxing stone	4,061	5,812	4,849	7,340
Agriculture	1,885	3,586	1,675	3,328
Railroad ballast	962	1,221	1,495	1,997
Cement	4,896	6,733	4,718	7,264
Lime	3,025	6,740	3,349	7,085
Miscellaneous uses	2,953	6,138	2,752	5,621
Total [2]	47,153	71,493	50,596	79,171

[1] Includes dense graded road base stone and concrete, bituminous, macadam, and surface treatment aggregates, and unspecified construction aggregate and roadstone (1969).
[2] Data may not add to totals shown because of independent rounding.

Dimension sandstone production and value declined although there was a higher average unit value in 1969. Output was 94,000 tons valued at $4.5 million compared with 115,000 tons and nearly $5 million in 1968. Most of the sandstone was fabricated for dressed architectural applications but quantities also were sold as rough architectural blocks, laboratory table tops, and curbing and flagging. Crushed and broken sandstone (including quartzite) production totaled 1,095,000 tons valued at $2.8 million, an increase of 39 and 22 percent, respectively. The stone was marketed mainly for aggregate, riprap, refractories (ganister), and glass manufacturing. Sandstone was quarried in 16 counties; Loraine, Coshocton, and Scioto Counties were the leading areas for dimension stone and Lorain, Geauga, and Lake Counties for crushed and broken stone. In the Quarry Group of National Safety Competition, Certificates of Achievement in Safety were awarded to Ohio Lime Co., J. E. Baker Co., National Lime & Stone Co., France Stone Co. (two quarries), East Ohio Limestone Co., Diamond Portland Cement Co. Division of the Flintkote Co., U.S. Gypsum Co., Standard Slag Co., National Gypsum Co., Southwestern Portland Cement Co., and Waterloo Coal Co., Inc. All quarries and plants worked without any lost-time injuries during the year.

Sulfur.—Sun Oil Co. recovered elemental sulfur at its Toledo Refinery. 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 Cleveland Builders Supply Co. The exfoliated vermiculite was marketed for plaster and concrete aggregate, horticultural and other applications.

MINERAL FUELS

Coal (Bituminous).—Production of bituminous coal continued to climb and exceeded the previous year by 6 percent as output totaled 51.2 million tons valued at $210 million. The average value per ton of coal rose from $3.96 in 1968 to $4.10 in 1969. This made the eighth consecutive year of increased production and established a new record high. Of the total tonnage, strip mines supplied 61 percent; underground mines, 36 percent, and auger mines, 3 percent. Captive coal accounted for 12 percent of the total output while the balance was sold on the open market. Although production increased, the number of mines producing over 1,000 tons decreased from 372 in 1968 to 322 in 1969. Underground mines decreased by nine for a total of 46; strip mines declined by 33 for a total of 230; augar mines totaled 46, decreasing by eight. Bituminous coal production was reported in Summit County which raised the number of reporting counties to 26 compared with 25 in 1968. Belmont and Harrison Counties continued to be the leading coal producing areas with 14.1 and 10.9 million tons, respectively. These counties accounted for nearly half of the State's total tonnage.

Table 10.—Coal (bituminous) production
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	39,390	$146,028
1966	43,341	164,444
1967	46,014	176,921
1968	48,323	191,427
1969	51,242	210,082

Coal recovered from underground mines increased from 16.3 million tons in 1968 to

18.6 million tons; average value was $4.65 per ton compared with $4.46 in 1968. Over 18 million tons of the underground coal was mechanically loaded from 32 of the 46 mines. Continuous mining machines numbering 79, an increase of four over 1968, continued the trend of increasing mechanization with over 10 million tons being mined and loaded compared with 9.4 million tons over the previous year. Eighty-one percent of the tonnage mined by continuous miners was loaded into shuttle cars; 18.7 percent onto conveyors and the remainder into rubber-tired mine cars. Coal not mechanically loaded was cut by 79 cutting machines and drilled with 47 mobile drills and 23 hand-held and post-mounted drills.

Auger production rose from 1.5 to 1.6 million tons and averaged $3.63 per ton compared with $3.39 in 1968. Noble County was the leading area for auger mined coal with an output of 315,492 tons. Jefferson, Tuscarawas, and Columbiana were other leading areas.

Strip production rose from 30.5 million tons in 1968 to 31.0 million tons in 1969. Average value was $3.79 compared with $3.72 in 1968. Belmont County was the leading area for strip-mined coal producing 7.3 million tons followed by Harrison, Jefferson, and Muskingum with 4.8 million, 4.0 million and 2.8 million tons, respectively. Other counties producing over a million tons were Noble, Coshocton, and Tuscarawas. Strip mine operators used 45 electric, 17 diesel-electric, 394 diesel and 13 gasoline powered shovels or draglines. Of the 469 powered machines, 250 had a dipper capacity of less than 3 cubic yards. Sixteen shovels and 17 draglines had capacities exceeding 12 cubic yards. Twenty-seven carryall scrapers, 19 of which had a dipper capacity of over 12 cubic yards, also were used along with 403 bulldozers. Nine miles was the average distance the coal was hauled from the pits to tipples.

Nineteen cleaning plants prepared 15.6 million tons by wetwashing and pneumatic methods. Of this total, 95.6 percent was by wetwashing, the balance by pneumatic methods. Underground mines accounted for 12.3 million tons of the cleaned coal; 3.2 million tons from strip mines and the remainder from auger mines. Over 4.2 million tons of coal was dried at six plants using 13 units. Tonnage dried increased over a million tons above that of 1968. The size of feed ranged from 0 to 2.0 inches.

Table 11.—Coal (bituminous) production, by counties [1]

(Thousand short tons and thousand dollars)

County	1968					1969				
	Number of mines			Total production [2]		Number of mines			Total production [2]	
	Underground	Strip	Auger	Quantity	Value	Underground	Strip	Auger	Quantity	Value
Athens	6	2	------	227	$880	3	4	------	113	$462
Belmont	9	22	5	12,566	50,595	9	19	4	14,093	59,921
Carroll	------	7	1	454	1,707	------	W	W	365	1,435
Columbiana	3	28	12	1,133	3,780	4	25	5	1,159	4,028
Coshocton	3	11	2	2,742	11,654	W	11	W	2,770	12,650
Gallia	2	5	3	107	314	3	5	------	89	278
Guernsey	1	6	1	509	1,582	------	3	------	58	W
Harrison	6	15	1	10,532	44,722	5	18	2	10,938	47,520
Hocking	------	9	------	131	506	------	7	1	89	330
Holmes	------	5	------	217	731	------	4	------	288	W
Jackson	3	18	------	910	3,167	W	15	W	976	3,358
Jefferson	5	32	12	5,022	18,999	3	26	11	5,160	20,164
Lawrence	------	4	------	W	W	------	W	------	W	W
Mahoning	------	12	------	505	2,054	------	W	W	397	1,561
Meigs	1	2	1	49	153	1	------	------	13	50
Monroe	1	------	------	W	W	W	------	------	W	W
Morgan	------	1	------	W	W	------	2	------	825	W
Muskingum	3	13	1	2,013	8,212	3	7	1	2,796	9,653
Noble	------	11	4	2,382	8,077	------	8	5	2,757	9,775
Perry	6	12	1	3,108	11,643	W	9	W	3,310	14,335
Stark	------	11	------	335	1,143	------	W	W	359	1,235
Summit	------	------	------	------	------	------	W	------	W	W
Tuscarawas	4	27	10	2,532	9,671	W	28	W	2,514	9,375
Vinton	2	8	------	227	953	1	6	------	311	1,329
Washington	------	1	------	W	W	------	W	------	W	W
Wayne	------	1	------	27	W	------	1	------	26	79
Undistributed	XX	XX	XX	2,597	10,885	14	32	17	1,835	12,542
Total	55	263	54	48,323	191,427	46	230	46	51,242	210,082

XX Not applicable.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Excludes mines producing less than 1,000 short tons.
[2] Data may not add to totals shown because of independent rounding.

Over 26 million tons of coal was crushed, and 4.2 million tons was treated. Most of the coal was treated with oil for allaying dust with calcium chloride to prevent freezing. Of the total coal production, 32.7 million tons was shipped by rail or water, 13.9 million tons by truck, and the rest was consumed locally.

Preliminary employment data indicates that an average of 7,900 men worked 15.6 million man-hours. Thirteen fatalities were recorded; the same as in 1968. Nonfatal injuries totaled 490. Of the total fatalities, eight were at underground mines, four at strip mines, and one at an auger mine. In National Safety Competition, Surface-Coal Group, Certificates of Achievement in Safety were awarded to Georgetown No. 24 and West Farm No. 22 mines of Hanna Coal Co., Division of Consolidated Coal Co., Broken Aro mine of Peabody Coal Co., and Carol 3 strip mine of Nucci Coal Co.

Peat.—Shipments and value of peat were greater than that of 1968 but lower unit prices were reported. The average value per ton decreased from $14.42 in 1968 to $10.73. Production was reported in 10 counties; Stark County ranked first in tonnage with two operations. At active operations, production of peat moss predominated, but quantities of reed-sedge and humas peat also were recovered. Most peat producers processed their material chiefly by shredding and drying. Only a limited quantity of peat was unprepared. Peat was sold chiefly in bulk form for soil improvement purposes.

Petroleum and Natural Gas.—Compared with 1968, petroleum production declined but value increased because of higher unit prices. Output in value of natural gas increased; the unit value also was higher. According to the American Association of Petroleum Geologists, total well completions increased from 1,163 in 1968 to 1,238 and footage drilled increased from 4,207,000 to 4,752,000. A total of 1,185 development and 53 wildcat completions were reported. Development wells were drilled in 44 counties; Stark County with 171 wells was the leading area. Significant development drilling also was conducted in Guernsey (148 wells) and Muskingum Counties (118 wells). Wildcat completions were reported in 23 counties; Guernsey County with 14 completions was the principal area for wildcat activity. The number of wildcat completions declined from 79 in 1968 to 53. Most drilling operators in Ohio used cable tool equipment.

Reserves on December 31, 1969 were 809,293 million cubic feet of natural gas (14.73 pounds per square inch absolute, at 60° F) and 127.4 million barrels of crude petroleum according to American Gas Association and American Petroleum Institute. Compared with the end of 1968, reserves of natural gas increased by 25.4 million cubic feet and crude petroleum decreased by 4.9 million barrels. Of the natural gas reserves 416,914 million cubic feet was held in underground storage. No reserves of natural gas liquids were reported owing chiefly to revisions of the previous years' reserves of 523,000 barrels.

Refineries were active throughout the State processing crude petroleum into gasoline and other petroleum products including asphalt, coke, lubricants, and paraffin. Companies used catalytic and thermal cracking and reforming, hydrocracking, coking, and alkylation processing for recovering gasoline and other products.

METALS

Aluminum.—Output and value of primary aluminum produced at the Hannibal reduction plant of Ormet Corp. were greater than that of 1968. A higher average value per ton also reported. Ormet Corp., jointly owned by Olin Corp. (formerly Olin-Mathieson Chemical Corp.) and Revere Copper & Brass, Inc., reduced alumina obtained by barge from a company-owned plant at Burnside, La. Bauxite imported from Surinam was processed into alumina at the Burnside plant. Olin Corp. operated a casting and rolling mill adjacent to the reduction plant.

Beryllium.—Beryllium metal, alloys, and compounds were produced from hand-sorted beryl by Brush Beryllium Corp. at Elmore. Production was mostly beryllium and beryl-copper master alloy.

Ferroalloys.—Shipments of ferroalloys were greater than that of 1968. Production at nine plants consisted mainly of ferroalloys of boron, columbium, chromium, manganese, silicon, silvery pig iron, silicomanganese, titanium, and vanadium. Ohio continued as the foremost producer among the 16 ferroalloy-producing States.

Iron and Steel.—Steel production at Ohio plants was 24.2 million short tons, 7 percent greater than that of 1968, accord-

Table 12.—Oil and gas well drilling in 1969, by counties

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Ashland	25	1	13				39	28,266
Ashtabula					3	1	4	18,293
Athens	2	4	5				11	27,500
Belmont	2	1					3	4,505
Carroll	66		4	1			71	376,168
Champaign						2	2	4,152
Columbiana	3	14	3		2	2	24	135,429
Coshocton	48	1	6	1		2	58	187,313
Delaware	1		1			1	3	8,055
Erie		1				1	2	5,404
Fairfield	3						3	8,002
Fulton			5			1	6	18,184
Guernsey	30	113	5	1	12	1	162	831,168
Hardin		3					3	4,318
Harrison					1	1	2	16,236
Henry	1						1	1,594
Hocking	31	4	5				40	119,761
Holmes	6	1	1				8	28,426
Jefferson	1						1	1,447
Knox	13	6	5				24	68,995
Lake			1				1	1,004
Lawrence		1					1	3,680
Licking	57	3	9			2	71	181,030
Lorain	3	1	9			1	14	23,083
Mahoning	1	3					4	21,523
Medina	8	12	6				26	80,816
Meigs	1	10	6		1	1	19	79,760
Mercer			1				1	1,220
Monroe	16	6	4	1			27	60,277
Morgan	2	9	5				16	14,157
Morrow	11		36			1	48	153,962
Muskingum	45	65	8		1	1	120	499,929
Noble		35	6		4		45	222,950
Perry	71	2	11				84	250,108
Portage			2				2	9,062
Putnam	1						1	1,304
Richland			1	1			2	8,030
Scioto		2					2	712
Seneca			1			1	2	4,184
Shelby	1		1				2	1,790
Stark	151	19	1			1	172	866,806
Tuscarawas	13	31	3			2	49	229,048
Vinton	3						3	3,731
Washington	12	20	5				37	77,903
Wayne	12	3	3				18	55,586
Wood			1			1	2	3,034
Wyandot			1			1	2	3,612
Total	640	371	174	5	24	24	1,238	4,751,517

Source: American Association of Petroleum Geologists (AAPG).

ing to the American Iron and Steel Institute. Production of pig iron was 16.9 million tons, 1.1 million tons above that of 1968. Shipments increased 8 percent and totaled 17 million tons valued at $1.05 billion. Nearly 15.7 million tons of basic pig iron was produced, 955,000 tons above that of 1968. Of the 45 blast furnaces in the State, 37 were active and eight idle. Ohio steel plants received 5.4 million tons of domestic iron ore and 3 million tons of imported iron ore. Iron ore receipts were 270,000 tons less than that of 1968. Receipts of agglomerates increased by 1.8 million tons and totaled 16.2 million tons. Of the agglomerated material, 15.3 million tons was domestic regular iron ore pellets. Foreign iron ore imported by Ohio steel companies came chiefly from Labrador, Quebec, and other parts of Canada and from Venezuela and Liberia. Lesser quantities were shipped from Chile, Brazil, and Australia. Blast furnaces consumed 4.2 million tons of domestic and 1 million tons of foreign iron ore as well as 20 million tons of agglomerates. In addition, 2.3 million tons of limestone and 1.2 million tons of dolomite were consumed as fluxing material. Tonnages of other materials consumed were coke and coke breeze 11.0 million, home and purchased scrap 1.1 million, slag scrap 226,000, mill cinder and roll scale 743,000 tons, open-hearth, basic oxygen, and Bessemer slag 872,000 tons, and flue dust 27,000 tons. Nearly 4.2 million tons of slag and 173,000 tons of scrap iron were produced

at blast furnaces and 668,000 tons of flue dust was recovered. Steel producers also consumed substantial quantities of supplemental fuels in blast furnaces including natural gas, bunker oil, and fuel tar.

Titanium.—Reactive Metals, Inc., jointly owned by the United States Steel Corp. and National Distillers & Chemical Corp., produced titanium sponge metal by sodium reduction of titanium tetrachloride at its Ashtabula plant. The sponge was shipped to the company's Niles plant for melting and processing. Republic Steel Corp. also melted titanium at its plants at Canton and Massillon. Primary titanium metal shipped from Henderson, Nevada was rolled and fabricated at Toronto by Titanium Metals Corporation of America (TMCA). Cabot Titanium Corp. at Ashtabula produced titanium pigments (titanium dioxide) used in manufacturing paint.

Zirconium.—Zirconium chunklets were produced at the Ashtabula plant of Reactive Metals, Inc. The company shipped the chunklets to Niles for production of ingots. The Chas. Taylor Sons Company, Cincinnati, produced zircon- and zirconia-base refractories. Zirconium oxide as well as zircon refractories were produced at Solon by Zirconium Corporation of America (ZIRCOA).

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Metallic:			
Cleveland Metal Abrasive Co., Div. of Fanner Mfg. Co.	Brookside Park Cleveland, Ohio 44109	Plant	Cuyahoga.
Do	---do	---do	Lucas.
Globe Steel Abrasives Co	P.O. Box 1247, P.O. Annex Mansfield, Ohio 44903	---do	Richland.
Metal Blast, Inc	871 East 67th St. Cleveland, Ohio 44103	---do	Cuyahoga.
The National Metal Abrasive Co.	3560 Norton Rd. Cleveland, Ohio 44111	---do	Do.
Steel Abrasives, Inc	Hamilton, Ohio 45010	---do	Butler.
Cement:			
Alpha Portland Cement Co. [1]	15 South Third St. Easton, Pa. 18043	---do	Lawrence.
Columbia Cement Co. [2]	P.O. Box 1513 Zanesville, Ohio 43701	---do	Muskingum.
The Diamond Portland Cement Co., [3] Div. of The Flintkote Co.	Middle Branch, Ohio 44652	---do	Stark.
General Portland Cement Co., [4] Peninsular Portland Cement Div.	709 Clay St. Ft. Wayne, Ind. 46802	---do	Paulding.
Marquette Cement Mfg. Co. [5]	20 North Wacker Dr. Chicago, Ill. 60606	---do	Lawrence.
Medusa Portland Cement Co. [6]	P.O. Box 5668 Cleveland, Ohio 44101	---do	Lucas.
PPG Industries, Inc. [7]	P.O. Box 31 Barberton, Ohio 44203	---do	Summit.
Southwestern Portland Cement Co. [4]	P.O. Box 191 Fairborn, Ohio 45324	---do	Greene.
Universal Atlas Cement Div., [4] U.S. Steel Corp.	Chatham Center, Box 2969 Pittsburgh, Pa. 15230	---do	Do.
Clays:			
Fire clay:			
AFC Corporation	P.O. Box 157 Canfield, Ohio 44406	Pit	Mahoning.
The Belden Brick Co	P.O. Box 910 Canton, Ohio 44701	Pit	Holmes.
Do [8]	---do	Pit	Stark.
Do [8 9]	---do	Pit	Tuscarawas.
The Belden Brick Co	---do	Underground	Do.
Cedar Heights Clay Co. [9]	P.O. Box 368 Oak Hill, Ohio 45656	Pit	Jackson.
Glen-Gery Corporation [8 10]	P.O. Box 1656 East Canton, Ohio 44730	Pit	Carroll.
Glen-Gery Corporation [10]	---do	Pit	Hocking.
Do	---do	Pit	Stark.
Kimble Coal Co. [8]	R.D. 1, Dover, Ohio 44622	Pit	Tuscarawas.
Metropolitan Industries, Inc.	306 Market Ave. North Canton, Ohio 44702	Pit	Columbiana.
H. K. Porter Co., Inc	Porter Bldg. Pittsburgh, Pa. 15219	Underground	Do.
Do	---do	---do	Jefferson.
Ralph A. Veon, Inc	Darlington, Pa. 16115	Pit	Columbiana.
Zoar Mining Co. [11]	Box 327 Beach City, Ohio 44608	Pit	Tuscarawas.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays—Continued			
Common clay and shale:			
Amvit Corp., AMVIT Div	24480 Lakeland Blvd. Euclid, Ohio 44123	Pit	Columbiana.
Do		Pit	Tuscarawas.
The Claycraft Co	P.O. Box 866 Columbus, Ohio 43216	Pit	Franklin.
Do		Pit	Tuscarawas.
Do		Pit	Wyandot.
Cleveland Builders Supply Co.[10]	2100 West Third St. Cleveland, Ohio 44113	Pit	Cuyahoga.
General Wadsworth Brick Corp.	Box 340 Wadsworth, Ohio 44281	Pit	Medina.
Hydraulic Press Brick Co	705 Olive St. St. Louis, Mo. 63101	Pit	Cuyahoga.
Marion Brick Corp	Box 548, Marion, Ohio 43301	Pit	Marion.
The Richland Brick Co.[10]	Box 328 Mansfield, Ohio 44901	Pit	Richland.
Coal (bituminous):			
B & N Coal Company[10]	Box 100 Dexter City, Ohio 45727	Strip	Noble.
B & N Coal Company[11]		Auger	Do.
Boich Mining Company	R.D. 1 Bloomingdale, Ohio 43910	Strip	Jefferson.
Do		Auger	Do.
Central Ohio Coal Company[12]	Box 98 Cumberland, Ohio 43732	Strip	Morgan, Muskingum, and Noble.
Cravat Coal Company	Box 157 Holloway, Ohio 43985	----do	Belmont.
Do		Underground	Do.
Do[10]		Strip	Harrison.
Cross Creek Coal Co	Box 167 New Philadelphia, Ohio 44663	----do	Tuscarawas.
Hanna Coal Company, Division of Consolidation Coal Company.	Cadiz, Ohio 43907	----do	Belmont.
Do		----do	Jefferson.
Do		Auger	Do.
Hanna Coal Company[13], Division of Consolidation Coal Company.		Underground	Belmont and Harrison.
Hanna Coal Company[11], Division of Consolidation Coal Company.		Strip	Harrison.
Hanna Coal Company, Division of Consolidation Coal Company.		Underground	Do.
Hardy Coal Company[12]	Berlin, Ohio 44610	Strip	Coshocton, Holmes, and Tuscarawas.
Hardy Coal Company[13]		----do	Holmes and Tuscarawas.
Hardy Coal Company		----do	Holmes.
Do		----do	Tuscarawas.
Island Creek Coal Company	P.O. Box 196 Freeport, Ohio 43973	Underground	Harrison.
J & M Mining, Inc.[10]	P.O. Box 188 New Philadelphia, Ohio 44663	Strip	Tuscarawas.
Do		Auger	Do.
The North American Coal Corporation[10]	12800 Shaker Boulevard Cleveland, Ohio 44120	Underground	Belmont.
The North American Coal Corporation.		----do	Jefferson.
Do[13]		----do	Monroe and Belmont.
Oglebay Norton Company[10]	P.O. Box 6508 Cleveland, Ohio 44101	----do	Belmont.
Ohio River Collieries Company	Route 1 Bloomingdale, Ohio 43910	Strip	Do.
Do		Auger	Do.
Peabody Coal Company	301 No. Memorial Drive St. Louis, Missouri 63102	Strip	Coshocton.
Do		----do	Perry.
Do		Underground	Do.
R. & F. Coal Company[10]	Box 218, Cadiz, Ohio 43907	Strip	Belmont.
Do		----do	Harrison.
R. & F. Coal Company		----do	Noble.
Simco-Peabody Coal Company	301 No. Memorial Drive St. Louis, Missouri 63102	----do	Coshocton.
Do		Underground	Do.
The Youghiogheny & Ohio Coal Company.	4614 Prospect Ave. Cleveland, Ohio 44103	----do	Belmont.
Do[10]		----do	Harrison.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Ferroalloys:			
Foote Mineral Co	Dept. 602, Route 100 Exton, Pa. 19341	Plant	Guernsey.
Do	do	----do	Jefferson.
Interlake Steel Corp	210 S. Michigan Ave. Chicago, Ill. 60604	----do	Washington.
Jackson Iron & Steel Co	Jackson, Ohio 45640	----do	Jackson.
Ohio Ferro-Alloys Corp	837 30th N.W. Canton, Ohio 44709	----do	Jefferson.
Do	do	----do	Muskingum.
Do	do	----do	Belmont.
Union Carbide Corp	270 Park Ave. New York, N.Y. 10017	----do	Ashtabula.
Do	do	----do	Washington.
Graphite (synthetic):			
The Ohio Carbon Co	12508 Berea Rd. Cleveland, Ohio 44111	----do	Cuyahoga.
Gypsum:			
Crude:			
The Celotex Corporation [14]	1500 North Dale Mabry Tampa, Fla. 33607	Pit	Ottawa.
United States Gypsum Co. [14]	101 South Wacker Dr. Chicago, Ill. 60606	Underground	Do.
Calcined: National Gypsum Company.	325 Delaware Ave. Buffalo, N.Y. 14202	Plant	Lorain.
Lime:			
Basic Incorporated	845 Hanna Bldg. Cleveland, Ohio 44115	----do	Seneca.
Cuyahoga Lime Company	Menlo Park, N.J. 08817	----do	Cuyahoga.
Diamond Shamrock Chemical Co., Unit of Diamond Shamrock Corp.	300 Union Commerce Bldg. Cleveland, Ohio 44115	----do	Lake.
The National Lime & Stone Co	First National Bank Bldg. Findlay, Ohio 45840	----do	Wyandot.
Huron Lime Co	P.O. Box 428 Huron, Ohio 44839	----do	Erie.
Ohio Lime Co	Woodville, Ohio 43469	----do	Sandusky.
Chas. Pfizer & Co., Inc	836 National Bank Bldg. Toledo, Ohio 43604	----do	Do.
PPG Industries, Inc	Barberton, Ohio 44203	----do	Summit.
Republic Steel Corp	1630 Republic Bldg. Cleveland, Ohio 44101	----do	Lake.
Standard Lime & Refractories Co., Div. Martin-Marietta Corp.	2000 First National Bank Bldg. Baltimore, Md. 21203	----do	Sandusky.
Union Carbide Corp., Chemicals & Plastics.	P.O. Box 299 Marietta, Ohio 45750	----do	Ashtabula.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	----do	Ottawa.
Peat:			
Beaver Peat Products Co	Box 136 Damascus, Ohio 44619	Bog	Mahoning.
Corell Peat Moss	Box 340, Rt. 1 Beach City, Ohio 44608	Bog	Stark.
Green Oaks Peat Moss Co	2240 Lake Rockwell Rd. Ravenna, Ohio 44266	Bog	Portage.
The Humus Co	2628 South Michigan St. South Bend, Ind. 46614	Bog	Wyandot.
Lantz Peat Moss, Inc	4594 Fulton Dr., N.W. Canton, Ohio 44718	Bog	Stark.
Montgomery Peat Moss Co	Route 1, Plymouth, Ohio 44865	Bog	Huron.
Moore's Humus & Nursery Co	R.D. 2 New Wilmington, Pa. 16142	Bog	Trumbull.
Dan E. Poljack	19675 Sheldon Rd. Cleveland, Ohio 44130	Bog	Cuyahoga.
Reynolds Farms, Inc	Route 1, Shelby, Ohio 44875	Bog	Richland.
Sphagum Peat Moss Products	Rt. 1 West Liberty, Ohio 43357	Bog	Champaign.
Paul Thompson Peat Co	R.D. 1 West Liberty, Ohio 43357	Bog	Logan.
W. C. Utzinger & Sons	6268 Jackson Pike Grove City, Ohio 43123	Bog	Franklin.
Perlite (expanded):			
The Cleveland Gypsum Co., Div. The Cleveland Builders Supply Co. [15]	2100 West Third St. Cleveland, Ohio 44113	Plant	Cuyahoga.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Lorain.
Philip Carey Corporation	320 South Wayne Ave. Cincinnati, Ohio 45215	----do	Hamilton.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	Plant	Ottawa.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Petroleum refineries:			
Ashland Oil and Refining Co	1409 Winchester Ave. Ashland, Ky. 41101	Plant	Hancock.
Do		do	Stark.
Chevron Asphalt Company	555 Market St. San Francisco, Calif. 94105	do	Hamilton.
Gulf Oil Corp	Pittsburgh, Pa. 15219	do	Do.
Do		do	Lucas.
Pure Oil Company, Div. of Union Oil Company of California.	Union Center, Los Angeles, Calif. 90017	do	Licking.
Do		do	Lucas.
Standard Oil Company of Ohio	Midland Bldg. Cleveland, Ohio 44115	do	Allen.
Do		do	Lucas.
Sun Oil Company [16]	1608 Walnut St. Philadelphia, Pa. 19103	do	Do.
Salt:			
Brine:			
Diamond Shamrock Chemical Co., a Unit of Diamond Shamrock Corp.	300 Union Commerce Bldg. Cleveland, Ohio 44115	Well	Lake.
PPG Industries, Inc. [17]	P.O. Box 31 Barberton, Ohio 44203	do	Summit.
Evaporated:			
Diamond Crystal Salt Co. [18]	916 South Riverside St. Clair, Mich. 48079	do	Do.
Excelsior Salt Works, Inc	P.O. Box 267 Pomeroy, Ohio 45769	do	Meigs.
Morton Salt Co., Div. of Morton International, Inc.	110 North Wacker Dr. Chicago, Ill. 60606	do	Wayne.
Rock:			
International Salt Co. [17]	Clarks Summit, Pa. 18411	Underground	Cuyahoga.
Morton Salt Co., Div. of Morton International, Inc.	110 North Wacker Dr. Chicago, Ill. 60606	do	Lake.
Sand and gravel:			
American Aggregates Corp	Garst Avenue at Avenue B Greenville, Ohio 45331	Pit	Champaign.
Do		Pit	Clark.
Do		Dredge	Do.
Do		Pit	Darke.
Do		Pit	Licking.
Do [11]		Pit	Franklin.
Do [10]		Pit	Montgomery.
American Materials Corp. [10]	P.O. Box 154 Hamilton, Ohio 45010	Pit	Butler.
American Materials Corp		Pit	Hamilton.
The F. H. Brewer Co	P.O. Box 128 Lancaster, Ohio 43130	Pit	Athens.
Do		Pit	Fairfield.
Canton Aggregate Co. [11]	1243 Raff Rd. S.W. P.O. Box 1387 Station C Canton, Ohio 44708	Pit	Stark.
The Central Silica Co	806 Market St. Zanesville, Ohio 43701	Pit	Knox.
Do		Pit	Perry.
Hilltop Concrete Corp	Lane Avenue Cincinnati, Ohio 45214	Pit	Greene.
Do		Pit	Montgomery.
Hocking Valley Concrete, Inc	R.D. 3, Logan, Ohio 43138	Pit	Hocking.
Wm. Miller Sand & Gravel Co	1287 Jackson Pike Columbus, Ohio 43223	Pit	Franklin.
The Middletown Sand and Gravel Co. [11]	2100 South Main St. Middletown, Ohio 45042	Pit	Butler.
Moraine Materials Co [10]	2500 East River Road Dayton, Ohio 45409	Pit	Montgomery.
Morrow Gravel Company	3535 Round Bottom Road Cincinnati, Ohio 45244	Pit	Knox.
Do		Pit	Warren.
Ohio Gravel Co., Div. of Dravo Corp. [10]	5253 Wooster Road Cincinnati, Ohio 45226	Pit	Butler.
Ohio Gravel Co., Div. of Dravo Corp. [9]		Pit	Hamilton.
Ohio Gravel Co., Div. of Dravo Corp.		Pit	Warren.
Pennsylvania Glass Sand Corp [10]	General Operations Dept. Berkeley Springs, W. Va. 25411	Pit	Portage.
Pennsylvania Glass Sand Corp		Pit	Tuscarawas.
R. W. Sidley, Inc	R.F.D. 1 Thompson, Ohio 44086	Pit	Geauga.
Do	Painsville, Ohio 44077	Pit	Do.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
Edgar Spring, Inc. [10]	Box 507 New Philadelphia, Ohio 44663	Pit	Columbiana.
Edgar Spring, Inc	----------	Pit	Holmes.
Do [19]	----------	Pit	Tuscarawas.
The Standard Slag Co. [10]	1200 Stambaugh Bldg. Youngstown, Ohio 44501	Pit	Pike.
The Standard Slag Co	----------	Pit	Portage.
Do	----------	Pit	Scioto.
Stocker Sand and Gravel Co. [10]	Gnadenhutten, Ohio 44629	Pit	Tuscarawas.
Tri-State Materials Corp	Box 1933 Parkersburg, W. Va. 26100	Pit	Meigs.
Smelters:			
Aluminum: Ormet Corp	----------	Plant	Monroe.
Titanium sponge: Reactive Metals, Inc.	----------	----do	Ashtabula.
Zinc: American Zinc Oxide Company.	----------	----do	Franklin.
Stone:			
Dolomite (crushed and broken):			
Basic Incorporated	845 Hanna Bldg. Cleveland, Ohio 44115	Quarry	Seneca.
Davon, Inc. [10]	Box 5765 Columbus, Ohio 43221	----do	Adams.
The Melvin Stone Co	R.R. 4 Wilmington, Ohio 45177	----do	Clinton.
National Lime and Stone Co	First National Bank Bldg. Findlay, Ohio 45840	----do	Wyandot.
Ohio Lime Co	Woodville, Ohio 43469	----do	Sandusky.
Chas. Pfizer & Co., Inc	836 National Bank Bldg. Toledo, Ohio 43604	----do	Do.
Standard Lime & Refractories Co., Div. Martin-Marietta Corp.	2000 First National Bank Bldg., Baltimore, Md. 21203	----do	Do.
Toledo Stone & Glass Sand Co	1800 Toledo Trust Bldg. Toledo, Ohio 43604	----do	Lucas.
Dolomite (dimension): E. R. Lintner Co.	Route 3, Flat Rock Rd. Bellevue, Ohio 44811	----do	Seneca.
Limestone (crushed and broken):			
American Aggregates Corp	Garst Avenue at Avenue B Greenville, Ohio 45331	----do	Madison.
American Aggregates Corp. [9]	----------	----do	Montgomery.
Armco Steel Corp	P.O. Box 911 Piqua, Ohio 45356	----do	Miami.
Bessemer Cement Co., Subsidiary of Louisville Cement Co. [8]	510 Hanna Bldg. Cleveland, Ohio 44115	----do	Mahoning.
Carbon Limestone Co	Lowellville, Ohio 44436	----do	Do.
Diamond Stone Quarries, Inc. [10]	R.F.D. 1 Albany, Ohio 45710	----do	Athens.
The France Stone Co	1800 Toledo Trust Bldg. Toledo, Ohio 43604	----do	Lucas.
Do	----------	----do	Sandusky.
Do	----------	----do	Seneca.
Do	----------	----do	Wood.
Marble Cliff Quarries Co	2100 Tremont Center Columbus, Ohio 43221	----do	Delaware.
Do	----------	----do	Franklin.
Do	----------	----do	Preble.
Maumee Stone Co	P.O. Box 369 Maumee, Ohio 43537	----do	Lucas.
Do	----------	----do	Paulding.
Do [10]	----------	----do	Wood.
National Lime & Stone Co	First National Bank Bldg. Findlay, Ohio 45840	----do	Allen.
Do	----------	----do	Auglaize.
Do	----------	----do	Crawford.
Do	----------	----do	Delaware.
Do	----------	----do	Hancock.
Do	----------	----do	Marion.
Do	----------	----do	Putnam.
Sandusky Crushed Stone Co., Inc.	P.O. Box 527 Sandusky, Ohio 44870	----do	Erie.
Standard Slag Co	1200 Stambaugh Bldg. Youngstown, Ohio 44501	----do	Mahoning.
Do	----------	----do	Ottawa.
Wagner Quarries Co	East Market St. Sandusky, Ohio 44870	----do	Erie.

See footnotes at end of table.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone (crushed and broken)—Continued			
Woodville Lime & Chemical Co.	Box 218 Woodville, Ohio 43469	Quarry	Sandusky.
Wyandot Dolomite, Inc	Carey, Ohio 43316	do	Wyandot.
Limestone (dimension):			
Bluffton Stone Co	Bluffton, Ohio 45817	do	Allen.
Gregory Stone Co., Inc	1860 No. Gettysburg St. Ludlow Falls, Ohio 45339	do	Miami.
Quartzite (crushed):			
Cambria Clay Products Co	Black Fork, Ohio 45615	do	Pike.
A. P. Green Refractories Co., Durex Division. [11]	P.O. Box 255 Oak Hill, Ohio 45656	do	Do.
Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	do	Geauga.
Southern Silica, Inc	Box 22 Richmondale, Ohio 45673	do	Ross.
Sandstone (crushed and broken):			
Alan Stone Company, Inc	P.O. Box 127 Chesterhill, Ohio 43728	do	Meigs.
Do		do	Monroe.
Alan Stone Company, Inc [10]		do	Washington.
Walter C. Best, Inc	Box 87 Chardon, Ohio 44024	do	Geauga.
PPG Industries, Inc	P.O. Box 31 Barberton, Ohio 44203	do	Summit.
Sperry Road Sand & Gravel Co., Inc.	R.D. 4, Hobart Rd. Willoughby, Ohio 44094	do	Lake.
Sandstone (dimension):			
Briar Hill Stone Co. [19]	Glenmont, Ohio 44628	do	Coshocton.
Briar Hill Stone Co. [10]		do	Holmes.
Briar Hill Stone Co. [11]		do	Knox.
Cleveland Quarries Co	Amherst, Ohio 44001	do	Erie.
Cleveland Quarries Co [20 21]		do	Lorain.
The Taylor Stone Co	McDermott, Ohio 45652	do	Scioto.
The Waller Brothers Stone Co. [11]		do	Do.

[1] Also cement rock. [2] Also shale and limestone. [3] Also clay, shale, and limestone.
[4] Also clay and limestone. [5] Also clay and cement rock. [6] Also sand, shale, and limestone.
[7] Also limestone. [8] Also shale. [9] Four operations. [10] Two operations. [11] Three operations.
[12] One operation in three counties. [13] One operation in two counties. [14] Also calcined.
[15] Also exfoliated vermiculite. [16] Also byproduct sulfur. [17] Also evaporated salt.
[18] Also brine. [19] Five operations. [20] Also grindstones and crushed and broken sandstone.
[21] Six operations.

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 Arel B. McMahan [1] and William E. Ham [2]

Value of minerals produced in Oklahoma in 1969 exceeded $1 billion for the third consecutive year. An aggregate gain of about 7 percent in value was reported in the output of mineral fuels with increases in all commodities except liquefied petroleum gases, which declined 13 percent. Value of coal production increased 66.6 percent. Overall nonmetallic mineral output value increased 14 percent but losses were recorded for tripoli and volcanic ash. The total value of metals production declined about 31 percent but a gain was registered for copper; losses were reported in output of lead and zinc; silver output value was equal to that of 1968.

Mineral fuels accounted for more than 94 percent of the total mineral output value in the State, nonmetallic minerals contributed almost 6 percent, and metals production accounted for less than 1 percent.

[1] Mineral specialist, Bureau of Mines, Bartlesville, Okla.
[2] Geologist, Oklahoma Geological Survey, Norman, Okla.

Table 1.—Mineral production in Oklahoma [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	726	$967	802	$1,182
Coal (bituminous) do.	1,089	6,401	1,838	10,662
Gypsum do.	931	2,565	[3] 980	3,912
Helium:				
High-Purity thousand cubic feet	308,600	8,700	220,500	7,718
Crude do.	--------	--------	132,900	1,123
Lead (recoverable content of ores, etc.) short tons	2,387	631	605	180
Natural gas million cubic feet	1,390,884	197,506	1,523,715	233,128
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels	13,905	38,829	14,621	38,931
LP gases do.	25,497	39,520	27,304	34,403
Petroleum (crude) do.	223,623	668,202	224,729	701,155
Salt thousand short tons	7	44	9	51
Sand and gravel do.	5,041	6,288	5,262	7,156
Stone do.	17,290	21,950	18,799	23,650
Zinc (recoverable content of ores, etc.) short tons	6,921	1,869	2,744	801
Value of items that cannot be disclosed: Bentonite, cement, copper, lime, silver, tripoli, and volcanic ash	XX	23,360	XX	26,758
Total	XX	1,016,832	XX	1,090,810
Total 1967 constant dollars	XX	1,015,952	XX	p 1,044,962

p Preliminary. 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."
[3] Supersedes figure shown in commodity chapter.

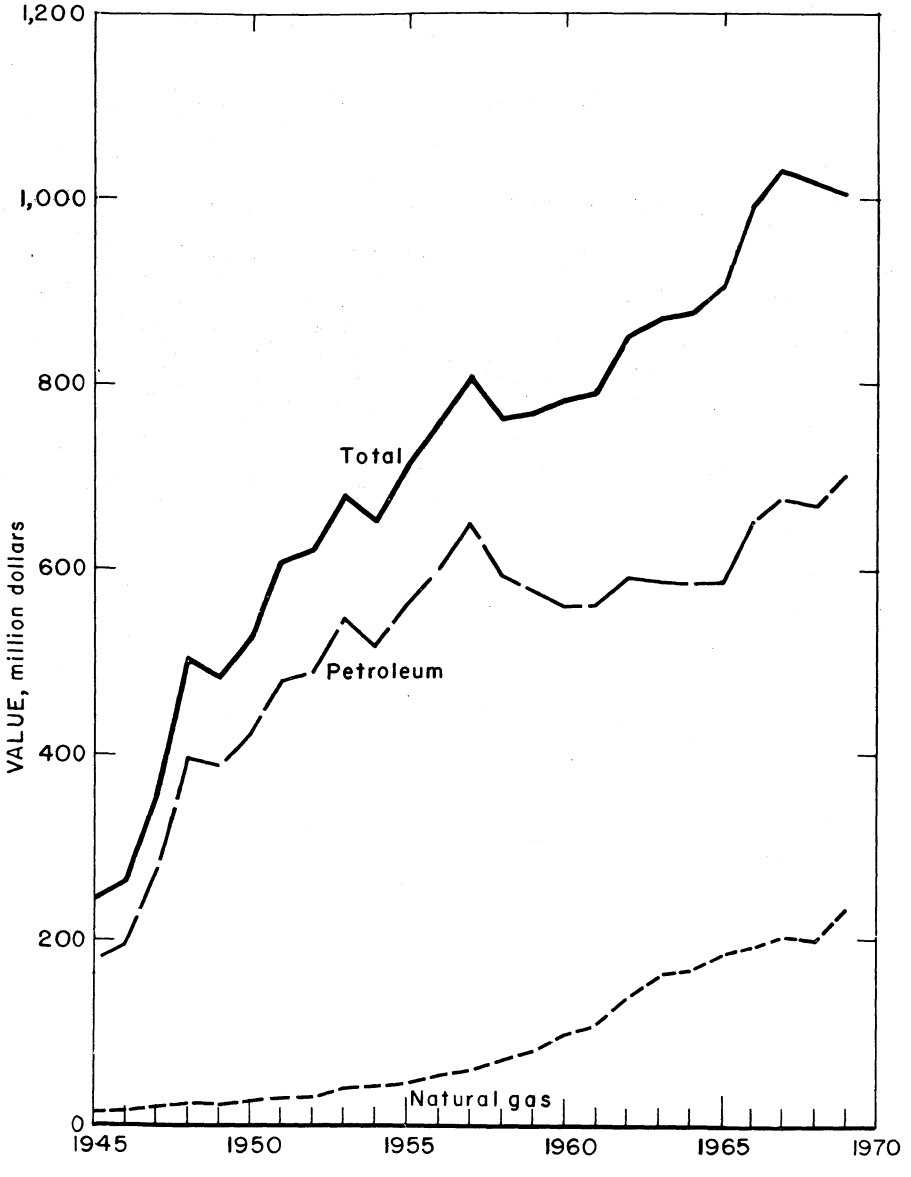

Figure 1.—Value of natural gas, petroleum, and total value of mineral production in Oklahoma.

Table 2.—Value of mineral production in Oklahoma by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Alfalfa	$6,592	$7,391	Petroleum, natural gas, natural gas liquids, sand and gravel.
Atoka	W	W	Stone, petroleum.
Beaver	50,575	57,697	Petroleum, natural gas, natural gas liquids, volcanic ash.
Beckham	7,652	7,677	Natural gas, natural gas liquids, petroleum.
Blaine	11,808	15,260	Petroleum, natural gas, gypsum, natural gas liquids.
Bryan	2,527	2,522	Petroleum, natural gas, stone, sand and gravel.
Caddo	21,902	22,356	Petroleum, natural gas, stone, gypsum, natural gas liquids.
Canadian	2,591	5,389	Natural gas, petroleum, sand and gravel, clays, gypsum.
Carter	61,777	66,645	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Cherokee	W	W	Stone.
Choctaw	272	546	Stone, sand and gravel.
Cimarron	14,780	16,473	Helium, petroleum, natural gas, natural gas liquids, stone.
Cleveland	17,045	17,515	Petroleum, natural gas, natural gas liquids, stone.
Coal	2,469	2,426	Petroleum, natural gas, stone.
Comanche	3,194	3,271	Stone, gypsum, petroleum, natural gas, sand and gravel.
Cotton	4,128	3,580	Petroleum, sand and gravel, natural gas.
Craig	168	W	Coal, petroleum, natural gas.
Creek	37,161	37,582	Petroleum, natural gas liquids, stone, natural gas, clays, sand and gravel.
Custer	4,879	8,065	Natural gas, petroleum, clays.
Dewey	27,423	26,845	Petroleum, natural gas, natural gas liquids, clays.
Ellis	10,370	11,202	Natural gas, petroleum.
Garfield	39,574	40,372	Petroleum, natural gas, natural gas liquids, sand and gravel.
Garvin	69,001	72,049	Petroleum, natural gas liquids, natural gas, sand and gravel.
Grady	20,642	21,125	Petroleum, natural gas, natural gas liquids, stone.
Grant	7,352	6,786	Petroleum, natural gas, natural gas liquids.
Greer	440	499	Stone, petroleum, clays, natural gas.
Harmon	20	20	Salt.
Harper	20,466	22,292	Natural gas, natural gas liquids, petroleum, sand and gravel.
Haskell	8,225	10,637	Natural gas, coal.
Hughes	5,397	5,660	Petroleum, natural gas, stone, sand and gravel.
Jackson	3,242	3,099	Copper, petroleum, gypsum, sand and gravel, silver, zinc.
Jefferson	3,133	2,712	Petroleum, natural gas, sand and gravel.
Johnston	W	W	Sand and gravel, stone.
Kay	14,399	16,399	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Kingfisher	50,424	59,386	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	1,360	2,000	Stone, petroleum, sand and gravel, natural gas.
Latimer	14,726	17,013	Natural gas, petroleum.
Le Flore	4,008	6,309	Natural gas, coal, stone, sand and gravel.
Lincoln	12,708	11,420	Petroleum, natural gas liquids, natural gas.
Logan	9,619	8,680	Petroleum, natural gas, sand and gravel, natural gas liquids.
Love	7,193	7,758	Petroleum, natural gas, natural gas liquids.
Major	24,663	27,215	Petroleum, natural gas, natural gas liquids, sand and gravel.
Marshall	6,660	6,599	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Mayes	W	W	Cement, stone, clays, petroleum.
McClain	25,283	25,711	Petroleum, natural gas, natural gas liquids, sand and gravel.
McCurtain	945	104	Sand and gravel, stone, petroleum.
McIntosh	308	236	Natural gas, stone, petroleum.
Murray	4,391	5,176	Stone, petroleum, natural gas, sand and gravel.
Muskogee	3,168	2,323	Petroleum, sand and gravel, stone, coal, natural gas.
Noble	6,138	6,463	Petroleum, natural gas, natural gas liquids, sand and gravel.
Nowata	2,702	2,345	Petroleum, stone, natural gas.
Okfuskee	6,212	5,310	Petroleum, natural gas, natural gas liquids.
Oklahoma	20,442	19,930	Petroleum, natural gas liquids, natural gas, sand and gravel, clays, stone.
Okmulgee	4,245	3,958	Petroleum, stone, natural gas, coal.
Osage	50,728	50,027	Petroleum, stone, natural gas.
Ottawa	3,683	2,334	Stone, zinc, tripoli, lead.
Pawnee	5,675	5,360	Petroleum, natural gas, sand and gravel, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Oklahoma by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Payne	$7,777	$7,548	Petroleum, natural gas, sand and gravel, stone.
Pittsburg	3,178	4,464	Natural gas, stone, clays.
Pontotoc	19,659	22,334	Petroleum, cement, stone, sand and gravel, clays, natural gas liquids, natural gas.
Pottawatomie	10,827	10,114	Petroleum, natural gas, stone.
Pushmataha	11	38	Sand and gravel.
Roger Mills	1,377	3,519	Natural gas, petroleum.
Rogers	14,094	15,529	Cement, coal, petroleum, stone, clays, natural gas.
Seminole	26,375	28,366	Petroleum, natural gas liquids, stone, natural gas, sand and gravel, clays.
Sequoyah	3,168	W	Lime, stone, sand and gravel, natural gas.
Stephens	75,624	82,349	Petroleum, natural gas, natural gas liquids.
Texas	62,952	70,520	Petroleum, natural gas, natural gas liquids, sand and gravel.
Tillman	1,023	923	Petroleum, sand and gravel.
Tulsa	9,920	9,417	Petroleum, stone, sand and gravel, clays, natural gas.
Wagoner	476	465	Petroleum, sand and gravel, natural gas.
Washington	5,663	4,560	Petroleum, stone, natural gas.
Washita	581	662	Natural gas, petroleum, gypsum.
Woods	9,568	12,409	Natural gas, petroleum, salt, sand and gravel.
Woodward	9,790	10,813	Natural gas, petroleum, natural gas liquids, sand and gravel.
Undistributed	10,284	17,031	
Total	1,016,832	1,090,810	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Adair and Delaware Counties are not listed because no production was reported.

Table 3.—Indicators of Oklahoma business activity

	1968	1969 [p]	Change, percent
Employment and labor force, annual average:			
Total labor force—thousands	998.6	1,023.7	+ 2.5
Unemployment—do	35.1	34.5	− 1.7
Employment:			
Construction—do	34.6	37.1	+ 7.2
Manufacturing—do	120.7	126.9	+ 5.1
Mining—do	40.9	40.4	− 1.2
All industries—do	963.5	989.2	+ 2.7
Factory payrolls—millions	$817.6	$899.1	+10.0
Personal income:			
Total—do	$7,259.0	$7,872.0	+ 8.4
Per capita	$2,855.0	$3,065.0	+ 7.4
Construction activity:			
Building permits, total private nonresidential—millions	$111.7	$139.1	+24.5
Heavy engineering awards—do	$39.1	$12.4	−68.3
State highway commission:			
Value of contracts awarded—do	$64.5	$79.7	+23.6
Value of contract work performed—do	$74.0	$75.4	+ 1.9
Cement shipments to and within Oklahoma thousand 376-pound barrels	6,044.7	7,282.1	+20.4
Farm marketing receipts—millions	$846.0	$908.3	+ 7.4
Mineral production—do	$1,016.8	$1,090.8	+ 7.3

[p] Preliminary.

Sources: Oklahoma Employment Security Commission, Employment and Earnings and Monthly Report on the Labor Force, Survey of Current Business, Construction Review, U.S. Army Corps of Engineers Tulsa District, Oklahoma State Highway Department, Farm Income Situation, and Bureau of Mines.

Employment and Wages.—The Oklahoma Employment Security Commission reported 40,400 persons employed in the mineral industry, compared with 40,900 in 1968; the loss in employment was mainly in the petroleum industry which accounts for approximately 95 percent of the State's mineral industry employment. The mineral production industry employs about 4 percent of the State's total labor force.

Government Programs.—Construction on the Arkansas-Verdigris River Navigation System was accelerated to meet the scheduled 1970 completion date. Construction was underway on facilities at the Port of Catoosa in Rogers County. Notable prog-

Table 4.—Worktime 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
1968:								
Coal	263	246	65	503	-----	20	39.78	1,378
Metal	351	280	98	776	-----	33	42.53	767
Nonmetal	576	238	137	1,095	-----	30	27.40	452
Sand and gravel	271	270	73	617	-----	14	22.68	1,471
Stone	1,212	267	323	2,687	1	58	21.96	2,675
Total	2,673	261	696	5,678	1	155	27.48	1,740
1969:p								
Coal	315	260	82	634	3	20	36.26	29,477
Metal	220	277	61	492	-----	15	30.47	886
Nonmetal	520	244	127	1,007	1	46	46.69	6,750
Sand and gravel	290	258	75	647	-----	19	29.36	630
Stone	1,355	270	366	3,054	-----	74	24.23	790
Total [1]	2,700	263	711	5,835	4	174	30.51	4,928

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

ress was made on construction of the five locks and dams of the navigation system in Oklahoma. At yearend, W. D. Mayo Lock and Dam (no. 14), nine miles southwest of Fort Smith, Ark., on the LeFlore-Sequoyah County Line, was 72 percent complete; Robert S. Kerr Lock and Dam (no. 15), eight miles south of Sallisaw, Okla., on the LeFlore-Sequoyah County Line, was 89 percent complete; Webbers Falls Lock and Dam (no. 16), five miles northwest of Webbers Falls in Muskogee County, was 62 percent complete; Lock and Dam No. 17, on the Verdigris River, seven miles south of Inola, Okla., in Wagoner County, was completed. The U.S. Army Corps of Engineers let contracts for plugging 1,050 abandoned oil and gas wells in the Oologah Reservoir in preparation for increasing the water capacity of the lake.

The Interstate Commerce Commission granted permits to 10 barge lines for operations on the Arkansas-Verdigris Waterway.

Construction of Hugo Dam on the Kiamichi River in Choctaw County was started. Construction of Kaw Dam and Reservoir in Kay County began in January with completion scheduled for 1975. The structure is designed primarily for flood control and navigational purposes, but provisions were made for addition of power generation facilities after completion.

Subsidy payments were made to qualified mine operators in Ottawa County in the Tri-State lead-zinc mining district under the Lead-Zinc Mining Stabilization Program (Public Law 89-238). Producers were eligible for subsidy payments on zinc through April while the market price was below 14.5 cents per pound. Payments were made on lead through May, at which time the market price climbed above 14.5 cents per pound; the market prices for zinc and lead remained above 14.5 cents for the rest of the year.

The Bureau of Mines Bartlesville Mineral Supply Field Office conducted mineral resource studies in the State involving coal, copper, clays, and petroleum.

Environmental Activities.—The Oklahoma Corporation Commission which regulates the petroleum industry amended the earthen pit lining rules to prevent pollution from "frac" pits. Effective February 3, 1969, all frac pits containing deleterious substances, including salt water, shall be constructed of or sealed with an impervious material to prevent seepage and subsequent pollution of surface and subsurface fresh water. Exceptions are detailed in "Regulations of the Oklahoma Corporation Commission, Conservation Division," issued in February 1969.

The Oklahoma Air Pollution Council appointed by the Governor under the Oklahoma Clean Air Act of 1967, held regular monthly meetings throughout the year. Regulations developed by the Council were submitted to the State Board of Health for consideration.

As an incentive for installation of air pollution control devices, the Oklahoma

Legislature passed an income tax credit bill effective April 18, 1969. The Act provides for total recovery of net investment costs for installation of air pollution control devices.

Armco Steel Corp. began construction of a $1 million air pollution control system at its Sand Springs plant in Tulsa County. The facility will cool and filter gases from two 75-ton electric furnaces. Completion of the facility was scheduled for late 1970.

Delta Mining Corp. began installation of an air pollution control system at its dolomitic limestone crushing plant at Troy in Johnston County. The system will collect dust from secondary crushers. The dust will be bagged and marketed for soil conditioner. Construction was scheduled for completion in 1970.

Strip-mine operators reclaimed mined land in accordance with the "Open Cut Land Reclamation Act" of 1968. The Act requires grading the tops of peaks to a minimum width of 10 feet, and ridges to a minimum of 15 feet. Acid-forming mineral seams must be covered by at least two feet of earth or spoil. The Act requires reforestation or seeding for grazing of all lands affected by surface mining.

Mine operators and landowners in the coal mining districts in eastern Oklahoma successfully experimented in test areas with total reclamation of strip-mined lands. Some lands have been reclaimed and seeded to grasses and small grains. In western Oklahoma, in the "red bed" copper mining district, Eagle-Picher Industries, Inc., planted numerous varieties of trees on the strip-mined arid land in Jackson County, two varieties were found that could be used for reforestation of affected lands.

In Harmon County, southwest Oklahoma, Western Salt Co. and Salton Salt Co. recovered salt from brine springs along Elm Fork Creek. Salt from the springs is a pollutant of Lake Texoma on the Red River. During the year, 1,470 tons of salt were removed from the source. Recent expansion by the two companies will increase the potential salt production from the springs to over 300,000 tons per year.

National Zinc Co., Inc., at Bartlesville, Washington County, completed a 275-ton-per-day acid plant. The plant, which recovers sulfuric acid from calcining gases generated in the process of smelting zinc concentrates to slab zinc, went on stream May 15.

The U.S. Geological Survey published a report pertaining to possible pollution of the fresh water aquifers in the Ogallala Formation in the Oklahoma Panhandle and adjacent areas of Texas, Kansas, Colorado, and New Mexico. The Ogallala aquifers are said to be threatened by waste salt water and brine disposed of through wells into the underlying Glorieta Sandstone. The report, Geological Survey Circular 630, "Hydrogeologic Information on the Glorieta Sandstone and the Ogallala Formation in the Oklahoma Panhandle and adjoining areas as Related to Underground Waste Disposal," is free on application to the U.S. Geological Survey, Washington, D.C.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Proved reserves of crude petroleum and natural gas declined for the third straight year, because exploratory and development drilling failed to find new reserves to keep pace with production rates. The American Petroleum Institute (API) reported a decline in reserves of less than 1 percent in proved crude petroleum and the American Gas Association, Inc. (AGA) reported a 4-percent decline in natural gas; however, a 4-percent increase was reported in natural gas liquid reserves.

Exploratory and development drilling was accelerated during the year. In 1969 a total of 3,113 wells, averaging 5,177 feet in depth, were drilled compared with 2,739 wells drilled averaging 4,912 feet in depth, in 1968. A total of 546 exploratory wells were drilled to an average depth of 5,750 feet, compared with 419 exploratory wells drilled in 1968 to an average depth of 4,755 feet.

The oil and gas tax depletion allowance was reduced from 27.5 percent to 23 percent by the first session of the 91st United States Congress. The effects of the depletion cut on the State's producers were analyzed by the Bureau for Business and Economic Research, University of Oklahoma, in "The Impact of Changes in the

Intangible Drilling Costs and Depletions Allowance Provisions on the Independent Oil Producers in Oklahoma and on the Oklahoma Economy," published in August 1969.

Williams Bros. Pipe Line Co. negotiated an agreement with the Arkansas-Verdigris River Navigation Port Authorities for construction and operation of a $2 million terminal and transportation service center at the Port of Catoosa in Rogers County. The facilities will handle oil products, fertilizers, and other chemicals, wet and dry. The terminal will handle transfer and storage between barges, trucks, rail carriers, and Williams Bros. 7,000-mile pipeline system. Continental Pipe Line Co. completed 80 miles of 2-inch diameter and 60 miles of 3-inch diameter lease connection lines.

Arkansas-Louisiana Gas Co. announced plans to construct an 80-mile, 30-inch diameter loop gas line in the Arkoma Basin of eastern Oklahoma and western Arkansas; a 42-mile, 30-inch diameter gas transmission line in Arkansas and Oklahoma; and a 22-mile, 30 inch diameter loop line in Latimer and Le Flore Counties, Okla.

The Kansas-Oklahoma Division of the Mid-Continent Oil and Gas Association, in cooperation with the Bureau of Mines, Bartlesville Petroleum Research Center (BPRC), Bartlesville, Okla., prepared a field index report showing 2,300 oil and gas areas in Oklahoma in 1968. The report, "Index to Names of Oil and Gas Fields in Oklahoma 1968," and a 1969 supplement are available from the BPRC and the Mid-Continent Oil and Gas Association, Tulsa, Okla. The latter association also published a report pertaining to water use by the petroleum industry of Oklahoma in secondary recovery of oil. The report "Water/Oil in Oklahoma" is available from the association's office in Tulsa, Okla.

Carbon Black.—Furnace carbon black was produced from liquid hydrocarbons at Ponca City, Kay County, by the Continental Oil Co. The product was used by the rubber industry in the manufacture of tires, shoe soles and heels, gaskets, conveyor belts, and hose. The output increased substantially in quantity and value in 1969.

Coal.—Bituminous coal output increased about 69 percent in quantity and about 67 percent in value in 1969. Production in 1969 exceeded 1 million tons and reached a 12-year high; in 1957 production was slightly over 2 million tons. Coal was produced by nine operators in six counties from 10 mines (seven strip, two underground, and one combination stripauger). Two operators produced less than 1,000 tons each from two mines (one strip and one underground) in two counties.

Table 5.—Coal (bituminous) production [1]

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	974	$5,520
1966	843	4,935
1967	823	4,703
1968	1,089	6,401
1969	1,838	10,662

[1] Excludes mines producing less than a thousand short tons.

About 70 percent of the coal was used in electric power generation; the remainder was used for metallurgical coking in the United States and abroad. Coal from Le Flore County was exported to Japan.

Development of the "Choctaw" mine in Haskell County was continued by Kerr-McGee Corp. The second shaft was completed in January to a total depth of 1,412 feet. With completion of the shaft, development work began on entries and haulageways which were scheduled for completion in 1971 when the mine will produce at a rate of 1 million tons per year. The first production was reported from the mine in June.

Training of coal miners for underground mine operation was continued at the Kerr-McGee "Mining Machine Operators School" at the Choctaw mine. Prospective employees are trained to operate continuous mining machines, set mine timbers, install roof bolts, and install conveyor belts. First aid training and emergency procedures are a part of the training program. The company plans to train about 150 to 200 miners for immediate employment in the Choctaw mine and will continue operation of the school through the life of the mine.

Howe Coal Co. continued development of its underground mine in Le Flore County. Two inclined shafts and a vertical shaft were completed; construction of another incline was scheduled for 1970. A 500-ton-per-hour washing plant was constructed at the mine site near Heavener. Production from the Howe mine is ex-

pected to reach 1 million tons per year in 1971 or early 1972.

Construction work began on an automated terminal for handling coal in the Port Arthur, Tex., Industrial Park. Coal from the Howe mine will be loaded at Port Arthur for shipment to Japan.

Peabody Coal Co. expanded its strip-mine operation in Craig County. A 25-cubic-yard shovel was placed in operation during the year; a 40-cubic-yard shovel was erected on the company's lease in 1968. Production from the two shovels is expected to exceed 1 million tons per year.

During the year, much interest was shown in Oklahoma coal by several large companies and many individuals. Elcor Chemical Corp. secured a prospecting permit for coal on 5,000 acres of "Indian Land" in southeast Oklahoma. North American Resources Corp. (formerly Texota Oil Co.) acquired leases on 26,000 acres of coal land.

The Bureau of Mines Bartlesville Mineral Supply Field Office conducted a study of the strippable coals in eastern Oklahoma. Resource estimates were calculated for economically strippable coal in 15 counties. The estimates are presented in tabular form by coal-seam thickness, by sulfur content, and by county. The study was part of a national study coordinated by the Bureau's Pittsburgh, Pa., office. The results will be published by the Bureau.

Helium.—The Bureau of Mines extracted helium from natural gas at its Keyes, Okla., plant. Total plant output was 353.4 million cubic feet, compared with 308.6 million cubic feet produced in 1968. High purity (Grade A) helium output was 220.5 million cubic feet valued at about $7.7 million. Crude helium output, 132.9 million cubic feet valued at about $1.1 million, was transported to the Cliffside gasfield in Potter County, Tex., for underground storage.

Natural Gas.—Oklahoma ranked third in the Nation in natural gas production in 1969. Gas was produced from 8,432 wells with Texas, Beaver, Latimer, and Harper Counties leading in production.

Proved recoverable reserves of natural gas in Oklahoma declined for the third consecutive year. At yearend, reserves equaled approximately 10.4 cubic feet of gas for each cubic foot produced, compared with 11.8 cubic feet of reserve for each cubic foot produced in 1968. New gas discoveries resulting from exploratory drilling, as reported by the AGA, added 888,456 MMcf to the reserve during the year.

The decline in proved reserves of natural gas in the United States and Oklahoma, according to a survey conducted by the Potential Gas Committee, is due to a lack of "wildcat" drilling. The Potential Gas Committee, financed by AGA, API, and the Independent Natural Gas Association of America, reported estimates of potential gas reserves in Kansas, Oklahoma, and west Texas at 125 trillion cubic feet. The Committee recommended deeper drilling as a necessity for expansion of proved recovery.

Table 6.—Marketed production of natural gas [1]

Year	Million cubic feet	Value (thousands)
1965	1,320,995	$182,297
1966	1,351,225	189,172
1967	1,412,952	202,052
1968	1,390,884	197,506
1969	1,523,715	233,128

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

Deep drilling in the troughs of the Arkoma and Anadarko Basins resulted in some significant discoveries during the year which increased the State's reserve potential. Glover-Hefner-Kennedy Oil Co. completed No. 1–1 Green, one mile south of Elk City, Beckham County, in the Anadarko Basin, to a total depth of 24,453 feet. The 1–1 Green is the deepest producing gas well in Oklahoma and the second deepest in the world. The producing zone of the 1–1 Green is from 21,604 to 22,652 feet, compared with a Gulf Oil Co. well in Pecos County, Tex., flowing at 22,752 feet. The 1–1 Green flow was gauged at 50 million cubic feet per day; unofficial estimates indicate that the flow could exceed 60 million cubic feet per day. In December, Glover-Hefner-Kennedy Oil Co. planned to drill a 25,000-foot wildcat about 9 miles northwest of 1–1 Green.

The Apache Corp. completed a producing gas well in Dewey County at a depth of 14,571 feet. The Marion Corp. completed a producing well in the Anadarko Basin in Ellis County with perforations from 11,290 to 11,687 feet.

Stephens Production Co. completed a producing gas well in Le Flore County, in

the Arkoma Basin, to a total depth of 8,182 feet. Cleary Petroleum Corp. completed a producing well in Haskell County to a total depth of 6,200 feet.

Drilling for low-relief targets at greater depth was expected to continue in the State. Union Oil Co. of California made location for a 24,500-foot well in Beckham County in November. Occidental Petroleum Corp. completed a producing well at 12,568 feet in the Anadarko Basin and announced plans to drill in the deep fields in Beckham County.

The Oklahoma Corporation Commission approved 1,440-acre spacing for the East Elk City Field in Beckham County. Normal gas well spacing is 640 acres.

The Bureau of Mines Bartlesville Petroleum Research Center and Sun Oil Co., DX Div., announced successful results of a chemical explosive fracturing experiment in a tight gas-producing sand formation in Osage County. A research team exploded 1,000 quarts of desensitized liquid nitroglycerin in a 5-foot section of hydraulically fractured sand. Tests after the explosion showed a 40-percent increase in the gas flow.

Natural Gas Liquids.—Output of natural gas liquids increased over 6 percent in 1969, with the recovery of 41.9 million barrels of liquefied petroleum gases (LPG), and natural gasoline and cycle products. LPG accounted for 65 percent of the volume and 47 percent of the value. Eighty-seven gas-processing plants were in operation during 1969, including two that were completed during the year.

Mobil Oil Corp. completed construction of a 12-million-cubic-foot-per-day (MMcfd) refrigerated-absorption plant at Taloga, and Mustang Gas Products Co. completed a 125-MMcfd plant at Calumet in Canadian County.

Kathol Natural Gas, Wichita, Kans., secured the Wetumka repressuring plant from Inland Petrochemical Co., Pittsburg, Kans. The plant was being reconditioned and converted to a refrigerated oil absorption process with capacity to handle 16 MMcfd of gas with a liquid output of 19,999 gallons per day.

The AGA reported an increase in recoverable reserves of natural gas liquids. Recoverable reserves were 465.7 million barrels at yearend, compared with 448.0 million barrels in 1968. Exploratory drilling added 6.8 million barrels to the reserve.

Petrochemicals.—Cherokee Nitrogen Co. announced an expansion of its facilities at Pryor in Mayes County. Additions to be made include installation of a 60-ton-per-day urea solution plant and facilities for

Table 7.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves Dec. 31, 1968	Changes in proved reserves, due to revisions, extensions and new discoveries in 1969	Proved reserves, Dec. 31, 1969 (production was deducted)	Changes from 1968 (percent)
Crude oil—thousand 42-gallon barrels	1,394,653	211,100	1,389,983	−0.3
Natural gas liquids [1]—do	448,023	58,335	465,694	+3.9
Natural gas—million cubic feet	18,368,265	888,456	17,593,197	−4.2

[1] Includes condensate, natural gasoline, and LP gases.

Source: American Gas Association and American Petroleum Institute; Proved Reserves of Crude Oil, Natural Gas Liquids and Natural Gas in the United States.

Table 8.—Natural gas liquids production

(Thousand 42-gallon barrels and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	13,575	$34,561	21,302	$32,208	34,877	$66,769
1966	13,717	35,715	23,482	44,381	37,199	80,096
1967	13,545	35,846	23,944	49,276	37,489	85,122
1968	13,905	38,829	25,497	39,520	39,402	78,349
1969	14,621	38,931	27,304	34,403	41,925	73,334

increasing output of urea-ammonium nitrate fertilizer solution 170 tons per day. Construction was scheduled for completion in February 1970.

Sun Oil Co., DX Div., announced plans for adding an isobutane cracker unit and a desulfurizer unit to its propylene tetramer recovery plant at Duncan, Stephens County. The plant feed is refinery gasses.

Petrolite Corp., Bareco Div., Tulsa, Okla., announced plans for modernization and expansion of its wax manufacturing facility at Barnsdall, Osage County. The plant will produce high-temperature melting wax for use in packaging and adhesive industries.

Petroleum.—Crude petroleum output was 224.7 million barrels compared with 223.6 million barrels in 1968. Production was obtained from 80,979 wells compared with 81,052 producing wells in 1968. Average daily production was 17.89 barrels from 14,685 allocated wells and 5.35 barrels from 66,294 unallocated wells. Daily average production from all producing wells was 7.62 barrels compared with a 7.5 barrel average in 1968. A strong demand for Oklahoma crude and an advance in the well production allowable increased the State's output during the year.

The Oklahoma Corporation Commission set the daily production oil allowable for the State's wells at 90 percent of the basic depth-acreage formula for January and February. The allowable was raised to 100 percent in March and remained unchanged through December.

Proved recoverable crude petroleum reserves declined for the third consecutive year. API data indicated a 4.7 million barrel decline in old fields, and extensions added 64.3 million barrels of reserves during the year. The State ranked fourth in the Nation in proved recoverable reserves with reserves at yearend of 1.4 billion barrels. At 1969 production rates, these reserves are sufficient for 6.2 years.

Table 9.—Crude petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1965	203,441	$587,944
1966	224,839	654,281
1967	230,749	676,095
1968	223,623	668,202
1969	224,729	701,155

Table 10.—Crude petroleum production, indicated demand, and stocks, in 1969, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Oklahoma
January	19,268	19,406	18,434
February	17,504	18,386	17,552
March	18,945	19,778	16,719
April	18,631	17,790	17,560
May	18,995	18,648	17,907
June	18,639	18,757	17,789
July	18,799	18,650	17,938
August	18,920	19,354	17,504
September	18,473	18,267	17,710
October	18,973	18,822	17,861
November	18,663	18,863	17,661
December	18,919	18,276	18,304
Total:			
1969	224,729	224,997	XX
1968	223,623	221,322	XX

XX Not applicable.

Rotary drilling activity increased during the first half of 1969. An average of 110 drill rigs were active each month from January 1 through June 30, as compared with 99 for the same period in 1968 and 97 in 1967. During the first half of the year, 252 exploratory wells were drilled resulting in a total of 55 oil and gas discoveries. For the same period in 1968, 210 wells were drilled with a total of 20 discoveries. Major County led the State in number of exploratory wells drilled.

Wilshire Oil Co. announced completion of a prolific shallow discovery well in Garvin County, 4 miles northeast of the West Civit oilfield. The well tested 1,008 barrels a day of 41° gravity crude oil at 3,350 feet. A discovery well drilled by the Daube Co., southwest of Byers, Garvin County, flowed at a rate of 900 barrels per day.

The State's refinery capacity at 14 plants was 470,800 barrels per stream day at yearend. Construction was completed in September on a new methyl-ethyl-ketone dewaxing unit at the Continental Oil Co. Ponca City refinery. The cost of the new unit was an estimated $5 million.

A study of petroleum recovery methods involving development of equipment and operating supply data and calculation of expenditures for developing and operating oil leases in the mid-continent area of Oklahoma and Kansas was begun by the Bartlesville Mineral Supply Field Office of the Bureau of Mines. The purpose of the study is to develop information related to forecasting hydrocarbon supply patterns

Table 11.—Oil and gas wells drilled in 1969, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Alfalfa	22	---	8	2	1	9	42
Atoka	---	---	1	---	---	---	1
Beaver [1]	118	33	25	6	2	4	188
Beckham	---	1	1	---	2	---	4
Blaine	7	16	15	2	2	6	48
Bryan	---	---	---	---	---	1	1
Caddo	6	1	4	---	---	4	15
Canadian	10	7	3	2	1	4	27
Carter	56	2	21	2	1	4	86
Cimarron [1]	16	3	7	1	---	---	27
Cleveland	5	---	6	3	1	9	24
Coal	5	---	2	---	1	3	11
Comanche	7	---	3	1	---	3	14
Cotton	6	---	5	---	---	3	14
Craig	1	---	1	---	---	2	4
Creek	79	---	21	1	---	7	108
Custer	---	5	3	1	---	3	12
Dewey	17	7	10	2	1	14	51
Ellis	4	7	10	---	3	3	27
Garfield	73	23	14	5	4	9	128
Garvin	58	3	41	5	1	19	127
Grady	7	3	8	---	4	6	28
Grant	6	1	7	---	---	8	22
Greer	1	2	2	---	---	5	10
Harper	1	12	23	---	---	6	42
Haskell	---	12	6	---	1	3	22
Hughes	11	12	18	5	1	9	56
Jackson	---	---	---	---	---	4	4
Jefferson	5	---	10	---	---	11	26
Johnston	---	---	---	---	---	2	2
Kay	58	2	41	2	---	15	118
Kingfisher	240	9	16	20	1	8	294
Kiowa	11	1	10	---	2	2	26
Latimer	---	16	6	---	---	1	23
Le Flore	---	20	14	---	2	---	36
Lincoln	2	2	9	1	1	8	23
Logan	30	1	6	4	---	9	50
Love	14	2	5	2	---	4	27
McClain	16	6	8	3	---	3	36
McCurtain	1	---	---	---	---	1	2
McIntosh	---	---	2	---	---	3	5
Major	69	11	22	17	9	5	133
Marshall	5	1	3	1	---	4	14
Murray	1	1	4	---	1	8	15
Muskogee	2	---	2	---	---	1	5
Noble	12	2	16	3	---	14	47
Nowata	8	---	9	---	---	2	19
Okfuskee	6	4	9	1	2	3	25
Oklahoma	17	2	5	2	---	9	35
Okmulgee	30	3	8	3	---	2	46
Osage	157	9	55	3	---	23	247
Pawnee	13	---	6	1	---	10	30
Payne	17	---	24	1	---	11	53
Pittsburg	---	15	5	---	1	4	25
Pontotoc	39	---	12	1	---	3	55
Pottawatomie	14	1	16	---	---	13	44
Pushmataha	---	---	---	---	---	1	1
Roger Mills	17	4	1	1	---	---	23
Rogers	5	---	---	---	---	1	6
Seminole	56	1	39	1	1	4	102
Sequoyah	---	6	1	---	---	---	7
Stephens	48	11	19	2	1	10	91
Texas [1]	20	17	34	1	4	8	84
Tillman	1	---	---	---	---	---	1
Tulsa	19	---	2	---	---	---	21
Wagoner	13	---	13	---	---	1	27
Washington	17	2	1	---	---	---	20
Washita	---	---	---	---	---	1	1
Woods	8	20	21	1	3	10	63
Woodward	7	21	14	1	3	16	62
Total	1,494	340	733	110	57	379	3,113

[1] Oklahoma Panhandle.

Table 12.—Production of crude petroleum, by fields

(Thousand 42-gallon barrels)

Field [1]	1965	1966	1967	1968	1969
Allen	2,192	2,636	2,773	2,713	3,260
Apache	1,518	3,102	4,287	4,545	3,841
Bowlegs	1,048	952	847	755	1,116
Burbank	12,017	10,655	8,795	7,537	6,550
Camrick	2,166	1,881	1,597	1,397	1,234
Cement	2,831	2,671	2,609	2,498	2,536
Cushing	3,110	3,499	3,978	4,565	5,095
Edmond, West	1,605	1,961	1,417	1,115	922
Enid, Northeast	2,143	2,196	2,170	1,480	-----
Eola-Robberson	3,473	3,632	4,492	5,190	5,019
Fitts	781	1,324	1,654	1,422	1,334
Garber	1,096	1,258	1,144	1,088	1,007
Glenn Pool	4,092	4,153	3,838	3,441	3,106
Golden Trend	13,544	13,440	12,952	11,961	11,661
Healdton	2,677	3,036	3,386	3,794	3,861
Hewitt	2,974	3,764	4,072	3,039	3,332
Knox	1,687	1,612	1,525	1,327	1,340
Loco	1,788	2,138	1,874	1,622	1,333
Oklahoma City	1,978	1,922	1,941	1,963	1,892
Payne	1,722	2,076	2,338	2,113	2,298
Postle	2,105	3,307	4,502	6,210	7,056
Putnam	3,081	4,879	6,130	6,253	4,722
Ringwood	1,074	5,533	4,969	3,915	3,424
Seminole	1,122	1,115	1,025	979	1,296
Sho-Vel-Tum	28,769	30,712	32,232	32,611	33,483
Sooner Trend	9,680	11,496	16,753	17,062	17,244
St. Louis	1,454	1,406	1,467	1,439	1,674
Stroud	1,151	1,220	1,239	1,133	1,123
Washington	614	729	-----	-----	1,099
Other fields	89,949	96,534	94,743	90,456	92,871
Total	203,441	224,839	230,749	223,623	224,729

[1] Based on Oil & Gas Journal data adjusted to Bureau of Mines total.

Table 13.—Petrochemical plants operating in 1969

Company	Location		Plant feed	Products and quantity [1]
	County	Nearest town		
ARCO Chemical Co. (Div. of Atlantic Richfield Co.)	Tulsa	Sand Springs	Petroleum fraction	Demulsifying agents, corrosion inhibitors, acid-layer-type petroleum sulfonate (sodium salt) and oil-layer-type petroleum sulfonate (sodium salt).
Cherokee Nitrogen Co. (Owned by Okla. Ordinance Works Authority)	Mayes	Pryor	Natural gas, urea	Ammonia (160 t/d), nitric acid (180 t/d), ammonium nitrate (150 t/d), and urea-ammonium nitrate solutions (240 t/d).
Continental Carbon Co.	Kay	Ponca City	Benzine, naphtha fraction, and propylene.	Benzine (350 b/d), propylene tetramer, and toluenexylenes mix (1,200 b/d).
Nipak, Inc.	Mayes	Pryor	Natural gas	Ammonia and urea (feed and fertilizer grade).
Do.	Tulsa	West Tulsa	----do----	Ammonia and diammonium phosphates.
Sun Oil Co. (DX Div.)	Stephens	Duncan	Refinery gases	Propylene tetramer (775 b/d). Construction: Isobutane cracker and merox desulfurizing unit.
Do.	Tulsa	Tulsa	Light reformates	Benzine, toluene, and mixed xylenes (2,200 b/d).
Petrolite Corp. (Bareco Div.)	Osage	Barnsdall	Petroleum hydrocarbons and chemicals.	Demulsifiers, corrosion inhibitors, fuel additives, industrial bactericides, antifoaming agents, antifoulants, emulsifiers, foamers, microcrystalline waxes, synthetic waxes, polymers.

[1] Quantity: b/d = barrels per day; t/d = tons per day.

under foreseeable circumstances as part of a nationwide study. It was assumed that representative leases, at various depths, consisted of 10 producing wells and two dry holes. Calculations were based upon the well and lease equipment required to produce and deliver the crude oil and gas to a pipeline.

NONMETALS

Nonmetallic mineral production valued at about $60 million was reported during 1969, a 14-percent increase over 1968 value. Cement, clays, gypsum, lime, salt, sand and gravel, and stone increased in value of output; volcanic ash and tripoli were the only nonmetallic minerals showing a decline in value in 1969. Nonmetallic mineral production accounted for almost 6 percent of the State's total mineral output value.

Cement.—Production of portland and masonry cement from the State's three plants in Mayes, Pontotoc, and Rogers Counties showed substantial gains during the year. The increase was attributed to increased building and highway construction.

Martin Marietta Corp. consolidated its Dewey Portland Cement Co. and Rocky Mountain Cement Co. in March to form the Dewey Rocky Mountain Cement Co. The production capacity of company plants will be 5.5 million barrels per year, 3 million barrels from a Rogers County plant and 2.5 million from a plant under construction in Colorado. The company has markets in Arkansas, Colorado, Kansas, and Oklahoma.

Clays.—Clay and shale, used in brick and tile products, were mined by 14 companies in 12 counties. Fire clay was produced in Creek County. Bentonite was mined in Dewey County. The output of clays, including bentonite, showed a substantial gain in both quantity and value. The increase was due to increased demands and resultant expansions in construction of brick and tile manufacturing facilities.

United Clay Pipe Co. completed a new $2 million clay-processing plant near Seminole, Seminole County, in December. The plant employs more than 100 men and has capacity to produce 40,000 tons of pipe per year.

Gypsum.—The output of gypsum was up 5 percent in quantity and 53 percent in value in 1969. Production was recorded from six counties in western Oklahoma. The gypsum was strip mined and was processed for use in wallboard, plaster, portland cement, and soil conditioner products. Republic Gypsum Co. announced plans to expand its wallboard plant at Duke in Jackson County.

Lime.—Chemical-grade lime for use in chemical products for water treatment and petroleum refining was produced at a plant in Sequoyah County. The output increased in 1969.

Table 14.—Clays sold or used by producers [1]

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	794	$806
1966	745	754
1967	744	869
1968	726	967
1969	802	1,182

[1] Excludes bentonite.

Salt.—Salt output value gained about 16 percent in 1969. Production was reported in Harmon and Woods Counties. Salt was recovered from surface incrustations on the Big Salt Plain in Woods County and from brine springs along Elm Fork Creek in Harmon County.

The Salton Salt Co. at Erick, Okla., was purchased by the Western Salt Co. Western began expansion of its newly acquired Harmon County operation and construction of a solar evaporation system to recover salt in Greer County. When construction is completed, the company will have a total of 293 acres of ponds for evaporating brine. The potential salt recovery rate will range from 900 to 1,400 tons per acre per year. Salt from Western will be processed at Erick into 26 products including table salt, rock salt, and salt for livestock feed, and the meat packing industry.

Flowers Salt Co. (operated by the former owners of Salton Salt Co.) began installation of another solar evaporation recovery system in Harmon County. Construction of the system was incomplete at yearend and no production was reported; salt will be recovered from 20 acres of ponds. Completed pump installations in the brine springs along Elm Fork Creek have a combined capacity of 130,000 gallons of brine per day. The brine contains 2.75 pounds of recoverable dry salt per gallon.

Sand and Gravel.—Production of over 5 million tons of sand and gravel was reported from 40 counties at 58 commercial operations. Contractors for the Oklahoma State Highway Department and the U.S. Army Corps of Engineers produced over 1.2 million tons. In 1969, value of the output rose 13.8 percent because of an increase in construction activities, mainly in highway construction and building construction, private residential and nonresi-

dential. Highway construction contracts were valued at more than $75.3 million in 1969, compared with $73.9 million in 1968; contracts awarded totaled over $79.6 million. Value of contracts awarded by the U.S. Army Corps of Engineers declined about $26.6 million in 1969.

Annual output rates of sand and gravel by individual commercial producers ranged from less than 25,000 tons to more than 400,000 tons. Eight operators, producing 200,000 to 500,000 tons each, accounted for 61.6 percent of total output.

Industrial sand was used for glass sand, molding, sand blasting, oil hydrafrac treatment, abrasives, and enamel. Sand and gravel was used for building, paving, ballast, fill, and decorative applications.

Table 15.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	4,570	$5,614	648	$409	5,218	$6,023
1966	4,329	6,151	1,711	1,414	6,040	7,565
1967	3,654	4,729	886	552	4,540	5,280
1968	4,283	5,691	758	595	5,041	6,288
1969	4,060	5,874	1,202	1,282	5,262	7,156

[1] Data may not add to totals shown because of independent rounding.

Table 16.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,874	$1,894	1,862	$1,943
Paving	927	888	939	1,012
Fill	345	201	280	192
Other [1]	932	2,337	892	2,593
Total [2]	4,078	5,320	3,973	5,741
Gravel:				
Building	137	282	19	31
Paving	47	79	51	70
Other [3]	21	10	17	33
Total [2]	205	371	86	134
Total sand and gravel [2]	4,283	5,691	4,060	5,874
Government-and-contractor operations:				
Sand:				
Building	71	91	288	359
Paving	311	195	781	749
Other [4]	8	6	5	4
Total	390	292	1,074	1,112
Gravel:				
Building	3	5	33	72
Paving	365	300	96	99
Total [2]	368	305	129	170
Total sand and gravel [2]	758	595	1,202	1,282
Grand total [2]	5,041	6,288	5,262	7,156

[1] Includes railroad ballast, other construction sand, and industrial sand (unground and ground).
[2] Data may not add to totals shown because of independent rounding.
[3] Includes fill, other construction gravel, and miscellaneous gravel (1969).
[4] Includes fill (1969) and other construction sand (1968).

Table 17.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Granite		Limestone		Sandstone		Miscellaneous stone		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1965	6	$503	13,121	$14,771	2,057	$2,092	1,233	$705	16,417	$18,071
1966	7	687	13,339	15,141	631	745	1,357	820	15,334	17,393
1967	12	949	13,543	15,594	1,248	1,469	1,552	920	16,355	18,932
1968	9	971	15,004	18,584	1,084	1,646	1,193	749	17,290	21,950
1969	12	1,274	16,871	20,645	474	712	1,441	1,019	18,799	23,650

[1] Data may not add to totals shown because of independent rounding.

Stone.—Stone production increased 8.7 percent and value increased over 7.7 percent in 1969. Stone was produced in 39 counties by 107 operations. Stone output included dolomite, granite, limestone, sandstone, and chat (chert and limestone rejects from the lead-zinc milling process). Dolomite was crushed and used in glassmaking and as soil conditioner; granite was quarried for dimension stone and monumental uses; limestone was crushed and used for construction, concrete aggregate, soil conditioner, in the manufacture of lime and cement, and as dimension stone; sandstone was crushed and used for concrete aggregate and glassmaking; chat was washed and screened and used as aggregate, abrasive material, and paving.

Sequoyah Industries, Inc., began preparations for opening a quarry in Johnston County. The quarry and attendant processing plant will be operated as Specialty Materials Co. High-grade limestone will be processed to produce "whiting" for use in carpeting base. Production was scheduled to begin early in 1970.

Sulfur.—Sulfur was recovered from sour natural gas at a plant in Marshall County. Byproduct sulfuric acid was produced from smelter gases at the National Zinc Co. smelter in Washington County.

Tripoli.—Tripoli, for use in buffing compounds and in foundry applications, was mined in Ottawa County; quantity and value decreased in 1969.

Volcanic Ash.—The Axtell Mining Corp., Laverne, Okla., in Beaver County, produced volcanic ash from one mine. The ash was used in scouring and cleansing compounds, hand soap, and for insulation.

METALS

Overall value of metals production decreased about 31 percent in 1969; value of lead decreased about 71 percent, and that of zinc about 57 percent. Copper output value increased 4 percent and the silver output value was equal to that of 1968. Cessation of pumping and subsequent flooding of the Picher field in Ottawa County caused the decline in lead and zinc output. The increase in value of copper output resulted from the rise in copper prices.

Copper.—Copper was produced from a deposit in Jackson County by Eagle-Picher Industries, Inc. The ore was treated at the company mill at Creta, Jackson County, and concentrates were shipped to a smelter in El Paso, Tex. Lobaris Copper Co. produced a few tons of copper ore for metallurgical testing from a deposit in Greer County.

Exploration and development activities in Beckham, Greer, and Jackson Counties were increased during the year by several mining companies. Eagle-Picher Industries, Inc., announced plans to install a 30-yard dragline at its Jackson County mine; thickness of overburden removed would be increased to 80 feet, a stripping ratio of about 160:1. Lobaris Copper Co. continued development of a strip mine and construction of a 500-ton-per-day flotation mill in Greer County; completion was scheduled for early 1970. Several mining companies were active in exploration of the "red bed" copper in the three counties. Early in the year, a drilling program was begun on a 4,000-acre lease in Greer County; several thousand acres were examined in southwest Beckham County; and drilling operations were accelerated in Jackson County.

The Bureau of Mines Bartlesville Mineral Supply Field Office terminated studies begun in July 1967 of "red bed" copper in Kansas, Oklahoma, and Texas. The results are presented in Bureau of Mines RI7422,

Table 18.—Mine production of lead and zinc, in terms of concentrate and recoverable metals [1]

(Short tons and thousand dollars)

Year	Material sold or treated	Lead concentrate		Zinc concentrate		Recoverable metal content			
						Lead		Zinc	
	Quantity	Quantity	Value [2]	Quantity	Value [2]	Quantity	Value [2]	Quantity	Value [2]
1965	595,205	3,896	$651	23,668	$2,277	2,813	$878	12,715	$3,713
1966	549,313	4,181	649	21,086	2,002	2,999	907	11,237	3,259
1967	442,858	3,935	536	19,764	1,812	2,727	764	10,670	2,954
1968	275,475	3,455	509	12,850	1,108	2,387	631	6,921	1,869
1969	97,995	851	NA	5,132	NA	605	180	2,744	801
1891–1969	NA	1,704,696	NA	9,892,049	NA	1,305,882	199,890	5,217,348	794,558

NA Not available.
[1] Based on Oklahoma ore and old tailings treated at mills during calendar year indicated.
[2] In comparing values of concentrate and metal, value given for concentrate is that actually received by producer, whereas value of recoverable metal is calculated from average price for all grades.

"Production Potential of Copper Deposits Associated with Permian Red Bed Formations in Texas, Oklahoma, and Kansas."

Germanium.—Germanium was recovered from residues accumulated at two of the State's zinc smelters and at the Eagle-Picher Industries, Inc., processing plant near Quapaw.

Lead.—The output of lead was down more than 74 percent in 1969. Twelve operators were active in Ottawa County in 1969, compared to 23 in 1968. The production loss was caused by a decline in ore reserves and by flooding of the Picher field, the main producing field in Ottawa County. In November 1968, Eagle-Picher Industries, Inc., shut down its pumping station serving the Picher field; by late 1969, a majority of the mines were flooded.

The market for Oklahoma lead gained during the year; the price climbed from a low of 13.5 cents per pound in January to 16.1 cents in December. Qualified ore producers were paid a subsidy through May.

Silver.—The value of silver recovered as a byproduct from smelting of copper concentrates produced at the Eagle-Picher Industries, Inc., mine at Creta, Jackson County, was equal to the 1968 value.

Uranium.—Kerr-McGee Corp. contracted to sell enriched uranium hexafluoride to Metropolitan Edison Co., Reading, Pa. The material will be used in electric power generation in a nuclear reactor under construction near Harrisburg, Pa. The nuclear feedstock will be produced at the Kerr-McGee plant under construction near Gore in Sequoyah County.

A plutonium fuels processing plant was constructed west of Guthrie in Logan County by Kerr-McGee Corp. The plant will produce plutonium fuel from plutonium and plutonium solutions for experimental fast-breeder and commercial thermal-power reactors.

Zinc.—Output of zinc declined more than 60 percent and the output value declined about 57 percent in 1969. Production was reported by 12 operators in Ottawa County, compared to 24 operators in 1968. A minor amount of zinc was recovered in smelting copper concentrates from Jackson County. The drop in production was attributed to a decrease in ore reserves and flooding in the Picher field. The Eagle-Picher Industries, Inc., Central Mill at Cardin was the only zinc concentrator operating in the State.

Custom Mills and Smelters.—Two horizontal retort zinc smelters were operated during the year. Zinc concentrates were treated by American Metal Climax, Inc., at Blackwell and National Zinc Co., Inc., at Bartlesville. National Zinc Co. completed construction of expanded zinc recovery facilities and increased capacity of the sulfuric acid plant to 275 tons per day.

Construction began on a $1.12 million expansion of facilities at J & S Iron Foundry at Dewey, Washington County. A new automated greensand match plate foundry unit will be added. Plant capacity will be increased by about 500 percent. Employment at the plant is expected to increase by 200 workers by the end of 1973; 1969 employment was 180.

Armco Steel Corp., Sand Springs, began a $4 million expansion program to double the capacity of its steel plant. Major products of the plant are reinforcing bars and fence posts.

Table 19.—Principal producers

Commodity and company	Address	Type of activity	County
Carbon Black: Continental Carbon Co.	P.O. Box 22085 Houston, Texas 77027	Furnace	Kay.
Cement:			
Dewey Rocky Mountain Cement Co.	1210 Fourth Nat'l. Bank Tulsa, Okla. 74119	Quarry and plant	Rogers.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	----do	Pontotoc.
Oklahoma Cement Co	P.O. Box 68 Pryor, Okla. 74361	----do	Mayes.
Clays:			
Acme Brick Co	P.O. Box 425 Fort Worth, Tex. 76101	Mine and plant	Custer, Oklahoma, Tulsa.
Chandler Materials Co	Box 627 Tulsa, Okla. 74101	----do	Rogers, Oklahoma.
Dewey Rocky Mountain Cement Co.	1210 Fourth National Bank Tulsa, Okla. 74119	----do	Rogers.
Filtrol Corp	3250 E. Washington Los Angeles, Calif. 90023	----do	Dewey.
Frankoma Pottery Co	Box 789 Sapulpa, Okla. 74066	----do	Creek.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colo. 80202	----do	Pontotoc.
Mangum Brick Co	Box 296 Mangum, Okla. 73554	----do	Greer.
Oklahoma Brick Corp	Box 87 Union City, Okla. 73090	----do	Canadian.
Oklahoma Cement Co	Box 68 Pryor, Okla. 74361	----do	Mayes.
Sapulpa Brick & Tile Corp	Box 460 Sapulpa, Okla. 74066	----do	Creek.
Superior Clay Products, Inc	Box 1501 Ada, Okla. 74820	----do	Pontotoc.
United Clay Pipe Co	Box 552 Seminole, Okla. 74868	----do	Seminole.
Wewoka Brick and Tile Co	415 W. 10th Street Wewoka, Okla. 74884	----do	Do.
Coal:			
Bills Coal Co., Inc	Route 1 Welch, Okla. 74369	Strip mine	Craig.
Evans Coal Co	Box 126 McCurtain, Okla. 74944	Strip and auger mine	Haskell.
Garland Coal & Mining Co	Box 186 Fort Smith, Ark. 72901	Strip mine	Do.
Howe Coal Co	Box 99 Heavener, Okla. 74937	Underground mine	Le Flore.
Kerr-McGee Corp	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	----do	Haskell.
McNabb Coal Co	Box C Catoosa, Okla. 74105	Strip mine	Rogers.
Peabody Coal Co	301 N. Memorial Drive St. Louis, Mo. 63102	----do	Craig, Rogers.
Copper and Silver: Eagle-Picher Ind., Inc.	P.O. Box 910 Miami, Okla. 74354	----do	Jackson.
Gypsum:			
Agricultural Gypsum Corp	Colony, Okla. 73021	Quarry	Washita.
Harrison Gypsum Co., Inc	P.O. Box 176 Lindsay, Okla. 73052	----do	Caddo.
Raymond Schweitzer Gypsum.	Route 2 Okarche, Okla. 73762	----do	Canadian.
Republic Gypsum Co	1100 Mercantile Bank Bldg. Dallas, Texas 75201	Quarry and plant	Jackson.
Texas Gypsum Co., Inc	P.O. Box 768 Irving, Texas 75060	Quarry	Comanche.
United States Gypsum Co	101 S. Wacker Drive Chicago, Ill. 60606	Quarry and plant	Blaine.
Universal Atlas Cement, Div. of United States Steel Corp.	Chatham Center—Box 2969 Pittsburgh, Pa. 15230	Quarry	Do.
Walton Gypsum Co	Route 1 Homestead, Okla. 73745	----do	Do.
Lead and Zinc:			
C & H Mining Co	Box 281 Picher, Okla. 74360	Underground mine	Ottawa.
Henry Eby	Box 464 Baxter Springs, Kans. 66713	----do	Do.
Geo. T., Inc	Box 128 Picher, Okla. 74360	----do	Do.
Lime: St. Clair Lime Co	Box 894 Oklahoma City, Okla. 73101	Plant and quarry	Sequoyah.

Table 19.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Salt:			
Blackmon Salt Co	Freedom, Okla. 73842	Solar Evaporation	Woods.
Western Salt Co	Route 2 Erick, Okla. 73645	----do	Harmon.
Sand and Gravel:			
Bagby-Harris Sand Co	P.O. Box 926 Jenks, Okla. 74037	Dredge	Tulsa.
The Dolese Co	13 NW 13th St. Oklahoma City, Okla. 73103	Stationary	Canadian, McClain, Kingfisher, Logan, Garfield.
McMichael Concrete Co	Box 9486 Tulsa, Okla. 74107	Dredge	Tulsa.
Midcontinent Glass Sand Co	Roff, Okla. 74865	Stationary	Pontotoc.
Mohawk Rock & Sand Co	1340 E. 16th St. Tulsa, Okla. 74120	Dredge	Tulsa.
Pennsylvania Glass Sand Corp. of Okla.	Berkeley Springs, W. Va. 25411	Stationary	Johnston.
Sand Products, Inc	3405 E. Reno Oklahoma City, Okla. 73117	Stationary and dredge.	Oklahoma.
Tulsa Sand Co	Box 1954 Tulsa, Okla. 74101	Stationary	Pawnee, Tulsa.
Yahola Sand & Gravel Co	323 Merchants Bank Bldg. Ft. Smith, Ark. 72901	----do	Muskogee.
Stone:			
Anchor Stone Co	Box 6130 Tulsa, Okla. 74106.	Quarry	Tulsa.
Arkhola Sand & Gravel Co	323 Merchants Bank Bldg. Ft. Smith, Ark. 72901	----do	Cherokee.
Dewey-Rocky Mountain Cement Co.	1210 Fourth Nat'l. Bank Tulsa, Okla. 74119	----do	Rogers.
Dolese Brothers Co	13 NW 13th St. Oklahoma City, Okla. 73101	----do	Caddo, Carter, Coal, Comanche, Kiowa, Murray, Pittsburg, Seminole.
Eagle-Picher Industries, Inc	P.O. Box 910 Miami, Okla. 74354	----do	Ottawa.
The Quapaw Company	Box 72 Drumright, Okla. 74030	----do	Creek, Okmulgee.
Sooner Rock and Sand Co	2835 NE 23rd Oklahoma City, Okla. 73111	----do	Murray.
Standard Industries, Inc	P.O. Box 15670 Admiral Station Tulsa, Okla. 74115	----do	Kay, Osage, Tulsa.
Trinity Concrete Products Co.	Box 1290 Dallas, Tex. 75221	----do	Atoka.
Tulsa Rock Co	Box 15691 Admiral Station Tulsa, Okla. 74115	----do	Tulsa.
Tripoli: The Carborundum Co., American Tripoli Div.	Seneca, Mo. 64865	Open Pit	Ottawa.
Vermiculite: Texas Vermiculite Co.	2651 Manila Road Dallas, Tex. 75200	Exfoliating plant	Oklahoma.
Volcanic Ash: Axtell Mining Corp.	Laverne, Okla. 73848	Open pit	Beaver.
Helium: U.S. Bureau of Mines	P.O. Box 46 Keyes, Okla. 73947	Helium processing	Cimarron.
Smelters:			
American Metal Climax, Inc., Blackwell Zinc Co.	Blackwell, Okla. 74631	Zinc	Kay.
Kaiser Chemicals, Inc	Tulsa, Okla. 74100	Magnesium	Tulsa.
National Zinc Co	Bartlesville, Okla. 74003	Zinc	Washington.
Petroleum Refineries:			
Allied Materials Corp	Stroud, Okla. 74079	Refinery	Lincoln.
Apco Oil Corp	Cyril, Okla. 73029	----do	Caddo.
Bell Oil and Gas Co	Ardmore, Okla. 73401	----do	Carter.
Champlin Pet. Co	Enid, Okla. 73701	----do	Garfield.
Continental Oil Co	Ponca City, Okla. 74601	----do	Kay.
Kerr-McGee Corp	Cushing, Okla. 74023	----do	Payne.
Do	Wynnewood, Okla. 73098	----do	Garvin.
Midland Cooperatives, Inc	Cushing, Okla. 74023	----do	Payne.
Okmulgee Refining Co	Okmulgee, Okla. 74447	----do	Okmulgee.
Sequoyah Refining Corp	Ponca City, Okla. 74601	----do	Kay.
Sun Oil Co., DX Div	Duncan, Okla. 73533	----do	Stephens.
Do	Tulsa, Okla. 74100	----do	Tulsa.
Texaco Inc	Tulsa, Okla. 74100	----do	Do.
Tonkawa Refining Co	Arnett, Okla. 73832	----do	Ellis.

Table 19.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural Gas Liquids:			
Champlin Petroleum Co	Fort Worth, Tex. 76100	Natural gas liquids processing.	Garfield, Oklahoma.
Cities Service Oil Co	Bartlesville, Okla. 74003	do	Garfield, Kay, Oklahoma, Texas.
Humble Oil & Refining Co	Tulsa, Okla. 74100	do	Dewey, Kingfisher.
Mobil Oil Corp	Taloga, Okla. 73667	do	Dewey, Grady, Stephens, Texas, Woodward.
Phillips Petroleum Co	Bartlesville, Okla. 74003	do	Garvin, Oklahoma.
Shell Oil Co	Oklahoma City, Okla. 73100	do	Beckham, Carter, Dewey.
Signal Oil & Gas Co	Ardmore, Okla. 73401	do	Carter.
Skelly Oil Co	Tulsa, Okla. 74100	do	Stephens.
Sun Oil Co	do	do	Cleveland, Grant, Harper, Kay, Lincoln, McClain.
Texaco, Inc	do	do	Beaver, Caddo, Lincoln, Love.
Union Texas Petroleum, Div. of Allied Chemical Corp.	do	do	Major.
Warren Petroleum Corp	do	do	Beaver, Garvin, Grady, Stephens.

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 Jerry J. Gray,[1] Gary A. Kingston,[2] and Mary Anne McComb [3]

The value of Oregon mineral production declined to $60.2 million, down 6.6 percent from the 1968 value of $64.4 million. Mineral production value for the State has declined for 3 consecutive years from the record-setting $107.5 million value reached in 1966. In 1966, demand for construction materials (clay, sand, gravel, and stone) was unusually high because a number of large dam projects were under construction concurrently. In the following 3 years, there were no comparable projects. Clay, sand, gravel, and stone still accounted for 66 percent of the total production value, a slight decrease from 1968 levels.

Three metals showed significant change in value of production when compared with 1968 levels. The value of silver and gold production increased several fold, while the value of mercury output fell 95.6 percent, despite a high market price.

Oregon's reactive and refractory metals industry continued to expand. Construction was begun by Advanced Alloys, Inc., at the Metallurgical Industrial Park, Washington County. Oregon Metallurgical Corp. (OREMET) of Albany entered the second stage of expansion with construction of a $3.5 million magnesium recovery facility.

[1] Geologist, Bureau of Mines, Albany, Oreg.
[2] Physical scientist, Bureau of Mines, Albany, Oreg.
[3] Economist, Bureau of Mines, Albany, Oreg.

Table 1.—Mineral production in Oregon [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	213	$284	215	$321
Diatomite short tons	120	W	85	W
Gem stones	NA	750	NA	750
Gold (recoverable content of ores) troy ounces	23	[3] 1	875	[3] 36
Lead (recoverable content of ores) short tons	W	W	(4)	(4)
Lime thousand short tons	120	2,407	115	2,337
Mercury 76-pound flasks	938	502	43	22
Nickel (content of ore and concentrate) short tons	17,294	W	17,056	W
Peat do	360	11	------	------
Pumice and volcanic cinder thousand short tons	725	977	875	1,139
Sand and gravel do	18,260	21,457	15,740	20,491
Silver (recoverable content of ores) troy ounces	335	1	4,749	9
Stone thousand short tons	14,312	21,168	11,662	18,897
Talc short tons	3	1	W	W
Zinc do	------	------	(4)	(4)
Value of items that cannot be disclosed: Cement, fire clay, copper, and values indicated by symbol W	XX	16,890	XX	16,162
Total	XX	64,449	XX	60,164
Total 1967 constant dollars	XX	r 63,777	XX	p 58,486

p Preliminary. r Revised. 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 fire clay; included with "Value of items that cannot be disclosed."

[3] Based on average U. S. Treasury price ($35.00) through Mar. 15, 1968, and Englehard selling quotations Mar. 20, 1968, through 1969.

[4] Less than ½ unit.

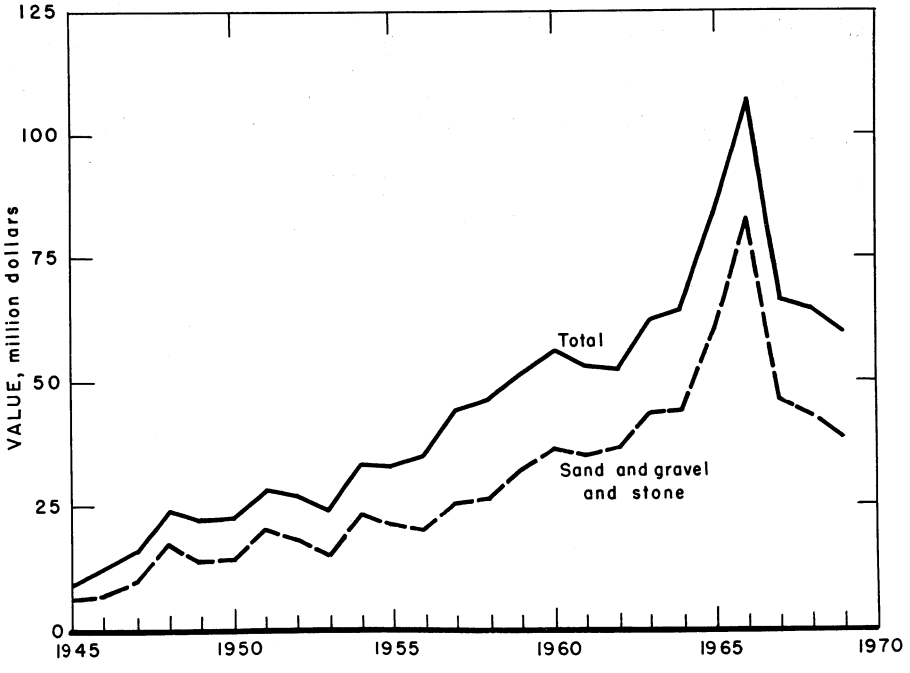

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Oregon.

Midland-Ross Corp. of Cleveland, Ohio, and the Gilmore Steel Co.'s Oregon Steel Mills, Inc., of Portland were completing construction of a $35-million steel-manufacturing complex at the Rivergate Industrial District in Portland. The projected facility will be the first fully integrated steel plant in the Pacific Northwest. The mill was to have a capacity of producing 400,000 tons of steel per year directly from iron ore.[4]

The State's first nuclear coordinator and an advisory task force, consisting of the heads of nine State agencies, were given the authority to determine nuclear plant location and to protect the public interest. The Bonneville Power Admininstration estimated that in the next 20 years the Pacific Northwest had the potential demand for 20 nuclear plants, each with a 1-million-kilowatt capacity. However, Oregon did not limit its investigation to nuclear power. The State Department of Geology and Mineral Industries drilled a number of shallow holes looking for geothermal steam sources. The most promising area was Klamath Falls, Klamath County. (Natural steam plants have been developed in Italy, Japan, New Zealand, Mexico, and the Soviet Union.) Construction has also begun on a steam plant in Sonoma County, Calif., which had an estimated potential of 1 million kilowatts. There were no plans for Oregon to develop steam power plants except to encourage private investors. In addition, the U.S. Tax Court declared geothermal steam to be a gas and eligible for the 22-percent depletion allowance granted for tax purposes to producers of natural gas and petroleum.

[4] Lomax, Alfred L. Big Steel Mill Comes to Portland. Oregon Business Review, v. 28, April 1969, pp. 1, 3.

Table 2.—Value of mineral production in Oregon, by counties

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Baker	$5,812	$4,566	Cement, stone, lime, sand and gravel, clays, gold, silver, pumice, diatomite, copper, lead, zinc.
Benton	907	566	Sand and gravel, stone, clays.
Clackamas	11,439	9,432	Cement, sand and gravel, stone, clays.
Clatsop	W	761	Stone, sand and gravel.
Columbia	1,068	W	Sand and gravel, stone.
Coos	500	1,083	Stone, sand and gravel.
Crook	191	265	Stone, sand and gravel, clays, mercury.
Curry	1,911	393	Stone, sand and gravel.
Deschutes	870	886	Pumice, sand and gravel, stone.
Douglas	9,295	W	Nickel, sand and gravel, stone, pumice, mercury.
Gilliam	W	1	Stone.
Grant	W	997	Stone, sand and gravel, gold, silver, lead.
Harney	W	W	Stone, sand and gravel.
Hood River	206	W	Do.
Jackson	1,191	1,049	Stone, sand and gravel, pumice, gold, silver.
Jefferson	235	83	Sand and gravel, pumice, stone, mercury.
Josephine	559	1,247	Sand and gravel, stone, gold, talc, silver.
Klamath	1,097	2,139	Stone, sand and gravel, pumice, clays.
Lake	722	503	Pumice, stone, sand and gravel, mercury, diatomite.
Lane	6,944	3,953	Sand and gravel, stone.
Lincoln	444	880	Stone, sand and gravel.
Linn	609	1,149	Sand and gravel, stone.
Malheur	W	W	Sand and gravel, lime.
Marion	649	652	Sand and gravel, clays, stone.
Morrow	53	152	Sand and gravel, stone.
Multnomah	7,448	7,937	Sand and gravel, lime, stone, clays.
Polk	411	460	Sand and gravel, stone, clays.
Sherman	191	572	Stone.
Tillamook	415	327	Stone, sand and gravel, clays.
Umatilla	715	568	Stone, sand and gravel.
Union	W	504	Stone, sand and gravel, clays.
Wallowa	308	168	Stone, sand and gravel.
Wasco	W	W	Do.
Washington	2,054	2,678	Stone, sand and gravel, clays.
Wheeler	238	106	Stone, sand and gravel.
Yamhill	261	515	Sand and gravel, stone, clays.
Undistributed [1]	7,706	15,572	
Total	64,449	60,164	

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.

A bill to authorize mineral exploration of Oregon's offshore lands was sent back to committee early in 1969. The bill would have given the State Land Division control over 2-year exploration permits, 20-year leases, and royalties paid to the State.

Employment, Trade, and Markets.—According to figures published by the Oregon Department of Employment, the 1969 civilian labor force increased 3.0 percent over the 1968 force which had posted a similar gain over that of 1967. Oregon's wage and salary employment index [5] averaged 147.1 in December of 1969, compared with 143.2 in December of 1968. This approximated the Nation's pattern, which reached 136.7 in December of 1969, compared with 132.2 a year earlier. For Oregon, the December seasonally adjusted unemployment rate was 4.5 percent, compared with 4.0 percent a year earlier; however, this was still below the 1967 rate of 4.6 percent. The seasonally adjusted December rate for the Nation was 3.3 percent in 1968 and 3.5 percent in 1969. Construction employment posted an excellent second quarter gain of 9.5 percent over 1968; however, fourth quarter employment fell to the same figure as in 1968. The mining industry was the only sector to show appreciable decline in employment (−7.2 percent); this was more than offset by a rise in the primary metals manufacturing sector (+9.5 percent). Hourly earnings in manufacturing rose 6.9 percent; the effect of wage increases was partially offset by a decline in the average production workweek from 39.6 hours in 1968 to 39.1 hours in 1969. Factory hourly earnings have doubled over the past two decades, while the Portland area Consumer Price Index rose approximately 55 percent for the same period.

The Oregon Business Review published three additional articles covering various aspects of the State's economy and mineral industries.[6] [7] [8]

Oregon State University economists studied the impact of the Northwestern Aluminum Co. plant to be built in the Warrenton area, Clatsop County. When published, the study could provide a model for other rural communities which have been rapidly industrializing. The research was to cover the impact of the facility's construction, as well as its operation.

Government Programs.—One contract was approved during the year by the Office of Minerals Exploration. Horse Heaven Mine Partnership received a $24,000 contract July 25,1969, to begin work at a Jefferson County mercury project (Horse Heaven mine). Government participation was $18,000.

[5] This index and all others used in the text assume a base of 1957–1959 = 100.

[6] Calmus, Thomas W. Current Trends in the National Economy Oregon Business Review, v. 28, February 1969, pp. 1, 4–8.

[7] Dasso, Jerome J. Economic Outlook for Oregon in 1969. Oregon Business Review, v. 28, February 1969, pp. 1–4.

[8] Shaffer, Leslie L. D., and Steve T. Hashimoto. The Semi-Precious Gem Industry of Oregon. Oregon Business Review, v. 28, No. 7, July 1969, pp. 1–4.

Table 3.—Indicators of Oregon business activity

		1968	1969 [p]	Change, percent
Annual average labor force and employment:				
Total labor force	thousands	882.7	909.6	+3.0
Unemployment	do	38.6	40.0	+3.6
Construction	do	31.1	32.4	+4.2
Lumber and wood products	do	72.4	70.9	−2.1
Food products	do	23.6	24.3	+3.0
All manufacturing	do	173.7	179.4	+3.3
All industries	do	677.9	704.4	+3.9
Factory payrolls	millions	$1,269.7	$1,389.0	+9.4
Personal income:				
Total	do	$6,660.0	$7,244.0	+8.8
Per capita		$3,323.0	$3,565.0	+7.3
Construction activity:				
Heavy engineering awards	millions	$150.0	$183.6	+22.4
Value of highway contracts awarded	do	$54.0	$127.8	+136.7
Expenditures on highway contract work	do	$59.2	$66.9	+13.0
Cement shipments to and within Oregon	thousand 376-pound barrels	3,622.0	3,642.9	+0.6
Cash receipts from farm marketings	millions	$512.8	$556.3	+8.5
Mineral production	do	64.4	60.2	−6.5

[p] Preliminary.

Sources: Survey of Current Business, Construction Review, Pacific Builder & Engineer, State Highway Commission, State Employment Department, and Bureau of Mines.

Table 4.—Employment and payrolls in mineral-industry establishments subject to Oregon unemployment-compensation law, by industries

Industry	1968		1969	
	Average annual employment	Total payrolls (thousands)	Average annual employment	Total payrolls (thousands)
Mining	1,566	$12,410	1,454	$12,105
Stone, clay, and glass products:				
Glass products	409	3,344	448	3,783
Hydraulic cement	264	2,314	254	2,417
Structural clay products	132	765	129	756
Concrete, gypsum, and plaster products	2,019	16,371	2,135	18,130
Cut-stone, stone, and pottery products	67	447	90	468
Miscellaneous	103	645	78	500
Total [1]	2,995	23,886	3,133	26,054
Primary metals:				
Blast furnaces, steelworks, rolling and finishing mills	1,210	11,261	1,255	12,929
Primary smelting and refining of nonferrous metals	2,914	25,486	3,167	29,301
Iron and steel foundries	2,266	18,164	2,534	21,652
Nonferrous foundries	635	4,982	758	6,014
Secondary smelting and refining of nonferrous metals and miscellaneous industries	214	1,665	214	1,836
Total [1]	7,238	61,558	7,929	71,731
Industrial chemicals	553	4,561	578	4,921
Petroleum refining and related products	430	3,125	554	3,663
Grand total [1]	12,782	105,540	13,648	118,474

[1] Data may not add to totals shown because of independent rounding.

Source: Oregon Employment Department. Industries may vary from those in the Bureau of Mines canvass.

Table 5.—Worktime 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
1968:								
Coal and peat	5	173	1	7	---	2	288.35	5,911
Metal	140	180	25	201	---	4	19.87	760
Nonmetal	123	182	22	179	---	5	27.91	9,149
Sand and gravel	1,595	205	326	2,611	2	64	25.28	5,162
Stone	1,023	250	256	2,052	---	62	30.21	1,079
Total [2]	2,886	218	630	5,051	2	137	27.52	3,470
1969 [p]:								
Coal and peat	5	78	(1)	2	---	1	405.02	14,581
Metal	110	182	20	164	---	3	18.34	134
Nonmetal	160	195	31	246	---	5	20.31	357
Sand and gravel	1,210	190	230	1,847	1	32	17.87	3,854
Stone	1,065	234	250	2,020	---	66	32.67	732
Total [2]	2,550	208	532	4,280	1	107	25.24	2,043

[p] Preliminary.
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Output of portland cement, 12 percent less than that of 1968, decreased for the third consecutive year, dropping 37 percent compared with the 1966 level. Oregon's only cement producer, Oregon Portland Cement Co., operating plants at Oswego (Clackamas County) and Lime (Baker County), acquired Idaho Portland Cement Co. with a plant at Inkom, Idaho. The local identity of the Idaho company

was maintained as a separate division of Oregon Portland Cement Co. Before the merger, the Oregon firm had an annual rated capacity of 4.5-million barrels (376 pounds each) of finished cement, while the Idaho firm's annual capacity was 1.2 million barrels.

Destinations of shipments of portland cement were chiefly within the State; out-of-State shipments were made to Washington and Idaho. Shipments were distributed, by percent, as follows: to ready-mixed concrete companies, 78.5; to concrete-product manufacturers, 9.6; to highway contractors, 6.8; to building material dealers, 3.4; to general contractors, 1.6; and to Federal, State, and local government agencies, 0.1. Trucking accounted for 82 percent of the portland cement shipped; the remainder went by rail. The ratio of bulk to paper-bag shipments was about 12 to 1.

Combined shipments from three plants in Oregon and Nevada were 3.7-million barrels of finished portland cement; the same plants shipped 3.8-million barrels in 1968. The average value of portland cement shipped from these plants was $3.83 per barrel, f.o.b. plant, compared with $3.58 in 1968.

Clays.—Clay or shale sold or used by producers increased slightly compared with the 1968 total; the mix of clay or shale types changed, and output value increased 13 percent. Shale used for cement manufacture decreased 28 percent compared with that of 1968 and was 70 percent lower than that of 1966. Because of a larger base, a 17-percent output increase in bloating shale and a 5-percent output increase in miscellaneous clays offset the 1969 lower output of shale for cement.

Expandable shale, for conversion to lightweight-concrete aggregate and pozzolan, was produced at the Empire Lite-Rock, Inc., Banks pit, Washington County. Miscellaneous clay, for making heavy-clay products, was produced at operations in Benton, Clackamas, Klamath, Marion, Multnomah, Polk, Tillamook, Union, Washington, and Yamhill Counties. One of Yamhill County's miscellaneous clay producers (Willamina Clay Products Co., Inc.) also produced fire clay. Both clays were used for building brick. Shale for cement manufacture was produced by Oregon Portland Cement Co. from its Nelson quarry, Baker County. Output of bentonite decreased at the Silver Wells and Sands pits of Central Oregon Bentonite Co., Crook County, because of lower demand for use in rotary-drilling mud, stock-feed pellet, binders, animal litter, insecticide carrier and a sealer for irrigation projects. Mandrones Mining Co., Inc., Clackamas County, decreased production of a carbonaceous shale which was mined, dried, processed, and packaged for use as a soil conditioner and as an animal-feed supplement. A small coal seam within the shale bed was handpicked to fire a drier.

Gems and Gem Materials.—Oregon's recreation mining industry continued to attract both tourists and local enthusiasts to numerous collecting and digging sites. The major portion of gems and gem material output was by this large number of amateur miners. Production was concentrated in the Lebanon, Linn County, Nyssa, Malheur County, and Prineville, Crook County, areas. The semiprecious gem industry of Oregon was reviewed.[9] Reasons were given why interest in this type of material had developed into a significant activity (the study estimated annual production at $1 million) for the State. The main conclusion reached was that the industry and its activities warranted a much more detailed study.

A half-ton petrified log went on display at the Oregon Museum of Science and Industry at Portland. The agatized wood was discovered on Bureau of Land Management (BLM) land near Scio by an individual and was donated by the BLM to the museum. Oregon's petrified wood was also the subject of three studies.[10] [11] [12]

A mineral locality in the Northern Coast Range for collecting large augite crystals was described,[13] and two eastern Oregon rock-collecting sites were also described, one for thundereggs (Oregon State rock) [14] and the other for agate.[15]

[9] Work cited in footnote 8.

[10] Dake, H. C. Oregon Tempskya Locality. Gems and Minerals, September 1969, No. 384, pp. 62–63.

[11] Gregory, Irene. Fossilized Palm Wood in Oregon. The Ore Bin, v. 31, No. 5, May 1969, pp. 93–110.

[12] Gregory, Irene. Worm-Bored Poplar from the Eocene of Oregon. The Ore Bin, v. 31, No. 9, September 1969, pp. 184–185.

[13] Nelson, Dennis O., and Gerald B. Shearer. The Geology of Cedar Butte Northern Coast Range of Oregon. The Ore Bin, v. 31, No. 6, June 1969, pp. 113–130.

[14] Rodgers, Jim. A Visit to Succor Creek. Lapidary Journal, v. 23, No. 2, May 1969, pp. 324–328.

[15] Rodgers, Jim. The Snakeskin Agate Area, Oregon. Lapidary Journal, v. 23, No. 7, October 1969, pp. 960–962.

Lime.—Output of lime decreased 4 percent compared with that of 1968. Four companies produced quicklime and hydrated lime. The 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 used by the Ash Grove and the Pacific Carbide companies; the other two firms were supplied from local limestone quarries.

Perlite.—Del T. Harmon and A.M. Matlock continued to stockpile, for testing purposes, small tonnages of perlite from deposits in Baker and Lake Counties, respectively. Supreme Perlite Co. expanded crude perlite from Nevada at its Portland plant for use mainly as a lightweight-plaster and concrete aggregate; smaller quantities were sold for soil conditioning, and for loose-fill insulation.

Pumice and Volcanic Cinder.—Output of pumice and volcanic cinder increased 21 percent compared with that of 1968. The material was used, mainly unprocessed, for road construction and maintenance by governmental agencies; smaller amounts were processed and used for lightweight-concrete aggregate, roofing, landscaping, concrete admixture (pozzolan), and as an abrasive. Road material usage increased from 522,991 tons in 1968 to 665,748 tons in 1969. Production was from Deschutes, Douglas, Jackson, Jefferson, Klamath, and Lake Counties. Production of concrete aggregate increased 4 percent compared with that of 1968; it was produced by Central Oregon Pumice Co. and Graystone Corp., Deschutes County. Decreases were recorded for landscaping uses (Deschutes County), concrete admixture uses (Baker County), and abrasive uses (Klamath County). Cinder output used for roofing increased 20 percent from 1968 levels and was produced in Deschutes County.

Roofing Granules.—Pioneer Division, Flintkote Co., doubled the production of roofing granules at its Portland plant compared with 1968 production. The source of raw material for the roofing granules was purchased river sand.

Sand and Gravel.—Output and value of sand and gravel fell 14 and 5 percent, respectively, compared with totals for 1968. This level of production resulted from two more or less opposing 3-year trends. Whereas commercial production (quantities reported are in million tons) increased from 10.1 in 1966 to 10.6 in 1967 and 12.5 in 1968, then decreasing to 11.9 in 1969, Government-and-contractor production (largely contractor for Federal, State, county, and municipal agencies) decreased from 25.3 in 1966 to 9.1 in 1967, 5.8 in 1968, and 3.8 in 1969. Output for Federal agencies decreased annually as follows: 20.2 (1966); 4.2 (1967); 3.5 (1968); and 1.1 (1969). The downward production trend was caused by the completion of a series of large dams. Output for counties also decreased in each of the reference years; 1.9 (1966); 1.3 (1967); 1.0 (1968); and 0.9 (1969). Output for State agencies tended to be related to the letting of highway contracts and fluctuated as follows: 3.1 (1966); 3.6 (1967); 1.3 (1968); and 1.8 (1969).

Production was reported from 34 of 36 counties; the exceptions were Gilliam and Sherman Counties. Output value exceeding $5 million was reported from Multnomah County, over $2 million from Clackamas and Lane Counties, and over $1 million from Douglas County.

Stone.—Production of stone decreased 19 percent in tonnage and 11 percent in value because of lessened demand in every type of use. The value did not drop as far as the tonnage, because within the concrete and roadstone use a greater percent was higher value concrete aggregate than in 1968. Basalt, accounting for 93 percent of the total output, was used for roadstone, asphalt and concrete aggregate, riprap, ballast, and fill.

Total output of limestone increased 11 percent. Limestone produced for lime manufacture gained 106 percent compared with that of 1968 (a large portion was stockpiled because lime output was less than the previous year); output for sugar refining gained 18 percent; output for cement manufacturing lost 13 percent; and output for paper manufacturing lost 12 percent. Two firms in Baker County mined limestone, Chemical Lime Co. mined at its Baboon Creek quarry and Oregon Portland

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	4,442	$5,361	4,357	$5,580
Road material	6,235	7,650	5,462	7,027
Fill	1,193	848	984	847
Other [1]	615	687	1,143	1,312
Total	12,485	14,546	11,946	14,766
Government-and-contractor operations:				
Building	221	290	301	403
Road material	2,968	4,210	3,323	5,139
Fill	110	69	126	74
Other [1]	2,476	2,342	44	109
Total	5,775	6,911	3,794	5,725
All operations:				
Building	4,663	5,651	4,658	5,983
Road material	9,203	11,860	8,785	12,166
Fill	1,303	917	1,110	921
Other [1]	3,091	3,029	1,187	1,421
Grand total	18,260	21,457	15,740	20,491

[1] Includes special sands and sand and gravel used for railroad ballast and miscellaneous purposes.

Cement Co. at its Durkee quarry. Output of sandstone and quartzite increased from 198,000 tons in 1968 to 319,000 tons in 1969, because of increased demand for road use, for cement manufacture, and for riprap-jetty material. Oregon Portland Cement Co. operated a sandstone quarry on Gnat Creek, Clatsop County. The sandstone, used for its silica content in cement production, was trucked to the Columbia River at Wauna and then barged to the firm's Lake Oswego plant. Bristol Silica Co., Jackson County, produced quartz (silica) from an open-pit deposit. The material was transported about 4 miles by truck to a screening plant at Gold Hill. Sized material was marketed for use in making silicon carbide and ferrosilicon.

Stone was produced from operations in 35 of the 36 counties; the exception was Malheur County. Output exceeded 1 million tons only in Washington County.

Talc and Soapstone.—A small quantity of talc was mined and shipped by John C. Pugh from a Josephine County deposit for sculpturing purposes to educational institutions. Soapstone, obtained from mines in Skagit County, Wash., was ground and prepared at the Portland plant of Stauffer Chemical Co. Output of the finished product, used as a carrier and diluent in pesticides, decreased 28 percent compared with that of 1968.

Vermiculite (exfoliated).—Production of expanded vermiculite was 106 percent over that of 1968 and 116 percent over that of 1966; however, the increased production did not reach the high of 1965. Crude vermiculite from the Republic of South Africa and Montana was exfoliated at Port-

Table 7.—Stone sold or used by producers by uses

(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Concrete and roadstone	12,434	$16,329	10,173	$16,250
Railroad ballast	174	265	W	W
Riprap	813	2,521	574	969
Other [1]	891	2,053	914	1,678
Total [2]	14,312	21,168	11,662	18,897

[1] Includes building stone (dimension), stone used at cement, paper, and chemical plants; sugar refineries; rock fill; dams; dikes; railroad ballast; and for miscellaneous unspecified purposes.

[2] Data may not add to totals shown because of independent rounding.

land plants of Vermiculite-Northwest, Inc., and Supreme Perlite Co., respectively. Expanded material was marketed for agricultural uses, for thermal insulation, and for plaster and concrete aggregate.

Water.—A 180-page report to the Polk County Commissioners prepared by Mid-Willamette Valley Council and Boatwright Engineers, Salem, suggested a need for a county-wide combined joint effort of all governmental agencies for water development and sewage treatment.

The Oregon Department of Geology and Mineral Industries drilled a number of shallow holes looking for heat concentrations near known natural hot springs in Harney, Klamath, and Lake Counties areas. These areas were considered as possible geothermal power sites. At Klamath Falls, three usable wells were drilled, one to heat the new Ponderosa retirement apartments and two to provide heating and hot water for the new Ponderosa Junior High School. At Lakeview, Desert Farms Inc., evaluated a pilot project to grow tomatoes for the local markets in a greenhouse heated from a hot-water well. Initial results were successful, and construction was underway on a larger greenhouse.

METALS

Aluminum.—Production declined 2.6 percent compared with that of the previous year.

Aluminum production capacity was rated at 191,000 tons annually—Reynolds Metals Co., Troutdale (100,000 tons), and Harvey Aluminum, Inc., The Dalles (91,000 tons). Additional capacity of 135,000 tons annually was proposed by Northwestern Aluminum Co.; a plant was planned for construction at Warrenton.

Reynolds Metals Co. began constructing a fifth potline to add 40,000 tons additional aluminum-reduction capacity when completed in 1971. Reynolds increased its holdings of ferruginous bauxite deposits through acquisition of Aluminum Company of America holdings in Columbia, Multnomah and Washington Counties. The Reynolds company held additional deposits in the same area as well as in Marion County. These high-iron deposits of alumina were discovered in 1944 by the State of Oregon Department of Geology and Mineral Industries.

At the Harvey Aluminum, Inc., plant, a $3.25 million pollution-control system was to be installed.

Copper.—Bear Creek Mining Co. and Cyprus Mines Corp. did not return to properties that they had been exploring in 1968 in eastern Baker County. Dennis Holding Co., Vancouver, British Columbia, Canada, operating under the name Baker Mountain Copper, Ltd., explored by soil sampling about 100 claims owned by Oregon Copper Co. Most of these claims, located in the Lower Powder River and Sparta mining districts, Baker County, were previously under option to Cyprus Mines Corp.

A minor amount of copper was recovered from gold-silver ore mined in Baker County.

Ferroalloys.—Union Carbide Co., Portland; Hanna Nickel Smelting Co., Douglas County (see Nickel); and National Metallurgical Corp., Lane County, continued active throughout the year.

Gold and Silver.—Reported gold and silver output came from five lode and four placer operations in Baker, Grant, Jackson, and Josephine Counties. The average annual price was $41.51 per ounce for gold and $1.79 per ounce for silver.

Baker Assets Co. began shipping concentrate from the Bald Mountain mine, Baker County, in November. Development work at the property was in progress throughout the year. Cornucopia placer, Baker County, was operated by Cornucopia Placers, Inc. These two companies accounted for most of the gold produced. Silver was recovered mainly at the Bald Mountain and the Silver Queen (Frank Ramsey) properties, Baker County, and the Badger Group (Beaver Rock Products, Inc.) mine, Grant County.

Omega Mining Co., Ltd., Vancouver, British Columbia, Canada, halted plans for a major gold mining program in the Bourne area of Baker County. Re-evaluation of assays taken in the exploration phase of property development indicated that the proposed large-scale mining and milling system was not economically feasible.

Iron and Steel.—New plants of Oregon Steel Mills, Inc., Portland, and Cascade Steel Rolling Mills, Inc., McMinnville, were in production. The Oregon Steel Mills plant began utilizing prereduced iron ore, thereby ending its previous com-

plete dependence upon scrap metal. Midland-Ross Corp., partner in the Oregon Steel complex, converted the iron ore to prereduced pellets. A new means of transporting iron-ore concentrate provided significant cost savings over conventional methods.[16] Cascade Steel Rolling Mills used scrap metal supplied by dealers in the Portland area.

Lead and Zinc.—A minor quantity of lead and zinc was recovered from silver ore mined in Baker County.

Magnesium.—Oregon Metallurgical Corp., Albany, Linn County, was to recover magnesium metal from magnesium chloride produced as a byproduct of titanium production. Construction of a $3.5 million plant, with a capacity of about 10,000 tons of magnesium per year, was started in January and was scheduled for completion in 1970. Metal recovery was to be by electrolysis.

Mercury.—Total output of 43 flasks (76 pounds of mercury each) represented a sharp drop from the 938 flasks produced in the previous year. This was in spite of a $505 average annual price per flask. Alcona Mining, Inc., recovered over half the total at the Elkhead mine, Douglas County.

Shaft sinking, drifting, and long-hole drilling exploration was contracted for a new area west of the Horse Heaven mine, Jefferson County. Horse Heaven Mining Co. obtained a $24,000 Office of Minerals Exploration loan to do the work. This property was the same one reported to have been worked by Ray Whiting in the previous year.

Dennis Holdings, Ltd., Vancouver, British Columbia, Canada, was negotiating the acquisition of the Canyon Creek mine, Grant County.

Nickel.—Hanna Mining Co. mined 1,184,450 tons of nickel laterite ore averaging 1.41 percent nickel at the Nickel Mountain mine, Douglas County. The ore contained 17,056 tons of nickel, 13,086 tons of which was recovered in 25,882 tons of ferronickel alloy metal at the nearby Hanna Nickel Smelting Co. smelter. Ferrosilicon produced by Hanna at Riddle, for use in the nickel reduction process, totaled 19,346 tons and had an average grade of 48.2 percent silicon.

Titanium.—Oregon Metallurgical Corp., Albany, began construction of a chlorination plant for converting the titanium-bearing mineral rutile into titanium tetrachloride. Sponge metal plant expansion also was started. Completion of these two plant units was expected by mid-year 1970. Ore supply from Australia was planned. The first shipment arrived in December at the port of Portland where it was placed in storage. The ore was to be moved to the plant by truck as needed.

Uranium.—Gulf Oil Corp., Nuclear Fuels Division, continued its investigations in Malheur and Harney Counties. Several areas were drilled as a part of an overall geologic study.

Zirconium.—Wah Chang Albany Corp., Albany, Linn County, producer of zirconium, hafnium, columbium, and tantalum metals, added ammonium sulfate fertilizer to its product line. Production of about 10 tons per day came from process effluent recovery.

MINERAL FUELS

Peat.—A peat bog near Enterprise, Wallowa County, that had been operated by Wes Cruikshank during 1968 was idle.

Petroleum.—No new drill footage was recorded for Oregon. By yearend, all offshore leases had been dropped; however, five firms held exploration permits to conduct geological and geophysical studies on State and Federal lands off Oregon. Dry land acreage leased for oil and gas was approximately 85,000 acres compared with more than 1 million acres leased during 1962. One drilling permit, issued during 1968, was in effect; R.E. Harrison of Seattle, Wash., attempted to deepen the Central Oils, Inc., "Morrow 1" in Jefferson County. No new footage was added to the 3,300-foot hole.

[16] Mining Engineering. Two New Ways to Slash Transportation Costs. V. 21, No. 9, September 1969, pp. 96–97.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
NONMETALS			
Cement:			
Oregon Portland Cement Co	111 S.E. Madison St. Portland, Oregon 97214	Plant	Baker and Clackamas.
Clay:			
Central Oregon Bentonite Co	Bear Creek Route Prineville, Oregon 97754	Pit and plant	Crook.
Ceramco, Inc	P.O. Box 5 McMinnville, Oregon 97128	----do	Yamhill.
Columbia Brick Works	1320 S.E. Water St. Portland, Oregon 97214	----do	Multnomah.
Corvallis Brick & Tile Works, Inc.	P.O. Box 327 Corvallis, Oregon 97330	----do	Benton.
Empire Lite-Rock, Inc	9255 N.E. Halsey St. Portland, Oregon 97220	----do	Washington.
Klamath Falls Brick & Tile Co	P.O. Box 573 Klamath Falls, Oregon 97601	----do	Klamath.
Mandrones Mining Co., Inc	Rt. 1, Box 337 Molalla, Oregon 97038	Pit	Clackmas.
McMinnville Brick Co	451 College Ave. McMinnville, Oregon 97128	Pit and plant	Yamhill.
Monmouth Brick & Tile Co	Rt. 1, Box 22 Monmouth, Oregon 97361	----do	Polk.
Monroe Clay Products Co	P.O. Box A Monroe, Oregon 97456	----do	Benton.
Needy Brick & Tile Co	Rt. 1, Box 102 Hubbard, Oregon 97032	----do	Clackamas and Marion.
Oregon Portland Cement Co	111 S.E. Madison St. Portland, Oregon 97214	Pit	Baker.
Scholls Tile Co	Rt. 2, Box 208 Hillsboro, Oregon 97123	Pit and plant	Washington.
Tillamook Clay Works	6690 Brickyard Road Tillamook, Oregon 97141	----do	Tillamook.
Willamina Clay Products Co., Inc.	9780 S.W. Hunziker St. Tigard, Oregon 97223	----do	Yamhill.
Diatomite:			
Keating Diatomaceous Earth Co	2019 Washington St. Baker, Oregon 97814	Mine and plant	Baker.
A. M. Matlock	P.O. Box 3307 Eugene, Oregon 97402	----do	Lake.
Lime:			
Ash Grove Lime & Portland Cement Co.	101 W. 11th St. Kansas City, Missouri 64105 (Portland, Oregon 97200)	Plant	Multnomah.
Chemical Lime Co	Baker, Oregon 97814	----do	Baker.
Pacific Carbide & Alloys Co	P.O. Box 17008 Portland, Oregon 97200	----do	Multnomah.
Perlite (expanded):			
Supreme Perlite Co	P.O. Box 66 North Portland, Oregon 97043	----do	Multnomah.
Pumice:			
Central Oregon Pumice Co	5 Greenwood Ave. Bend, Oregon 97701	Mine and plant	Deschutes.
Graystone Corp	Box 1087 Bend, Oregon 97701	----do	Do.
Chester Hiatt	147 N. 12th St. Redmond, Oregon 97756	----do	Do.
Oregon Portland Cement Co	111 S.E. Madison St. Portland, Oregon 97214	Mine	Baker.
Parks Pumice Mining	Box 54 Chemult, Oregon 97731	----do	Klamath.
Jed Wilson & Son	Box 125 La Pine, Oregon 97739	Mine and plant	Lake.
Roofing Granules:			
Flintkote Co	P.O. Box 2744 Portland, Oregon 97208	Plant	Multnomah.
Sand and Gravel:			
Baker Rock Crushing	2030 E. Main St. Hillsboro, Oregon 97123	Pit and plant	Washington.
Bethel-Danebo Sand & Gravel	150 Bertelsen Road S. Eugene, Oregon 97402	----do	Lane.
Copeland Sand & Gravel	695 S.E. J St. Grants Pass, Oregon 97526	----do	Josephine.
Delta Sand & Gravel	999 Division Ave. Eugene, Oregon 97402	----do	Lane.
Eugene Sand & Gravel	Box 1067 Eugene, Oregon 97401	----do	Do.
Glacier Sand & Gravel	5975 E. Marginal Way Seattle, Washington 98134	----do	Multnomah.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Sand and Gravel—Continued			
McKenzie Sand & Gravel	Box 347 Eugene, Oregon 97400	Pit and plant	Lane.
M.P. Materials	645 Seventh St. Salem, Oregon 97300	----do	Marion.
Milwaukie Sand & Gravel	1635 S.E. McLoughlin Blvd. Milwaukie, Oregon 97222	Dredge and plant	Clackamas.
Morse Brothers	Lebanon, Oregon 97355	Pit and plant	Benton and Linn.
Chas. T. Parker Construction	6457 N.E. Columbia Blvd. Portland, Oregon 97203	----do	Multnomah.
Portland Sand & Gravel	10717 S.E. Division Ave. Portland, Oregon 97266	----do	Do.
Rich Valley Top Soil Co	Box 30 Oregon City, Oregon 97045	----do	Clackamas.
Rock Creek Sand & Gravel	Clackamas, Oregon 97015	----do	Multnomah.
Roseburg Sand & Gravel	Box 1207 Roseburg, Oregon 97470	----do	Douglas.
Ross Island Sand & Gravel	4129 S.E. McLoughlin Blvd. Portland, Oregon 97200	Dredge and plant	Multnomah.
Umpqua River Navigation Co	Box 25 Reedsport, Oregon 97467	----do	Douglas.
Wildish Sand & Gravel	Box 1106 Eugene, Oregon 97401	Pit and plant	Lane.
Willamette Hi-Grade Concrete Co.	Foot N. Portsmouth Ave. Portland, Oregon 97203	Dredge and plant	Multnomah.
Stone:			
L. V. Anderson	Box 757 Oakridge, Oregon 97463	Quarry and plant	Lane.
Boise Cascade Corp	La Grande, Oregon 97850	----do	Union, Umatilla, Wallowa.
L. H. Cobb	8275 S.W. 145th Ave. Beaverton, Oregon 97005	----do	Washington.
J. C. Compton	Box 86 McMinnville, Oregon 97128	----do ----do	Baker, Deschutes, Harney.
Eckman Creek Quarries	Box 15 Waldport, Oregon 97394	----do	Lincoln.
Georgia-Pacific Corp	Drawer AA Pilot Rock, Oregon 97868	----do	Grant, Lincoln, Umatilla.
L. W. Govro	Rt. 4, Box 253-W Albany, Oregon 97321	Quarry and plant	Linn.
Roy L. Houck Sons	1158 Chemeketa N.E. Salem, Oregon 97301	----do	Coos, various.
Hughes & Dodd	Box 246 Medford, Oregon 97501	----do	Coos, Curry, Jackson.
Peter Kiewit Sons Co	Box 1777 Vancouver, Washington 98663	----do	Various.
Materne Bros	Box O—Rosewood Station Spokane, Washington 99208	----do	Do.
Oregon Portland Cement Co	111 S.E. Madison St. Portland, Oregon 97214	----do	Baker.
Pacific Crushing Co	610 Irving Drive Eugene, Oregon 97402	----do	Klamath, Lane.
Pioneer Construction Co	7881 N.W. St. Helens Road Portland, Oregon 97229	----do	Multnomah.
Quality Rock Co	Rt. 2, Box 608 Beaverton, Oregon 97005	----do	Washington.
Rogue River Paving Co., Inc	1133 S. Riverside Medford, Oregon 97501	----do	Coos, Douglas Jackson, Josephine.
Roseburg Sand & Gravel Co	Box 1207 Roseburg, Oregon 97470	----do	Coos, Douglas, Lane.
Sunset Crushed Rock	Clatsop Airport Astoria, Oregon 97103	----do	Clatsop.
Jed Wilson & Son	Box 125 La Pine, Oregon 97739	----do	Lake.
Talc and Soapstone:			
John H. Pugh	2891 Elk Lane Grants Pass, Oregon 97526	Mine	Josephine.
Stauffer Chemical Co	P.O. Box 68 Portland, Oregon 97403	Plant	Multnomah.
Vermiculite (exfoliated):			
Supreme Perlite Co	P.O. Box 66 North Portland, Oregon 97043	----do	Do.
Vermiculite-Northwest, Inc	P.O. Box A Auburn, Washington 98002	----do	Do.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
METALS			
Aluminum:			
Harvey Aluminum Co	The Dalles, Oregon 97058	Plant	Wasco.
Reynolds Metals Co	Troutdale, Oregon 97060	----do	Multnomah.
Ferroalloys:			
Hanna Nickel Smelting Co	Riddle, Oregon 97469	----do	Douglas.
Union Carbide Corp., Mining and Metals Division [1]	Portland, Oregon 97200	----do	Multnomah.
National Metallurgical Co	Springfield, Oregon 97477	----do	Lane.
Gold and Silver:			
Baker Assets Co	Baker, Oregon 97814	Mine and mill	Baker.
Beaver Rock Products, Inc	Albany, Oregon 97321	Mine	Grant.
Cornucopia Placer Co	Halfway, Oregon 97834	Placer	Baker.
Ray Evans	Kerby, Oregon 97531	----do	Josephine.
Frank Ramsey	Baker, Oregon 97814	Mine	Baker.
Mercury:			
Alcona Mining, Inc	366 S. 79th St. Springfield, Oregon 97477	----do	Douglas.
C. F. Taylor	1128 Phelps Ave. San Jose, California 95117 (Prineville, Oregon)	----do	Crook.
Nickel:			
Hanna Mining Co	Riddle, Oregon 97469	----do	Douglas.
Steel:			
Cascade Steel Rolling Mills, Inc	McMinnville, Oregon 97128	Plant	Yamhill.
Oregon Steel Mills	Portland, Oregon 97200	----do	Multnomah.
Titanium:			
Oregon Metallurgical Corp	Albany, Oregon 97321	do	Linn.
Zirconium:			
Wah Chang Albany Corp	Albany, Oregon 97321	----do	Do.

[1] Produces ferromanganese and silicomanganese.

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 C. Gordon Leaf [1]

The value of mineral production in Pennsylvania in 1969 increased 8 percent over that of 1968 to a total of $976 million. Bituminous coal production accounted for 73 percent of the increase with a total value increase of $53 million. Anthracite production decreased 1.0 million tons, continuing its downward trend for the seventh consecutive year, but the total value increased by $3.5 million because of a $1.14 per ton price increase. Collectively, anthracite and bituminous coal production accounted for 58 percent of the total mineral production value in 1969. Stone production continued to rise with an increase in value of $10 million. Other commodities showing an increase in value were portland cement, clays, lime, crude petroleum, sand and gravel, peat, zinc, pyrites, and tripoli. Commodities with decreases in total value were masonry cement, copper, natural gas, natural gas liquids, kaolin, cobalt, gold and silver, iron ore, mica, and sericite schist.

Leading producing counties, with primary commodities in parentheses, were Washington (bituminous coal), Greene (bituminous coal), Northampton (cement), Allegheny, Cambria, Indiana, Armstrong (bituminous coal), and Schuylkill (anthracite).

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Pennsylvania [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	43,018	$123,176	44,893	$126,941
Masonry—thousand 280-pound barrels	3,151	8,706	3,085	8,504
Clays [2]—thousand short tons	3,034	17,679	2,727	19,637
Coal:				
Anthracite—do	11,461	97,245	10,473	100,770
Bituminous—do	76,200	408,982	78,631	461,579
Copper—short tons	4,850	4,059	3,382	3,215
Gem stones	NA	4	NA	4
Lime—thousand short tons	1,702	24,272	2,008	28,952
Natural gas—million cubic feet	87,987	24,460	79,134	21,841
Natural gas liquids:				
Natural gasoline and cycle products—thousand 42-gallon barrels	27	73	22	61
LP gases—do	37	95	35	78
Peat—short tons	35,806	385	34,613	407
Petroleum (crude)—thousand 42-gallon barrels	4,160	18,698	4,448	20,086
Sand and gravel—thousand short tons	18,101	31,076	18,105	31,451
Stone—do	62,812	108,151	66,992	117,726
Zinc [3] (recoverable content of ores, etc.)—short tons	30,382	8,203	33,035	9,646
Value of items that cannot be disclosed: Clays (kaolin), cobalt, gold, iron ore, mica, pyrites, sericite-schist, silver, and tripoli	XX	28,780	XX	25,470
Total	XX	904,044	XX	976,368
Total 1967 constant dollars	XX	894,270	XX	p916,415

p Preliminary. 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 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.

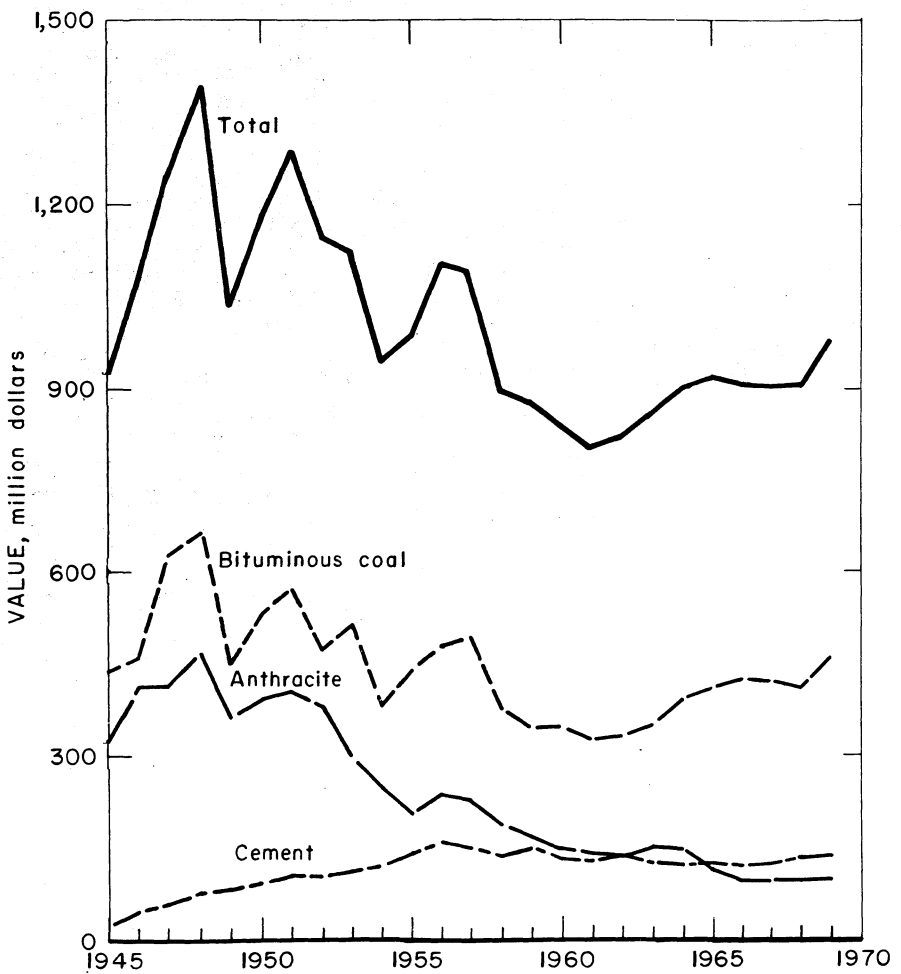

Figure 1.—Value of bituminous coal, anthracite, cement, and total value of mineral production in Pennsylvania.

Table 2.—Value of mineral production in Pennsylvania, by counties [1] [2]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	W	W	Stone, lime, clays, sericite-schist.
Allegheny [3]	$31,463	$34,646	Coal, cement, clays, sand and gravel, stone, iron ore (pigment material).
Armstrong	32,746	42,098	Coal, clays, sand and gravel, stone.
Beaver	3,647	3,420	Sand and gravel, coal, clays.
Bedford	W	W	Stone, coal, lime, sand and gravel.
Berks	W	W	Iron ore, cement, stone, clays, cobalt, coal, sand and gravel, pyrites.
Blair	W	2,138	Stone, coal.
Bradford	W	W	Sand and gravel.
Bucks	W	12,376	Stone, sand and gravel, clays.
Butler [4]	11,741	12,694	Coal, cement, stone, lime, sand and gravel.
Cambria	W	W	Coal, clays, stone, iron ore (pigment material).
Carbon	5,714	5,450	Coal, stone, sand and gravel.
Centre	18,117	21,808	Lime, stone, coal, clays.
Chester	W	W	Stone, lime, clays.
Clarion	11,264	17,143	Coal, stone, sand and gravel, clays.
Clearfield	27,605	27,564	Coal, clays.
Clinton	W	W	Coal, stone, clays.
Columbia	3,164	3,982	Coal, stone, sand and gravel, peat, lime.
Crawford	458	537	Sand and gravel.
Cumberland	W	3,021	Stone, sand and gravel, clays.
Dauphin	3,511	3,253	Stone, sand and gravel, coal, clays.
Delaware	W	W	Stone.
Elk	W	W	Coal, stone.
Erie	W	W	Sand and gravel, peat.
Fayette	6,809	7,578	Coal, stone, clays.
Forest	W	461	Sand and gravel.
Franklin	1,658	1,581	Stone, sand and gravel.
Fulton	W	W	Do.
Greene	80,454	89,913	Coal.
Huntingdon	W	W	Sand and gravel, stone, coal, clays.
Indiana	W	W	Coal, clays.
Jefferson	W	W	Coal, clays, stone.
Lackawanna	W	W	Coal, sand and gravel.
Lancaster	7,416	10,794	Stone, coal, clays, sand and gravel.
Lawrence	W	W	Cement, stone, coal, sand and gravel, clays, peat.
Lebanon	23,565	23,850	Iron ore, lime, stone, copper, cobalt, pyrites, gold, silver.
Lehigh	30,875	34,654	Cement, zinc, stone.
Luzerne	36,264	37,769	Coal, stone, sand and gravel, peat, clays.
Lycoming	W	W	Stone, sand and gravel, coal, tripoli.
McKean	284	217	Clays, stone.
Mercer	1,405	2,166	Sand and gravel, coal, stone, peat.
Mifflin	W	W	Sand and gravel, stone, lime.
Monroe	826	869	Stone, sand and gravel, clays.
Montgomery	W	W	Stone, cement, lime, clays.
Montour	W	W	Stone, lime.
Northampton	63,071	60,824	Cement, stone, sand and gravel.
Northumberland	W	W	Coal, clays, stone.
Perry	W	W	Stone.
Philadelphia	W	-------	
Potter	108	107	Stone.
Schuylkill	39,140	41,241	Coal, stone, sand and gravel.
Snyder	518	398	Sand and gravel, stone, coal.
Somerset	18,111	23,911	Coal, stone, clays.
Sullivan	200	160	Coal.
Susquehanna	W	W	Stone.
Tioga	W	W	Coal, sand and gravel.
Union	W	W	Stone.
Venango	W	W	Coal, sand and gravel, stone.
Warren	988	696	Sand and gravel.
Washington	W	W	Coal, stone, clays.
Wayne	800	632	Sand and gravel, stone, peat.
Westmoreland	22,441	W	Coal, sand and gravel, stone.
Wyoming	W	1,322	Sand and gravel, stone.
York [4]	9,891	10,226	Cement, stone, lime, clays, sand and gravel, mica.
Undistributed	409,792	436,868	
Total [5]	904,044	976,368	

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

[1] Cameron, Juniata, and Pike Counties are not listed because no production was reported.

[2] Values 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] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Pennsylvania business activity

		1968	1969	Change, percent
Employment and labor force, annual average: [1]				
Total labor force	thousands	r 4,912.3	5,013.2	+2.1
Unemployment	percent of work force	3.2	2.9	−9.4
Employment:				
Manufacturing	thousands	r 1,564.7	1,580.9	+1.0
Durable goods	do	r 928.7	940.2	+1.2
Lumber and wood products	do	r 14.7	14.5	−1.4
Furniture and fixtures	do	29.1	29.8	+2.4
Stone, clay, and glass products	do	r 64.1	66.7	+4.1
Primary metals	do	r 254.0	253.0	−.4
Fabricated metal products	do	r 113.1	116.3	+2.8
Nonelectrical machinery	do	r 139.4	141.7	+1.6
Electrical equipment	do	r 158.8	160.9	+1.3
Transportation equipment	do	r 75.4	77.9	+3.3
Instruments	do	38.3	38.7	+1.0
Nondurable goods	do	r 636.0	640.6	+.7
Food products	do	r 114.2	114.6	+.4
Apparel and related products	do	r 180.9	182.4	+.8
Paper products	do	r 45.9	48.7	+6.1
Printing	do	r 71.3	69.5	−2.5
Chemical products	do	r 61.8	63.0	+1.9
Nonmanufacturing	do	r 2,694.8	2,788.8	+3.5
Mining	do	r 38.1	38.9	+2.1
Contract construction	do	r 193.5	203.1	+5.0
Personal income: [2]				
Total	millions	r $40,102	p $43,243	+7.8
Per capita		$3,413	p $3,664	+7.4
Construction activity:				
New residential [3]	thousands	$573.8	$563.4	−1.8
New nonresidential [3]	do	$977.1	$1,214.9	+24.3
Cement shipments to and within Pennsylvania [4]	thousand 376-pound barrels	r 19,972	19,901	−.4
Mineral production [4]	millions	$904	$976	+8.0

p Preliminary. r Revised.
[1] Pennsylvania Bureau of Employment Security.
[2] Survey of Current Business.
[3] Pennsylvania Department of Labor and Industry.
[4] U.S. Bureau of Mines.

Table 4.—Worktime 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
1968:								
Bituminous coal	22,002	231	5,073	40,603	30	897	22.83	6,089
Anthracite	6,932	217	1,508	11,011	4	504	46.13	4,182
Metal	1,473	299	441	3,538	1	32	9.33	2,124
Nonmetal	1,442	252	364	2,954	1	103	35.21	6,028
Sand and gravel	1,236	239	296	2,488	-----	70	28.14	3,421
Stone	8,403	270	2,268	18,549	3	281	15.31	1,661
Peat	50	230	12	91	-----	1	10.98	44
Total [1]	41,538	240	9,961	79,234	39	1,888	24.32	4,517
1969: p								
Bituminous coal	21,300	244	5,184	41,511	26	1,010	24.96	5,583
Anthracite	6,300	221	1,399	10,156	13	440	44.60	9,586
Metal	1,385	290	419	3,348	1	29	8.96	2,044
Nonmetal	1,255	252	318	2,578	1	73	28.71	5,307
Sand and gravel	1,125	250	282	2,426	-----	55	22.67	739
Stone	8,460	278	2,352	18,692	2	296	15.94	1,706
Peat	56	232	13	106	-----	1	9.43	160
Total [1]	39,895	249	9,967	78,817	43	1,904	24.70	4,864

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

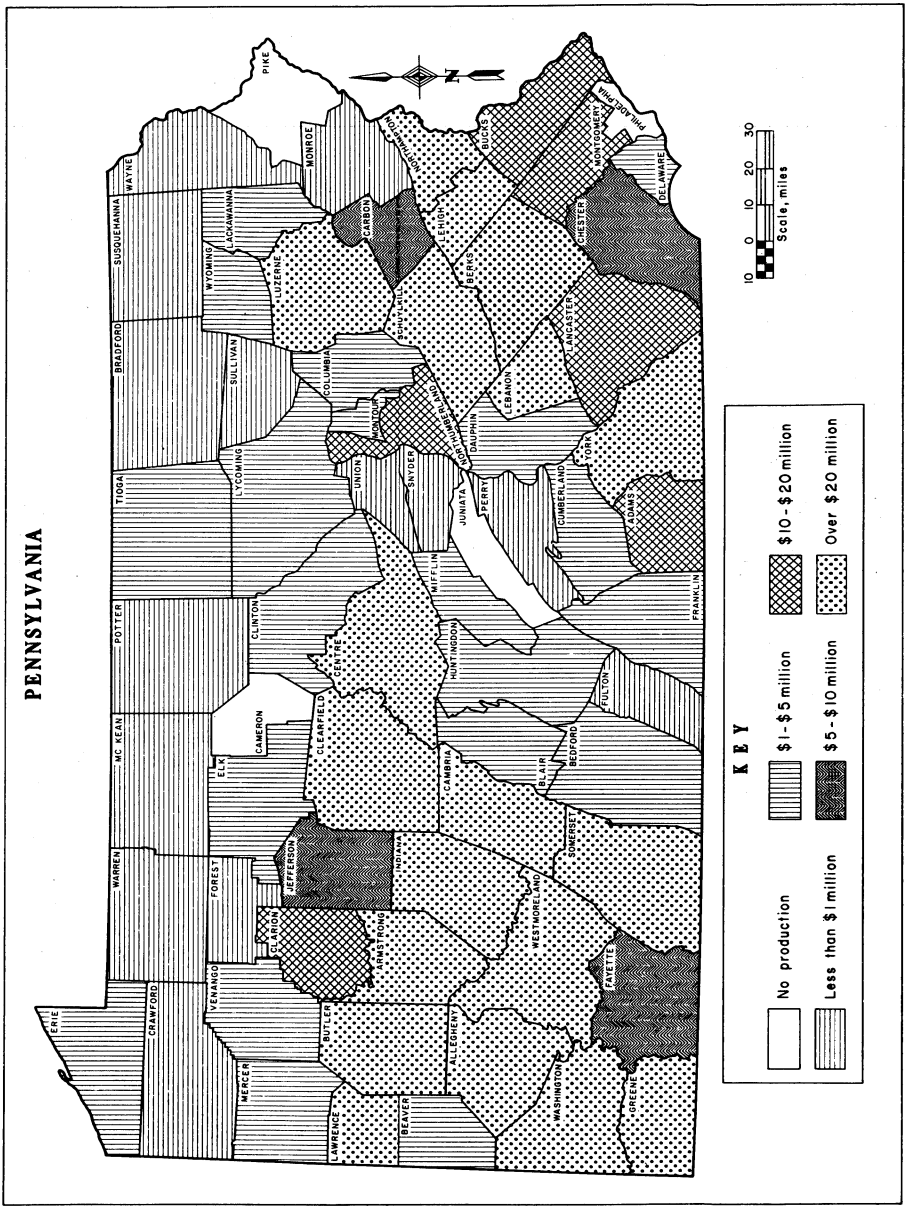

Figure 2.—Change in value of county mineral production from 1968.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Anthracite).—Anthracite production decreased for the seventh consecutive year and reached a new modern-day low of 10.5 million tons in 1969. Production has steadily decreased since 1917 when a peak of 100 million tons was reached.

The total value of anthracite production increased 4 percent to $101 million. This was an increase of $1.14 per short ton over 1968 value. Truck and rail shipments of Pennsylvania anthracite to other States totaled 2.6 million tons, shipments to Canada totaled 373,000 tons, and shipments to other foreign countries totaled 853,000 tons.

Of the total production, 9.9 million tons was processed from preparation plants, 535,000 tons from river dredging, and 17,000 tons was used at collieries for power and heat; 5.6 million tons was shipped by truck and 4.9 million tons by rail.

Underground mine production accounted for 2.1 million tons or 20 percent of the total production. Of this, 1.3 million tons was mechanically loaded by 106 scraper loaders, 25 mobile loaders, and 158 conveyor and pit-car loaders (including duckbills and other self-loading conveyors). Fresh-mined anthracite produced from strip pits totaled 4.6 million tons, which was 44 percent of the total production. The Lehigh Region produced 1.6 million tons of this strip coal, 2.0 million tons came from the Schuylkill Region, and 0.9 million tons came from the Wyoming Region. Equipment used to recover coal from culm banks and strip pits included 104 power shovels and 165 draglines. Of the 3.3 million tons of anthracite produced from culm banks (31 percent of the total production), 1.8 million tons came from the Schuylkill Region, 0.8 million tons came from the Lehigh Region, and 0.7 million tons came from the Wyoming Region. Five hundred and thirty-five thousand tons of anthracite was produced by dredging (5 percent of the total production). Of this total, 483,000 tons came from the Susquehanna River with an average value of $4.33 per ton and 53,000 tons from the Schuylkill River with an average value of $3.50 per ton. Anthracite (from all sources) shipped by rail had an average value of $9.11 per ton, $10.07 per ton by truck, and $11.23 per ton for colliery fuel.

The anthracite industry averaged 221 days worked during the year with an average of 6,300 men working daily (632 men less than in 1968). Of the average number of men working daily, 1,529 worked underground, 1,718 in strip pits, 548 at culm banks, 1,612 at preparation plants, 62 on dredges, and 831 at other surface jobs. Productivity from all operations except dredges averaged 7.24 tons per man-day, while dredges averaged 31.56 tons per man-day for an overall average of 7.53 tons per man-day (0.09 ton per man-day less than in 1968).

Eleven counties produced anthracite during 1969. Schuylkill County was the leading producer for the second consecutive year and produced 4.1 million tons. Following Schuylkill County were Luzerne (3.4 million tons), Northumberland (1.3 million tons), and Carbon, Lancaster, Lackawanna, Columbia, Dauphin, Berks, Sullivan, and Snyder, all with less than half a million tons.

Thirteen work deaths were reported for the year, more than 3 times the total for 1968. The fatalities were as follow: Roof falls (one), underground haulage (one), gas or dust explosion (one), haulage on surface (one), strip mines (three), haulage at mechanical cleaning plants (one), machinery at mechanical cleaning plants (one), and all other (four). The frequency rate of fatalities increased from 0.36 million man-hours worked in 1968 to 1.28 million man-hours in 1969. Nonfatal lost-time injuries dropped from 504 in 1968 to 440 in 1969, and the frequency rate dropped from 45.77 injuries per million man-hours of exposure to 43.32 in 1969.

Coal (Bituminous).—Production of bituminous coal totaled 78.6 million tons with a value of $462 million, compared with 76.2 million tons valued at $409 million in 1968. This represents a 3-percent increase in production and a 13-percent increase in value. The average price per ton increased from $5.37 in 1968 to $5.87 in 1969. Open-market sales of 49.7 million tons averaged $4.89 per ton, and the 28.9 million tons not sold on the open market (captive) averaged $7.56 per ton. Of the 78.6 million

tons produced, 57.8 million tons was shipped by rail or water, 15.5 million tons by truck, and the remainder by other means. Unit-train shipments totaled 20 million tons, 2 million more than in 1968.

Eight hundred and thirty mines operated in Pennsylvania in 1969, including 228 underground mines, a decrease of 33 from 1968; 541 strip mines, an increase of 52; and 61 auger mines, 6 more than in 1968. Of the total production, 56.0 million tons (71 percent) came from underground mines, 22.0 million tons (28 percent) came from strip mines, and 622,000 tons (1 percent) came from auger mines.

Of the total output, 65 percent was mechanically cleaned at 77 preparation plants. Of the cleaned coal, 43.9 million tons came from underground mines, 6.8 million tons came from strip mines, and 61,000 tons came from auger mines. Wet washing methods, other than by jig washers, were used to clean 30.4 million tons; 12.2 million tons was cleaned in jig washers, and 8.1 million tons was cleaned by pneumatic methods. Thermal drying of 4.5 million tons of coal was done at 10 plants in 11 thermal units.

A total of 37.3 million tons of coal was crushed at 163 plants. Forty-two plants treated 8.9 million tons with oil, 1.6 million tons with a combination of calcium chloride and oil, and 665,000 tons wih calcium chloride.

Mechanical loading was practiced at 171 underground mines loading 55.8 million tons. The 108 mobile loading machines accounted for 8.4 million tons, 45.2 million tons was cut and loaded by 458 continuous mining machines. An additional 79 mobile loading machines were used with the continuous mining machines. Nine longwall machines loaded 2.0 million tons. The balance of the mechanical loading was by duckbills, scraper loaders, and hand-loaded face conveyors.

There were 209 cutting machines cutting 8.8 million tons of underground coal, and 160 hand-held and post-mounted drills, which drilled 1.8 million tons. Thirty-five mobile drills drilled 7.0 million tons. Three hundred and four rotary drills and 273 percussion drills were used for roof bolting. Miscellaneous drilling functions were performed with 50 other drills.

Underground haulage was by 970 trolley locomotives, 45 battery-powered locomotives, and 4 other locomotives. There were 431 miles of main-line track and 237 miles of working-section track. In addition 574 motor belt conveyors each averaging 1,896 feet carried large tonnages. Other haulage was accomplished by 1,008 cable-reel and 26 battery shuttle cars, plus 12 shuttle buggies.

Strip mining equipment included 570 power shovels, 20 fewer than in 1968, and 315 draglines, 23 fewer than in 1968. Most of the shovels and draglines were diesel-powered with a dipper capacity of less than 3 cubic yards. Only 10 draglines had a dipper capacity of over 12 cubic yards. There were 28 carryall scrapers (one less than in 1968), 7 of which had a dipper capacity of over 12 cubic yards. Other equipment included 652 bulldozers, 46 horizontal and 134 vertical drills, and 1,010 trucks which averaged 17 tons in capacity and traveled an average distance of 7 miles from pit to tipple.

Auger mining equipment included 55 augers, 9 bulldozers, and 5 horizontal and 2 vertical drills. Seventy-one trucks, which averaged 16 tons in capacity, traveled an average distance of 8 miles from pit to tipple.

Washington County led in coal production with 13.8 million tons, followed by Greene (12.1 million tons), Indiana (8.1 million tons), Armstrong (7.4 million tons), and Cambria (7.1 million tons). Greene and Washington Counties accounted for most of the captive coal produced in Pennsylvania.

During the year, 26 fatal and 1,010 nonfatal lost-time injuries occurred. This was a decrease of 4 fatal injuries, but an increase of 113 nonfatal injuries. Injury rates were 0.63 fatal and 24.33 nonfatal per million man-hours of exposure and 0.33 fatal and 12.84 nonfatal per million short tons mined. Eighteen of the fatal injuries occurred underground (10 from rock falls, two on transportation, three on machinery, two from electricity, and one from miscellaneous causes), one at a mechanical cleaning plant, two on transportation outside the mine, and five in strip mines.

In the 1969 National Safety Competition, Certificates of Achievement in Safety for outstanding safety records in the Underground-Coal Group were awarded to the Harman No. 5 mine, Harman Coal Corp., Timblin, Pa., for 63,674 man-hours worked

without a disabling work injury; Kinseley No. 10 mine, Kinseley Coal Co., Reynoldsville, Pa., for 38,610 man-hours worked; and Penn Hill No. 2 mine, Penn Hill Coal Co., Clymer, Pa., for 36,096 man-hours worked. A Certificate of Achievement in Safety in the Surface-Coal Group was awarded to Simca Mining No. 2 mine, Simca Mining, Inc., Curwensville, Pa., for 31,547 man-hours worked without a disabling work injury.

Natural Gas Liquids.—Production of natural gas liquids decreased 11 percent to 57,000 42-gallon barrels. Of the total, 22,000 barrels was natural gasoline and cycle products and 35,000 barrels was liquefied petroleum (LP) gases and ethane from natural gas processing plants. LP gases and ethane averaged $2.23 per barrel ($2.56 in 1968), and natural gasoline and cycle products averaged $2.77 per barrel ($2.70 in 1968). According to the Oil and Gas Journal, proved reserves of natural gas liquids totaled 1 million barrels at yearend 1969.

Peat.—Production of peat increased 3 percent. Ten operations in seven counties reported production of 39,600 short tons. Sales totaled 34,600 tons. The average price per ton ($11.76) was $1.02 more than that for 1968. Of the total output, more than one-half was humus peat; the remainder was reed sedge and moss peat. Most of the peat produced was shredded for preparation prior to marketing.

For the third straight year Luzerne County was the State's leading producer with 42 percent of the total production; other peat-producing counties were Wayne, Lackawanna, Erie, Columbia, Lawrence, and Mercer.

Petroleum and Natural Gas.—Production of crude petroleum increased 7 percent as a result of new water-flood projects in the Bradford field. Penn-grade crude petroleum production totaled 4.4 million 42-gallon barrels valued at $20 million, with an additional 45,000 barrels of Corning-grade crude oil, valued at $132,750, produced in Crawford and Erie Counties from the Medina (Lower Silurian) Sandstone. The number of producing oil wells decreased from 42,500 in 1968 to 37,625 in 1969. Estimated proved recoverable reserves of crude oil at yearend totaled 54.7 million barrels, a decrease of 4.5 million barrels from that of yearend 1968.

Natural gas production totaled 79 billion cubic feet (Bcf), a decrease of 10 percent from that of 1968. A total of 61.3 Bcf of

Table 5.—Coal (bituminous) production, by counties

County	Number of mines				Production (thousand tons)	Average price per ton
	Underground	Strip	Auger	Total		
Allegheny	9	12	---	21	4,808	$6.86
Armstrong	22	41	11	74	7,399	4.73
Beaver	W	5	W	W	267	4.61
Bedford	W	W	---	W	16	5.19
Blair	1	---	---	1	2	6.76
Butler	W	30	W	W	2,098	4.23
Cambria	40	24	1	65	7,066	6.60
Centre	2	20	---	22	1,050	3.99
Clarion	---	66	---	66	3,771	4.38
Clearfield	15	55	9	79	5,919	4.05
Clinton	---	16	---	16	551	4.46
Elk	4	10	7	21	367	4.41
Fayette	3	34	1	38	778	5.19
Greene	19	4	---	23	12,076	7.45
Huntingdon	---	W	---	W	W	W
Indiana	39	29	12	80	8,070	5.67
Jefferson	10	38	8	56	1,440	4.49
Lawrence	---	21	1	22	848	3.80
Lycoming	---	3	---	3	50	3.65
Mercer	---	4	---	4	182	4.02
Somerset	30	70	6	106	4,254	4.90
Tioga	---	8	---	8	743	4.19
Venango	---	12	---	12	504	3.70
Washington	12	18	---	30	13,769	6.90
Westmoreland	10	16	2	28	2,593	6.52
Other counties	12	5	3	55	10	4.30
Total	228	541	61	830	78,631	5.87

W Withheld to avoid disclosing individual company confidential data.

gas was produced from the shallow (Upper Devonian or younger) reservoirs, while production from the deep (Oriskany or older) reservoirs totaled 17.8 Bcf. The estimated number of producing gas wells decreased from 17,000 in 1968 to 16,600 in 1969. Estimated proved reserves of natural gas totaled 1,304 Bcf, including 499 Bcf in storage at yearend. This was a decrease of 41 Bcf from that of 1968.

The Oil and Gas Division, Pennsylvania Bureau of Topographic and Geologic Survey, reported 986 new wells drilled and 47 wells deepened during 1969. Of these, 539 were oil wells, 249 gas wells, 122 service wells, 15 miscellaneous wells, one stratigraphic test, and 60 dry holes. Of the old wells drilled deeper, 26 were gas wells, nine were oil wells, and 12 were dry. Total footage of all wells drilled was 1,930,944. Of 895 well completions, 42 were exploratory (31 percent successful), and 853 were development (95 percent successful).

Deep drilling (Middle Devonian or older) increased from 39 wells in 1968 to 43 wells in 1969. Most of the deep development drilling was in the Medina gas area of Crawford County, where 13 gas wells were drilled in the Indian Springs field. Activity in the shallow gasfields was in Indiana, Jefferson, and Armstrong Counties, where development continued in the Big Run and Marchand fields. Shallow oil drilling was carried on in the Bradford field of McKean County in the Bradford and associated sandstones. One hundred and twenty-one oil wells were drilled in the Red Valley and Venango Second sand areas of Venango and Forest Counties. Warren County was again the most active oil area, with 234 successful wells completed in 1969.

Indiana County continued to be the most active gas area, with 121 successful wells completed. Seismic crews put in 39 crew-weeks during the year compared with 23 crew-weeks in 1968. A tract of 1,100 acres of State Forest land was leased through competitive bidding at $8.17 per acre. A total bonus of $8,987 was received for this tract, which carries a yearly rental of $1 per acre. At yearend there were 144,983 acres of State Forest lands under lease for oil and gas exploration and development, including 59,109 acres in gas storage. A total of 785 acres of State Game land was leased during 1969. At yearend, 24 leases were active, totaling 13,613 acres. There are 35 productive wells on 18 leases of State Game lands.

NONMETALS

Cement.—Shipments of portland cement increased 4 percent, with the average value per 376-pound barrel decreasing $0.03 to $2.83. Masonry cement shipments decreased 2 percent, with the average value per 280-pound barrel remaining at $2.76. Finished portland cement was produced at 22 plants which had a total annual production capacity of 51.7 million barrels, an increase of 500,000 barrels from that of 1968. Twenty plants shipped masonry cement during 1969.

For cement surveys, Pennsylvania is divided into two districts. Eastern and western Pennsylvania are separated by a line running south from the Pennsylvania-New York State line along the eastern boundaries of Potter, Clinton, Centre, Huntingdon, and Franklin Counties. Portland cement shipments from the five plants in western Pennsylvania totaled 12.0 million barrels at an average price of $3.17 per barrel, of which 93 percent was types I and II (general use and moderate heat), 3 percent was type III (high-early-strength), and 1 percent was portland-pozzolan. Of the total shipments from western Pennsylvania, 10.3 million barrels was shipped by truck in bulk, 837,000 barrels by truck in containers, 738,000 barrels by railroad in bulk, and 32,000 barrels by railroad in containers.

Portland cement shipments of all types from 17 plants in eastern Pennsylvania totaled 32.9 million barrels at an average price of $2.70 per barrel, of which 90 percent was types I and II, 6 percent type III, and 2 percent white cement. Of the total shipments from eastern Pennsylvania, 20.9 million barrels was by truck in bulk, 7.7 million barrels by railroad in bulk, 3.6 million barrels by truck in containers, and the remainder by railroad in containers.

Of the 11.7 million barrels of portland cement produced in western Pennsylvania, 3.3 million barrels was air-entrained; of 31.5 million barrels produced in eastern Pennsylvania, 4.8 million barrels was air-entrained. Portland cement stocks at yearend totaled 1.7 million barrels in western Pennsylvania and 2.4 million barrels in eastern Pennsylvania.

Ready-mixed concrete companies purchased 19.1 million barrels of portland cement shipped from eastern Pennsylvania and 7.9 million barrels from western Pennsylvania; concrete products manufacturers purchased 8.1 million barrels from the east and 1.4 million barrels from the west; building material dealers purchased 3.2 million barrels from the east and 880,000 barrels from the west; and highway contractors purchased 2.0 million barrels from the east and 1.2 million barrels from the west.

Limestone and cement rock were the chief raw materials used for the manufacture of portland cement; 9.2 million tons was consumed in eastern Pennsylvania, and 3.1 million tons was used in western Pennsylvania. Other raw materials used included shale, clay, sand, slag, gypsum, iron ore, bauxite, and mill scale. Eastern Pennsylvania purchased 742 million kilowatt-hours of electricity, and western plants bought 316 million kilowatt-hours.

Prepared masonry cement shipped from 15 plants in eastern Pennsylvania totaled 2.0 million barrels at an average price of $2.67 per barrel. Shipments from five plants in western Pennsylvania totaled 1.1 million barrels at $2.92 per barrel.

The leading portland cement shipping county was Northampton, with 41 percent of the State's total shipments, followed by Lehigh County. Other counties shipping portland cement were Allegheny, Butler, and Lawrence in the west, and Berks, Montgomery, and York in the east. Northampton County also led in shipments of masonry cement with 26 percent of the total.

The United States is the only major cement-producing nation in the world which still uses the 376-pound barrel as a major unit of measure for cement. During 1969, Canadian companies abandoned their own 350-pound barrel and adopted the 2000-pound short ton as their standard unit of cement measure.

Clays.—Total production of clays (excluding kaolin) decreased 10 percent in tonnage. A higher unit value resulted in an increase of 11 percent in value. Fire clay, which decreased 15 percent in tonnage and increased 14 percent in value, accounted for 44 percent of total production. Common clay and shale, decreasing 6 percent in tonnage and increasing 6 percent in value, accounted for the remaining 56 percent of the total. Clay was produced in 28 counties, led by Clearfield and Lawrence.

Gem Stones.—Hobbyists and amateur lapidarists collected mineral specimens.

Graphite.—Manufacturing of artificial graphite in Pennsylvania in 1969 was carried on at three plants in Elk and Northampton Counties. The output, in the form of anodes, electric motor brushes and brush stock, and other items, was produced from petroleum coke, lampblack, pitch cokes, hydrocarbon gases, and other raw materials.

Gypsum.—A gypsum-calcining plant continued operations at Philadelphia.

Table 6.—Clays sold or used by producers, by kinds and uses [1]

(Thousand short tons)

Use	Fire clay		Miscellaneous clay	
	1968	1969	1968	1969
Refractories:				
Firebrick and block	681	665	-----	-----
High-alumina brick	15	W	-----	-----
Other	[2] 91	[2] 98	W	W
Heavy clay products:				
Building brick	585	393	1,223	1,177
Vitrified sewer pipe	45	W	67	64
Undistributed	[3] 7	[3] 50	[4] 319	[4] 279
Total	1,424	1,206	[5] 1,610	1,520

W Withheld to avoid disclosing individual company confidential data.

[1] Excludes kaolin.

[2] Includes mortar, clay crucibles (1968), foundries and steelworks (bulk), and other refractories.

[3] Includes other heavy clay products (1968), pottery, floor and wall tile, portland and other hydraulic cements, and other uses (1969).

[4] Includes other heavy clay products, drain tile, exports (1968), pottery (1968), floor and wall tile (1968), lightweight aggregate, filler, foundries and steelworks (bulk), mortar (1969), portland and other hydraulic cements, and other uses.

[5] Data may not add to totals shown because of independent rounding.

Iron Oxide Pigments.—Red iron oxide pigments were recovered during plant processing of bauxite to alumina in Allegheny County. Yellow iron oxide pigments in the form of sulfur mud were mined from an open pit in Cambria County. Finished natural and manufactured iron oxide pigments were shipped from one plant in Carbon County and two plants in Northampton County.

Lime.—Lime production (quicklime and hydrated lime) increased 18 percent in tonnage and 19 percent in value over 1968. Production of quicklime increased from 1.4 million tons in 1968 to 1.7 million tons; hydrated lime increased from 284,000 tons in 1968 to 312,000 tons. The average price per ton of quicklime increased from $13.90 to $14.07, while that of hydrated lime increased from $16.02 to $16.29 per ton. The chemical industry and other industrial markets consumed most of the quicklime sold, with the remainder distributed among construction, agricultural, and refractory markets. Of the total hydrated lime sold or used, 44 percent was consumed by the chemical and other industrial markets, with the remainder distributed among agricultural and construction markets. Thirteen plants were operated in 11 counties. Of the 13 plants, six sold both quicklime and hydrated lime, four sold only quicklime, one sold only hydrated lime, one plant used only quicklime, and one plant sold or used both quicklime and hydrated lime.

Centre County again led in production, with three large plants each producing quicklime and hydrated lime. They accounted for 46 percent of the total quicklime sold and used, 24 percent of the hydrated lime sold and used, and 39 percent of the total lime value. Sixty-three percent of the total lime sold and used was consumed in Pennsylvania, 15 percent in Maryland, 7 percent in New Jersey, 4 percent in New York, and 4 percent in Ohio.

Mica.—Residual mica was produced and processed near Glenville in York County. The processed mica was used in paint, roofing, grease, electric insulation, welding rods, rubber, and textile coating.

Perlite (Expanded).—Crude perlite from Colorado was expanded at one plant each in Allegheny, Delaware, Lehigh, Luzerne, Montgomery, Philadelphia, and York Counties. Expanded perlite was sold or used chiefly for building plaster, with other uses being loose fill insulation, concrete aggregate, filler, soil conditioning, filter, cryogenic applications, charbase, refractory, and material for castable insulation and bonding mortars.

Pyrites.—Pyrite was recovered by flotation in the milling process for magnetic iron ore at the Grace and Cornwall concentrators in Berks and Lebanon Counties. The concentrate was shipped for consumption to the Bethlehem Steel Corporation sulfuric acid plant at Sparrows Point, Md.

Sand and Gravel.—Sand and gravel production remained at about the 1968 level although the total value increased 1 percent. Commercial sand production totaling 10.5 million tons sold for an average value of $1.84 per ton. Building, paving, and fill accounted for 82 percent of the commercial sand use with the remainder being used for other construction purposes and for industrial sand. Industrial uses included glass, molding, grinding and polishing, blast, fire or furnace, engine, abrasives, chemical, filler, foundry uses, pottery, porcelain, tile, and other uses. Commercial gravel production totaling 7.6 million tons sold for an average value of $1.59 per ton. Building construction used 48 percent, paving construction 46 percent, and fill, railroad ballast, and miscellaneous uses accounted for the remainder. Seventy percent of the commercial sand and gravel production was shipped by truck; the remaining 30 percent was shipped by railroad and waterway. Commercial sand and gravel plants included 87 stationary, 11 portable, and 4 dredges.

Sand and gravel was produced in 37 counties. Bucks County led the State in production with 20 percent of the total commercial tonnage and 19 percent of the value. Other leading producers were Westmoreland, Erie, Beaver, Wyoming, and Armstrong Counties.

Stone.—Production of stone increased 7 percent and the value of production increased 9 percent from that of 1968. The principal factor contributing to the stimulated mineral activity was the increase (24.3 percent) in nonresidential construction.

Of the total stone production, 66.9 million tons was crushed or broken. Increased production was reported for all types of

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Molding	142	$421	542	$869
Building	5,420	8,296	5,094	7,811
Paving	3,433	5,343	3,443	5,473
Fire or furnace	50	171	38	132
Fill	28	38	89	138
Undistributed [1]	1,313	4,725	1,279	4,920
Total	10,386	18,994	[2] 10,487	[2] 19,342
Gravel:				
Building	3,599	5,921	3,630	5,900
Paving	3,367	5,324	3,476	5,714
Fill	373	214	330	227
Undistributed [3]	286	386	183	266
Total	7,625	11,845	7,619	[2] 12,108
Total sand and gravel	18,011	30,839	[2] 18,105	[2] 31,451
Government-and-contractor operations:				
Sand: Other	67	171	------	------
Gravel:				
Paving	3	7	------	------
Other	20	59	------	------
Total	23	66	------	------
Total sand and gravel	90	237	------	------
All operations:				
Sand	10,453	19,165	10,487	19,342
Gravel	7,648	11,911	7,619	12,108
Grand total	18,101	31,076	[2] 18,105	[2] 31,451

[1] Includes glass, grinding and polishing, blast, engine, filtration (1968), hydrafrac (1969), ground, and other sand.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes railroad ballast, miscellaneous, and other gravel.

crushed stone except basalt, slate, and oystershell. Sixty-four percent of the crushed stone was used as aggregate, 17 percent for cement manufacture, 8 percent for furnace flux, 5 percent for lime manufacture, 2 percent for agricultural purposes, and the remainder for stone sand, railroad ballast, dust abatement in coal mines, riprap, refractory, and other uses.

All types of dimension stone except those classified as miscellaneous stone decreased in production in 1969. Production decreased 15 percent in tonnage and 3 percent in total value from that of 1968. Slate production accounted for 33 percent of the dimension stone tonnage and 62 percent of its value, while sandstone and quartzite accounted for 48 percent of the tonnage but less than 24 percent of the value.

The leading type of stone produced was limestone and dolomite comprising 85 percent of the tonnage and 77 percent of the total value.

Fifty-one counties reported stone production from 231 crushed-stone and 49 dimension-stone quarries. Leading counties in production were Montgomery, Northampton, Lancaster, Bucks, York, Adams, Berks, Centre, Chester, and Lawrence.

Some of the operations receiving Certificates of Achievement for safety in the 1969 National Safety Competition, Quarry Group, were Millard Quarry, Bethlehem Mines Corp., Annville, Pa., for 485,840 man-hours worked without a disabling work injury; Hanover Quarry, Bethlehem Steel Corp., Hanover, Pa., for 396,460 man-hours worked; McCoy Quarry, Bethlehem Mines Corp., Bridgeport, Pa., for 211,168 man-hours worked; Hillsville Quarry, Eastern Limestone Operation, Hillsville, Pa., for 205,117 man-hours worked; Charmian Quarry, GAF Corp. (Industrial Products Div.), Blue Ridge Summit, Pa., for 174,428 man-hours worked; Bessemer Quarry, Bessemer Ce-

ment Co., Bessemer, Pa., for 128,508 man-hours worked; Bethlehem Quarry, Bethlehem Mines Corp., Bethlehem, Pa., for 128,065 man-hours worked; and Valley Forge-Catanach Quarry, Martin-Marietta Corp. (Appalachian Stone Div.), Malvern, Pa., for 104,119 man-hours worked without a disabling work injury.

Table 8.—Stone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone	75	$1,361	72	$1,781
Curbing and flagging	34	1,091	22	754
Other uses [1]	40	4,009	31	3,759
Total	[2] 148	[2] 6,460	125	6,294
Crushed and broken stone:				
Riprap	160	203	132	192
Construction aggregates [3]	37,649	55,506	42,581	65,932
Furnace flux (limestone)	5,316	10,828	5,075	9,740
Railroad ballast	702	1,067	576	987
Agricultural	1,490	4,080	1,423	3,776
Other uses [4]	17,347	30,005	17,079	30,804
Total	62,664	[2] 101,690	66,866	[2] 111,432
Grand total	62,812	[2] 108,151	[2] 66,992	[2] 117,726

[1] Includes monumental, surface plates, refractory blocks, roofing slate, and millstock.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes dense-graded road base stone and concrete, bituminous, macadam, and surface treatment aggregates; and unspecified construction aggregate and roadstone (1969).
[4] Includes cement and lime manufacture, refractory, filler, chemical, and other uses.

Table 9.—Stone sold or used by producers, by counties

(Thousand short tons and thousand dollars)

Counties	1968		1969	
	Quantity	Value	Quantity	Value
Armstrong	412	$886	226	$483
Berks	4,173	5,169	3,883	5,345
Blair	1,700	2,078	1,221	2,123
Bucks	3,432	5,026	4,351	6,312
Butler	2,082	3,707	1,684	3,640
Centre	3,483	5,564	3,809	6,268
Chester	2,540	4,544	3,251	5,722
Clinton	W	W	607	854
Cumberland	1,370	2,211	1,414	2,337
Dauphin	W	W	1,348	2,152
Huntingdon	W	2,202	W	1,283
Lancaster	3,338	4,606	4,712	7,742
Lawrence	W	W	3,217	4,260
Lebanon	2,142	3,677	2,388	4,165
Lehigh	W	W	2,564	3,010
Luzerne	W	W	575	878
McKean	W	W	W	30
Mercer	W	W	277	W
Mifflin	W	W	W	462
Montgomery	5,330	9,119	5,423	9,446
Northampton	W	W	5,417	10,453
Northumberland	87	248	260	407
Potter	W	W	3	107
Schuylkill	W	W	W	701
Somerset	W	W	961	2,253
Venango	5	22	W	W
Westmoreland	W	W	1,527	2,775
York	3,945	8,732	4,121	8,953
Undistributed [1]	28,779	50,358	13,754	25,565
Total	[2] 62,812	[2] 108,151	[2] 66,992	117,726

W Withheld to avoid disclosing individual company confidential data.
[1] Includes Adams, Allegheny, Bedford, Cambria, Carbon, Clarion, Columbia, Delaware, Elk, Fayette, Franklin, Fulton, Jefferson, Lycoming, Monroe, Montour, Perry, Snyder, Susquehanna, Union, Washington, Wayne, and Wyoming Counties and data indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Sulfur.—Sulfur and hydrogen sulfide were recovered in liquid purification of oil refinery gases at four refineries in two counties. Four refineries recovered sulfur and one recovered hydrogen sulfide, which was converted directly into sulfuric acid. One of the refineries in Delaware County, formerly Sinclair Oil Corp., was changed to BP Oil Corp., a subsidiary of British Petroleum Corp. Ltd.

Talc (Sericite-Schist).—Sericite-schist, which resembles talc mineralogically and is suitable for many of the same uses because of similar chemical and physical properties, was produced from an open pit and processed near Aspers, Adams County. The schist was used as an asphalt filler and as an ingredient in insecticides, joint cement, and enamel coating.

Tripoli (Rottenstone).—Two operations in Lycoming County produced tripoli. One operation near Muncy prepared the material for use as a filler. The other operation near Oriole processed the material by drying, crushing, and grinding in Raymond Roller Mills, and used it as an abrasive and as a filler.

Vermiculite (Exfoliated).—Two operations, one each in Bucks and Lawrence Counties, produced exfoliated vermiculite in 1969. The major use was for insulation. Other uses included plaster aggregate, concrete aggregate, soil conditioning, horticulture, and fire base.

METALS

Cobalt.—Cobalt was recovered as a by-product of pyrite concentrate produced from the mining and flotation of magnetite in Berks and Lebanon Counties. The cobalt content decreased by 15 percent.

Copper, Gold, and Silver.—Copper concentrate production decreased 30 percent in tonnage and 21 percent in value. The concentrate was recovered by flotation of magnetic iron ore from the Cornwall mine in Lebanon County. The concentrate contained gold and silver, both of which decreased considerably in quantity and value.

Three sites in Lancaster County that were once mining scenes of colonial days were receiving attention for their potential as sources of silver. According to a report in Skillings Mining Review, the three areas of interest are the old Bamford mine, a few miles west of Lancaster, near Landisville; the old Pequea mine, a few miles east of the Conestoga River on Silver Mine Road; and an old limestone quarry north of Gap. Interest was revived in the area when Dr. Jacob Freedman of the geology department of Franklin and Marshall College, Lancaster, working for the U.S. Geological Survey, made a geochemical study of the area beginning in 1966 and found highly concentrated areas of lead and zinc.

Iron Ore.—Usable iron ore production and shipments decreased 10 percent in tonnage and 11 percent in value. Magnetite, produced from the Cornwall and Grace underground mines in Lebanon and Berks Counties, was crushed, concentrated by magnetic separation, and pelletized at agglomerating plants at the mine sites. Most of the iron ore pellets were shipped to company-owned iron and steel plants.

Iron and Steel.—Pig iron production totaled 22.3 million tons in 1969, 6 percent higher than the previous year. Most of the pig iron produced (95 percent) was classed as basic. The remaining 5 percent was Bessemer, malleable, and direct castings.

Forty-four blast furnaces were active during the year (one less than in 1968), and 14 furnaces were idle.

Iron ore consumption totaled 23.5 million tons; 53 percent in agglomerating plants, 43 percent in blast furnaces, and the remainder in steel furnaces. Receipts of iron ore totaled 24.9 million tons, 65 percent of which came from foreign countries and 35 percent from domestic sources. At the beginning of 1969 iron ore stocks were 11.1 million tons and at yearend they were 9.8 million tons. The iron and steel industry consumed 2.9 million tons of dolomite, 2.8 million tons of limestone, and 1.6 million tons of other fluxes. Other materials consumed included 14.1 million tons of coke, 1.8 million tons of steel furnace slag, 1.5 million tons of mill cinder and roll scale, 0.9 million tons of raw flue dust, and 0.5 million tons of coke breeze. Steel furnaces consumed 21.5 million tons of pig iron and hot metal and 11.3 million tons of home and purchased scrap. Blast furnaces consumed 1.0 million tons of home and purchased scrap and 0.1 million tons of slag scrap. Agglomerates consumed in blast furnaces included 11.9 million tons of sinter (self-fluxing), 5.3 million tons of iron ore pellets (regular), 4.5 million tons of U.S. sinter (regular), and 2.8 million tons of foreign iron ore and other agglom-

erates. Blast furnaces produced 178,000 tons of scrap, 6.8 million tons of slag, and recovered 798,000 tons of flue dust.

Zinc.—Zinc ore was mined and processed in Lehigh County. Mine output of zinc was 9 percent more than that of 1968, based on the quantity of recoverable zinc metal. The value of production increased 18 percent. Zinc ore concentrates were shipped to the New Jersey Zinc Company smelter at Palmerton. Products from the smelter included rolled zinc, slab zinc, zinc diecasting alloys, dry-battery shells, zinc oxide, spiegeleisen, and cadmium.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
Nonmetallic: Satellite Alloy Corp	9800 McKnight Rd. Pittsburgh, Pa. 15237	Plant	Allegheny.
Metallic:			
Abrasive Metals Co	26th & B. & O. RR Pittsburgh, Pa. 15222	do	Do.
Durasteel Abrasive Co	2601 Smallman St. Pittsburgh, Pa. 15222	do	Westmoreland.
Industeel Corp	37th & A. V. RR Pittsburgh, Pa. 15222	do	Allegheny.
Pangborn Div., the Carborundum Co.	P.O. Box 380 Hagerstown, Md. 21740	do	Butler.
Cement:			
Allentown Portland Cement Co.[1]	7th St. at Thruway Allentown, Pa. 18101	do	Berks.
Allentown Portland Cement Co	do	do	Montgomery.
Bessemer Cement Co., subsidiary of Louisville Cement Co.	510 Hanna Bldg. Cleveland, Ohio 44115	do	Lawrence.
Coplay Cement Manufacturing Co.[1]	North 2d St. Coplay, Pa. 18037	do	Lehigh.
Do	Easton Rd. Coplay, Pa. 18037	do	Northampton.
Dragon Cement Co., div. of Martin-Marietta Corp.[1]	5A Joyce Kilmer Ave. New Brunswick, N.J. 08903	do	Do.
Giant Portland Cement Co.[1]	1500 Chestnut St. Philadelphia, Pa. 19102	do	Lehigh.
Green Bag Cement Co., div. of Marquette Cement Manufacturing Co.	20 North Wacker Dr. Chicago, Ill. 60606	do	Allegheny.
Hercules Cement Co., div. of American Cement Corp.[1]	555 City Line Ave. Bala-Cynwyd, Pa. 19004	do	Northampton.
Keystone Portland Cement Co.[1]	1400 South Penn Sq. Philadelphia, Pa. 19102	do	Do.
Lehigh Portland Cement Co.[1]	718 Hamilton St. Allentown, Pa. 18105	do	Lehigh.
Lone Star Cement Corp.[1]	P.O. Box 6237 West End Br. Richmond, Va. 23230	do	Northampton.
Medusa Portland Cement Co.[2]	P.O. Box 5668 Cleveland, Ohio 44101	do	Lawrence.
Medusa Portland Cement Co.[3 4]	do	do	York.
National Portland Cement Co.[1]	1023 West St. George Ave. Linden, N.J. 07036	do	Northampton.
Penn-Dixie Cement Corp.[5]	P.O. Box 152 Nazareth, Pa. 18064	do	Butler.
Penn-Dixie Cement Corp.[1]	do	do	Northampton.
Universal Atlas Cement Div., U.S. Steel Corp.	Chatham Center Pittsburgh, Pa. 15230	do	Allegheny.
Universal Atlas Cement Div., U.S. Steel Corp.[1]	do	do	Northampton.
The Whitehall Cement Manufacturing Co.[1]	123 South Broad St. Philadelphia, Pa. 19109	do	Lehigh.
Clay and shale:			
Fire:			
Drexel Refractories Div., Drexel Dynamics Corp.	P.O. Box 50 Kittanning, Pa. 16201	Underground	Armstrong.
Eastvale-Standard Clay Products Co.[4]	Box 681 Beaver Falls, Pa. 15010	do	Beaver.
Freeport Brick Co	Drawer F Freeport, Pa. 16229	do	Armstrong.
Freeport Brick Co., Kittanning Brick Div.	R.D. 1 Adrian, Pa. 16210	do	Do.
Hanley Co	28 Kennedy St. Bradford, Pa. 16701	do	Jefferson.
Harbison Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15222	do	Armstrong.
Do	do	Pit	Cambria, Centre, Clearfield, Fayette, Somerset.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clay and shale—Continued			
Fire—Continued			
Ralph A. Veon, Inc.	Darlington, Pa. 16115	Pit	Lawrence.
Kaolin: The Philadelphia Clay Co.	236 West North St. Carlisle, Pa. 17013	Pit	Cumberland.
Common clay and shale:			
Alwine Brick Co., subsidiary of Glen-Gery Corp.	New Oxford, Pa. 17350	Pit	Adams.
Bylite Corp	P.O. Box 1628, North End Station Wilkes-Barre, Pa. 18705	Pit	Luzerne.
Fenati Brick Co., Inc	New Castle, Pa. 16101	Pit	Lawrence.
Glen-Gery Corp	227 North 5th St. Reading, Pa. 19601	Pit	Berks, Dauphin, Lancaster, Northumberland, York.
Hanley Co	28 Kennedy St. Bradford, Pa. 16701	Pit	McKean.
McAvoy Vitrified Brick Co	Phoenixville, Pa. 19460	Pit	Chester.
McQuiston Coal Co. [6]	109 East Moody Ave. New Castle, Pa. 16101	Pit	Lawrence.
Milliken Brick Co., Inc. [4]	2100 Montier St. Pittsburgh, Pa. 15221	Pit	Allegheny.
The Robinson Clay Product Co.	65 West State St. Akron, Ohio 44309	Pit	Montgomery.
Coal:			
Anthracite:			
Blue Coal Corp. [4]	101 South Main St. Ashley, Pa. 18706	Underground	Luzerne.
Blue Coal Corp. [7]	do	Culm bank	Do.
Blue Coal Corp. [8]	do	Strip	Do.
Carbondale Coal Co., Inc. [4]	78 Cottage St. Carbondale, Pa. 18407	do	Lackawanna.
Gangloff Brothers [4]	New Ringgold, Pa. 17960	Culm bank	Northumberland.
Glen-Nan Coal Co., Inc	St. Mary's and River Road Wilkes-Barre, Pa. 18702	Underground	Luzerne.
Greenwood Stripping Corp	1 Venice St. Nesquehoning, Pa. 18240	Strip	Carbon, Schuylkill.
Jeddo-Highland Coal Co. [8]	800 Exeter Ave. West Pittston, Pa. 18643	do	Luzerne.
Jeddo-Highland Coal Co. [4]	do	Culm bank	Do.
Kerris & Helfrick, Inc	Lehigh & Popular St. Mount Carmel, Pa. 18751	Strip	Columbia, Northumberland, Schuylkill.
Lehigh Valley Anthracite, Inc.	800 Exeter Ave. West Pittston, Pa. 18643	Culm bank	Carbon, Schuylkill, Luzerne.
Do	do	Strip	Columbia, Luzerne, Schuylkill.
Pennsylvania Power & Light Co.	901 Hamilton St. Allentown, Pa. 18101	Dredge	Lancaster.
Ken Pollock, Inc. [4]	Route 11 Hunlock Creek, Pa. 18621	Culm bank	Luzerne.
Reading Anthracite Co	200 Mahantongo St. Pottsville, Pa. 17901	do	Northumberland, Schuylkill.
Do	do	Strip	Do.
Bituminous:			
Barnes & Tucker Co	357 Lancaster Ave. Haverford, Pa. 19041	Underground	Cambria, Indiana.
Bethlehem Mines Corp	701 East 3d St. Bethlehem, Pa. 18016	do	Cambria, Washington.
Buckeye Coal Co	P.O. Box 900 Youngstown, Ohio 44501	do	Greene.
Gateway Coal Co. for J & L	Box 608 California, Pa. 15419	do	Do.
Harmar Coal Co. [4]	Box 500 Library, Pa. 15129	do	Allegheny.
Jones & Laughlin Steel Corp	Box 608 California, Pa. 15419	do	Greene.
Mathies Coal Co	Box 500 Library, Pa. 15129	do	Washington.
Pittsburgh Coal Co. [4]	do	do	Do.
United States Steel Corp	525 Wm. Penn Pl. Pittsburgh, Pa. 15219	do	Greene, Washington.
Graphite (synthetic):			
Airco Speer Carbon Products, div. of Air Reduction Co., Inc.	Theresia St. St. Marys, Pa. 15857	Plant	Elk.
Chas. Pfizer & Co., Inc., MPM Division.	235 East 42d St. New York, N.Y. 10017	do	Northampton.
Stackpole Carbon Co	St. Marys, Pa. 15857	do	Elk.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Gypsum (calcined): United States Gypsum Co. [9]	101 South Wacker Dr. Chicago, Ill. 60606	Plant	Philadelphia.
Iron ore:			
Bethlehem Mines Corp. [10]	701 East 3d St. Bethlehem, Pa. 18016	Underground	Berks.
Bethlehem Mines Corp. [11]	----do	----do	Lebanon.
Iron oxide pigments:			
Crude:			
Allegheny Ludlum Steel Corp.	2000 Oliver Bldg. Pittsburgh, Pa. 15222	Plant	Allegheny.
Lanzendorfer Minerals Co.	Twin Rocks, Pa. 15960	Pit	Cambria.
Finished:			
Minerals, Pigments, & Metals Div., Chas. Pfizer & Co., Inc.	640 North 13th St. Easton, Pa. 18042	Plant	Northampton.
The Prince Manufacturing Co.	Bowmanstown, Pa. 18030	----do	Carbon.
Reichard-Coulston, Inc.	15 East 26th St. New York, N.Y. 10010	----do	Northampton.
Lime:			
The J. E. Baker Co. [1]	P.O. Box 1189 York, Pa. 17405	----do	York.
Mercer Lime & Stone Co.	1640 Oliver Bldg. Pittsburgh, Pa. 15222	----do	Butler.
National Gypsum Co. [1]	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Centre.
Standard Lime & Refrac. Co., div. Martin-Marietta Corp. [1]	2000 First National Bank Bldg. Baltimore, Md. 21203	----do	Do.
Warner Company [1]	1721 Arch St. Philadelphia, Pa. 19103	----do	Do.
Do.	----do	----do	Chester.
Mica (crude): Micalith Mining Co., Inc.	P.O. Box 1671 Phoenix, Arizona 85001	Pit	York.
Peat:			
Benton Peat	Benton, Pa. 17814	Bog	Columbia.
Blue Ridge Industries, Inc.	Box 128, R.D. 2 White Haven, Pa. 18661	Bog	Luzerne.
D. M. Boyd Co.	226 Francis St. New Wilmington, Pa. 16142	Bog	Mercer.
Corry Peat Products Co.	515 West Columbus Ave. Corry, Pa. 16407	Bog	Erie.
International Peat, Inc.	R.D. 1 White Haven, Pa. 18661	Bog	Luzerne.
Lake Benton Peat Moss	1418 North Main St. Scranton, Pa. 18508	Bog	Lackawanna.
Pennsylvania Peat Moss, Inc.	21st & Laurel Sts. Hazleton, Pa. 18201	Bog	Luzerne.
Stillers Blue Ridge Peat Co.	R.D. White Haven, Pa. 18661	Bog	Do.
Wayne Peat Humus Co., Inc.	P.O. Box 315 Gouldsboro, Pa. 18424	Bog	Wayne.
Welker's Greenhouse, Inc.	New Castle, Pa. 16101	Bog	Lawrence.
Perlite (expanded):			
C-E Refractories	Port Kennedy, Pa. 19463	Plant	Montgomery.
The Celotex Corp.	1500 North Dale Mabry Tampa, Fla. 33607	----do	Luzerne.
Insul-Fil Manufacturing Co.	Box 325 Primos, Pa. 19018	----do	Delaware.
Pennsylvania Perlite Corp.	P.O. Box 2002 Lehigh Valley, Pa. 18001	----do	Lehigh, York.
Perlite Manufacturing Co.	P.O. Box 478 Carnegie, Pa. 15106	----do	Allegheny.
Petroleum refineries:			
Atlantic Richfield Co.	260 South Broad St. Philadelphia, Pa. 19102	----do	Philadelphia.
Franklin Refinery, div. of Sonneborn Sons, Inc.	Franklin, Pa. 16323	----do	Venango.
Gulf Oil Corp.	P.O. Box 7408 Philadelphia, Pa. 19101	----do	Erie.
Kendall Refining Co., div. of Witco Chemical Co.	Bradford, Pa. 16701	----do	McKean.
Pennsylvania Refining Co.	Karns City, Pa. 16041	----do	Butler.
Pennzoil Company	Oil City, Pa. 16301	----do	Venango.
Quaker State Oil Refining Corp.	Farmers Valley, Pa. 16749	----do	McKean, Venango.
Sinclair Oil Corp.	600 Fifth Ave. New York, N.Y. 10001	----do	Delaware.
Sun Oil Company	1608 Walnut St. Philadelphia, Pa. 19101	----do	Do.
United Refining Co.	Warren, Pa. 16365	----do	Warren.
Valvoline Oil Co., div. of Ashland Oil and Refining Co.	Freedom, Pa. 15042	----do	Beaver.
Wolf's Head Oil Refining Co., Inc.	Reno, Pa. 16343	----do	Venango.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Davison Sand & Gravel Co	34th Ave. & 4th St. New Kensington, Pa. 15068	Dredge	Westmoreland.
East Falls Sand & Gravel	R.D. 1 Falls, Pa. 18615	Pit	Wyoming.
Emlenton Limestone Co., Inc	Box 67 Emlenton, Pa. 16373	Pit	Armstrong.
Erie Sand Steamship Co	Erie, Pa. 16500	Dredge	Erie.
Glacial Sand & Gravel Co	P.O. Box 10 Kittanning, Pa. 16201	Pit	Armstrong, Clarion.
Lycoming Silica Sand Co	401 Broad St., Box 159 Montoursville, Pa. 17754	Pit	Lycoming.
Manorville Sand Co	Box 251 Manorville, Pa. 16238	Pit	Armstrong.
Mount Cydonia Sand Co., Inc	R.D. 1 Fayetteville, Pa. 17222	Pit	Franklin.
Pennsylvania Glass Sand Corp	Berkeley Springs, W. Va. 25411	Pit	Huntingdon, Mifflin.
Pennsy Supply, Inc	1001 Paxton St. Harrisburg, Pa. 17104	Pit	Dauphin.
Seidle Sand & Gravel, Inc	R.D. 4 Mercer, Pa. 16137	Pit	Mercer.
State Aggregates, Inc	635 Lucknow Lane Harrisburg, Pa. 17110	Pit	Bradford.
Tionesta Sand & Gravel, Inc	Hawthorne, Pa. 16230	Pit	Forest.
Warner Company	1721 Arch St. Philadelphia, Pa. 19103	Pit	Bucks.
Wyoming Sand & Stone Co	Falls, Pa. 18615	Pit	Wyoming.
Smelters (zinc):			
The New Jersey Zinc Co	Palmerton, Pa. 18071	Plant	Carbon.
St. Joseph Lead Co	Josephtown, Pa. 15061	----do	Beaver.
Stone:			
Limestone and dolomite—crushed:			
Appalachian Stone Div., Martin-Marietta Corp.	Box 120 Mercersburg, Pa. 17236	Quarry	Centre, Chester, Fayette, Franklin.
Bethlehem Mines Corp.[12]	701 East 3d St. Bethlehem, Pa. 18016	----do	Adams, Lebanon.
Bethlehem Mines Corp	----do	----do	Dauphin, Mifflin, Montgomery, Northampton.
Bradford Hills Quarries, Inc	Box 231 Easton, Pa. 18042	----do	Chester, Lancaster, Montgomery, Perry.
G. & W. H. Corson, Inc.[13]	Plymouth Meeting, Pa. 19462	----do	Montgomery.
Eureka Stone Quarry, Inc	Lower State and Pickertown Rds. Eureka, Pa. 18914	----do	Bucks.
Eastern Industries Inc	Box 188 Wescosville, Pa. 18090	----do	Berks, Lehigh.
Lycoming Silica Sand Co	P.O. Box 159 Montoursville, Pa. 17754	----do	Clinton, Columbia, Lycoming, Montour.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	----do	York.
New Enterprise Stone & Lime	New Enterprise, Pa. 16664	----do	Bedford, Blair, Franklin, Huntingdon.
United States Steel Corp	Hillsville, Pa. 16132	----do	Lawrence.
Miscellaneous—crushed and broken:			
Better Materials Corp	Route 232 & Swamp Rd. Penns Park, Pa. 18943	----do	Bucks.
Gill Quarries, Inc	P.O. Box 187 Fairview Village, Pa. 19434	----do	Bucks, Montgomery.
M & M Stone Co	Harleysville, Pa. 19438	----do	Do.
Miscellaneous—dimension:			
Burdo & Burdo	29 Washington Ave. Belmont Heights Philadelphia, Pa. 19100	----do	Do.
F. Cantono & Sons	454 Germantown Pike Lafayette Hill, Pa. 19444	----do	Delaware.
Di Bonaventura Quarries, Inc	4989 West Thompson St. Philadelphia, Pa. 19131	----do	Do.
Oystershell—crushed: Reading Poultry Food Co.	Orrton & Noble Sts. Reading, Pa. 19600	Plant	Berks.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Sandstone and quartzite—crushed:			
Addy Asphalt Co	P.O. Box 1231 Wilkes-Barre, Pa. 18700	Quarry	Luzerne.
Commercial Stone Corp	P.O. Box 188 Belle Vernon, Pa. 15012	----do	Fayette.
Coolbaugh Sand & Stone, Inc	32 Railroad Ave. Scranton, Pa. 18505	----do	Luzerne.
Detwilers Industries, Inc., subsidiary of New Enterprise Stone & Lime Co., Inc.	New Enterprise, Pa. 16664	----do	Bedford, Somerset.
Eidemiller Enterprises, Inc	Greensburg, Pa. 15601	----do	Westmoreland.
Harbison Walker Refractories Co.	2 Gateway Center Pittsburgh, Pa. 15219	----do	Schuylkill.
Keeler Supply Co., Inc	Box 12 Clifford, Pa. 18413	----do	Susquehanna.
Latrobe Construction Co	P.O. Box 150 Latrobe, Pa. 15650	Underground	Westmoreland.
North American Refractories Co.	6th Street Bldg. Cleveland, Ohio 44114	Quarry	Carbon, Huntingdon.
State Aggregates, Inc	635 Lucknow Lane Harrisburg, Pa. 17110	----do	Susquehanna.
Summit Quarries, div. of J. Robert Bazley, Inc.	P.O. Box 298 Pottsville, Pa. 17901	----do	Schuylkill.
Sandstone and quartzite—dimension:			
Delaware Quarries	Lumberville, Pa. 18933	----do	Bucks.
Firestone Products Co., Inc	300 Willow Grove Ave. Glenside, Pa. 19038	----do	Montgomery.
Martin Stone Quarries	Box 157 Bechtelsville, Pa. 19505	----do	Susquehanna.
Media Quarry Co	131 East 2d St. Media, Pa. 19063	----do	Delaware.
Penn Kress Flagstone Co., Inc	Bridge St. Pittsburgh, Pa. 15209	----do	Potter.
J. G. Robinson, Inc	P.O. Box 6 Fort Washington, Pa. 19034	----do	Wyoming.
Paul Tompkins Estate	Hancock, N.Y. 13783	----do	Wayne.
Valley Forge Building Stone	P.O. Box 195 Morgantown, Pa. 19543	----do	Chester.
Slate—crushed:			
GAF Corp., Building, Industrial Floor Products Div.	140 West 51st St. New York, N.Y. 10020	----do	York.
Pennsylvania Lightweight Aggregate, Inc.	Bangor, Pa. 18013	----do	Northampton.
Slate—dimension:			
Capitol Slate Co., Inc	P.O. Box 281 East Bangor, Pa. 18040	----do	Do.
Anthony Dally & Sons, Inc	Robinson Ave. Pen Argyl, Pa. 18072	----do	Do.
Doney Slate Co	Pen Argyl, Pa. 18072	----do	Do.
Emerald Slate Corp	Alpha Road Wind Gap, Pa. 18091	----do	Do.
North Bangor Slate Co	Bangor, Pa. 18013	----do	Do.
Penn Big Bed Slate Co., Inc	446 Main St. Slatington, Pa. 18080	----do	Lehigh.
Stephens-Jackson Co	Main St. & Schanck Ave. Pen Argyl, Pa. 18072	----do	Northampton.
D. Stoddard & Sons, Inc	Bangor, Pa. 18013	----do	Do.
Traprock (basalt)—crushed and broken:			
Bucks County Crushed Stone, Inc.	Ottsville, Pa. 18942	----do	Bucks.
V. Di Francesco & Sons	17 Mifflin Ave. Havertown, Pa. 19083	----do	Chester.
Do	----do	----do	Delaware.
GAF Corp., Building, Industrial & Floor Products Div.	140 West 51st St. New York, N.Y. 10020	----do	Adams.
The General Crushed Stone Co.	712 Drake Bldg. Easton, Pa. 18042	----do	Bucks, Delaware.
Vernon B. Horn	R.D. Chalfont, Pa. 18914	----do	Bucks.
Kibblehouse Quarries, Inc	Perkiomenville, Pa. 18074	----do	Montgomery.
Montgomery Stone Co., Inc. [14]	Montgomeryville, Pa. 18936	----do	Do.
Pottstown Trap Rock Quarries, Inc.	R.D. 1 Douglasville, Pa. 19518	----do	Berks, Montgomery.
Tohickon Quarry Co	Quakertown, Pa. 18951	----do	Bucks.
Warner Company	1721 Arch St. Philadelphia, Pa. 19103	----do	Berks.
Traprock (basalt)—dimension:			
Coopersburg Granite Co	Coopersburg, Pa. 18036	----do	Do.
French Creek Granite Co	St. Peters, Pa. 19470	----do	Chester.
Granite—crushed: Mignatti Constr. Co., Inc.	2310 Terwood Ave. Bethayres, Pa. 19006	----do	Montgomery.
Granite—dimension: Carl Galantino, Inc.	42 Hirst Ave. East Lansdowne, Pa. 19050	----do	Delaware.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sulfur:			
Atlantic Richfield Co	3144 Passyunk Ave. Philadelphia, Pa. 19145	Plant	Philadelphia.
Gulf Oil Corp	P.O. Box 7408 Philadelphia, Pa. 19101	do	Do.
B P Oil Corp., subsidiary of British Petroleum Corp. Ltd.	P.O. Box 428 Marcus Hook, Pa. 19061	do	Delaware.
Sun Oil Co	1608 Walnut St. Philadelphia, Pa. 19103	do	Do.
Talc (sericite-schist): Summit Industries, Inc.	Drawer C Aspers, Pa. 17304	Pit	Adams.
Tripoli (rottenstone):			
Keystone Filler & Manufacturing Co.	Muncy, Pa. 17756	Pit	Lycoming.
Penn Paint & Filler Co	Antes Fort, Pa. 17720	Pit	Do.
Vermiculite (exfoliated):			
Hyzer & Lewellen	P.O. Box 155 Southampton, Pa. 18966	Plant	Bucks.
W. R. Grace & Company, Zonolite Div.	62 Whittemore Ave. Cambridge, Mass. 02140	do	Lawrence.
Zinc: The New Jersey Zinc Co. [1]	160 Front St. New York, N.Y. 10038	Underground	Lehigh.

[1] Also limestone.
[2] Also limestone and shale.
[3] Also limestone and clay.
[4] 2 operations.
[5] Also limestone and sand and gravel.
[6] Also fire clay.
[7] 3 operations.
[8] 4 operations.
[9] Also expanded perlite.
[10] Also byproduct cobalt and pyrites.
[11] Also byproduct gold, silver, copper, cobalt, and pyrites.
[12] Also lime.
[13] Also cement and lime.
[14] Also dimension.

The Mineral Industry of Puerto Rico, the Panama Canal Zone, the Virgin Islands, Pacific Island 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] Eduardo Aguilar [2] and Roy Y. Ashizawa [3]

PUERTO RICO [4]

Mineral production in Puerto Rico was valued at $67 million, a slight decrease from that of 1968. Construction materials, represented by cement, sand and gravel, and stone comprised about 42 percent, 35 percent, and 20 percent, respectively, of the total value.

[1] Supervisory mining engineer, Bureau of Mines, Bartlesville, Okla.

[2] Chief, Mineralogy and Geology Section, Economic Development Administration, Commonwealth of Puerto Rico.

[3] Mineral specialist, Bureau of Mines, San Francisco, Calif.

[4] Prepared by Harry F. Robertson and Eduardo Aguilar.

Table 1.—Mineral production in Puerto Rico [1]

Mineral		1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Cement	thousand 376-pound barrels	8,923	$27,577	8,943	$27,920
Clays	thousand short tons	512	481	438	454
Lime	do.	39	1,187	41	1,505
Salt	do.	32	395	32	395
Sand and gravel	do.	16,146	24,723	9,432	23,296
Stone	do.	7,367	13,580	6,985	13,550
Total		XX	67,943	XX	67,120
Total 1967 constant dollars		XX	r 67,265	XX	p 65,374

r Revised. p Preliminary. 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 Puerto Rico, by districts

(Thousands)

Senatorial district	1968	1969	Minerals produced in 1969 in order of value
Aguadilla	$1,683	$2,935	Sand and gravel, stone.
Arecibo	1,538	3,810	Do.
Guayama	4,560	2,356	Stone, sand and gravel.
Humacao	1,078	1,741	Sand and gravel, stone.
Mayaguez	4,330	3,922	Sand and gravel, stone, salt.
Ponce	23,572	25,385	Cement, sand and gravel, stone, lime, clays.
San Juan	31,182	26,971	Cement, sand and gravel, stone, clays.
Total	67,943	67,120	

Union Carbide Corp. began construction to increase production and accelerated proposed expansions, ultimately costing $300 million, at its petrochemical complex at Peñuelas. The original facility, operated since 1959, currently produces ethylene, glycols, and various alcohols. Nine major units will be added to the plant between 1969 and 1971 during the first stage of the expansion. Plant products and annual capacities will be as follows: Olefin, 775 million pounds; butadiene, 160 million pounds; ethylene oxide-glycol, 450 million pounds; glycol esters, 200 million pounds; low density polyethylene, 300 million pounds; bisphenol A, 35 million pounds; plasticisers, 150 million pounds; cumene, 640 million pounds; phenol, 200 million pounds; and acetone, 120 million pounds. In the second stage of the expansion the olefin unit will be expanded.

Fibers International, jointly owned by Phillips Petroleum Co., and Rhone-Poulenc confirmed that annual capacity of its nylon 66 plant near Guayama was being expanded to 20 million pounds. Completion is expected in 1971.

A five-company financed facility under construction at the Commonwealth Oil Refining Co., Inc. (Corco) complex near Carbide's facility at Peñuelas was dedicated. This complex involves Corco, W. R. Grace & Co., Air Products and Chemicals Inc., PPG Industries, and Hercules, Inc., and will produce aromatics, olefins, oxo-alcohols, o-xylene, and industrial gases.

A new program of geological studies of the sea floor, covering an area of 1,500 sq. miles off the south and southwest coast of Puerto Rico, was undertaken by scientists of the U.S. Geological Survey, Department of the Interior, in cooperation with the Industrial Development Administration of Puerto Rico. Objective of the survey is evaluation of the heavy mineral, gas, and oil potentials.

Puerto Rico Sun Oil Co. received approval of the Public Service Commission (PSC) to dredge a harbor at Yabucoa. The dredging operation will be the first step in construction of a petrochemical complex and oil refinery. One of the conditions made by the PSC is that Sun Oil Co. will be responsible for any damages that it causes to private or public areas along the coast. The PSC also requires that some 5 million cubic meters of the dredged material be deposited at a depth of at least 60 feet below the ocean surface. The remaining dredged material, used for fill, must be properly drained. The company began working on the first of three docks for the complex; the facility is a construction dock where barges and other ships will unload building material.

The Water Resources Authority planned construction of a thermonuclear powerplant on the south coast. The 600-megawatt plant, to be located in Puerto de Jobos in Aguirre Bay, will be built by the Westinghouse Electric Corp. and will be a boiling water reactor with integral superheater type.

San Juan Cement Co., Inc. continued construction of a new plant in the Barrio Espinosa area of Dorado, west of San Juan. Annual capacity of the plant will be 2.5 million barrels of portland cement. Electrostatic precipitators were installed to control dust emission from the kilns. Initital production at the plant was scheduled for mid-1970.

The Geologic Division of the U.S. Geological Survey, working under a cooperative agreement with the Puerto Rico Economic Development Administration, continued a program of preparing geologic maps of several 7½-minute quadrangles of the Island. Reports were published on the geology of the Aguadilla quadrangle and the Moca and Isabela quadrangles.[5] A stratigraphic study in east-central Puerto Rico was published.[6]

The Geological Society of Puerto Rico published a comprehensive bibliography and index of the geology of Puerto Rico and vicinity.[7]

Government-company negotiations for exploiting copper deposits at Utuado and Lares continued. American Metal Climax, Inc. (AMAX) proposed operating the mines as a joint venture with Kennecott Copper Corp. Royalty rates, air and water pollution controls, and construction of a

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[5] Monroe, W. H. Geologic Map of the Aguadilla Quadrangle, Puerto Rico. Misc. Geol. Inv., Map No. I–569, U.S. Geol. Survey, 1969.
———. Geologic Map of the Moca and Isabela Quadrangles, Puerto Rico. Misc. Geol. Inv., Map No. I–565, U.S. Geol. Survey, 1969.

[6] Briggs, R. P. Changes in Stratigraphic Nomenclature in the Cretaceous System, East-Central Puerto Rico. U.S. Geol. Survey Bull. 1274–O, 1969, pp. 01–031.

[7] Hooker, Majorie. Bibliography and Index of the Geology of Puerto Rico and Vicinity 1868–1968. The Geol. Soc. of Puerto Rico, 1969, 53 pp.

smelter, refinery, and sulfuric acid plant were included in the discussions.

A contract for constructing the Rio de la Plata Dam on the Toa Alta River (or drainage system) was awarded. Along with the existing Loiza Dam, it will rank as one of the most important dams in Puerto Rico. The new dam will be 263 meters wide across the crest with a maximum height of 40 meters. The dam will include a concrete intake and pumping station. The pumping station will contain two 20-million-gallon-per-day pumps and two 10-million-gallon-per-day pumps. The dam marks the first stage in a project that includes a water treatment plant that eventually will be expanded to quadruple its initial treatment capacity.

The sand resources of Puerto Rico were investigated by an engineer of the U.S. Bureau of Mines assisted by geologists of the Puerto Rico Department of Public Works during June–July 1969; results of the investigation were reported informally.[8] Data relating to output and estimated resources of Puerto Rico's principal sand producers were obtained and correlated with the projected needs of the construction industry to show the relationship between known sand resources and future requirements. The results indicated that the conventional sand supply has decreased rapidly while the demand continued a strong upward trend in the foreseeable future. Obviously, assuming no change in consumption patterns, the answer lies in development of another source of construction sand.

Other major sources of fine aggregate available to Puerto Rico include flood plain and terrace gravel deposits underlying agricultural land; manufactured sand and aggregate from decomposed granitic rocks cropping out in the southeast (Humacao) and west-central (Adjuntas) parts of the Island and, an offshore sand deposit, off the east coast of Puerto Rico (Escollo de Arena, Vieques Island).

REVIEW BY MINERAL COMMODITIES

Nonmetals.—*Cement.*—Construction industry activity resulted in increased shipments of portland cement. Domestic production gained slightly while imports—principally from Colombia, Venezuela, and Japan—gained 11 percent. Most of the cement was sold to building material dealers, ready-mix concrete companies, and concrete product manufacturers. Concrete is a major component of all types of construction on the Island.

Clay.—Output of clay by the Puerto Rican Cement Co., Inc., a major producer and consumer, dropped about 21 percent compared with that of 1968. The clay is used as a raw material in cement manufacture at the San Juan and Ponce plants.

Diazlite, Inc., processed clay with an oil additive to make lightweight aggregate at its plant near Trujillo Alto. Installation of a second rotary kiln to increase plant capacity was planned. Fines produced at the plant are a potential competitor for sand in concrete.

Lime.—Puerto Rican Cement Co., Inc., processed high-grade limestone into quicklime and hydrated lime at Ponce. About 69 percent of the hydrated lime output was used as mason's lime in the construction industry. The remainder was used for sugar refining, water purification and softening, and in alumina production. The quicklime was used principally as a fluxing agent in electric steel furnaces.

[8] Christiansen, Carl, H. F. Robertson, and P. A. Hamilton. Sand Resources and Production in Puerto Rico. Report to the Secretary of Public Works, 1969, 64 pp.

Table 3.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments		
		Quantity	Value	
			Total	Average per barrel
1965	7,269	7,284	$23,415	$3.21
1966	8,071	7,603	24,277	3.19
1967	7,963	8,447	27,397	3.24
1968	8,924	8,923	27,577	3.09
1969	8,945	8,943	27,920	3.12

Salt.—Recovery of salt from seawater remained at about the same level as that of 1968. Producers were Sal De Borinquen, Ponce Salt Industries, and other producers along the southwest coast. Seawater is passed through a series of evaporating ponds to increase salinity to the precipitation point. Crude salt, imported from Gran Inagua, was refined by Ponce Salt Industries for domestic use.

Sand and Gravel.—The volume of sand and gravel produced in Puerto Rico in 1969 was adjusted downward in accordance with the survey of active sand and gravel producers conducted during June–July. Most of the material was used as concrete aggregate. Silica sand from inland deposits west of San Juan was used in nearby cement and glass plants, in foundries, in sandblasting, and in marble polishing. Puerto Rico Glass Corp. was the principal user of the white, high-grade sands. Feldspar and other raw material, also used in making the glass, were imported.

A joint seminar on the manufacture and use of sands was planned for February 1970. The meeting would be jointly sponsored by the Puerto Rico Department of Public Works and the Aggregate Producers Association of Puerto Rico. The predicted acute shortage of fine, natural aggregate in Puerto Rico and how to meet the problem, would be the theme of the seminar.

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,269	$6,554	2,726	$6,730
Paving	3,032	3,678	1,945	4,445
Fill	1,064	920	1,012	1,205
Total	7,365	11,152	5,683	12,379
Gravel:				
Building	2,798	5,336	1,760	5,839
Paving	3,352	5,488	1,147	3,779
Fill	735	679	675	776
Total	6,885	11,503	3,582	10,395
Total sand and gravel	14,250	22,655	9,265	22,774
Government-and-contractor operations:				
Sand:				
Building	4	8	137	425
Paving	565	803	30	98
Fill	624	522	------	------
Total	1,193	1,333	167	522
Gravel:				
Building	5	10	------	------
Paving	338	468	------	------
Fill	360	257	------	------
Total	703	735	------	------
Total sand and gravel [1]	1,896	2,066	167	522
Grand total [1]	16,146	24,723	9,432	23,296

[1] Data may not add to totals shown because of independent rounding.

The Department of Public Works was authorized by legislative action in Law No. 132 to regulate the extraction of sand, gravel, stone, and other aggregates, whether on public or private land. The Department of Public Works now requires a royalty of 15 cents per cubic meter for extraction of sand, gravel, or stone to be used as concrete aggregate and 5 cents per cubic meter for material used as fill. The law became effective on February 27 1969.

Stone.—Although domestic cement output registered a slight increase in 1969, production of crushed limestone, the principal raw material did not gain accordingly. Imports of 95,000 barrels of

hydraulic cement clinker from Colombia in the last quarter of 1969 resulted in decreased domestic consumption of crushed limestone and clay. Andesite, tuffaceous siltstone, and other volcanic stones were mined in all districts except Arecibo. Granite was produced in Humacao and Guayama Districts. Marble from various parts of the Island was sawed and polished to make slabs and shapes by Marmoles Cienne at a plant west of Bayamon.

Mineral Fuels.—Crude and unfinished oil imported from Venezuela and the Netherlands Antilles averaged 196,100 barrels per day, up 16 percent from the 1968 imports. Caribbean Gulf Refining Corp. at Cataño and Corco at Guayanilla refined crude and unfinished oils; Phillips Petroleum Co. at Guayama refined only unfinished oils.

Table 5.—Stone sold or used by producers
(Thousand short tons and thousand dollars)

Year	Dimension limestone		Crushed limestone [1]	
	Quantity	Value	Quantity	Value
1965	74	$180	4,236	$6,607
1966	88	231	4,416	7,555
1967	101	293	5,578	8,767
1968	101	293	5,619	9,408
1969	101	292	5,238	9,380

	Miscellaneous stone [2]		Total	
	Quantity	Value	Quantity	Value
1965	1,034	$2,324	5,344	$9,111
1966	1,228	2,755	5,732	10,541
1967	1,590	3,735	7,269	12,795
1968	1,647	3,879	7,367	13,580
1969	1,646	3,878	6,985	13,550

[1] Includes limestone for cement and lime.
[2] Includes granite, marble, and miscellaneous stone.

About mid-November, Corco began operating its new aromatics unit at Peñuelas. The new unit gives Corco the capacity to export benzene and other aromatics. The new unit doubles the company's aromatics capacity and is integrated with its first aromatics unit. When running at full capacity, the plants will produce 13 to 15 percent of the U.S. benzene supply or 6 percent of the free world supply. The aromatics are recovered from a wide variety of feed stocks, including byproduct from other process units.

Corco also announced plans to expand its daily oil refining capacity at its Peñuelas plant to 175,000 barrels. A major factor in the expansion is the signing of a long term contract by Corco with the Puerto Rico Water Resources Authority to supply fuel-oil for two 400-megawatt generating units being built at the south coast, government-owned steam-electric plant.

Metals.—Various sizes of steel reinforcing bars for use in concrete structures were produced by Industrial Siderurgica, Inc., at its steel mill near Cataño. Two 20-ton electric furnaces were used to melt domestic and imported iron and steel scrap.

Ponce Mining Corp. and the Puerto Rico Mining Commission continued negotiations on formulation of a contract to allow exploitation of the copper deposit near Utuado and Lares. Under the latest proposal Ponce Mining Corp. would operate the mines as a joint venture with Cobre Caribe (Kennecott Copper Corp.).

PANAMA CANAL ZONE [9]

The value of mineral production in the Panama Canal zone dropped about 11 percent compared with that of 1968. Sand and gravel and stone used as roadstone and concrete aggregate comprised the mineral output.

[9] Prepared by Harry F. Robertson.

VIRGIN ISLANDS [10]

Expansion of dock and ore handling facilities continued at the Harvey Aluminum, Inc., St. Croix alumina plant. Completion is scheduled for late 1970. A new high-capacity bauxite unloader will increase the unloading rate considerably. Modification in several areas of the alumina process resulted in increased production and improvement in quality control.

Near Christiansted, St. Croix, Hess Oil and Chemical Corp. constructed a new 75,000 barrel-per-day refining unit that more than doubled the capacity of the original refinery. A 30,000-barrel-per-day vacuum gas-oil desulfurization plant and an 18,000-barrel-per-day benzene-toulene-xylene (BTX) plant were completed. Other related petrochemical facilities were scheduled for construction in the near future.

Table 6.—Mineral production in the Panama Canal Zone and Virgin Islands [1]

Mineral	1968		1969	
	Short tons	Value	Short tons	Value
Canal Zone:				
Sand and gravel	55,000	$77,000	59,535	$96,803
Stone [2]	106,130	290,208	74,095	231,007
Total	XX	367,208	XX	327,810
Total 1967 constant dollars	XX	r 363,572	XX	p 319,192
Virgin Islands:				
Stone (basalt)	365,677	1,555,007	411,358	1,682,483
Total 1967 constant dollars	XX	r 1,539,611	XX	p 1,638,250

r Revised. p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Includes basalt.

At St. Croix, a suction dredge was used to recover sand offshore from Christiansted. The dredged sand was stockpiled on the beach and often was mixed with manufactured sand (ground basalt) to improve the quality of concrete. Reportedly, permission to stockpile the sand on the beach was withdrawn early in 1970.

Basalt was mined and crushed for concrete aggregate, roadstone, and riprap. Quarries on St. Croix and on St. Thomas accounted for the stone output. Companies producing aggregates on St. Croix were Caribbean Material Supply Co. and Springfield Crusher, Inc.; on St. Thomas, Controlled Concrete, Inc. was the operating Company. Both Springfield Crusher, Inc., and Controlled Concrete, Inc., are subsidiaries of Masonry Products, Inc., a United States-based company.

[10] Prepared by Harry F. Robertson.

PACIFIC ISLAND POSSESSIONS [11]

REVIEW BY ISLANDS

American Samoa.—Basalt rock, volcanic cinder, and dredged coral limestone and sand were processed by Government crews for use in improvement of roads and utilities and in building construction. A rock crusher and concrete and asphalt batch plants were operated at the Tafuna Public Works Compound near the Pago Pago International Airport.

Guam.—A building boom on Guam resulted in production of more than 654,000 tons of coral aggregate during 1969. Over 60 percent of the quantity was processed for use in concrete and concrete products, 20 percent for road base, and the remainder for road surfacing and as riprap. Public Works crews quarried coral material in the Barrigada, Dededo, and Malojloj areas. Commercial producers of crushed coral and coral sand operated plants at Agana and Oka.

[11] Prepared by Roy Y. Ashizawa.

Table 7.—Mineral production in the Pacific Island Possessions

Area and mineral	1968		1969	
	Short tons	Value	Short tons	Value
American Samoa:				
Pumice (volcanic cinder)	20,535	$51,338	1,565	$5,478
Sand	20,000	19,000	7,000	7,000
Stone	52,718	79,077	54,183	107,739
Total	XX	149,415	XX	120,217
Guam: Stone	559,529	998,032	654,176	1,399,127
Wake: Stone	41,000	132,000	9,000	45,000

XX Not applicable.

Wake.—The Wake Island group is a U-shaped coral atoll, with the islands of Wilkes and Peale comprising about one-third of each tip and connected to the main island by causeways. During 1969, coral was quarried on Wilkes Island for use as concrete aggregate in housing construction and for rehabilitation of facilities damaged by Typhoon Sarah.

Other Pacific Island Possessions.—No mineral production was reported on the islands of Canton, Enderbury, Jarvis, Johnston, Midway, and Palmyra. Requirements for construction and maintenance of facilities on Johnston Island were supplied by contractors from Hawaii and the U.S. mainland.

TRUST TERRITORY OF THE PACIFIC ISLANDS [12]

The Trust Territory of the Pacific Islands comprises some 2,100 islands scattered over an expanse of ocean about the size of the conterminous United States. Deposits of phosphate rock and bauxite exist on several of the islands, but neither of these minerals was mined during 1969.

Mineral production in the territory was limited to the quarrying of basalt rock and coral in the Mariana, Palau and Caroline Islands, and of coral in the Marshall Islands. Large quantities of these materials were produced and processed for use in construction and for restoring facilities damaged by typhoons. Crushed coral was more commonly utilized as road base and concrete aggregate. Marine biologists conducted studies of the Crown-of-Thorns starfish, which was destroying the live coral of the reef areas.

[12] Prepared by Roy Y. Ashizawa.

The Mineral Industry of Rhode Island

By Arthur Sykes Lees [1]

The value of mineral production in Rhode Island for 1969 was approximately 5 percent greater than in 1968. Production was limited to sand and gravel and stone. Hobbyists collected a minor amount of mineral specimens and gem stones. The value of sand and gravel was 68 percent of the total value of the minerals produced. The remainder was accounted for by the value of stone production, including miscellaneous crushed stone and riprap, crushed and sized limestone, and dimension granite.

Reports from mineral producers show small increases in sand and gravel and crushed stone production and a large decrease in dimension stone production, compared with 1968 mineral production figures. The 1969 production of sand and gravel was about 8 percent greater than in 1968 and prices were slightly higher. The actual increase in price could not be determined accurately because a number of reports gave delivered prices. Crushed stone production in 1969 increased 3.9 percent over 1968, but the sale price remained essentially the same. Output of dimension stone dropped 36 percent below 1968 production and the price dropped slightly.

[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Value of mineral production in Rhode Island, by counties [1]

(Thousand dollars)

County	1968	1969	Minerals produced in 1969, in order of value
Kent	W	W	Sand and gravel.
Newport	$90	$35	Sand and gravel, stone.
Providence	1,820	2,022	Do.
Washington	W	W	Stone, sand and gravel.
Undistributed [2]	2,312	2,376	
Total	4,222	4,433	
Total 1967 constant dollars	4,180	p 4,316	

p Preliminary.
W Withheld to avoid disclosing individual company confidential data.
[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.—Indicators of Rhode Island business activity

	1968	1969 p	Change, percent
Employment and labor force, annual average: [1]			
Total labor force—thousands	391.8	392.0	+0.1
Unemployment—percent of work force	3.6	3.7	+2.8
Employment:			
Manufacturing—thousands	127.0	127.1	+0.1
Durables—do	49.5	50.4	+1.8
Nondurables—do	77.5	76.7	−1.0
Nonmanufacturing—do	216.6	216.3	−0.1
Construction—do	15.2	14.4	−5.3
Service (including mining)—do	53.8	53.0	−1.5
Payroll: Average weekly earnings: [2]			
Manufacturing	r $102.02	$107.64	+5.5
Personal income: [3]			
Total—millions	r $3,244	$3,442	+6.1
Per capita	r $3,573	$3,779	+5.8
Construction activity:			
Cement shipments to and within Rhode Island, thousand 376-pound barrels	1,090	1,015	−6.9
Mineral production value—thousands	$4,222	$4,433	+5.0

p Preliminary. r Revised.
[1] Rhode Island Department of Labor.
[2] Rhode Island Economic Trends.
[3] Survey of Current Business.

Table 3.—Worktime 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
1968:								
Sand and gravel	200	191	38	306	---	7	22.91	288
Stone	72	251	18	148	---	3	20.28	1,054
Total	272	207	56	454	---	10	22.05	538
1969: p								
Sand and gravel	180	186	34	281	---	6	21.38	884
Stone	80	242	19	160	---	3	18.80	1,579
Total [1]	260	203	53	440	---	9	20.44	1,136

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Petroleum.—There is no petroleum production in Rhode Island, but the Mobil Oil Corporation has a crude petroleum refinery in East Providence. The refinery utilizes both foreign and domestic crudes to produce asphalt, its only product. Plant capacity in 1969 was 10,000 barrels per stream day. The asphalt is marketed competitively in the northeastern United States.

Gem Stones.—Bowenite, a semiprecious variety of serpentine and the Rhode Island State stone, is probably collected in greatest quantity. It occurs in metamorphosed limestone in the vicinity of Limerock, where it is sought by mineral collectors and "rock hounds". Other minerals collected include agate, various pegmatite minerals, fluorescent calcite, and sulphides. Most specimens are collected from mine and quarry dumps and from quarries and other exposed rock outcrops.

Sand and Gravel.—The 1969 production of sand and gravel, as usual, played an important role in the economy of Rhode Island. Building construction used 55 percent for concrete aggregate, and highway construction and maintenance used 25.8 percent. Another 11.9 percent was used for fill and 3.2 percent was used for winter sanding of the highways. The remainder went for miscellaneous uses.

Stone.—Decreased demand and increased difficulty in production resulting from unfavorable reserve conditions resulted in the big drop in granite dimension stone production and the slight decrease in price in 1969 compared with 1968. Crushed limestone production increased 3.2 percent, and the price decreased about 9 percent from 1968; the markets remained essentially the same. Agricultural lime was the biggest product, followed by roofing aggregate, metallurgical flux, and terrazzo chips. Production of crushed miscellaneous stone, including granitized gneiss and conglomerate, was up about 3.9 percent over 1968 production, but prices remained about the same. About 32.8 percent went into highway construction and maintenance while 26.4 percent was equally distributed to construction aggregate and riprap. Mineral filler accounted for 17.1 percent, manufactured fines 14.5 percent, and 6.6 percent was used for winter road sanding. The remainder went for miscellaneous uses.

Table 4.—Principal uses and value of sand and gravel

Use	Sand		Gravel	
	Percent	Value (thousands)	Percent	Value (thousands)
Building construction	67	$789	58	$1,074
Paving	22	258	26	477
Other	11	128	16	290

Table 5.—Average value per ton, by use, of sand and gravel

Use	Sand	Gravel
Building construction	$1.23	$1.49
Paving	1.18	1.13
Other	.97	.85

Table 6.–Principal producers

Commodity and company	Address	Type of activity	County
Petroleum:			
Mobil Oil Corporation	1001 Wampanoag Trail E. Providence, R.I. 02915	Refinery	Providence.
Sand and gravel:			
A. Cardi Construction Co., Inc	451 Arnold Rd. Coventry, R.I. 02816	Pit	Kent.
Coventry Sand & Gravel Co	Reservoir Road Coventry, R.I. 02816	Pit	Do.
Del Bonis Sand & Gravel Co	950 Phenix Ave. Cranston, R.I. 02920	Pit	Providence.
Forte Brothers, Inc	14 Whipple St. Berkeley, R.I. 02900	Pit	Do.
Lapham Sand & Gravel Co	R.F.D. 2, Greenville Rd. Woonsocket, R.I. 02895	Pit	Do.
Mack Sand & Gravel Co	Pawtucket, R.I. 02860	Pit	Do.
Peckham Bros. Co., Inc	Paradise Ave. Middletown, R.I. 02840	Pit	Newport.
Rhode Island Sand & Gravel Co., Inc	Kilvert St. Hillsgrove, R.I. 02886	Pit	Kent.
J. Romanella & Sons Inc	Box 546, Westerly, R.I. 02891	Pit	Washington.
J. Santoro, Inc	11 Herbert Street Providence, R.I. 02909	Pit	Providence.
Silvestri Brothers, Inc	Shun Pike Johnston, R.I. 02919	Pit	Do.
South County Sand & Gravel Co., Inc	North Rd. Peace Dale, R.I. 02883	Pit	Washington.
Tasca Sand & Gravel Co	Box 113, RFD 4, Esmond, R.I. 02917	Pit	Providence.
Town Line Sand & Gravel, Inc	Victory Highway Slatersville, R.I. 02876	Pit	Do.
Whitehead Bros. Co	60 Hanover Road Florham Park, N.J. 07932	Pit	Kent.
Stone:			
Granite, dimension:			
Providence Granite Co	210 Kingsley Ave. Providence, R.I. 02903	Quarry	Washington.
Limestone, crushed: [1]			
The Conklin Limestone Co., Inc	R.F.D. 1 Lincoln, R.I. 02865	-----do	Providence.
Miscellaneous stone, crushed and broken:			
M. A. Gammino Construction Co	875 Phenix Ave. Cranston, R.I. 02920	-----do	Do.
Peckham Brothers Co., Inc	Paradise Ave. Newport, R.I. 02840	-----do	Newport.

[1] Also dimension limestone.

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 Division of Geology, State Development Board, for collecting information on all minerals except fuels.

By Robert C. Johnson [1] and Norman K. Olson [2]

South Carolina established a new mineral production value record of $55.9 million in 1969. New production records were set for masonry and portland cement, kaolin, miscellaneous clay, feldspar, sand and gravel, and vermiculite. South Carolina ranked second nationally in the production of kaolin and vermiculite, third in kyanite, and fourth in feldspar.

The State's business activity in 1969 continued to increase. Per capita income was $2,580, an increase of $204, or 8.6 percent, from that of 1968, and it was 70 percent of the National per capita income. Mineral production value continued to be one of the leading growth segments of the State's economy.

Government Programs.—The basic program of acquiring data on the geology and mineral resources of South Carolina was continued by the Division of Geology, South Carolina State Development Board. During 1969, 22 projects were active and 17 reports were published. Geologic mapping was in progress on the following 7½ minute quadrangles: Sumter West, Irmo NE, Wampee, James Island, Lake View, Dongola, Dovesville, Tamassee, Satolah, Cashiers, Owdoms, Fair Play, Holly Springs, Whetstone, Old Pickens, Seneca, and Walhalla. Work continued on the Myrtle Beach and Winnsboro 15-minute quadrangles. Mineral resources studies continued in the following counties: Edgefield, Orangeburg, Newberry, Pickens, and McCormick. Additional studies conducted during the year were on the petrography and geophysics of the Rock Hill gabbro pluton in York County, and the peat resources of the State.

Preparation began on both the Mineral Resources and Mineral Industries Map of South Carolina and the Directory of the Mineral Industry of South Carolina.

Reports published by the Division of Geology during 1969 included: Bulletin 35, Heavy Mineral Resources of South Carolina; Bulletin 38, Groundwater Resources of Greenville County, South Carolina; MS-15, Geomorphology of the South Carolina Lower Coastal Plain (Map and text); MR-4, Radioactive Mineral Resources of South Carolina; and Geologic Notes; Volume 13, Numbers 1, 2, 3, and 4, and Volume 14, Number 1.

At yearend, 457 miles, or 60 percent, of the total Interstate Highway System designated for South Carolina was open to traffic. Work was in progresss on 237 miles of highway and not yet started on 63 miles.

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[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] State geologist, Division of Geology, State Development Board, Columbia, S.C.

Table 1.—Mineral production in South Carolina[1]

	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	1,936	$8,923	2,444	$10,911
Sand and gravel—do	5,662	8,074	5,692	8,229
Stone—do	8,942	13,717	8,846	13,506
Value of items that cannot be disclosed: Cement, feldspar, kyanite, scrap mica, peat, pyrite, and vermiculite	XX	21,144	XX	23,217
Total[2]	XX	51,858	XX	55,864
Total 1967 constant dollars	XX	51,763	XX	p 54,182

p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Data may not add to totals shown because of independent rounding.

Table 2.—Value of mineral production in South Carolina, by counties[1]

(Thousand dollars)

County	1968	1969	Minerals produced in 1969 in order of value
Aiken	$7,231	$7,652	Kaolin, sand and gravel.
Berkeley	------	W	Limestone.
Cherokee	W	W	Limestone, miscellaneous clay, sand and gravel.
Chesterfield	W	W	Sand and gravel.
Colleton	W	W	Peat.
Dorchester	W	W	Cement, marl, miscellaneous clay, sand and gravel, limestone.
Edgefield	W	W	Miscellaneous clay.
Fairfield	1,184	1,310	Granite, miscellaneous clay.
Florence	W	W	Sand and gravel.
Greenville	W	W	Granite, sand and gravel.
Greenwood	W	W	Granite, miscellaneous clay.
Horry	W	W	Sand and gravel, miscellaneous clay.
Jasper	W	W	Sand and gravel.
Kershaw	848	973	Sand and gravel, kaolin, granite, miscellaneous clay.
Lancaster	508	523	Mica, Miscellaneous clay, sand and gravel.
Laurens	W	W	Vermiculite, granite.
Lexington	4,216	4,519	Sand and gravel, granite, miscellaneous clay, kaolin.
Marion	W	W	Miscellaneous clay, sand and gravel.
Marlboro	W	W	Sand and gravel, kaolin, miscellaneous clay.
Newberry	W	W	Granite, miscellaneous clay.
Orangeburg	W	W	Cement, miscellaneous clay, marl.
Pickens	W	W	Granite.
Richland	1,913	2,667	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	35,958	38,221	
Total[2]	51,858	55,864	

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, Anderson, Bamberg, Barnwell, Beaufort, Calhoun, Charleston, Chester, Clarendon, Darlington, Dillon, Georgetown, Hampton, Lee, McCormick, Oconee, Saluda, Union, and Williamsburg.
[2] Data may not add to total shown because of independent rounding.

Table 3.—Indicators of South Carolina business activity

	1968	1969	Change, percent
Employment and labor force, annual average:			
Total work force—thousands	1,013.9	1,049.0	+3.5
Unemployment—do	44.6	41.7	−6.5
All employment—do	r 982.7	1,007.1	+2.7
Wage and salary employment:			
Mining—do	1.6	1.7	+6.3
Contract construction—do	48.2	49.1	+1.9
Manufacturing—do	323.8	339.2	+4.8
Transportation, communication, and public utilities—do	32.8	35.3	+7.6
Trade—do	128.0	135.4	+5.8
Finance, insurance and real estate—do	26.3	28.3	+7.6
Services—do	76.6	80.8	+5.5
Government—do	133.7	139.7	+4.5
Personal income:			
Total—millions	r $6,341	$6,947	+9.6
Per capita	r $2,376	$2,580	+8.6
Construction activity:			
Total construction projects—thousands	22.0	22.2	+.9
State Highway Department:			
Value of contracts, construction awards—millions	$66.6	$86.6	+29.1
Farm marketing receipts—do	r $374.1	$398.0	+6.4
Mineral production value—do	$51.9	$55.9	+10.8

r Revised.

Sources: South Carolina Employment Security Commission, South Carolina State Highway Department, U.S. Department of Commerce, U.S. Bureau of Mines.

Table 4.—Worktime 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
1968:								
Nonmetal and peat	943	253	241	1,942	1	30	15.96	4,157
Sand and gravel	359	250	90	807	---	16	19.83	503
Stone	777	260	202	1,665	---	29	17.41	3,365
Total [1]	2,079	255	532	4,414	1	75	17.22	3,190
1969: p								
Nonmetal and peat	925	255	236	1,917	---	41	21.39	460
Sand and gravel	350	239	84	781	1	17	23.05	10,428
Stone	760	263	200	1,584	---	28	17.68	527
Total [1]	2,040	255	520	4,281	1	86	20.32	2,303

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

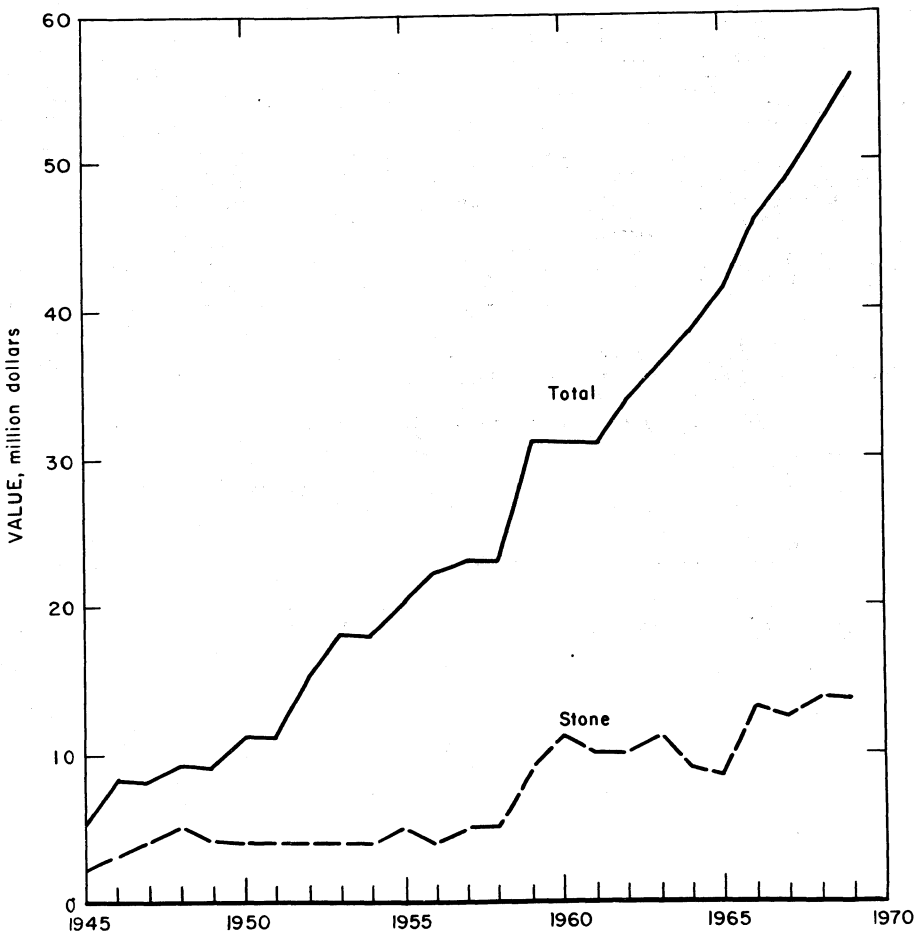

Figure 1.—Value of stone, and total value of mineral production in South Carolina.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Portland and masonry cement were produced by two companies in Dorchester and Orangeburg Counties. Portland cement shipments increased more than 10 percent and set a new record in 1969; shipments and value of masonry cement also set new records. Out of State shipments were to Florida, Georgia, North Carolina, and Virginia. Additional production capacity may be necessary to sustain an appreciable growth rate in South Carolina's cement industry.

Clays.—Clay production in 1969 accounted for 20 percent of South Carolina's total mineral production value. An unusually high increase in clay production, 26 percent over 1968, was indicated, but much of this increase may be attributed to improved coverage in gathering miscellaneous clay production data.

South Carolina continued to rank second nationally in the production of kaolin which increased 3 percent to 596,371 tons, and value increased to a record high of $8,884,487. Kaolin was used in numerous manufactured products such as rubber, fertilizer, brick, ceramics, paint, fiber glass and insecticides. Kaolin was produced by 13 companies at 23 mines in five counties during the year. In 1969, two new kaolin mines reported production: The Gardner mine in Aiken County operated by Southeastern Clay Co. and the Koon mine in Kershaw County operated by Carolina Ceramics, Inc.

Table 5.—Kaolin sold or used by producers, by uses

(Thousand short tons)

Use	1968	1969
Rubber	272	267
Firebrick and block	37	48
Insecticides and fungicides	5	15
Paint	7	5
Other uses [1]	260	261
Total [2]	581	596

[1] Includes whiteware, stoneware (1968), other pottery and stoneware (1969), floor and wall tile, architectural terra cotta (1968), mortar (1968), foundries and steelworks, kiln furniture (1968), other refractories, paper filling and coating, linoleum and oilcloth (1968), fertilizers, plaster and plaster products (1968), other fillers, exports (1968), building brick (1969), drain tile (1969), vitrified sewer pipe (1969), and other uses.

[2] Data may not add to totals shown due to independent rounding.

Miscellaneous clay production in 1969, 1.8 million tons valued at $2.0 million, increased 36 percent in tonnage and 65 percent in value from 1968 levels, establishing new high records. Much of this record increase was due to a change of canvass forms which allowed better coverage of miscellaneous clay production in the State. Twenty-two mines were operated by 16 companies in 15 counties during 1969. The principal uses of miscellaneous clay are in the manufacture of building brick and tile. The demand for specialty brick continued to grow in 1969.

Feldspar.—A new record was established in 1969 with increases of 21 percent in tonnage and 33 percent in value over 1968 levels. The State ranked fourth nationally in feldspar production. One company produces feldspar in South Carolina. The byproduct feldspar is recovered as a silica-feldspar mixture from crushed granite fines. The recovered mixture is used primarily in the manufacture of pottery, glass, and rubber.

Kyanite.—Kyanite production from the one mine in South Carolina declined 5 percent in 1969, but value remained about the same as that in 1968. Production was 27 percent below the record year of 1964. The State continued to rank third nationally in kyanite output. Kyanite is used principally in the manufacture of refractories.

Mica.—One operation in Lancaster County produced scrap mica from mica schist. Production and value in 1969 declined 10 and 1 percent, respectively, from 1968 levels. Output and value were respectively 40 and 5 percent lower than they were in the record year of 1955. The scrap mica is used mainly in the manufacture of pipeline enamel and other paints and coatings.

Pyrite.—Pyrite continued to be recovered in the beneficiation of kyanite ore in York County. Production rose 26 percent and

value increased 25 percent over 1968 levels. The pyrite is a fine grained, pure material especially suited for use as a colorant in glass.

Sand and Gravel.—In 1969, sand and gravel was produced in 16 counties by 24 companies at 29 locations. Sand and gravel was the fourth leading mineral commodity in value in South Carolina. Output was 5.7 million tons valued at $8.2 million, increases of 1 and 2 percent, respectively, over 1968 levels. Ninety-five percent of the sand and gravel was processed before shipment; all was commercial production. Fifty-two percent of output was shipped by truck and 48 percent by rail.

A continued growth trend is expected for the sand and gravel industry, but this depends mainly upon long term increases in construction activity.

Table 6.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,854	$1,874	$0.66	2,908	$1,967	$0.68
Blast	13	62	4.77	17	90	5.29
Gravel, Fill	5	4	.80	W	W	W
Other sand and gravel [1]	2,790	6,134	2.20	2,767	6,170	2.23
Total [2]	5,662	8,074	1.43	5,692	8,229	1.45

W Withheld to avoid disclosing individual company confidential data; included with "Other sand and gravel."

[1] Includes paving, railroad ballast (1969), fill, glass, molding, fire or furnace, engine, filtration, chemical, filler, foundry, pottery, abrasive (1969), and other industrial sands; structural, paving, railroad ballast (1968), and miscellaneous gravel (1969), and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 7.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Dorchester	3	388	$329	3	W	W
Lexington	6	1,064	1,867	6	1,113	$2,169
Richland	1	100	80	1	W	W
Spartanburg	1	49	49	1	W	W
Other counties [1]	17	4,061	5,749	18	4,579	6,060
Total	28	5,662	8,074	29	5,692	8,229

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

[1] Includes Aiken, Cherokee, Chesterfield, Florence, Greenville, Horry, Jasper, Kershaw, Lancaster, Marion, Marlboro, and Sumter Counties, and counties indicated by symbol W.

Stone.—Twenty-four percent of the State's total mineral production value in 1969 was derived from stone. Crushed granite was produced in nine counties by four companies from 11 quarries. Nine stationary and two portable plants were operated in 1969. Pickens, Lexington and Richland Counties led the State in output of crushed granite. Crushed granite declined 5 percent in tonnage and 3 percent in value from 1968 levels. Crushed granite was used as bituminous aggregate, dense graded road base stone, macadam aggregate, surface treatment aggregate, concrete aggregate, railroad ballast, fine aggregate, riprap, and jetty stone. Twenty-nine per-

cent of the crushed granite was transported by rail and the remainder by truck. One new quarry for crushed granite (Gray Court) was opened by Vulcan Materials Co. in Laurens County.

Dimension granite tonnage and value declined 15 and 19 percent, respectively, in 1969. The decline was due to decreased demand for monumental stone. Three companies operated five quarries in Fairfield, Kershaw and Newberry Counties.

Crushed limestone production statistics included marl prior to 1969, but in 1969 a separation was made. However, due to company confidential figures, marl data cannot be disclosed. The combined totals of crushed limestone and marl in 1969 showed an increase of 11 percent in tonnage and 6 percent in value. Crushed limestone was produced by three companies at three quarries in Berkeley, Cherokee, and Dorchester Counties. Marl was produced by two companies at two quarries in Dorchester and Orangeburg Counties. Crushed limestone is used primarily as agricultural limestone and aggregates. Marl is used in the manufacture of cement. In 1969, Superior Stone Co. began operation of the Cross limestone quarry in Berkeley County.

Vermiculite.—Vermiculite production set a new record in 1969 with increases of 16 percent and 22 percent, respectively, in output and value. The State continued to rank second nationally in vermiculite production. Two companies operated numerous small open-pit mines in Laurens and Spartanburg Counties. Two plants near Enoree and one near Traveler's Rest expanded vermiculite. Expanded vermiculite was used as concrete aggregate, as loose-fill insulation, and as a soil conditioner or substitute.

METALS

Ferroalloys.—Mobil Oil Corp., Charleston, continued to produce ferrophosphorus as a byproduct of elemental phosphorus furnace operations. Pittsburgh Metallurgical Co., Charleston, produced ferrosilicon, ferrochromium, and ferrochromium silicon.

Zirconium.—M & T Chemicals, Inc., located near Andrews, Georgetown County, continued operation of a grinding plant for the production of dry-milled and granular zircon for foundry, refractory, ceramic, and glass uses.

MINERAL FUELS

Peat.—One company produced reed-sedge peat near Bennetts Point in Colleton County. Production and value declined 34 and 33 percent, respectively, in 1969. The decline may be partly attributed to wet weather conditions.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Giant Portland Cement Co.	150 Strafford Ave. Wayne, Pa. 19087	Plant	Dorchester.
Santee Portland Cement Co.	Box 698 Holly Hill, S.C. 29059	----do	Orangeburg.
Clays:			
Kaolin:			
Cyprus Mines Corp.	Box 1201 Trenton, N.J. 08618	Open-pit mine	Aiken.
Dixie Clay Co.	230 Park Ave. New York, N.Y. 10017	----do	Do.
J. M. Huber Corp.	630 Third Ave. New York, N.Y. 10017	2 open-pit mines	Do.
National Kaolin Products Co.	Box 431 Aiken, S.C. 29801	Open-pit mine	Do.
Southeastern Clay Co.	Box 1022 Aiken, S.C. 29801	6 open-pit mines	Do.
Miscellaneous:			
Broad River Brick Co.	Box 550 Gaffney, S.C. 29340	Open-pit mine	Cherokee.
Giant Portland Cement Co.	150 Strafford Ave. Wayne, Pa. 19087	----do	Dorchester.
Richtex Corp.	Box 3307 Columbia, S.C. 29203	3 open-pit mines	Fairfield and Richland.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays—Continued			
Miscellaneous—Continued			
Santee Portland Cement Co	Box 698 Holly Hill, S.C. 29059	Open-pit mine	Orangeburg.
Southern Brick Co	Box 208 Ninety Six, S.C. 29666	2 open-pit mines	Greenwood and Newberry.
Feldspar, crude:			
Spartan Minerals Co	Route 1, Box 14A Pacolet, S.C. 29372	Plant	Spartanburg.
Kyanite:			
Commercialores, Inc	Box 98 Clover, S.C. 29710	Open-pit mine	York.
Mica, scrap:			
The Mineral Mining Corp	Kershaw, S.C. 29067	do	Lancaster.
Peat:			
Ti-Ti Peat Humus Co., Inc	Box 425 Charleston, S.C. 29402	Bog	Colleton.
Pyrite: See Kyanite.			
Sand and gravel:			
Becker Sand & Gravel Co	Box 848 Cheraw, S.C. 29520	5 open-pit mines	Chesterfield, Dorchester, Marlboro, Sumter.
Columbia Silica Sand Co	Box 1519 Columbia, S.C. 29202	2 open-pit mines	Lexington.
Palmetto Quarries Co	Drawer 5185 Columbia, S.C. 29205	Open-pit mine	Richland.
Pennsylvania Glass Sand Corp	Gen. Operations Dept. Berkeley Springs, W. Va. 25411	do	Lexington.
Wilson Bros. Sand Co., Inc	Box 945 Greenwood, S.C. 29646	do	Do.
Stone:			
Granite, crushed:			
Palmetto Quarries Co	Drawer 5185 Columbia, S.C. 29205	3 quarries	Fairfield, Greenwood, Richland.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	2 quarries	Fairfield and York.
Vulcan Materials Co	Drawer 8834 Greenville, S.C. 29604	4 quarries	Greenville, Laurens, Pickens, Spartanburg.
Weston & Brooker Co	650 Knox-Abbott Ave. Cayce, S.C. 29033	Quarry	Lexington.
Granite, dimension:			
Comolli Granite Co	Box 898 Elberton, Ga. 30635	Quarry	Kershaw.
Kershaw Granite Co., Inc	Box 250 Elberton, Ga. 30635	3 quarries	Kershaw and Newberry.
Winnsboro Granite Co	Rion, S.C. 29132	Quarry	Fairfield.
Limestone, crushed:			
Ideal Cement Co	620 Ideal Cement Bldg. Denver, Colo. 80202	Quarry	Dorchester.
Superior Stone Co	Box 2568 Raleigh, N.C. 27602	do	Berkeley.
Vulcan Materials Co	Drawer 8834 Greenville, S.C. 29604	do	Cherokee.
Marl, crushed:			
Giant Portland Cement Co	150 Strafford Ave. Wayne, Pa. 19087	Quarry	Dorchester.
Santee Portland Cement Co	Box 698 Holly Hill, S.C. 29059	do	Orangeburg.
Vermiculite:			
Crude:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	Several open-pit mines	Laurens and Spartanburg.
Patterson Vermiculite Co	Route 1 Enoree, S.C. 29335	Open-pit mine	Laurens.
Exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	2 expanding plants	Greenville and Laurens.
Patterson Vermiculite Co	Route 1 Enoree, S.C. 29335	Mill and expanding plant.	Laurens.

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 M. Clair Smith [1] and Charles Koch [2]

Value of mineral production in South Dakota for 1969 totaled $54.9 million, 2 percent more than that in 1968. The value has been relatively stable, for the past 7 years, ranging from $50 to $55 million. The value of mineral production in 1969 was distributed as follows: Nonmetals, $29.6 million; metals, $25.0 million; and fuels, $362,000. The value of metals increased 5 percent while the value of nonmetals and fuels decreased 1 percent and 10 percent respectively. Minerals obtained from pegmatites in Pennington and Custer Counties decreased 22 percent in value.

Sand and gravel, stone, and cement comprised 93 percent of the nonmetals value; gold represented nearly 99 percent of the metals total. These commodities represented 95 percent of the total value of mineral production in the State.

[1] Mining engineer, Bureau of Mines, Denver, Colo.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in South Dakota [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Beryllium concentrate—short tons	75	$35	46	$23
Cement:				
Masonry—thousand 280-pound barrels	54	180	49	181
Portland—thousand 376-pound barrels	1,826	6,228	1,556	5,715
Clays—thousand short tons	226	1,119	187	1,171
Feldspar—long tons	39,077	264	29,434	194
Gem stones	NA	34	NA	36
Gold (recoverable content of ores, etc.)—troy ounces	593,052	[2] 23,283	593,146	[2] 24,621
Gypsum—thousand short tons	16	65	11	46
Lead (recoverable content of ores, etc.)—short tons	-------	-------	1	[3]
Mica (scrap)—do	W	W	423	20
Petroleum (crude)—thousand 42-gallon barrels	187	401	158	362
Sand and gravel—thousand short tons	11,558	11,578	11,158	10,807
Silver (recoverable content of ores, etc.) thousand troy ounces	138	295	124	223
Stone—thousand short tons	1,860	9,687	2,092	10,839
Value of items that cannot be disclosed: Coal (lignite, 1968), columbium-tantalum concentrate (1969), lime, lithium minerals, uranium [4] (recoverable content U_3O_8), tin (1969), and value indicated by symbol W	XX	939	XX	683
Total	XX	54,108	XX	54,921
Total 1967 constant dollars	XX	r 49,132	XX	p 50,322

p Preliminary. 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] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

[3] Less than ½ unit.

[4] Value estimated based on $8.00 (1968) per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 (1968) and $6.10 (1969) per pound for commercial sales.

Table 2.—Value of mineral production in South Dakota, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Aurora	$97	$67	Sand and gravel.
Beadle	126	249	Do.
Bon Homme	185	45	Do.
Brookings	101	259	Sand and gravel, stone.
Brown	346	265	Sand and gravel.
Brule	140	196	Do.
Buffalo	20	6	Do.
Butte	W	W	Clays, sand and gravel.
Campbell	83	154	Sand and gravel, stone.
Charles Mix	206	194	Sand and gravel.
Clark	223	72	Do.
Clay	99	27	Do.
Codington	W	501	Do.
Corson	55	50	Do.
Custer	437	967	Sand and gravel, feldspar, stone, lime, petroleum, lithium minerals, beryllium concentrate, mica (scrap), columbium-tantalum concentrate.
Davison	263	266	Sand and gravel.
Day	179	325	Do.
Deuel	117	106	Do.
Dewey	W	13	Do.
Douglas	225	196	Do.
Edmunds	122	89	Do.
Fall River	W	W	Uranium, sand and gravel.
Faulk	148	148	Sand and gravel.
Grant	6,639	7,845	Stone, sand and gravel.
Gregory	119	204	Sand and gravel.
Haakon	143	------	
Hamlin	178	139	Sand and gravel.
Hand	185	122	Do.
Hanson	W	536	Stone.
Harding	482	402	Petroleum, sand and gravel.
Hughes	132	83	Sand and gravel.
Hutchinson	251	96	Do.
Hyde	92	389	Do.
Jackson	817	291	Do.
Jerauld	37	114	Do.
Jones	41	14	Do.
Kingsbury	102	114	Do.
Lake	147	203	Do.
Lawrence	23,725	24,939	Gold, silver, stone, sand and gravel, lead.
Lincoln	166	146	Sand and gravel.
Lyman	307	322	Do.
Marshall	198	166	Sand and gravel.
McCook	64	75	Do.
McPherson	128	44	Do.
Meade	369	176	Sand and gravel, gypsum.
Mellette	229	23	Sand and gravel.
Miner	------	54	Do.
Minnehaha	1,245	W	Stone, sand and gravel.
Moody	398	184	Sand and gravel.
Pennington	10,625	8,329	Cement, stone, sand and gravel, lime, clays, tin, beryllium concentrate, mica (scrap), columbium-tantalum concentrate, feldspar, lithium minerals.
Perkins	101	248	Sand and gravel.
Potter	196	88	Do.
Roberts	87	88	Do.
Sanborn	61	70	Do.
Shannon	64	94	Do.
Spink	89	418	Do.
Stanley	W	150	Do.
Sully	79	135	Do.
Todd	115	3	Do.
Tripp	94	W	Stone.
Turner	174	424	Sand and gravel.
Union	53	79	Do.
Walworth	W	70	Do.
Washabaugh	111	70	Do.
Yankton	18	86	Do.
Ziebach	68	285	Do.
Undistributed [2]	2,785	3,408	
Total	54,086	54,921	

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

[1] Bennett County not listed because no production was reported.

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

Table 3.—Indicators of South Dakota business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	267.2	269.8	+1.0
Employment	do	259.3	262.1	+1.1
Unemployment	do	7.9	7.7	−2.5
Agricultural employment	do	61.4	61.2	−.3
Nonagricultural employment:	do	197.9	200.9	+1.5
Mining	do	2.2	2.2	------
Construction	do	8.5	8.0	−5.9
Manufacturing	do	15.4	15.9	+3.2
Government	do	50.0	50.9	+1.8
All other	do	121.8	123.9	+1.7
Payroll data:				
Agriculture	millions	$396.0	$422.1	+6.6
Mining	do	$4.4	$4.7	+6.8
Construction	do	$61.2	$65.2	+6.5
Manufacturing	do	$107.7	$114.8	+6.6
Government	do	$291.2	$310.3	+6.6
All other	do	$595.5	$634.6	+6.6
Personal income:				
Total	millions	$1,887.0	$2,011.0	+6.6
Per capita		$2,838	$3,051	+7.5
Construction activity:				
Highway construction contracts awarded	do	$32.1	$48.3	+50.5
Cement shipments to and within the State	thousand 376-pound barrels	1,560.0	1,375.0	−11.9
Value of building permits	millions	$42.4	$45.9	+8.3
Residential	do	$14.8	$17.0	+14.9
Nonresidential	do	$27.6	$28.9	+4.7
Business receipts:				
Retail sales	millions	$1,065.2	$1,129.6	+6.0
Farm marketing receipts	do	$958.0	$1,033.4	+7.9
Mineral production	do	$54.1	$54.9	+1.5
Utility production and consumption:				
Production of electric energy	million kilowatt hours	6,137.0	6,881.1	+12.1
Natural gas consumption	billion cubic feet	24.8	33.8	+36.3

p Preliminary.

Sources: Business Research Bureau, University of South Dakota, Vermillion, S. Dak.; Engineering News-Record, v. 184, No. 16, Apr. 30, 1970, pp. 12–13; U.S. Bureau of Mines.

South Dakota was again the leading gold producing State in the Nation, yielding 593,146 ounces valued at $24.6 million. Nearly all of this output was from Homestake Mining Co.'s mine at Lead, which was operated at capacity throughout the year. The company and Local 7044, United Steel Workers of America, AFL-CIO, signed a 3-year contract in December. Governor Farrer acted as mediator after the contract negotations became deadlocked.

The properties and assets of Northwest Beryllium Corp., which consisted of several mining claims in Custer, Pennington, and Lawrence Counties and a processing plant located at Keystone, were sold in May.

Construction of a pilot plant for developing a process to convert lignite coal to a pipeline gas for commercial purposes was started. Ground breaking ceremonies were held August 18, 1969, at Rapid City. Ground preparation at a location southeast of the city began in October, with construction of the plant scheduled for 1970. The U.S. Department of the Interior has allotted funds for this project.

Highway construction contracts awarded during the year amounted to $48.3 million, $27.3 million of the total being allotted to the Interstate Highway System.[3]

Several publications were prepared by U.S. Bureau of Mines and U.S. Geological Survey personnel or under cooperative agreements with these agencies.[4]

[3] Engineering News-Record, State Highway Departments' Construction Contracting Plans for 1970 and Budgets for Maintenance. Apr. 30, 1970, v. 184, No. 16, pp. 12–13.

[4] Bayley, R. W. Structure and Mineralization of Precambrian Rocks in the Galena-Roubaix District, Black Hills, S. Dak. U.S. Geol. Survey Bull. 1312–E, 1970, 15 pp.

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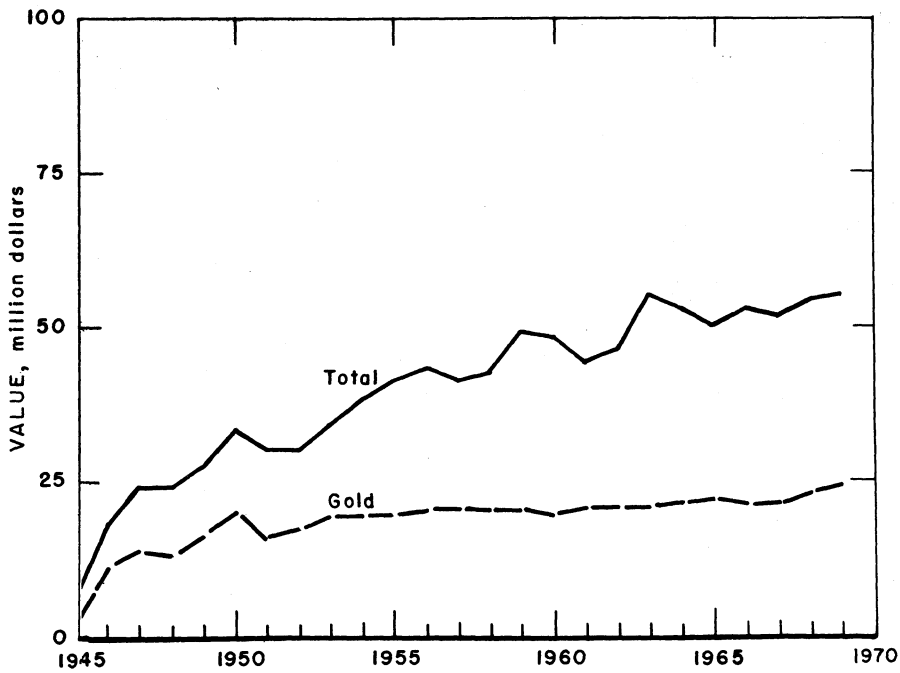

Figure 1.—Value of mine production of gold, and total value of mineral production in South Dakota.

Employment and Injuries.—The extent of employment and injuries in the mineral industry, exclusive of the petroleum industry, is presented in table 4.

Table 4.—Worktime 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
1968:								
Coal	3	156	(1)	4	------	------	--------	------
Metal	1,603	302	494	3,953	2	118	30.35	4,152
Nonmetal	214	191	41	330	1	7	24.22	18,846
Sand and gravel	737	158	116	1,049	------	23	21.93	730
Stone	469	231	108	919	------	14	15.23	283
Total [2]	3,026	248	760	6,256	3	162	26.37	3,783
1969: [p]								
Coal	5	170	1	4	------	------	------	------
Metal	1,675	311	522	4,176	2	87	21.31	4,505
Nonmetal	175	211	37	315	1	10	34.90	19,860
Sand and gravel	760	172	130	1,190	------	26	21.86	581
Stone	495	234	116	984	1	19	20.32	8,140
Total [2]	3,105	259	805	6,669	4	142	21.89	5,065

[p] Preliminary.
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—The South Dakota Cement Commission, from its Rapid City plant, shipped 49,000 barrels (280-pound) of masonry cement, 5,000 barrels less than the previous year, and 1.6 million barrels (376-pound) of portland cement, 270,000 barrels less than last year. Twenty-two percent of the output was used in highway construction. About 75 percent of the shipments were made by truck.

The plant required 304,128 tons of limestone, 58,073 tons of shale, 22,497 tons of sand, 12,443 tons of gypsum, and 7,803 tons of iron ore for the 1969 cement production.

Clays.—The total tonnage—186,929 short tons—of bentonite and those clays used in manufacturing brick, cement, and lightweight aggregate was 39,000 short tons, 17 percent, less than that in 1968; the value, however, was greater because of the price increase of clay for brick manufacture. American Colloid Co., the only company presently processing bentonite in South Dakota, obtained its raw materials from South Dakota and Wyoming.

Feldspar.—Production of feldspar was down about 25 percent to 29,434 long tons, or nearly 10,000 long tons less than in 1968. International Minerals & Chemical Corp. increased the price paid to individual suppliers. The company is also offering a bonus to producers who supply 1,200 tons or more of acceptable feldspar per year to its grinding plant at Custer. The plant ground 33,419 long tons of the company's own production and 3,235 long tons purchased. The majority of ground feldspar was shipped to 19 States, Canada, and Mexico, where it was used in glass, pottery, enamel, and porcelain.

Gypsum.—The total gypsum production obtained in Meade County was used in the manufacture of cement.

Lime.—Since the erection of kilns at Rapid City by Pete Lien & Sons in 1964, lime production has steadily increased. About 75 percent of the output from this plant is used for soil stablization in the highway construction programs of South Dakota and neighboring States. Black Hills Lime Co. at Pringle prepares a metallurgical grade of lime.

Lithium Minerals.—Lithium production consisted of handsorted lepidolite and amblygonite. The amount shipped was 14 times greater than that shipped in 1968.

Mica.—Scrap mica production was only one-sixth that of last year, with only four mines contributing to the output.

Sand and Gravel.—Sand and gravel was produced in all but four counties. Of the total output of 11.1 million tons, 7.9 million (71 percent) was produced for governmental agencies. Ninety-two commercial respondents operated at 144 locations; the 71 agency crews operated at 220 locations. The total amount consisted of 1.7 million tons of sand and 9.4 million tons of gravel. Custer, Codington, Pennington, and Spink Counties supplied 2.1 million tons, 19 percent of the State total.

Stone.—Stone production of 2 million tons was obtained from granite, quartzite, limestone, sandstone, quartz, traprock, and miscellaneous stone. The value of granite, mostly prepared for monumental and architectural purposes, amounted to $7.6 million or 70 percent of the $10.8 million total. Limestone and quartzite production was valued at $3 million.

Output of monumental and architectural granite came from five companies operating in Grant County in the northeast corner of the State.

Table 5.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Aurora	92	$97	72	$67
Beadle	126	126	245	249
Bon Homme	184	185	81	45
Brookings	83	101	232	251
Brown	315	346	315	265
Brule	137	140	191	196
Buffalo	24	20	4	6
Butte	367	368	157	81
Campbell	100	83	138	154
Charles Mix	200	200	193	194
Clark	223	223	72	72
Clay	88	99	58	27
Codington	300	315	545	501
Corson	94	55	81	50
Custer	90	86	693	672
Davison	240	263	296	266
Day	163	179	312	325
Deuel	107	117	131	106
Dewey	54	43	14	13
Douglas	205	225	179	196
Edmunds	113	122	90	89
Fall River	206	160	47	48
Faulk	148	148	164	148
Grant	113	120	224	225
Gregory	104	119	210	204
Haakon	143	143	------	------
Hamlin	152	178	113	139
Hand	216	185	109	122
Hanson	82	82	------	------
Harding	107	107	59	59
Hughes	143	132	83	83
Hutchinson	251	251	130	96
Hyde	92	92	387	389
Jackson	817	817	291	291
Jerauld	37	37	111	114
Jones	53	41	14	14
Kingsbury	102	102	114	114
Lake	145	147	274	203
Lawrence	W	W	41	42
Lincoln	152	166	134	146
Lyman	312	307	340	322
McCook	63	64	125	75
McPherson	125	128	41	44
Marshall	188	198	152	166
Meade	303	304	140	130
Mellette	229	229	23	23
Minnehaha	548	558	713	686
Miner	------	------	52	54
Moody	373	398	171	184
Pennington	1,689	1,526	446	553
Perkins	79	101	207	248
Potter	187	196	88	88
Roberts	80	87	95	88
Sanborn	59	61	86	70
Shannon	66	64	92	94
Spink	88	89	438	418
Stanley	W	W	131	150
Sully	79	79	175	135
Todd	120	115	7	3
Tripp	39	39	------	------
Turner	159	174	385	424
Union	53	53	95	79
Walworth	W	W	101	70
Washabaugh	111	111	70	70
Yankton	18	18	88	86
Ziebach	68	68	295	285
Undistributed	154	191	------	------
Total [1]	11,558	11,578	11,158	10,807

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

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Sand and gravel sold or used by producers, by class of operation and use

(Thousand short tons and thousand dollars)

Class of operation and use	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	456	$498	485	$529
Paving	113	139	148	207
Fill	58	65	68	54
Total	627	702	701	790
Gravel:				
Construction:				
Building	220	319	217	313
Paving	1,795	1,803	2,282	2,188
Fill	139	110	43	38
Miscellaneous	43	54	9	8
Total [1]	2,197	2,286	2,551	2,548
Total sand and gravel	2,824	2,988	3,252	3,338
Government-and-contractor operations:				
Sand:				
Building	1	1	5	4
Paving	1,738	1,736	1,015	982
Fill	1	1	1	1
Other	11	6	21	12
Total [1]	1,751	1,744	1,041	999
Gravel:				
Building	------	------	624	629
Paving	6,983	6,847	6,222	5,822
Fill	------	------	19	18
Total [1]	6,983	6,847	6,864	6,470
Total sand and gravel [1]	8,734	8,587	7,906	7,469
All operations:				
Sand	2,378	2,446	1,742	1,789
Gravel	9,180	9,133	9,416	9,018
Total [1]	11,558	11,578	11,158	10,807

[1] Data may not add to totals shown because of independent rounding.

Table 7.—Stone sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind of stone	1965		1966		1967		1968		1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dolomite	-----	-----	-----	-----	(1)	$1	-----	-----	-----	-----
Granite	20	$2,945	24	$4,067	48	6,160	38	$6,519	44	$7,620
Limestone	869	1,412	1,101	1,793	[2] 882	[2] 1,399	[2] 1,082	[2] 1,694	989	1,207
Quartz, quartzite, and sandstone	651	1,007	984	1,997	[2] 781	[2] 1,623	676	1,402	1,055	2,004
Quartz and quartzite	NA	NA	NA	NA	NA	NA	563	1,193	1,046	1,962
Sandstone	NA	NA	NA	NA	NA	NA	113	209	W	W
Traprock	-----	-----	-----	-----	-----	-----	-----	-----	3	8
Other stone	14	24	78	137	155	512	64	71	(1)	(1)
Total [3]	1,554	5,387	2,186	7,995	1,866	9,694	1,860	9,687	2,092	10,839

NA Not available. W Withheld to avoid disclosing individual company confidential data.
[1] Less than ½ unit.
[2] Excludes dimension stone; included with "Other stone."
[3] Data may not add to totals shown because of independent rounding.

Table 8.—Stone sold or used by producers, by use

Use		1968		1969	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension stone:					
Rough construction and rubble	short tons	11,986	W	3,463	W
Dressed architectural	cubic feet	205,685	W	145,395	W
Rough monumental	do				
Dressed monumental	do	151,852	$3,269	349,282	$4,969
Curbing and flagging	do	W	W	---	---
Total (approximate)	short tons	47,400	6,535	44,200	7,622
Crushed and broken stone:					
Refractory	short tons	W	W	35,000	96
Riprap	do	76,779	81	61,853	90
Railroad ballast	do	286,245	435	320,893	511
Road aggregates	do	W	W	714,147	1,108
Concrete aggregate	do	335,447	785	523,867	1,004
Cement	do	388,911	W	304,128	222
Other	do	[1] 694,891	[1] 1,117	[2] 88,166	[2] 185
Total [3]	do	1,812,273	3,152	2,048,054	3,217
Total stone (approximate)	do	1,859,700	9,687	2,092,300	10,839

W Withheld to avoid disclosing individual company confidential data; included in "Totals."
[1] Includes stone used for abrasives, agricultural limestone, bituminous aggregate, dense graded road base, flux, lime, other fillers, stone sand, surface treatment aggregates, and terrazzo and exposed aggregate.
[2] Includes stone used for abrasives, lime, roofing aggregates, and stone sand.
[3] Data may not add to totals shown because of independent rounding.

METALS

Beryllium.—Beryl production, most of which was sold to Beryl Ores Co. of Arvada, Colo., was about two-thirds of that of 1968.

Columbium and Tantalum.—The small shipment of columbium and tantalum made in 1969 was a collection of material produced from several mines in the Custer-Keystone area.

Gold and Silver.—Gold production, all from Lawrence County, was almost the same amount as 1968 production; the value, however, was $1.3 million greater. Silver production decreased 10 percent in quantity and $72,000 in value below that of 1968. Homestake Mining Co. was the principal producer; some silver was also produced by Silver Queen Mine Co.

The directors of Homestake Mining Co. authorized a deep-level development program with an inside shaft from the 4,850- to the 6,800-foot level, near the Ross shaft. This new shaft, with the levels served by it, will be used to develop ore bodies in the west part of the mine.

Lead.—A small amount of lead was recovered as a byproduct of silver ore by Silver Queen Mine Co., operating in Lawrence County.

Tin.—A shipment of cassiterite concentrates was made by Northwest Beryllium Corp. in 1969 from stockpiles.

Table 9.—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)
1965	1	---	2,032	628,259	$21,989	129	$167
1966	1	---	2,002	606,467	21,226	110	142
1967	1	1	1,896	601,785	21,062	121	188
1968	1	2	1,922	593,052	23,283	138	295
1969	2	1	1,935	593,146	24,621	124	223
1876-1969	NA	NA	NA	33,602,342	964,066	12,631	10,134

NA Not available.
[1] Excludes placer gravel.

Table 10.—Homestake mine ore milled and receipts for bullion [1]

Year	Ore milled (thousand short tons)	Receipts for bullion products	
		Total (thousands)	Per ton
1965	2,032	$22,094	$10.88
1966	2,002	21,309	10.64
1967	1,896	21,200	11.18
1968	1,922	22,064	11.48
1969	1,935	24,570	12.70

[1] From 1876 to 1969 inclusive, this mine yielded bullion and concentrates that brought a net return of $892.4 million.

Source: Homestake Mining Co. Annual Report 1969, p. 22.

Uranium.—With the start of mining of newly discovered uranium ore bodies by Susquehanna-Western, Inc., a subsidiary of The Susquehanna Corp., uranium production nearly equaled that of 1968. After a temporary shutdown the Edgemont mill operated by Mines Development, Inc., also a subsidiary of The Susquehanna Corp., resumed production in the fourth quarter of 1969.

Vanadium.—No vanadium was produced in 1969.

MINERAL FUELS

Coal (Lignite).—The Firesteel strip mine, operated in Dewey County in 1968, was not productive in 1969.

Petroleum.—Output of petroleum decreased 16 percent. The 24-well Buffalo field yielded 149,832 barrels; the 2-well Barker Dome field yielded 8,356 barrels.

The drilling of 61 exploratory wells set a new drilling record with the Muddy formation (Cretaceous) as the main objective; none of the wells were completed as producers. Harding County in the northwest part of the State led in drilling with 19 exploratory wells. Next was Fall River County with 18 wells, followed by Corson County with 10 wells. Oil shows were found in two wells. One was a Red River formation (Ordovician) test 8 miles northeast of the Buffalo field; the other well was a Mission Canyon formation (Mississippian) test 50 miles south of the Buffalo field.

Two oil and gas lease sales were held in 1969—on May 14 and on November 19. At the May 14 sale, 53,417.66 acres were leased for a total bonus of $59,225, with a high bid of $3.81 per acre and an average bid of $1.11 per acre. A total of 141,455.51 acres was sold at a bonus of $55,588 at the November 19 sale. High bid was $11.25 per acre for a parcel of land in Harding County; bids averaged about 39 cents an acre. Most of the leased land was in the northwest part of the State.

Table 11.—Oil and gas well drilling, by county

County	Dry [1]	Total	Footage
1968:			
Exploratory completions (no development wells):			
Butte	4	4	11,951
Fall River	13	13	31,866
Harding	6	6	32,950
Total	23	23	76,767
1969:			
Exploratory completions:			
Butte	6	6	22,141
Corson	10	10	35,800
Fall River	18	18	40,559
Harding	19	19	82,341
Meade	4	4	12,842
Perkins	3	3	13,129
Total	60	60	206,812
Development completions:			
Harding	1	1	8,805
Total all drilling	61	61	215,617

[1] None of the exploratory or development wells were completed as producers.

Sources: Petroleum Information Corp., 1968 and 1969 Résumés, Oil and Gas Operations in the Rocky Mountain Region.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Beryllium:			
L. W. Judson	Hermosa, S. Dak. 57744	See Mica	Pennington.
Northwest Beryllium Corp.	218–219 American National Bank Bldg. Rapid City, S. Dak. 57701	Stockpile	Do.
Cement:			
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Wet-process, 3-rotary-kiln plant.	Do.
Clays:			
American Colloid Co	5100 Suffield Court Skokie, Ill. 60076	Open pit mine and plant	Butte.
Light Aggregates, Inc	Box 1922 Rapid City, S. Dak. 57701	do	Pennington.
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Open pit mine	Do.
Columbium and tantalum:			
Walter Clifford	Box 823 Custer, S. Dak. 57730	Stockpile	Custer.
Northwest Beryllium Corp.	218–219 American National Bank Bldg. Rapid City, S. Dak. 57701	do	Pennington.
Feldspar:			
George Bland	Custer, S. Dak. 57730	2 open pit mines	Custer.
International Minerals & Chemical Corp., Industrial Minerals Division.	Administration Center Old Orchard Road Skokie, Ill. 60079	4 open pit mines and dry-grinding plant.	Do.
Gold:			
Homestake Mining Co	Lead, S. Dak. 57754	Underground mine, amalgamation-cyanidation mill, and refinery.	Lawrence.
Gypsum:			
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Open pit mine	Meade.
Lime:			
Pete Lien & Sons	Box 3124, P.O. Annex Rapid City, S. Dak. 57703	1-rotary-kiln, 1-vertical-kiln, continuous-hydrator plant.	Pennington.
Mica (scrap):			
L. W. Judson	Hermosa, S. Dak. 57744	Open pit mine	Do.
Northwest Beryllium Corp.	218–219 American National Bank Bldg. Rapid City, S. Dak. 57701	Stockpile	Do.
Petroleum:			
The Ozark Corp	Box 2491 Casper, Wyo. 82601	Crude oil wells	Custer (Barker Dome field).
Pennzoil United, Inc	900 Southwest Tower Houston, Tex. 77002	do	Harding (Buffalo field).
Phillips Petroleum Co	Frank Phillips Bldg. Bartlesville, Okla. 74003	do	Do.
Sand and gravel (commercial):			
Aggregates, Inc	Selby, S. Dak. 57472	Pit and plant	Butte.
		Pit	Deuel.
		Pit	Lyman.
		Pit	Pennington.
Concrete Materials Co	3000 West Madison Street Sioux Falls, S. Dak. 57104	Pit and 2 plants	Minnehaha.
F. J. McLaughlin Co	Watertown, S. Dak. 57201	do	Codington.
Floyd Oberg & Sons Construction Co.	Colton, S. Dak. 57018	Pit	Aurora.
		Pit and plant	Codington.
		Pit	Edmunds.
		Pit	Minnehaha.
		Pit	Spink.
Hallett Construction Co	Crosby, Minn. 56441	2 pits and plants	Codington.
Hogan Construction Co	Rock Rapids, Iowa 51246	Pit and plant	Charles Mix.
		Pit	Lincoln.
		Pit	Union.
L. G. Everist, Inc	302 Paulton Bldg. Sioux Falls, S. Dak. 57102	Pit and plant	Brookings.
		do	Pennington.
Moeckly & Olson, Inc	Amherst, S. Dak. 57421	Pit and plant	Day.
		Pit	Edmunds.
		Pit	Roberts.
		2 pits	Walworth.
Pickus Construction Co	Box 1414 Aberdeen, S. Dak. 57401	Pit and plant	Brown.
Tom Luke Construction	Kimball, S. Dak. 57335	3 pits	Brule.
		3 pits and plant	Davison.
		2 pits	Douglas.
		3 pits	Lyman.
Silver:			
Homestake Mining Co	Lead, S. Dak. 57754	See Gold	Lawrence.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:			
Cold Spring Granite Co	Cold Spring, Minn. 56320	2 quarries	Grant.
Concrete Materials Co	3000 West Madison Street Sioux Falls, S. Dak. 57104	Quarry and plant	Minnehaha.
Dakota Granite Co	Box 269 Milbank, S. Dak. 57252	2 quarries	Grant.
Delano Granite Works, Inc.	Delano, Minn. 55328	Quarry	Do.
Hills Materials Co	Box 1392 Rapid City, S. Dak. 57701	Quarry and plant	Pennington.
L. G. Everist, Inc	302 Paulton Bldg.	do	Minnehaha.
	Sioux Falls, S. Dak. 57102	do	Pennington.
Pete Lien & Sons	Box 3124, P.O. Annex Rapid City, S. Dak. 57703	do	Do.
Robert Hunter Granite Co., Inc.	Milbank, S. Dak. 57252	Quarry	Grant.
South Dakota Cement Commission.	Drawer 351 Rapid City, S. Dak. 57701	Quarry and plant	Pennington.
Spencer Quarries, Inc	Spencer, S. Dak. 57374	Quarry	Hanson.
Steiner-Rausch Granite Co., Inc.	Ortonville, Minn. 56278	do	Grant.
Tin:			
Northwest Beryllium Corp.	218–219 American National Bank Bldg. Rapid City, S. Dak. 57701	Stockpile	Pennington.
Uranium:			
Susquehanna-Western, Inc.	Edgemont, S. Dak. 57735	Underground mine	Fall River.
Mines Development, Inc.	do	Acid-leach mill	Do.

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 Doss H. White, Jr. [1] and Robert E. Hershey [2]

In 1969, the mining and petroleum industries in Tennessee produced mineral commodities valued at $205 million, an increase of 2 percent over the value of 1968. The State continued as the principal domestic source of ball clay, pyrite and zinc.

Highlighting Tennessee's mineral industry during the year were the announcements of a major zinc discovery in central Tennessee near Carthage and a new petroleum pool on the Cumberland Plateau. Expansion plans were also announced by the aluminum and copper industries.

Increases were recorded in most sectors of the State's economy, with the exception of the value and volume of construction activity. This was due mainly to the constricted money market during 1969.

[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	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite—short tons	20,964	$362	16,341	$295
Cement:				
Portland—thousand 376-pound barrels	8,488	27,691	9,159	29,403
Masonry—thousand 280-pound barrels	1,370	3,836	1,331	3,587
Clays [2]—thousand short tons	1,562	5,772	1,719	7,064
Coal (bituminous)—do	8,148	29,647	8,082	30,682
Copper (recoverable content of ores, etc.)—short tons	14,196	11,881	15,353	14,596
Gold (recoverable content of ores, etc.)—troy ounces	140	[3] 5	126	[3] 5
Natural gas—million cubic feet	48	9	57	11
Petroleum (crude)—thousand 42-gallon barrels	6	W	32	W
Phosphate rock—thousand short tons	3,149	23,628	W	W
Sand and gravel—do	7,344	11,140	6,175	9,709
Silver (recoverable content of ores, etc.) thousand troy ounces	90	192	79	141
Stone [4]—thousand short tons	32,083	43,854	33,265	46,192
Zinc (recoverable content of ores, etc.)—short tons	124,039	33,491	124,532	36,363
Value of items that cannot be disclosed: Clay (fuller's earth), lime, pyrite, stone (crushed sandstone 1968), and values indicated by symbol W	XX	9,826	XX	27,402
Total [5]	XX	201,334	XX	205,451
Total 1967 constant dollars	XX	r 196,620	XX	p 192,100

p Preliminary. 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 fuller's earth; included with "Value of items that cannot be disclosed."

[3] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

[4] Excludes crushed sandstone (1968) included with "Value of items that cannot be disclosed."

[5] Data may not add to totals shown because of independent rounding.

Table 2.—Value of mineral production in Tennessee, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Anderson	$7,911	$8,530	Coal, limestone.
Bedford	W	W	Limestone.
Benton	1,978	2,456	Sand and gravel, limestone.
Bledsoe	W	W	Coal.
Blount	W	W	Limestone, marble.
Bradley	363	W	Limestone.
Campbell	7,358	6,826	Coal, limestone, sandstone.
Cannon	W	W	Limestone.
Carroll	W	-------	
Carter	W	W	Do.
Claiborne	5,341	6,588	Coal, limestone.
Clay	W	W	Limestone.
Cocke	W	W	Do.
Coffee	W	W	Do.
Cumberland	2,005	1,610	Limestone, sandstone, sand and gravel, coal.
Davidson	11,679	11,103	Limestone, cement, miscellaneous clay, phosphate rock.
Decatur	W	W	Limestone, sand and gravel.
De Kalb	W	W	Limestone.
Dickson	W	W	Do.
Fayette	79	W	Limestone, sand and gravel.
Fentress	546	369	Limestone, coal, sandstone.
Franklin	6,572	6,247	Cement, limestone, sand and gravel, miscellaneous clay.
Gibson	W	W	Sand and gravel.
Giles	W	1,573	Phosphate rock, limestone, sand and gravel.
Grainger	W	W	Limestone, marble.
Greene	W	W	Limestone.
Grundy	953	599	Coal, sand and gravel, limestone.
Hamblen	W	W	Limestone.
Hamilton	10,777	11,590	Cement, limestone, sand and gravel, coal, miscellaneous clay.
Hancock	W	W	Zinc, limestone.
Hardeman	W	W	Sand and gravel.
Hardin	W	W	Limestone, sand and gravel.
Hawkins	W	W	Sandstone.
Haywood	78	46	Sand and gravel.
Henderson	W	W	Do.
Henry	3,261	4,095	Ball clay, fuller's earth.
Hickman	W	W	Phosphate rock.
Humphreys	W	W	Limestone, sand and gravel.
Jefferson	25,531	26,394	Zinc, limestone.
Johnson	W	W	Limestone.
Knox	18,250	20,310	Cement, zinc, limestone, lime, sand and gravel, marble, miscellaneous clay.
Lauderdale	109	97	Sand and gravel.
Lincoln	W	W	Limestone.
Loudon	664	447	Limestone, barite, marble, miscellaneous clay, sand and gravel.
Macon	W	W	Limestone.
Marion	9,276	8,433	Cement, coal, limestone.
Marshall	W	W	Limestone.
Maury	14,519	13,557	Phosphate rock, limestone.
McMinn	961	782	Limestone, sand and gravel, barite.
McNairy	W	W	Sand and gravel.
Meigs	W	W	Limestone.
Monroe	268	W	Limestone, barite, sand and gravel.
Montgomery	W	W	Limestone.
Moore	------	W	Do.
Morgan	1,445	1,200	Coal.
Obion	345	257	Sand and gravel.
Overton	224	W	Limestone, coal.
Perry	------	144	Sand and gravel.
Pickett	2	24	Limestone.
Polk	W	W	Copper, pyrites, zinc, limestone, silver, sand and gravel, gold.
Putnam	1,054	693	Limestone, coal, sand and gravel.
Rhea	205	W	Limestone, coal.
Roane	W	W	Limestone.
Robertson	W	W	Do.
Rutherford	1,024	1,024	Do.
Scott	2,544	W	Coal.
Sequatchie	1,214	1,011	Coal, limestone.
Sevier	742	587	Limestone, sand and gravel.
Shelby	792	825	Sand and gravel.
Smith	94	61	Limestone.
Stewart	W	W	Limestone, sand and gravel.
Sullivan	W	W	Cement, limestone, miscellaneous clay.
Sumner	1,944	1,090	Limestone.
Tipton	W	W	Sand and gravel.
Unicoi	W	W	Sand and gravel, limestone.
Union	W	W	Marble, limestone.

See footnotes at end of table.

Table 2.—Value of mineral production in Tennessee, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Van Buren	$980	W	Coal.
Warren	W	W	Limestone.
Washington	637	W	Limestone, sand and gravel, miscellaneous clay.
Wayne	W	W	Sand and gravel, limestone.
Weakley	2,392	$2,454	Ball clay, miscellaneous clay.
White	W	W	Limestone.
Williamson	W	W	Phosphate rock, limestone.
Wilson	W	W	Limestone.
Undistributed [2]	57,217	64,431	
Total [3]	201,334	205,451	

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, Crockett, Dyer, Houston, Jackson, Lake, Lawrence, Lewis, Madison, and Trousdale.

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

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Selected indicators of Tennessee business activity

		1968	1969	Change, percent
Employment (average):				
Total nonagricultural	thousands	r 1,309	1,326.7	+1.4
Mining	do	7.2	7.5	+4.2
Manufacturing	do	r 466	466	0.0
Personal income:				
Total	millions	r $10,252	$11,197	+9.2
Per capita		r $2,594	$2,810	+8.3
Construction activity:				
Number of housing units		25,546	22,242	−12.9
Valuation	millions	$266	$254	−4.5
Farm marketing receipts	do	$619.5	$678.0	+9.4
Mineral production	do	$201	$205	+2.0
Utility sales	million kilowatt-hours	49,282	52,028	+5.6

r Revised.

Sources: U.S. Department of Agriculture, U.S. Department of Commerce, and U.S. Department of Labor.

Government Programs.—The Tennessee Valley Authority (TVA) and North American Rockwell Corporation signed an agreement to provide TVA with technical information developed from the company's research program for fast breeder nuclear reactors.

Preliminary construction work began on TVA's Sequoyah nuclear plant located in southeastern Tennessee. The plant will produce 2.4 million kilowatts of electricity from two lightwater reactors in the steam supply system. The first of the two generating units is scheduled for operation in 1973.

Construction of the 1.35-million-kilowatt, TVA Raccoon Mountain pumped-storage hydroelectric project near Chattanooga is scheduled to begin in mid-1970. Four reversible-pump turbine units will be installed in an underground power house connected to a 500-acre mountain-top lake by a 30-foot-diameter shaft. The first unit is scheduled for operation in 1974.

Work continued on TVA's Cumberland steamplant in northwest Tennessee. At completion the two-unit facility will have a 2.6-million-killowatt generating capacity.

Work continued on a cooperative project involving Bureau of Mines and the Tennessee Division of Geology to study strippable coal to determine remaining reserves in the northern part of the Cumberland Plateau. Methods to improve the beneficiation of Tennessee phosphate ores were investigated by the Bureau of Mines' Tuscaloosa Metallurgical Research Laboratory, University, Ala.

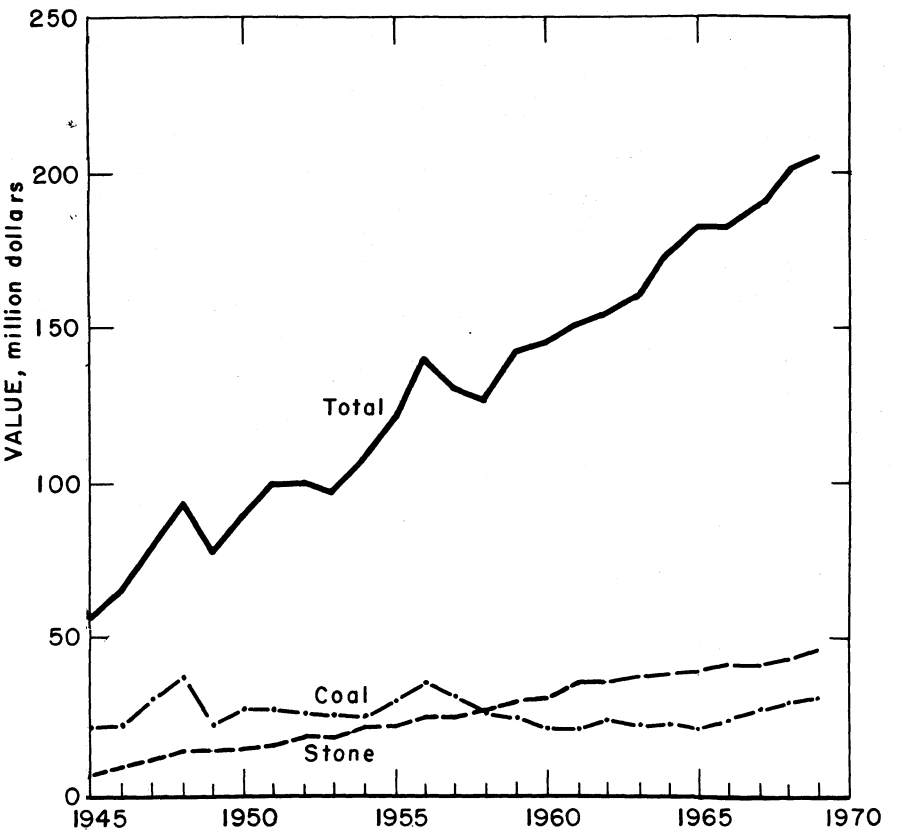

Figure 1.—Value of stone, coal, and total value of mineral production in Tennessee.

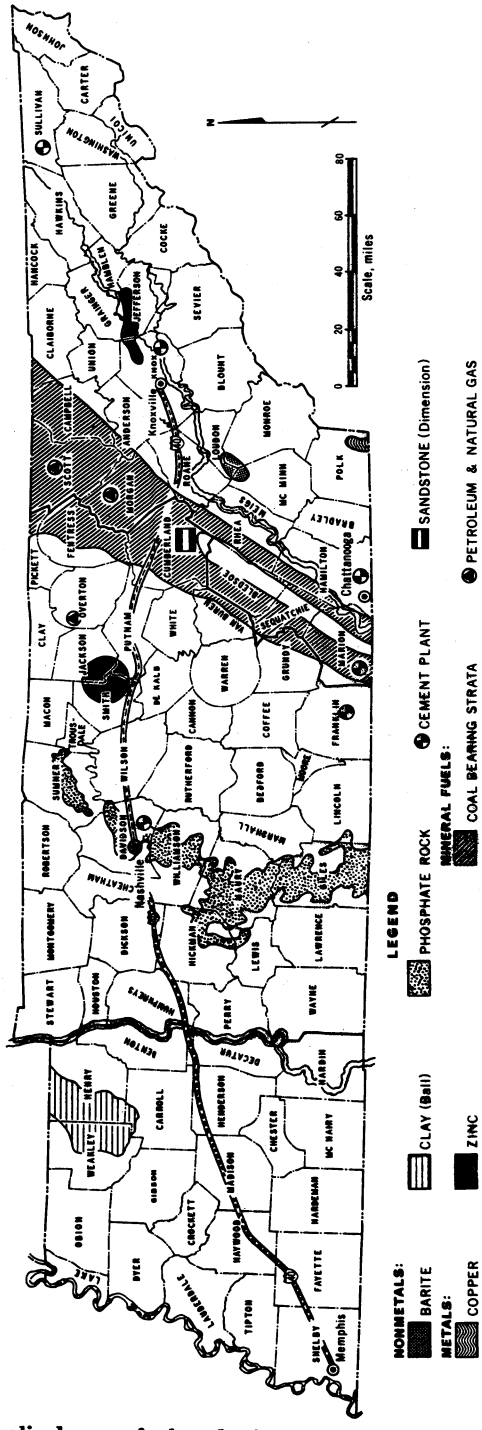

Figure 2.–Generalized map of selected mineral industries in Tennessee.

Table 4.—Worktime 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
1968:								
Coal	2,020	206	415	3,357	6	105	33.07	12,094
Metal	1,682	275	474	3,792	2	105	28.21	6,745
Nonmetal	680	246	167	1,387	-------	35	25.23	1,127
Sand and gravel	554	256	142	1,217	1	25	21.37	6,891
Stone	2,750	273	751	6,175	3	112	18.62	3,363
Total	7,686	252	1,949	15,928	12	382	24.74	6,083
1969:p								
Coal	2,045	211	432	3,479	3	86	25.58	6,261
Metal	1,695	262	453	3,624	1	95	26.49	3,593
Nonmetal	650	267	173	1,468	-------	37	25.21	424
Sand and gravel	550	266	146	1,280	-------	30	23.44	3,341
Stone	2,830	265	751	6,727	2	112	16.95	2,351
Total	7,770	250	1,955	16,578	6	360	22.08	3,349

p Preliminary.

REVIEW OF MINERAL COMMODITIES

NONMETALS

Production of nonmetals accounted for 60 percent of the total value of mineral production, a decrease of 3 percent below the value of nonmetals in 1968. The three principal commodities, in order of value, were stone, cement, and phosphate rock.

Barite.—Barite production was by three companies operating five mines in the Sweetwater District in eastern Tennessee. The ore was recovered by open-pit mining methods and shipped by rail for use in chemicals, drilling mud, and paint. One deposit, first mined in the early 1900's, was being reworked. Production and value declined 22 and 18 percent, respectively, under that of the previous year due to the depletion of reserves.

Cement.—The Tennessee cement industry, consisting of four companies operating six plants, ranked fifth nationally in the manufacture of masonry cement. Four plants produced both masonry and portland cement while two plants produced only the portland variety.

Masonry cement sales and value decreased 3 percent and 6 percent, respectively, while sales and value of portland cement increased 8 percent and 6 percent, respectively.

Shipments of masonry cement within the State accounted for 53 percent of the total production while out-of-state shipments, by percent, were to Georgia (30), North Carolina (6), Kentucky (3), Virginia (3), Alabama (2), and South Carolina (2); three other states divided the remaining 1 percent.

Forty-four percent of the State's portland cement production went to local consumers. Out-of-State shipments, by percent, were to North Carolina (23), Georgia (21), Virginia (4), Kentucky (2), Alabama (2), South Carolina (1); five other states received less than 1 percent each.

Clays.—During 1969, the clay industry produced ball clay, a high-grade ceramic raw material; fuller's earth, an absorbent clay; and miscellaneous clays used in the manufacture of structural clay products, refractories, and cements. The State ranked first in the Nation in the production of ball clay and fifth in the production of fuller's earth. Production and value for all clay products reached a new high.

Ball clay production was 453,000 tons valued at $5.9 million, an increase of 43,000 tons and $836,000 over the amounts of the previous year. Ball clay was mined in Henry and Weakley Counties by open-pit methods. The clay was air dried and shredded before shipment by rail and barge. End product uses were whiteware (60 percent); floor and wall tile, pottery, refractories, heavy clay products, and miscellaneous uses (40 percent).

Fuller's earth production and value increased 10 percent over that of 1968. Fuller's earth was mined by open-pit methods in Henry County in the northwestern sector of the State. The clay was processed by drying, crushing, and calcining. The end

product was for use as an absorbent material.

Table 5.—Ball clay sold or used by producers, by uses

Use	Short tons	
	1968	1969
Whiteware, etc.	225,048	270,061
Floor and wall tile	80,300	W
Other uses [1]	105,179	183,433
Total	410,527	453,494

[1] Includes art pottery, firebrick and block, kiln furniture, other refractories (1968), heavy clay products, enameling (1968), fillers (1968), and other uses (1968), and uses indicated by symbol W.

Miscellaneous clay production increased 10 percent over that of 1968. Finished products were building brick (54 percent), lightweight aggregate (22 percent), cement (16 percent), and miscellaneous uses (8 percent).

Graphite.—Union Carbide Corp. produced artificial graphite from petroleum coke for the manufacture of electrodes at its plant near Columbia, Tenn.

Lime.—Production and value of quick and hydrated lime increased 4 and 8 percent, respectively, over that of 1968. Williams Lime Mfg., Co. and Foote Mineral Co. produced lime for building and chemical use. Shipments of lime within the State accounted for 32 percent of the total production. Other States receiving lime were North Carolina (62 percent), South Carolina (2 percent), Kentucky (2 percent), and other states (2 percent).

Oceanic Lime Co., Inc. announced plans to construct a $16 million quarrying, crushing, and lime burning facility in Franklin County. The plant will begin operations in 1971 with a capacity of 1.2 million tons per year.

Perlite.—Chemrock Corp. expanded perlite from New Mexico at the Nashville plant. End uses were for filter aids and concrete aggregate. Production and value increased above that of 1968.

Phosphate Rock.—The State's phosphate industry is situated in a six-county area in the central part of the State and ranked third in the Nation in the production of phosphate rock.

Marketable production increased slightly over that of 1968. Value, however, declined more than 20 percent. This seemingly large percentage decline in value is attributable to the change of the point in processing at which the unit value is taken. Previous to 1969, the value for marketable phosphate rock in Tennessee was for an agglomerated product used as a furnace charge in the manufacture of elemental phosphorus. The 1969 figure, although unpublished, reflects the value of the phosphate rock before agglomeration, that is, the marketable production value equivalent to that used in other areas.

Production was by five companies operating 19 mines. The rock was mined by open-pit methods and shipped by rail and truck to plants located within the phosphate area. Much of the mining was carried out by local companies under contract to the phosphate producers. Over 99 percent of the phosphate rock was reduced to elemental phosphorus.

Phosphate rock from deposits owned by TVA were mined under contract, and the rock was shipped to the agency's fertilizer manufacturing complex at Muscle Shoals, Ala.

Pyrite.—In 1969, Tennessee led the Nation in pyrite output. Cities Service, Inc., Copperhill Division, recovered pyrite concentrates by flotation of sulfide ores mined in Polk County. The concentrate was used in producing sulfuric acid, iron sinter, sulfur dioxide, and ferric sulfate.

Market demands were good for all pyrite-based products. Sulfuric acid sales were high, and iron sinter sales were approximately 35 percent above that of the previous 2 years. Sulfur dioxide and ferric sulfate sales were at a record high.

Sand and Gravel.—The production of sand and gravel in 1969 was 16 percent lower than that of the previous year. However, the average value per ton increased from $1.52 in 1968 to $1.57 in 1969. The decrease in production was due primarily to the decline in construction activity in the State.

The sand and gravel industry in 1969 consisted of 49 mines operating in 32 counties. Commercial operators produced 90 percent of the total tonnage, and Government-and-contractor production accounted for the remaining 10 percent. Fifty-seven percent of the commercial production was by stationary plant, 19 percent by portable plant, and 24 percent by dredge. Government-and-contractor production was by stationary plant (44 percent) and portable plant (56 percent). Commercial sand and gravel shipments were by truck (77 percent), railway (20 percent), and barge (3 percent).

Sand uses during the year were structural (52 percent), paving (24 percent) and fill (3 percent). The remaining 21 percent was industrial sand used for glass, pottery, blast, furnace, engine, chemical, and molding.

Stone.—Tennessee's stone industry crushed limestone, sandstone, and marble and quarried dimension sandstone and marble. Production and value decreased for all stone commodities except crushed limestone. The decrease in production and value reflected depressed construction activities during the year.

Production of crushed limestone was by 52 commercial operators at 90 locations in 59 counties. Government-and-contractor production was from 29 quarries in 23 counties. End uses were road-base stone (46 percent), concrete aggregate (15 percent), bituminous aggregate (11 percent), agricultural stone (7 percent), cement (7

Table 6.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Benton	7	959	W	6	1,010	$1,695
Fayette	1	68	$79	3	49	47
Giles	1	251	151	1	200	200
Grundy	1	152	W	1	W	W
Haywood	1	85	78	1	51	46
Lauderdale	1	118	109	1	108	97
Monroe	1	W	W	1	W	15
Obion	2	W	345	2	W	257
Perry	--	------	------	1	144	144
Polk	1	W	W	1	30	68
Shelby	4	786	W	4	704	825
Other counties [1]	28	4,925	10,378	27	3,880	6,318
Total [2]	48	7,344	11,140	49	6,175	9,709

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Carroll (1968), Cumberland, Davidson (1968), Decatur, Franklin, Gibson, Greene (1968), Hamilton, Hardeman, Hardin, Henderson, Humphreys, Knox, Loudon, McMinn, McNairy, Putnam, Sevier, Stewart, Tipton, Unicoi, Washington, and Wayne Counties, and counties indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Table 7.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1968			1969		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,471	$3,768	$1.52	1,703	$2,527	$1.48
Paving	1,054	1,717	1.63	787	1,381	1.75
Molding	304	1,044	3.43	W	W	W
Other sands [1]	515	1,480	2.87	786	2,531	3.22
Total sand	4,344	8,009	1.84	3,276	6,439	1.97
Gravel:						
Paving	2,044	1,843	.90	1,984	1,978	1.00
Structural	692	968	1.40	692	956	1.38
Fill	80	72	.90	W	W	W
Other gravel [2]	184	248	1.35	223	336	1.51
Total gravel [3]	3,000	3,131	1.04	2,898	3,271	1.13
Total sand and gravel [3]	7,344	11,140	1.52	6,175	9,709	1.57

[1] Includes glass, pottery, blast, fire and furnace, engine, chemical, fill and other sands, and use indicated by symbol W.
[2] Includes railroad ballast, miscellaneous and other gravel, and use indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

percent), and miscellaneous uses (14 percent). Production and value increased 3 and 6 percent, respectively, over that of 1968.

Three companies located in the northern part of the Cumberland Plateau crushed sandstone for stone sand and concrete and bituminous aggregate uses. Production and value decreased 24 percent and 2 percent from that of the previous year.

Two eastern Tennessee companies crushed marble from five quarries for terrazzo, mineral food, and agricultural use.

Four eastern Tennessee companies quarried dimension marble in Blount, Grainger, Knox, Union and Loudon Counties. Sales of dimension marble were for architectural rough blocks (56 percent), sawed stone (30 percent), cut stone (12 percent), and rough stone (2 percent). Production decreased 38 percent and value decreased 34 percent, reflecting a depression in construction activity.

Five companies in a two-county area in the northern part of the Cumberland Pla-

Table 8.—Crushed limestone sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968			1969		
	Number of quarries	Short tons	Value	Number of quarries	Short tons	Value
Bradley	2	W	$363	2	W	W
Campbell	3	W	W	3	650	W
Cumberland	2	W	1,233	2	W	W
Davidson	7	4,040	4,622	7	4,946	$5,591
Fentress	1	150	W	1	159	202
Franklin	4	884	W	4	888	1,348
Grainger	1	W	W	1	80	108
Jefferson	6	1,894	W	5	1,825	2,251
Knox	8	W	W	8	2,647	4,019
Marion	4	1,404	1,828	4	1,264	1,815
Pickett	1	2	2	1	15	24
Rutherford	3	783	1,024	3	771	1,024
Smith	1	75	94	1	61	61
Sumner	3	W	W	3	1,070	1,090
Unicoi	1	7	8	1	31	39
Union	1	W	W	1	101	135
Washington	6	W	W	5	294	371
Other counties [1]	66	22,802	32,886	67	18,310	26,438
Total [2]	120	32,040	42,060	119	33,109	44,512

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

[1] Includes Anderson, Bedford, Benton, Blount, Cannon, Carter, Claiborne, Clay, Cocke, Coffee, Decatur, De Kalb, Dickson, Fayette, Giles, Greene, Grundy, Hamblen, Hamilton, Hancock, Hardin, Hawkins, Humphreys, Johnson, Lincoln, Loudon, Macon, Marshall, Maury, McMinn, Meigs, Monroe, Montgomery, Moore, Overton, Polk, Putnam, Rhea, Roane, Robertson, Sequatchie, Sevier, Stewart, Sullivan, Warren, Wayne, White, Williamson, and Wilson Counties, and counties indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 9.—Crushed limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

	1968			1969		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	23,813	$30,659	$1.29	26,986	$35,445	$1.31
Cement	2,354	3,070	1.30	2,329	3,285	1.41
Agstone	2,338	2,986	1.28	W	W	W
Stone sand	470	740	1.58	38	58	1.53
Asphalt filler	W	W	W	6	W	W
Lime	216	347	1.60	W	W	W
Mine dusting	11	W	W	W	W	W
Whiting	3	W	W			
Other uses [1]	2,834	4,258	1.50	3,750	5,725	1.53
Total [2]	32,040	42,060	1.31	33,109	44,512	1.34

[1] Includes riprap, fluxing stone, railroad ballast, filter stone (1969), glass (1968), other fillers (1968), mineral food, drain fields (1969), magnesia (1969), other uses and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

teau quarried dimension sandstone. Sales were for rough construction (38 percent), architectural house veneer (31 percent), architectural cut (13 percent), flagging and sawed architectural (9 percent), and rubble (9 percent). Production was down 29 percent and value decreased 12 percent below that of 1968.

Vermiculite.—W. R. Grace & Co. expanded crude vermiculite from South Carolina for use in loose-fill insulation, building plaster, concrete aggregate, and agriculture.

METALS

Zinc and copper were the principal metals produced in Tennessee during 1969. Metals accounted for 25 percent of the total value of mineral production in the State, an increase of 2 percent over that of the previous year.

Aluminum.—Tennessee's aluminum industry consisted of two primary smelters operated by the Aluminum Company of America (Alcoa) and Consolidated Aluminum Corp. (Conalco), and a secondary smelter operated by the Excel Smelting Corp.

Alcoa placed a 100,000-ton potline, the world's largest, on stream during the year at its plant near Alcoa, Blount County. Construction of a duplicate line began and is slated for operation during 1972.

Copper.—Cities Service Inc., Copperhill Division, produced copper from sulfide ore mined at five underground mines in Polk County in the southeastern part of Tennessee. Production increased 8 percent over that of 1968, and the 23 percent increase in value reflected higher copper prices during the year.

The company announced a $70 million expansion of mining, metallurgical, and chemical processing facilities at the Copperhill Division. Included are plans for a new mine shaft in the Cherokee ore body and the construction of a new sulfuric acid plant to convert metallurgical gases into acid. The expansion will increase both copper and all byproduct production. Completion is scheduled for mid-1972.

Ferroalloys.—Tennessee's ferroally industry consists of five companies which operate seven plants. During the year, Tennessee Metallurgical Co., Chattanooga, put on stream a two-furnace plant with a capacity of 18,000 tons per year. Initial plant production was confined to silicon metal. Three plants in central Tennessee produced ferrophosphorus, a byproduct of elemental phosphorus output.

Gold.—Gold recovered as a byproduct from copper refining decreased for the second consecutive year.

Manganese.—Foote Mineral Co. operated plants in Knoxville and New Johnsonville and produced manganese metal from foreign ore, using the electrolytic process.

Silver.—The production of byproduct silver, recovered during copper refining, decreased for the second consecutive year.

Titanium.—At its plant near New Johnsonville, Tenn., E. I. duPont de Nemours and Co., Inc., produced titanium dioxide for pigments from concentrates produced in Florida and Georgia.

Zinc.—Tennessee continued to lead the Nation in zinc production with 23 percent of the Nation's total. Four companies mined zinc ore from nine mines in eastern Tennessee. Zinc concentrates were also recovered by one company as a byproduct from the processing of sulfide copper ore.

Total crude ore milled in the State was over 4 million short tons. The ores were processed by flotation and the concentrates shipped to smelters in Illinois, Missouri, New York, Ohio, Oklahoma, Pennsylvania, and Texas.

American Zinc Co. increased production capacity at its eastern Tennessee mines. Expansion of the company's Immel mine is expected to increase production by 20 percent to 2,000 tons per day. However, adverse ground conditions slowed development during the year.

The company announced that the Young mine will be expanded as soon as further exploration justifies the capital expenditure.

Plans were announced to expand the American Zinc Co.—New Market Zinc Co. joint venture operation (New Market mine) from 2,800 to 3,600 tons per day by 1972.

New Jersey Zinc Co. announced the discovery of a major ore body in the Smith-Jackson County area of central Tennessee. Exploration has indicated 13 to 50 million tons of ore averaging 5 to 10 percent zinc. The company holds leases on five areas in Central Tennessee where significant mineralization has been discovered.

In July 1969, the company began sinking a 12-foot-diameter, concrete-lined pilot shaft with a planned depth of 1,350 feet. At yearend work had progressed below the 700-foot level.

Table 10.—Mine production of recoverable gold, silver, copper, lead, and zinc

Commodity	1968			1969			Earliest record to date	
	Number of producers	Quantity	Value (thousands)	Number of producers	Quantity	Value (thousands)	Quantity	Value (thousands)
Gold_____troy ounces__	1	140	$5	1	126	$5	25,162	$624
Silver_____do____	1	89,525	192	1	78,614	141	4,662,210	4,019
Copper_____short tons__	1	14,196	11,881	1	15,353	14,596	635,366	271,272
Lead_____do____	----	-------	------	----	-------	------	27,324	3,240
Zinc_____do____	5	124,039	33,491	5	124,532	36,363	2,395,944	542,760
Total_____	XX	XX	45,569	XX	XX	51,105	XX	821,915

XX Not applicable.

A number of other companies were prospecting in the central Tennessee area, and approximately 1 million acres had been leased by yearend.

MINERAL FUELS

Mineral fuels accounted for 15 percent of the total value of mineral production in Tennessee, the same percent as in 1968.

Coal (Bituminous).—Coal production in 1969 was 66,000 tons less than that of the previous year. Coal was produced from 185 mines in 16 counties in the Cumberland Plateau region of east central Tennessee.

In the nine northern counties comprising the northern part of the coalfield (District 8), 6.5 million tons of coal were produced from 138 mines. Underground mining accounted for 53 percent of the total tonnage, contour stripping for 39 percent, and auger mining for 8 percent. Coal shipments were by rail and barge (66.5 percent) and truck (33.5 percent).

Coal production in the seven counties in southern Tennessee (District 13) was 1.6 million tons from 47 mines. Underground mining accounted for 83 percent of the total tonnage while the remaining 17 percent was by contour stripping methods. Shipments were by rail and barge (80.3 percent) and truck (19.7 percent).

Coke.—One company in Chattanooga produced coke and breeze in 44 ovens from coal mined in Kentucky and West Virginia. Coke commodities produced included coke oven gas, ammonium sulfate, tar, crude light gas, toluene, and crude naphtha.

Natural Gas:—Six wildcat wells and one development gas well were completed during the year. Natural gas production totaled 57,000 million cubic feet with 94 percent produced in Scott and Morgan Counties.

Petroleum.—Wildcat exploration during 1969 resulted in three new petroleum wells. Scott County was the site of a new pool discovery. The discovery well and an offset had the capacity of 260 barrels of oil per day from the Fort Payne formation.

In Morgan County, one deep test was abandoned after reaching a depth of 8,025 feet. At yearend a basement test was underway on the crest of the Sequatchie anticline in Sequatchie County.

Total oil production for 1969 was 31,532 barrels; 98 percent was produced in Scott and Morgan Counties.

Table 11.—Coal (bituminous) production [1] in 1969, by counties

(Thousand tons and thousand dollars)

County	Number of mines operation			Production [2]				
	Underground	Strip	Auger	Underground	Strip	Auger	Total	
							Quantity	Value
Anderson	24	13	3	1,615	552	85	2,252	W
Bledsoe	-------	1	-------	-------	W	-------	W	W
Campbell	16	20	6	213	1,240	127	1,580	5,683
Claiborne	6	5	1	1,060	369	W	W	W
Cumberland	-------	1	-------	-------	W	-------	W	W
Fentress	5	-------	-------	33	-------	-------	33	166
Grundy	-------	1	-------	-------	W	-------	W	W
Hamilton	1	1	-------	6	W	-------	W	W
Marion	26	-------	-------	826	-------	-------	826	3,271
Morgan	10	9	-------	W	W	-------	305	1,200
Overton	3	-------	-------	8	-------	-------	8	28
Putnam	1	-------	-------	W	-------	-------	W	W
Rhea	1	-------	-------	2	-------	-------	2	6
Scott	8	6	1	425	385	W	W	W
Sequatchie	11	2	-------	130	W	-------	W	W
Van Buren	-------	3	-------	-------	W	-------	W	W
Undistributed [3]	-------	-------	-------	155	825	36	3,077	20,329
Total [2]	112	62	11	4,473	3,371	238	8,082	30,682
Earliest record to date	-------	-------	-------	-------	-------	-------	453,836	NA

NA Not available. W Withheld to avoid disclosing individual company confidential data; included in "Undistributed."

[1] Excludes mines producing less than 1,000 short tons annually.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes mines and value indicated by symbol W.

Table 12.—Oil and gas well drilling in 1969

County	Development wells				Exploratory wells			
	Oil	Gas	Dry	Footage	Oil	Gas	Dry	Footage
Clay	-------	-------	-------	-------	-------	-------	1	628
Coffee	-------	-------	-------	-------	-------	-------	1	817
Fentress	-------	-------	-------	-------	-------	-------	1	555
Humphreys	-------	-------	-------	-------	-------	-------	1	1,405
Macon	-------	1	1	812	-------	4	2	3,463
Morgan	-------	-------	-------	-------	-------	-------	2	9,331
Overton	-------	-------	-------	-------	-------	-------	1	1,801
Scott	1	-------	-------	1,490	3	-------	-------	2,945
Smith	-------	-------	-------	-------	-------	2	1	1,791
Sumner	-------	-------	-------	-------	-------	-------	4	1,739
Total	1	1	1	2,302	3	6	14	24,475

Source: American Association of Petroleum Geologists.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Consolidated Aluminum Corp	1100 Richmond St. Jackson, Tenn. 38310	Plant	Madison.
Aluminum Company of America	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	----do	Blount.
Barite:			
Godsey Mines, Inc	Box 227 Sweetwater, Tenn. 37874	2 open pit mines and plants.	Loudon and McMinn.
National Lead Co	Box 187 Sweetwater, Tenn. 37874	Open pit mine and plant.	Monroe.
B. C. Wood	Box 284 Sweetwater, Tenn. 37874	----do	Loudon.
Cement:			
General Portland Cement Co	1300 American National Bank Bldg. Chattanooga, Tenn. 37402	Plant	Hamilton.
Ideal Cement Co	Ideal Cement Bldg. Denver, Colo. 80202	----do	Knox.
Marquette Cement Mfg. Co	20 N. Wacker Drive Chicago, Ill. 60606	2 plants	Davidson and Franklin.
Penn-Dixie Cement Corp	Box 152 Nazareth, Pa. 18064	----do	Marion and Sullivan.
Clay:			
Ball:			
Bell Clay Co	Gleason, Tenn. 38229	4 open pit mines and plant.	Weakley.
Cyprus Mines Corp	Box 1201 Trenton, N. J. 08618	Open pit mine and plant.	Do.
Kentucky-Tennessee Clay Co	Box 77 Mayfield, Ky. 42066	----do	Henry.
Laird Brick Co., Inc	Puryear, Tenn. 38251	----do	Do.
H. C. Spinks Clay Co., Inc	Box 829 Paris, Tenn. 38242	2 open pit mines and plant.	Henry and Weakley.
Fuller's earth:			
Southern Clay Co., Inc	Box 838 Paris, Tenn. 38242	Open pit mine and plant.	Henry.
Miscellaneous:			
W. G. Bush & Co., Inc	1136 2nd Ave. North Nashville, Tenn. 37208	----do	Davidson.
General Portland Cement Co	1300 American National Bank Bldg. Chattanooga, Tenn. 37402	----do	Hamilton.
General Shale Products Corp	Box 3547 Johnson City, Tenn. 37601	4 open pit mines and plants.	Hamilton, Knox, Sullivan, Washington.
Shalite Corp	Box 441 Knoxville, Tenn. 37901	Open pit mine and plant.	Knox.
Tennlite, Inc	Green Brier, Tenn. 37073	----do	Davidson.
Coal:			
Consolidated Coal Co	Box 460 Middlesboro, Ky. 40965	2 underground mines and plants.	Anderson and Claiborne.
Farco Coal Co	414 Cotton Exchange Bldg. Memphis, Tenn. 38103	1 auger and 2 strip mines.	Campbell.
Grundy Mining Co	Box 874 Jasper, Tenn. 37347	Underground mine.	Marion.
Oliver Springs Mining Co., Inc	Box 350 Oliver Springs, Tenn. 37840	3 underground mines.	Anderson.
Tennco., Inc	Box 498 Lake City, Tenn. 37769	1 auger and 2 strip mines.	Do.
Coke:			
Woodward Iron Co	4800 Central Avenue Chattanooga, Tenn. 37410	Plant	Hamilton.
Copper:			
Tennessee Copper Co	Copperhill, Tenn. 37317	5 underground mines, mill, smelter, chemical plant.	Polk.
Ferroalloys:			
Chromium Mining and Smelting Co.	3720 Place Victoria Montreal, Quebec, Canada	Plant	Shelby.
Hooker Chemical Corp	Box 591 Columbia, Tenn. 38402	----do	Maury.
Mobil Chemical Co	Box 1136 Richmond, Va. 23208	----do	Do.
Monsanto Co	800 N. Lindbergh Blvd. St. Louis, Mo. 63141	----do	Do.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Ferroalloys—Continued			
Stauffer Chemical Co	299 Park Ave. New York, N.Y. 10017	Plant	Maury.
Union Carbide Corp	270 Park Ave. New York, N.Y. 10017	----do	Roane.
Gold:			
Tennessee Copper Co	Copperhill, Tenn. 37317	*See* Copper	Polk.
Graphite, artificial:			
Union Carbide Corp	270 Park Ave. New York, N.Y. 10017	Plant	Maury.
Lime, primary:			
Foote Mineral Co	Rt. 8, Asbury Rd. Knoxville, Tenn. 37914	Limekiln	Knox.
Williams Lime Mfg. Co	Box 2286 Knoxville, Tenn. 37901	----do	Do.
Natural gas:			
Macon Gas Development Co	Lafayette, Tenn. 37083	6 wells	Macon.
Pemberton Oil and Lumber Co	Oneida, Tenn. 37841	21 wells	Morgan and Scott.
Irvin Vawter	Albany, Ky. 42602	2 wells	Scott.
Perlite, expanded:			
Chemrock Corp	Osage St. Nashville, Tenn. 37208	Plant	Davidson.
Petroleum:			
David Law	Box 1751, Garrity Bldg. Parkersburg, W. Va. 26101	Well	Scott.
Mack Petroleum Co	Box 629 Knoxville, Tenn. 37901	4 wells	Morgan.
Pemberton Oil and Lumber Co	Oneida, Tenn. 37841	15 wells	Morgan and Scott.
Irvin Vawter	Albany, Ky. 42602	2 wells	Scott.
Petroleum, refinery:			
Delta Refinery Co	543 W. Mallory Ave. Memphis, Tenn. 38106	Refinery	Shelby.
Phosphate rock:			
Hooker Chemical Corp	Box 591 Columbia, Tenn. 38402	5 mines and plants.	Hickman and Maury.
Mobil Chemical Co	Box 432 Mount Pleasant, Tenn. 38474	----do	Giles, Hickman, and Maury.
Monsanto Co	800 N. Lindbergh Blvd. St. Louis, Mo. 63141	4 mines and plants.	Davidson, Giles, Maury, Williamson.
Stauffer Chemical Co	299 Park Ave. New York, N. Y. 10017	3 mines and plant.	Maury.
M. C. West, Inc	Box 381 Columbia, Tenn. 38402	Mine and plant.	Hickman.
Pyrite:			
Tennessee Copper Co	Copperhill, Tenn. 37317	*See* Copper	Polk.
Sand and gravel:			
Camden Gravel Co	Camden, Tenn. 38320	Open pit mine	Benton.
Dixie Sand & Gravel Co	515 River St. Chattanooga, Tenn. 37402	Dredge	Hamilton.
Hardy Sand Co	Box 629 Evansville, Ind. 47702	2 open pit mines.	Benton.
Memphis Stone & Gravel Co	Box 6247 Memphis, Tenn. 38106	----do	Benton and Shelby.
Sangravel Co., Inc	1136 2nd Ave. North Nashville, Tenn. 37208	Dredge	Humphrey.
Silver:			
Tennessee Copper Co	Copperhill, Tenn. 37317	*See* Copper	Polk.
Stone:			
Limestone, crushed:			
American Zinc Co	20 S. 4th Street St. Louis, Mo. 63102	*See* Zinc	Jefferson and Knox.
Hoover, Inc	Box 7201 Nashville, Tenn. 37210	2 quarries	Davidson and Rutherford.
Ralph Rogers & Co	720 Argyle Avenue Nashville, Tenn. 37203	3 quarries	Anderson, Coffee, and Sumner.
The Stone Man Inc	Box 2098 Chattanooga, Tenn. 37409	7 quarries	Bedford, Fayette, Hamilton, Moore, Polk, Rutherford, and Warren.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone, crushed—Continued			
Vulcan Materials Co	Box 7 Knoxville, Tenn. 37901	20 quarries	Benton, Blount, Claiborne, Cocke, Davidson, Decatur, Hamilton, Hardin, Humphreys, Knox, Loudon, Marion, Sevier, Sullivan, Wayne, and Williamson.
Marble, crushed:			
Appalachian Marble Co	2607 Middlebrook Pike Knoxville, Tenn. 37921	2 quarries and mill.	Knox.
John J. Craig Co	Box 9300 Knoxville, Tenn. 37920	3 quarries	Blount and Loudon.
Marble, dimension:			
Appalachian Marble Co	2607 Middlebrook Pike Knoxville, Tenn. 37921	2 quarries and mill.	Knox.
John J. Craig Co	Box 9300 Knoxville, Tenn. 37920	4 quarries	Blount and Loudon.
Georgia Marble Co	Box 1550 Knoxville, Tenn. 37901	2 quarries and mill.	Knox and Union.
Imperial Black Marble Corp	801 Bluff Drive Knoxville, Tenn. 37919	Quarry	Grainger.
Sandstone, crushed:			
Hunt's Gap Sand & Clay Corp	Kingsport, Tenn. 37600	----do	Hawkins.
Turner Bros. Stone Co., Inc	Crossville, Tenn. 38555	----do	Cumberland.
White Silica Sand Co., Inc	Box 6056 Knoxville, Tenn. 37914	----do	Campbell.
Sandstone, dimension:			
Ross L. Brown Cut Stone Co., Inc.	Crab Orchard, Tenn. 37723	Quarry and mill.	Cumberland.
Crab Orchard Stone Co., Inc	Box 238 Crossville, Tenn. 38555	----do	Do.
Cumberland Mountain Stone Co.	Crab Orchard, Tenn. 37723	Quarry	Do.
Turner Bros. Stone Co., Inc	Crossville, Tenn. 38555	----do	Do.
Vermiculite, exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	Plant	Davidson.
Zinc:			
American Zinc Co	20 S. 4th St. St. Louis, Mo. 63102	5 underground mines and mill.	Jefferson and Knox.
New Jersey Zinc Co	160 Front St. New York, N. Y. 10038	2 underground mines and mills.	Hancock and Jefferson.
New Market Zinc Co	Box 66 New Market, Tenn. 37820	Underground mine and mill.	Jefferson.
Tennessee Copper Co	Copperhill, Tenn. 37317	*See* Copper	Polk.
U. S. Steel Corp	Box 599 Fairfield, Ala. 35064	Underground mine and mill.	Jefferson.

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 the Bureau of Economic Geology, the University of Texas at Austin, for collecting information on all minerals except fuels.

By Owen W. Jones,[1] F. F. Netzeband,[2] and Roselle Girard [3]

The mineral industry of Texas maintained its important position in the economy of the State, of the southwest region, and of the Nation in 1969 with a total mineral value of $5.77 billion, about one-quarter of the national total. In 1969 Texas remained the Nation's foremost producer of petroleum, natural gas, natural gas liquids, and magnesium metal; and produced significant quantities of cement, clays, gypsum, lignite, lime, salt, sand and gravel, stone, and sulfur. A total of 26 different commercial minerals was produced.

The mineral resources of Texas are widely distributed over the entire State; 237 of the 254 counties were mineral productive. Mineral fuels—petroleum, natural gas, natural gas liquids, and lignite—were produced in 208 counties, covering most parts of the State. Nonmetals were produced in 160 counties, and metals were produced in eight counties. Fourteen counties had total mineral value in excess of $100 million.

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[2] Mining engineer, Bureau of Mines, Dallas, Tex. (Retired).
[3] Geologist, Bureau of Economic Geology, The University of Texas at Austin, Austin, Tex.

Table 1.—Mineral production in Texas [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	34,499	$107,532	36,037	$117,989
Masonry—thousand 280-pound barrels	1,059	3,371	1,110	3,873
Clays—thousand short tons	4,687	8,860	4,407	8,664
Gem stones	NA	150	NA	150
Gypsum—thousand short tons	1,039	3,616	1,314	4,398
Helium:				
High-purity—thousand cubic feet	362,100	9,400	140,500	4,917
Crude—do.	1,038,700	11,100	1,190,300	13,053
Lime—thousand short tons	1,564	21,154	1,633	22,107
Natural gas—million cubic feet	7,495,414	1,011,881	7,853,199	1,075,888
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels	97,075	269,182	96,628	289,042
LP gases—do.	189,162	278,068	194,599	237,411
Petroleum (crude)—do.	1,133,380	3,450,707	1,151,775	3,696,328
Salt—thousand short tons	8,534	42,663	9,261	43,012
Sand and gravel—do.	31,843	41,546	29,972	39,756
Stone—do.	48,480	58,006	46,638	64,986
Sulfur (Frasch process)—thousand long tons	2,571	105,482	2,552	68,360
Talc—short tons	125,880	517	163,812	668
Value of items that cannot be disclosed: Asphalt (native), bromine, coal (lignite), graphite, iron ore (usable), magnesium chloride (for metal), magnesium compounds (except for metal), mercury, pumicite, sodium sulfate, uranium, (recoverable content U_3O_8), and crude vermiculite	XX	82,596	XX	79,368
Total	XX	5,505,831	XX	5,769,970
Total 1967 constant dollars	XX	r 5,499,090	XX	p 5,542,221

r Revised. p Preliminary. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

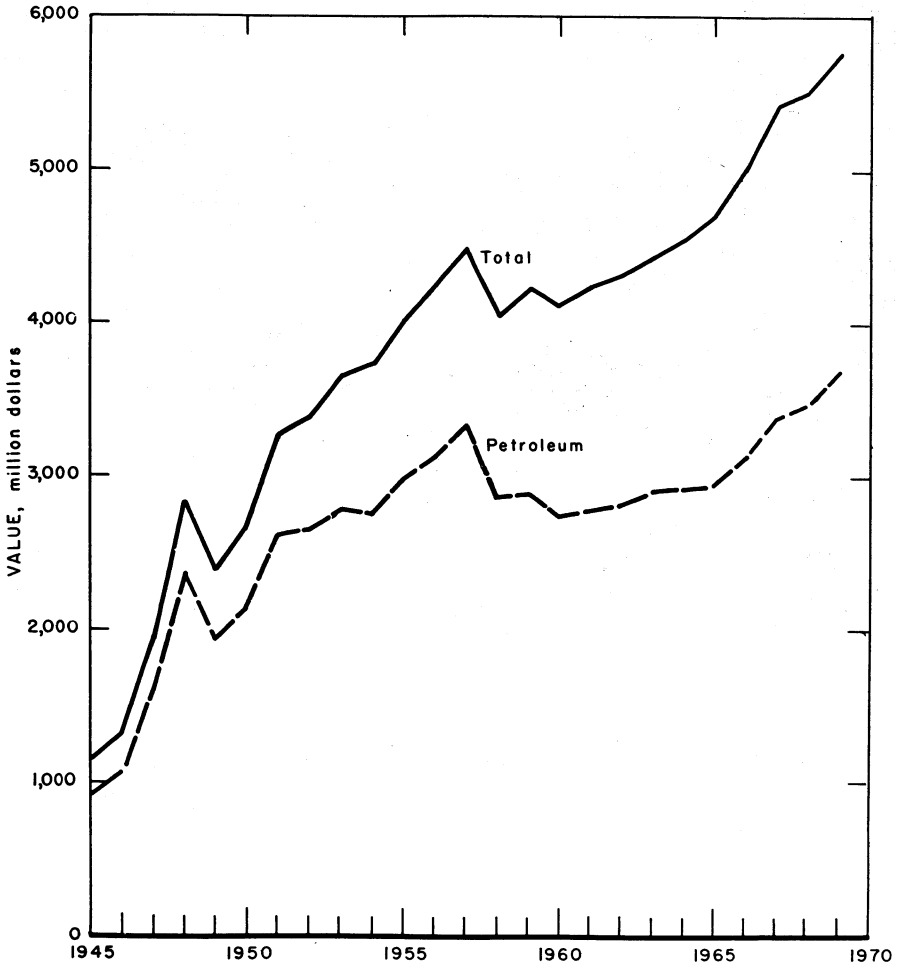

Figure 1.—Value of petroleum and total value of mineral production in Texas.

Table 2.—Value of mineral production in Texas, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Anderson	$28,013	$33,514	Petroleum, natural gas, natural gas liquids, stone.
Andrews	250,951	262,096	Petroleum, natural gas liquids, natural gas.
Angelina	267	247	Clays, natural gas, petroleum.
Aransas	14,260	12,223	Natural gas, petroleum, natural gas liquids, stone.
Archer	25,429	21,689	Petroleum, natural gas.
Armstrong	830	------	
Atascosa	20,218	23,709	Petroleum, natural gas, natural gas liquids.
Austin	6,958	7,499	Petroleum, natural gas, sand and gravel, natural gas liquids.
Bastrop	802	826	Clays, petroleum, natural gas, sand and gravel.
Baylor	3,918	4,107	Petroleum, sand and gravel, natural gas.
Bee	20,631	19,001	Natural gas, petroleum, natural gas liquids, stone.
Bell	W	W	Stone, sand and gravel.
Bexar	27,808	30,310	Cement, stone, sand and gravel, petroleum, lime, natural gas liquids, clays, natural gas.
Blanco	17	3	Sand and gravel.
Borden	28,397	33,247	Petroleum, natural gas, sand and gravel.
Bosque	W	155	Stone, sand and gravel.
Bowie	152	82	Petroleum, natural gas.
Brazoria	232,265	242,105	Petroleum, natural gas liquids, natural gas, salt, magnesium chloride, bromine, magnesium compounds, lime, sand and gravel.
Brazos	W	305	Petroleum, sand and gravel, stone, natural gas.
Brewster	W	W	Mercury, clays, petroleum.
Briscoe	13	------	
Brooks	43,104	45,117	Natural gas, petroleum, natural gas liquids.
Brown	2,281	2,233	Stone, petroleum, natural gas, clays.
Burleson	155	522	Stone, petroleum, natural gas.
Burnet	5,170	4,731	Stone, graphite, sand and gravel.
Caldwell	13,161	12,816	Petroleum, natural gas.
Calhoun	21,451	27,501	Natural gas, stone, petroleum, natural gas liquids, lime, sand and gravel.
Callahan	5,000	5,555	Petroleum, natural gas, stone, natural gas liquids.
Cameron	1,641	2,555	Natural gas, petroleum.
Camp	2,536	2,748	Petroleum, natural gas.
Carson	15,808	28,554	Natural gas, petroleum, natural gas liquids.
Cass	17,849	22,786	Natural gas liquids, petroleum, natural gas, iron ore.
Chambers	89,064	93,543	Petroleum, natural gas, salt, natural gas liquids, clays.
Cherokee	6,194	7,099	Petroleum, natural gas liquids, natural gas, clays.
Childress	476	385	Petroleum, sand and gravel, natural gas.
Clay	13,736	12,076	Petroleum, natural gas, stone.
Cochran	41,084	45,680	Petroleum, natural gas, natural gas liquids.
Coke	25,329	23,597	Petroleum, natural gas liquids, natural gas, sand and gravel.
Coleman	5,247	4,673	Petroleum, natural gas, natural gas liquids, stone, clays, sand and gravel.
Collin	17	163	Stone, sand and gravel.
Collingsworth	3,519	1,039	Natural gas, petroleum.
Colorado	51,111	52,497	Natural gas liquids, natural gas, sand and gravel, petroleum.
Comal	W	W	Lime, stone, sand and gravel.
Comanche	240	139	Natural gas, clays, petroleum, natural gas liquids, stone.
Concho	1,544	1,279	Petroleum, natural gas, natural gas liquids.
Cooke	32,664	30,184	Petroleum, natural gas liquids, natural gas, sand and gravel.
Coryell	------	505	Stone, sand and gravel.
Cottle	32	84	Petroleum, sand and gravel, natural gas.
Crane	178,094	186,517	Petroleum, natural gas, natural gas liquids, sand and gravel.
Crockett	34,935	38,976	Petroleum, natural gas, natural gas liquids.
Crosby	951	1,168	Sand and gravel, petroleum, natural gas.
Culberson	3,064	377	Petroleum, gypsum, natural gas.
Dallam	37	29	Natural gas.
Dallas	13,807	11,965	Cement, sand and gravel, stone, clays.
Dawson	33,045	33,700	Petroleum, natural gas, stone, natural gas liquids.
Denton	871	1,294	Sand and gravel, clays, petroleum, natural gas.
DeWitt	16,621	11,556	Natural gas, petroleum, natural gas liquids, sand and gravel, stone.
Dickens	177	616	Petroleum, natural gas.
Dimmit	1,107	1,358	Do.
Donley	46	262	Sand and gravel, natural gas.
Duval	33,837	33,502	Petroleum, natural gas, salt, natural gas liquids, sand and gravel.
Eastland	4,029	3,148	Petroleum, natural gas liquids, natural gas, clays, sand and gravel, stone.
Ector	253,797	270,940	Petroleum, natural gas, natural gas liquids, cement, stone, sand and gravel.
Edwards	74	67	Petroleum, natural gas.
Ellis	24,443	W	Cement, stone, clays.
El Paso	7,194	7,142	Cement, stone, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Erath	$678	$1,062	Natural gas, natural gas liquids, petroleum, sand and gravel.
Falls	52	100	Petroleum, natural gas.
Fayette	1,928	2,060	Petroleum, sand and gravel, clays, stone, natural gas.
Fisher	22,731	24,510	Petroleum, natural gas liquids, natural gas, gypsum, clays.
Floyd	W	W	Sand and gravel.
Foard	2,223	1,820	Petroleum, sand and gravel, natural gas.
Fort Bend	57,635	60,993	Petroleum, sulfur, natural gas, salt, natural gas liquids, clays.
Franklin	14,095	11,353	Petroleum, natural gas, natural gas liquids.
Freestone	3,601	3,273	Natural gas, stone, petroleum, natural gas liquids, clays.
Frio	4,614	4,532	Petroleum, natural gas, natural gas liquids.
Gaines	124,859	139,483	Petroleum, natural gas, natural gas liquids, sodium sulfate, stone.
Galveston	57,437	50,870	Petroleum, natural gas, natural gas liquids, sulfur, clays, sand and gravel.
Garza	14,976	14,505	Petroleum, natural gas, sand and gravel.
Gillespie	W	W	Gypsum, sand and gravel, talc, stone.
Glasscock	11,414	17,797	Petroleum, natural gas.
Goliad	12,326	10,837	Do.
Gonzales	1,827	1,415	Natural gas, petroleum, clays, sand and gravel.
Gray	41,505	48,055	Petroleum, natural gas, natural gas liquids.
Grayson	29,974	32,083	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Gregg	133,998	153,186	Petroleum, natural gas, natural gas liquids.
Grimes	172	189	Petroleum, stone, natural gas.
Guadalupe	10,891	10,270	Petroleum, sand and gravel, stone, clays, natural gas.
Hale	7,563	8,607	Petroleum, natural gas, natural gas liquids.
Hall	46	42	Sand and gravel.
Hamilton	150	82	Natural gas.
Hansford	23,905	25,995	Natural gas, helium, natural gas liquids, petroleum.
Hardeman	5,225	5,580	Petroleum, gypsum, natural gas liquids, natural gas, sand and gravel.
Hardin	30,122	30,480	Petroleum, natural gas, natural gas liquids, sand and gravel.
Harris	127,514	138,986	Petroleum, cement, natural gas liquids, natural gas, lime, salt, sand and gravel, clays.
Harrison	15,462	13,582	Natural gas, petroleum, natural gas liquids, coal, clays.
Hartley	137	1,975	Natural gas, petroleum.
Haskell	10,597	12,288	Petroleum, natural gas liquids, natural gas, stone.
Hays	W	400	Sand and gravel.
Hemphill	5,171	7,029	Natural gas, petroleum.
Henderson	26,066	30,679	Petroleum, natural gas, natural gas liquids, clays.
Hidalgo	34,730	33,814	Natural gas, natural gas liquids, petroleum, sand and gravel, clays, stone.
Hill	1,064	W	Lime, stone.
Hockley	71,692	81,370	Petroleum, natural gas liquids, natural gas.
Hood	118	635	Stone, sand and gravel, natural gas.
Hopkins	7,606	6,988	Petroleum, natural gas, clays.
Houston	7,384	6,879	Petroleum, natural gas, natural gas liquids, sand and gravel.
Howard	51,538	51,368	Petroleum, natural gas, stone, sand and gravel, natural gas liquids.
Hudspeth	W	1,230	Talc, sand and gravel, stone, gypsum.
Hunt	182	133	Natural gas.
Hutchinson	36,642	34,000	Petroleum, natural gas, natural gas liquids, salt, stone.
Irion	4,114	4,837	Petroleum, natural gas liquids, natural gas.
Jack	22,668	18,914	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Jackson	82,461	102,117	Petroleum, natural gas, natural gas liquids, sand and gravel.
Jasper	2,025	2,443	Petroleum, natural gas, clays, lime, sand and gravel.
Jefferson	74,864	66,107	Petroleum, natural gas, sulfur, natural gas liquids, salt, sand and gravel, clays.
Jim Hogg	22,683	23,225	Petroleum, natural gas, natural gas liquids.
Jim Wells	75,665	74,587	Do.
Johnson	W	W	Lime, stone, sand and gravel.
Jones	9,853	9,538	Petroleum, natural gas liquids, natural gas, stone.
Karnes	26,209	24,458	Petroleum, uranium, natural gas, natural gas liquids.
Kaufman	2,222	3,007	Petroleum, stone, natural gas.
Kenedy	18,170	21,643	Natural gas, petroleum, natural gas liquids.
Kent	50,741	63,282	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kerr	W	W	Sand and gravel.
Kimble	42	138	Sand and gravel, natural gas, petroleum.
King	3,489	3,735	Petroleum, natural gas.
Kleberg	171,248	180,990	Petroleum, natural gas, natural gas liquids, stone.
Knox	5,885	6,615	Petroleum, sand and gravel, natural gas.
Lamar	22	-------	

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Lamb	$2,358	$2,872	Petroleum, natural gas, stone.
Lampasas	16	26	Sand and gravel.
La Salle	1,162	1,768	Natural gas, petroleum.
Lavaca	10,500	7,794	Natural gas, natural gas liquids, petroleum, sand and gravel, stone.
Lee	61	31	Petroleum, natural gas, sand and gravel.
Leon	4,585	4,199	Petroleum, natural gas, natural gas liquids, stone.
Liberty	51,859	44,963	Petroleum, sulfur, natural gas liquids, natural gas, sand and gravel.
Limestone	3,208	3,099	Natural gas, sand and gravel, clays, petroleum, stone.
Lipscomb	16,916	14,386	Natural gas, petroleum, stone.
Live Oak	23,136	21,966	Natural gas liquids, natural gas, petroleum.
Llano	543	624	Stone, vermiculite, talc, sand and gravel.
Loving	8,923	7,346	Petroleum, natural gas.
Lubbock	945	1,256	Do.
Lynn	1,293	1,328	Do.
McCulloch	W	W	Sand and gravel, stone.
McLennan	6,496	W	Cement, sand and gravel, natural gas liquids, stone, clays, petroleum, natural gas.
McMullen	10,474	9,904	Natural gas, petroleum, natural gas liquids.
Madison	4,813	3,273	Do.
Marion	7,019	5,933	Petroleum, natural gas, natural gas liquids.
Martin	8,103	8,483	Petroleum, natural gas.
Mason	136	17	Sand and gravel.
Matagorda	81,459	71,913	Natural gas, petroleum, natural gas liquids, sulfur, salt.
Maverick	5,013	4,592	Petroleum, natural gas, natural gas liquids.
Medina	711	709	Petroleum, clays, natural gas.
Menard	915	1,092	Petroleum, natural gas.
Midland	77,269	45,937	Petroleum, natural gas liquids, natural gas, sand and gravel.
Milam	W	W	Coal, petroleum, sand and gravel, natural gas.
Mills	7	153	Stone.
Mitchell	10,181	13,323	Petroleum, natural gas, stone, sand and gravel.
Montague	15,589	14,704	Petroleum, natural gas, natural gas liquids, sand and gravel.
Montgomery	34,934	41,364	Petroleum, natural gas liquids, natural gas, sand and gravel.
Moore	r 34,856	62,292	Natural gas, natural gas liquids, helium, petroleum.
Morris	W	W	Iron ore.
Motley	1,132	1,319	Petroleum, sand and gravel, natural gas.
Nacogdoches	5,163	7,192	Natural gas, petroleum, natural gas liquids, iron ore, clays.
Navarro	4,668	4,653	Petroleum, natural gas, sand and gravel, clays.
Newton	5,434	5,283	Petroleum, natural gas, natural gas liquids.
Nolan	28,319	30,819	Petroleum, cement, natural gas, gypsum, natural gas liquids, stone, sand and gravel.
Nueces	98,536	96,786	Natural gas, petroleum, natural gas liquids, cement, lime, stone, sand and gravel.
Ochiltree	28,793	26,980	Petroleum, natural gas, natural gas liquids.
Oldham	W	1,805	Sand and gravel, natural gas, petroleum, clays.
Orange	10,979	11,020	Petroleum, cement, natural gas, natural gas liquids.
Palo Pinto	3,640	10,545	Stone, natural gas, petroleum, natural gas liquids, clays, sand and gravel.
Panola	38,456	39,940	Natural gas, natural gas liquids, petroleum.
Parker	3,705	4,535	Natural gas liquids, natural gas, stone, clays, petroleum, sand and gravel.
Pecos	125,685	148,099	Natural gas, petroleum, natural gas liquids, sulfur, sand and gravel.
Polk	5,798	6,224	Petroleum, natural gas.
Potter	71,139	16,486	Natural gas, natural gas liquids, cement, helium, sand and gravel, stone, petroleum.
Presidio	W	W	Mercury.
Rains	991	315	Natural gas.
Randall	W	700	Stone.
Reagan	25,076	30,223	Petroleum, natural gas liquids, natural gas.
Red River	94	89	Petroleum, natural gas.
Reeves	20,616	23,801	Natural gas, petroleum, natural gas liquids, sand and gravel.
Refugio	102,866	116,992	Petroleum, natural gas, natural gas liquids.
Roberts	8,824	8,718	Petroleum, natural gas.
Robertson	W	251	Sand and gravel, natural gas, stone, petroleum.
Rockwall	104	------	
Runnels	11,222	9,797	Petroleum, natural gas, natural gas liquids.
Rusk	46,882	51,233	Petroleum, natural gas liquids, natural gas, clays.
Sabine	4	3	Sand and gravel.
San Augustine	[2]	------	
San Jacinto	2,351	1,223	Petroleum, natural gas, sand and gravel.
San Patricio	44,107	43,340	Petroleum, natural gas, natural gas liquids, stone, sand and gravel, clays.
San Saba	26	13	Stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Schleicher	$13,065	$11,493	Petroleum, natural gas, natural gas liquids.
Scurry	152,440	173,221	Petroleum, natural gas liquids, natural gas, stone, magnesium chloride, clays.
Shackelford	9,854	12,696	Petroleum, natural gas, natural gas liquids, stone.
Shelby	937	901	Natural gas, petroleum.
Sherman	16,848	11,520	Do.
Smith	13,386	14,816	Petroleum, natural gas, natural gas liquids, clays.
Somervell	W	W	Sand and gravel.
Starr	36,174	37,017	Petroleum, natural gas, natural gas liquids, pumicite, clays.
Stephens	7,668	8,603	Petroleum, natural gas liquids, natural gas, sand and gravel.
Sterling	8,797	8,644	Petroleum, natural gas.
Stonewall	20,373	22,058	Petroleum, natural gas liquids, natural gas, sand and gravel.
Sutton	2,604	2,740	Petroleum, natural gas, sand and gravel.
Tarrant	8,119	9,625	Cement, sand and gravel, stone, natural gas.
Taylor	12,958	13,130	Petroleum, stone, natural gas, sand and gravel, clays.
Terrell	1,987	4,376	Natural gas.
Terry	29,498	35,637	Petroleum, sodium sulfate, natural gas liquids, natural gas.
Throckmorton	6,432	6,703	Petroleum, natural gas.
Titus	13,254	13,869	Do.
Tom Green	7,770	7,033	Petroleum, natural gas, natural gas liquids, sand and gravel.
Travis	5,086	W	Lime, stone, sand and gravel, petroleum, natural gas.
Trinity	128	27	Natural gas.
Tyler	3,950	4,609	Petroleum, natural gas.
Upshur	10,827	12,582	Petroleum, natural gas, sand and gravel.
Upton	83,531	86,080	Petroleum, natural gas, natural gas liquids, sand and gravel.
Uvalde	W	W	Asphalt, stone, sand and gravel, natural gas.
Val Verde	446	463	Natural gas, petroleum.
Van Zandt	38,835	46,197	Petroleum, natural gas liquids, salt, natural gas, clays.
Victoria	25,229	24,060	Petroleum, natural gas, sand and gravel, natural gas liquids.
Walker	263	214	Natural gas, clays, sand and gravel, petroleum, stone.
Waller	44,561	54,248	Natural gas, natural gas liquids, petroleum, sand and gravel.
Ward	58,076	66,087	Petroleum, natural gas, natural gas liquids, sodium sulfate, salt, sand and gravel.
Washington	848	861	Petroleum, stone, sand and gravel, natural gas.
Webb	8,709	9,715	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Wharton	80,768	60,151	Petroleum, sulfur, natural gas, natural gas liquids, clays, sand and gravel.
Wheeler	9,589	9,943	Petroleum, natural gas, natural gas liquids, sand and gravel.
Wichita	29,621	29,085	Petroleum, natural gas, stone, sand and gravel.
Wilbarger	13,411	13,480	Petroleum, natural gas, natural gas liquids, sand and gravel.
Willacy	12,173	12,736	Petroleum, natural gas, natural gas liquids.
Williamson	5,419	W	Stone, lime, petroleum, sand and gravel, natural gas.
Wilson	2,721	2,968	Petroleum, natural gas.
Winkler	98,717	106,523	Petroleum, natural gas, natural gas liquids.
Wise	28,326	35,178	Natural gas, stone, natural gas liquids, petroleum, clays.
Wood	74,076	91,662	Petroleum, natural gas liquids, natural gas, sand and gravel clays.
Yoakum	91,154	114,616	Petroleum, natural gas, natural gas liquids, salt.
Young	12,178	12,810	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Zapata	4,189	4,141	Natural gas, petroleum.
Zavala	1,377	1,526	Petroleum, natural gas.
Undistributed	33,687	74,228	
Total	5,505,831	5,769,970	

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 1968 or 1969: Bailey, Bandera, Castro, Deaf Smith, Delta, Fannin, Jeff Davis, Kendall, Kinney, Parmer, Real, and Swisher.

[2] Less than ½ unit.

Table 3.—Indicators of Texas business activity

		1968	1969 p	Change, percent
Annual average labor force and employment:				
Total labor force	thousands	4,302.8	4,589.6	+6.7
Unemployment	do	117.4	122.8	+4.6
Employment:				
Construction	do	215.3	232.0	+7.8
Mining	do	103.1	104.7	+1.6
All manufacturing	do	707.6	749.2	+5.9
All industries	do	4,000.2	4,159.2	+4.0
Factory payrolls	millions	$4,406.2	$4,867.1	+10.5
Personal income:				
Total	do	$33,254	$36,401	+9.5
Per capita		$3,020	$3,254	+7.7
Construction activity:				
Building permits (total private nonresidential)	millions	$613.3	$703.3	+14.7
State highway commission:				
Value of construction started	do	$417.5	$496.2	+18.9
Value of construction completed	do	$313.2	$176.9	−43.5
Cement shipments to and within Texas	thousand 376-pound barrels	28,356	30,051	+6.0
Farm marketing receipts	millions	$2,669.0	$2,808.1	+5.2
Mineral production	do	$5,505.8	$5,770.0	+4.8

p Preliminary.

Sources: Texas Employment Commission, Survey of Current Business, Construction Review, Texas Highway Department, The Farm Income Situation, and Bureau of Mines.

An important part of the State's industry processed minerals and mineral fuels produced in other States and foreign countries, as well as Texas. Smelters treated antimony, copper, iron, lead, mercury, manganese, tin, and zinc ores; reduction and refining plants treated bauxite ores; and processing plants prepared barite, perlite, vermiculite, pumicite, talc, limestone, and uranium. Oil refineries processed crude oil, both foreign and domestic; numerous gasoline plants processed natural gas to recover natural gas liquids and, in some areas, sulfur from sour gas. A number of secondary minerals—silver, gold, cadmium, and other metals—were recovered at primary metal smelters.

Much of the mineral fuels production, both crude and refined (except lignite), was consumed in markets outside the State. Pipelines, trucks, rail tank cars, and barges transported these fuels to eastern, midwestern, and western markets; and ocean tankers carried them to foreign countries. Conversely, nonmetallic minerals, except salt and sulfur, depended primarily on local and intrastate markets.

Industrial expansion in Texas created unprecedented demands for the State's minerals and intermediate products. Most of the growth was in oil, gas, and petrochemical industries. Refining and processing facilities were developed to meet increased demands for petroleum products. The petrochemical industry added large new capacities to match mounting demands for new products and growing markets for established products.

Texas has been richly endowed with abundant mineral resources, a 375-mile coastline with a dozen major deep-water ports, a warm climate, ample supplies of water and electric power, and a favorable labor market. These factors have resulted in the development of an immense basic mineral industry that supplies national and international markets as well as intrastate markets. Supplemental processing industries include oil refining, natural gas liquid recovery, petrochemical plants; and ferrous, nonferrous, and light metal extractive plants.

Trends and Developments.—Production of mineral fuels established new record highs as demand growth continued. Oil refineries were expanded and modernized to increase production of basic products. Output of total natural gas liquids continued to advance for the ninth consecutive year.

Output of all four metallic minerals increased. A new uranium processing mill was under construction in Live Oak County by Susquehanna-Western, Inc., with start-up scheduled for the second half of 1970. American Magnesium Co., at its new plant in Scurry County, attained partial production during the year. United States Steel Corp. continued construction of a large integrated steel mill in the Bayport area, southeast of Houston.

The nonmetallic industries were inconsistent, with most construction materials showing a decline and chemical minerals showing a net increase. Expansion and modernization was conducted at gypsum, lime, cement, and other nonmetallic mineral installations.

Air and water pollution control programs costing millions of dollars were being conducted by the various mineral industries in Texas. Both legislative and enforcement officials took stronger stands against pollution. Several lime quarries and plants were shut down for noncompliance with antipollution laws.

Legislation and Government Programs.—The legislature passed bills making it a misdemeanor to disobey the codes on air and water pollution. Violation of standards set by either the Texas Water Quality Board or the Texas Air Control Board became punishable by fines up to $1,000 per day per offense. Another bill enacted in 1969 empowered the Water Quality Board to regulate solid-waste-disposal dumps and sanitary land fills.

The Air Control Board amended its rules to allow local enforcement officers to enter an industrial plant after observing illegal discharge from the smoke flues for more than 5 minutes within an hour.

The Texas Railroad Commission (RRC) and the State General Land Office amended their rules controlling offshore drilling. Both assigned liability for pollution to the "responsible" operator.

Texas asked the U.S. Supreme Court to settle a century-old dispute with Louisiana over the exact location of the Sabine River boundary between the two States. Louisiana averred that, based on terms of a boundary agreement between France and Spain, Spain held the land west of the Sabine. France later sold the adjoining land to the United States by the Louisiana Purchase agreement, and Louisiana's claim extends to the west bank of the river. Texas, on the other hand, claimed that when Louisiana was admitted to the Union in 1812 the congressional act of admission set the boundary in the middle of the river. The western half of the river could possibly be underlain by millions of barrels of oil.

In October, the Department of Transportation issued new safety regulations for pipelines carrying hazardous liquids. The regulations will become effective April 1, 1970. The regulations cover design, construction, operation, and maintenance of pipelines.

Employment and Injuries.—Employment and injury statistics of the mineral industry as compiled by the U.S. Bureau of Mines are shown in table 4. Employment data in mining and related industries as reported by the Texas Employment Commission are shown in table 5.

Table 4.—Worktime 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
1968:								
Coal	110	288	32	254	—	2	7.88	532
Metal	1,337	314	420	3,356	—	32	9.54	681
Nonmetal and native asphalt	3,095	288	893	7,233	—	175	24.19	1,081
Sand and gravel	1,987	259	515	4,741	4	118	25.73	5,499
Stone	4,485	309	1,386	11,677	1	221	19.01	1,225
Total [1]	11,014	295	3,246	27,262	5	548	20.28	1,856
1969: [p]								
Coal	130	305	40	320	—	2	6.25	425
Metal	1,450	342	495	3,998	2	61	15.76	4,036
Nonmetal and native asphalt	3,315	284	967	7,836	1	201	25.78	1,751
Sand and gravel	1,880	260	488	4,482	1	117	26.33	2,241
Stone	4,485	293	1,316	10,999	1	234	21.37	1,272
Total [1]	11,260	291	3,305	27,636	5	615	22.43	1,955

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 5.—Employment data in mining and related industries
(Thousand employees)

Industry	Employment		Weekly hours worked		Weekly earnings	
	1968	1969	1968	1969	1968	1969
Manufacturing	707.6	749.2	41.6	41.4	$119.81	$125.03
Stone, clay, and glass products	28.7	30.3	42.4	32.7	106.00	115.29
Primary metals	32.3	34.1	42.0	41.7	138.60	144.70
Transportation equipment	98.4	106.5	42.4	42.3	148.40	155.66
Chemicals	61.5	63.5	r42.5	42.5	156.40	164.90
Petroleum and related industries	36.7	36.0	42.9	42.4	167.31	178.93
Petroleum refining	34.6	33.5	----	42.3	------	182.74
Nonmanufacturing	2,704.4	2,862.0	----	----	------	------
Mining	103.1	104.7	43.0	43.1	147.06	156.88
Crude petroleum and natural gas	96.8	98.0	42.9	43.0	149.29	159.10
Other mining	6.3	6.7	44.3	44.5	110.75	121.93
Construction	215.3	232.0	----	----	------	------

r Revised.
Source: Texas Employment Commission; U.S. Bureau of Labor Statistics.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The fossil fuels were the dominant mineral commodities produced, and accounted for approximately 92 percent of the total minerals value in 1969. Crude oil, the single most valuable mineral commodity, constituted approximately 64 percent of the total value; natural gas, 19 percent; and natural gas liquids, 9 percent.

The State's oil production was regulated to match supply with demand. The January 1969 market demand factor (MDF) was 43.7 percent of the base allowable as compared with 41.3 percent in December 1968. The MDF decreased to 42.8 percent in February, then gradually increased to 63.5 percent in June. (The previous record high factor—54 percent—was in August and part of September 1967 owing to the Arab-Israeli war interruption of world oil supplies.) The July MDF was 54.7 percent; August, 53.1 percent; September, 52.1 percent; October, 53.7 percent; November, 52.7 percent; and December 62.7 percent.

Table 6.—Production and value of mineral fuels

Year	Crude petroleum		Natural gas [1]	
	Thousand 42-gallon barrels	Value (thousands)	Million cubic feet	Value (thousands)
1965	1,000,749	$2,962,119	6,636,555	$858,396
1966	1,057,706	3,141,387	6,953,790	903,993
1967	1,119,962	3,375,565	7,188,900	948,935
1968	1,133,380	3,450,707	7,495,414	1,011,881
1969	1,151,775	3,696,328	7,853,199	1,075,888

Year	Natural gas liquids					
	Natural gasoline and cycle products		LP gas		Total	
	Thousand 42-gallon barrels	Value (thousands)	Thousand 42-gallon barrels	Value (thousands)	Thousand 42-gallon barrels	Value (thousands)
1965	89,821	$256,959	139,229	$204,666	229,050	$461,625
1966	92,625	269,332	151,425	260,755	244,050	530,087
1967	95,991	277,105	177,367	320,326	273,358	597,431
1968	97,075	269,182	189,162	278,068	286,237	547,250
1969	96,628	289,042	194,599	237,411	291,227	526,453

[1] Marketed production, gas either sold or consumed by producers including losses in transmission, amounts added to storage, and increases in gas pipelines.

Table 7.—Production trends of crude oil, natural gas, and natural gas liquids
(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
1965	1,001	1,185	168	2,354	42.5	50.4	7.1	1.1	2.2	7.0	2.1
1966	1,058	1,242	179	2,479	42.7	50.1	7.2	5.7	4.8	6.5	5.3
1967	1,120	1,284	199	2,603	43.0	49.3	7.7	5.9	3.4	11.2	5.0
1968	1,133	1,338	208	2,679	42.3	49.9	7.8	1.2	4.2	4.5	2.9
1969	1,152	1,402	211	2,765	41.7	50.7	7.6	1.7	4.8	1.4	3.2

[1] One barrel of crude oil equivalent to 5,600 cubic feet of natural gas or 57.6 gallons of natural gas liquids, a composite of 52.7 gallons of natural gasoline and 60.8 gallons of LP gases.

Table 8.—Comparison of mineral fuels production in Texas and the United States

Fuel	Production [1] as oil equivalent				Change from 1968 (percent)		Percent of fuels				Texas percent of United States	
	Texas		United States				Texas		United States			
	1968	1969	1968	1969	Texas	United States	1968	1969	1968	1969	1968	1969
Crude oil	1,133	1,152	3,329	3,372	+1.7	+1.3	42.3	41.7	46.4	45.0	34.0	34.2
Natural gas	1,338	1,402	3,450	3,696	+4.8	+7.1	49,9	50.7	48.0	49.4	38.8	37.9
Natural gas liquids	208	211	401	422	+1.4	+5.2	7.8	7.6	5.6	5.6	51.9	50.0
Total equivalent	2,679	2,765	7,180	7,490	+3.2	+4.3	100.0	100.0	100.0	100.0	37.3	96.9

[1] Million barrels of oil equivalent, derived by gas and liquids factors reported in table 7.

Table 9.—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 1968		Texas		United States	
	1968	1969	1968	1969	1968	1969	Texas	United States	1968	1969	1968	1969
Crude oil	13,810	13,063	30,707	29,632	45.0	44.1	−5.4	−3.5	12.2	11.3	9.2	8.8
Natural gas	21,250	20,070	51,312	49,127	41.4	40.9	−5.6	−4.3	15.9	14.3	14.9	13.3
Natural gas liquids	r 2,921	2,663	r 6,269	5,938	r 46.6	44.8	−8.8	−5.3	r 14.0	12.6	15.6	14.1
Total oil equivalent	r 37,981	35,796	r 88,288	84,697	43.0	42.3	−5.8	−4.1	14.2	12.9	12.3	11.3

r Revised.
[1] Million barrels of oil equivalent, derived by gas and liquids factors reported in table 7.

Table 10.—Estimated proved recoverable reserves of natural gas, natural gas liquids, and crude oil in 1969 by railroad districts

Railroad district	Proved reserves, Dec. 31, 1968	Extensions and revisions	New fields and new pools	Production [p]	Proved reserves, Dec. 31, 1969 [1]	Change from Dec. 31, 1968 [1]
NATURAL GAS [2] (MILLION CUBIC FEET)						
1	2,245,944	+10,537	5,869	135,143	2,127,201	−118,743
2	10,774,613	+94,621	232,691	657,166	10,445,403	−329,210
3	25,529,462	−562,856	377,467	1,594,086	23,751,987	−1,777,475
4	32,370,346	−107,784	528,857	1,575,794	31,215,625	−1,154,721
5	1,347,687	−115,039	316,183	120,736	1,428,567	+80,880
6	6,339,422	+66,194	28,780	437,195	5,997,201	−342,221
7B	774,066	+103,116	3,258	94,733	786,257	+12,191
7C	3,917,013	+37,125	21,450	209,646	3,766,150	−150,863
8	18,438,065	−173,211	281,752	1,329,267	17,217,339	−1,220,726
8A	3,245,675	−42,838	1,307	202,959	3,001,185	−244,490
9	2,243,361	−150,934	13,890	181,395	1,925,141	−318,220
10	11,775,452	+39,238	37,107	1,120,850	10,730,566	−1,044,886
Total	119,001,106	−801,831	1,848,611	7,658,970	112,392,622	−6,608,484
NATURAL GAS LIQUIDS [3] (THOUSAND BARRELS)						
1	35,094	+107	16	3,289	31,928	−3,166
2	159,439	+900	1,654	14,368	147,625	−11,814
3	803,577	−2,050	4,650	63,359	742,818	−60,759
4	721,112	+10,203	12,380	65,244	678,451	−42,661
5	82,037	+7,417	5,312	6,953	87,813	+5,776
6	468,520	+10,343	445	25,357	453,951	−14,569
7B	44,330	+15,251	400	7,800	52,181	+7,851
7C	162,267	+9,016	154	16,900	154,537	−7,730
8	605,342	+23,704	2,383	65,493	565,936	−39,406
8A	351,096	−7,924	9	20,474	322,707	−28,389
9	75,816	+2,702	540	9,358	69,700	−6,116
10	496,743	−115,154	1,248	38,545	344,292	−152,451
Total	4,005,373	−45,485	29,191	337,140	3,651,939	−353,434
CRUDE OIL [4] (THOUSAND BARRELS)						
1	149,873	+22,364	1,988	17,059	157,166	+7,293
2	910,201	+34,022	13,255	70,995	886,483	−23,718
3	1,935,865	+32,149	11,676	145,262	1,834,428	−101,437
4	639,195	−2,062	8,172	81,440	563,865	−75,330
5	148,560	−108	19	13,605	134,866	−13,694
6	2,679,932	+26,308	1,930	117,888	2,590,282	−89,650
7B	240,742	+36,124	3,677	38,099	242,444	+1,702
7C	361,183	+28,555	3,255	44,640	348,353	−12,830
8	3,393,831	+55,382	3,771	284,402	3,168,582	−225,249
8A	2,725,493	+41,748	3,610	204,673	2,566,178	−159,315
9	366,246	+19,269	7,621	57,569	335,567	−30,679
10	258,785	+3,880	1,272	28,969	234,968	−23,817
Total	13,809,906	+297,631	60,246	1,104,601	13,063,182	−746,724

[p] Preliminary.
[1] Change reflects production and net additions and withdrawals in storage.
[2] Committee on Natural Gas Reserves of American Gas Association.
[3] Committees on natural gas liquid reserves of American Petroleum Institute and American Gas Association.
[4] Committees on crude oil reserves of the American Petroleum Institute and American Gas Association.

Although Texas and Louisiana still have some spare productive capacity, there is mounting evidence that in Texas this is rapidly diminishing. In April 1969, the MDF of 49.9 percent yielded 3.0 million barrels of crude oil and condensate per day. In July 1967, production had averaged 3.2 million barrels per day with a lower MDF (48.0 percent). If more crude oil is needed from Texas, the MDF will have to be increased at an accelerating rate, and within a few years the upper limit of Texas crude oil producing capacity should become evident.[4]

During the year, a total of 8,656 exploratory and developmental holes were drilled, according to The American Association of Petroleum Geologists, Inc. (AAPG). The industry completed 5,159 of these as producers, and abandoned 3,497 ventures as

[4] Energy Division of The Chase Manhattan Bank. The Petroleum Situation in April 1969. May 22, 1969, 4 pp.

dry holes. Exploratory drilling totaled 2,718 holes, and resulted in 330 oil producers, 207 gas producers, and 57 condensate producers; 2,124 holes were dry and abandoned. Developmental drilling totaled 5,938 holes and resulted in 3,926 oil producers, 524 gas producers, and 115 condensate producers; 1,373 wells were dry and abandoned.

Pipelines.—Product and natural gas pipelines accounted for the major construction projects completed in 1969. Diamond Shamrock Oil and Gas Co. began laying a 631-mile, 8-inch products line from Dumas to Deer Park. The line was completed to Ft. Worth in 1969. Cosden Pipeline Co. completed a 74-mile, 8-inch products line from south of Colorado City to Abilene.

Major new gas reserves have found a readily available market. Gas from the Grey Ranch field of Pecos County was connected by a 30-inch Coastal-States-Gas-Producing-Co. pipeline to San Antonio. El Paso Natural Gas Co. completed a 90-mile, 36-inch line from Pecos to Van Horn and a 201-mile, 36- and 30-inch line from Waha to El Paso. Lo-Vaca Gathering Co., a subsidiary of Coastal States Gas-Producing Co., completed a 40-mile, 30-inch line from Grey Ranch to Gomez field; and a 46-mile, 30-inch line from the New Braunfels area to the Austin area.

Houston Natural Gas Co. had contracted for reserves in the new Mi Vida field, straddling the Reeves-Ward County line, and was to construct a 500-mile, 36-inch pipeline to transmit gas to Houston from this and several other Delaware Basin and Val Verde Basin gasfields.

Shell Pipeline Corp. completed a 138-mile, 16-inch crude oil line from Wasson field, 60 miles northwest of Midland, to McCamey.

A 200-mile, large-diameter pipeline is to be constructed by SACROC unit owners to deliver carbon dioxide gas from the Brown-Bassett field in Terrell County and the Puckett field of Pecos County to the SACROC unit in Scurry County. SACROC operators plan to use carbon dioxide slugs, along with their present pressure maintenance by waterflood, to recover a greater percentage of the oil in the Kelly-Snyder field.

Asphalt (Native).—Uvalde County supplied all of the native asphalt rock. Most of the output was used in highway maintenance. Production was higher than in 1968.

Carbon Black.—Carbon black production in 1969 was 1,442 million pounds, an increase of 16 million pounds or 1 percent over that in 1968. The rubber industry remained the largest market for carbon black. The Texas share of U.S. production was 48.7 percent. There were 14 furnace plants and four channel plants operating in 13 counties. Furnace black accounted for 1,333 million pounds, or 92.4 percent of total production. Channel black accounted for 109 million pounds or 7.6 percent of total production.

Phillips Petroleum Co. completed expansion of its Borger plant. Capacity was increased by 28 million pounds to a total capacity of 318 million pounds per year—the world's largest carbon black plant even before the expansion. The company also completed a 5-million-pound-per-year expansion at Orange. New capacity will be 95 million pounds per year.

J. M. Huber Corp. at Baytown was constructing a 130-ton-per-day furnace black plant.

Coal (Lignite).—Texas Utilities Co. continued constructing a 1.1 megawatt generating plant in Freestone County. The plant will be fueled with lignite. Lignite deposits in Freestone and Limestone Counties will supply the 5-million-ton-per-year requirements of the plant.

Lignite was mined in Milam and Harrison Counties by two producers in 1969. Most of the Milam County production was used as fuel for electric power generation, but the Harrison County production was processed into activated carbon.

Helium.—Four helium extraction plants were operated in Texas. Two of these plants are owned and operated by the Bureau of Mines; two plants owned by Phillips Petroleum Co. produced helium for sale to the Bureau. The Linde Division, Union Carbide Corp. helium purification and liquefaction plant at Amarillo was not operated in 1969.

Total helium production from the two Bureau of Mines plants—one at Amarillo and one at Exell—was 313.5 MMcf (million cubic feet) compared with 332.1 MMcf in 1968. They sold a combined total of 140.5 MMcf for $4.9 million ($35 per Mcf). The 173.0 MMcf produced but not sold (and consequently not shown in table

l) was placed in underground storage in connection with the governmental helium conservation program.

The two plants owned by Phillips Petroleum Co. in Moore and Hansford Counties produced and sold 1,190.3 MMcf of crude helium, an increase of 151.6 MMcf over 1968. This helium was purchased by the Bureau of Mines for $13.0 million and stored in Cliffside field, Potter County, for conservation purposes.

An extensive modernization program was initiated at the Exell plant in early 1969. The target completion date is September 1970.

Natural Gas.—Texas continued to be the leading natural gas producing State and supplied 38 percent of the total domestic output. Marketed production of natural gas was 7,853 billion cubic feet (MMMcf), up 4.8 percent over 1968. The average wellhead price was 13.7 cents per Mcf, an increase from 13.5 cents per Mcf in 1968. Natural gas production was obtained from 207 of the State's 254 counties; 23 counties had producion exceeding 100 MMMcf. The top 10 counties accounted for 37.3 percent of the State total. These 10 counties and output of each (in MMMcf) were as follows: Pecos, 515.5; Kleberg, 478.9; Nueces, 320.3; Brazoria, 280.3; Waller, 257.3; Moore, 242.2; Matagorda, 233.2; Ector, 224.9; Hidalgo, 192.5; and Jim Wells, 183.6.

During December, there were 23,689 producing gas wells in Texas with average production of 847,277 cubic feet per well per day, according to the Texas Railroad Commission. Each of the 182,903 wells producing casinghead or associated gas averaged 32,795 cubic feet per day, a 15.9-percent increase from 1968 levels.

The oil and gas industry of Texas completed 264 exploratory gas wells and 639 developmental gas wells according to the AAPG. The Permian Basin remained one of the most active exploration areas in the State and Nation. Exploration for deep gas reserves continued in 1969. Important new fields were discovered in the Val Verde and Delaware Basin areas. The most significant of the deep gas reserves discovered was the Mi Vida field on the Reeves-Ward County line. The discovery well, in Ward County, had an initial daily production rate of 43.5 MMcf from the Fusselman Formation at 16,100 feet and 138.8 MMcf from the Ellenburger Formation at 18,483 feet.

Other significant gas discoveries in the Delaware Basin included the ROC field in Ward County (initial daily production rate was 25.0 MMcf from Devonian-age sediments and 10.5 MMcf from the Ellenburger), the Barstow field in Ward County, and the South Wink field in Winkler County.

In the offshore area, a prolific gas field was discovered in Block 129-L, High Island area. The discovery well, located in federal waters about 30 miles south of Sabine Pass, had an initial production rate of 80.0 MMcf per day.

Wilcox gas production was established at Katy field in Waller County. Initial flowrate was 16.5 MMcf per day. Katy field already had large gas reserves in the shallower Yegua sediments.

According to the American Gas Association, Inc., proved natural gas reserve as of December 31, 1969 was 112,393 billion cubic feet, a decline of 6,608 billion cubic feet or 5.6 percent from that in 1968. The reported State reserve was 40.9 percent of the national total.

Natural Gas Liquids.—Texas was the principal producer of natural gas liquids in 1969, supplying 50.2 percent of the Nation's output. Although production of the combined liquids increased 1.7 percent, the value declined to $526.5 million, a 3.8-percent drop.

At yearend there were 331 natural gasoline plants and 42 gas cycling plants in the State, according to the Texas Railroad Commission. Installed capacity was reported as 27.0 MMMcfd by The Oil & Gas Journal, a 1.7-MMMcfd decrease from 1968 capacity. As reported by the American Petroleum Institute, proved natural gas liquids reserve in Texas at yearend was 3,651,939,000 barrels, compared with the 4,005,373,000 barrels at the end of 1968. This was a decrease of 353,434,000 barrels or 8.8 percent. Texas had 44.8 percent of the total domestic proved gas liquids reserve at the end of 1969.

Gas processing plant construction was down in 1969. Cities Service Oil Co. completed the Myrtle Springs plant in Van Zandt County to process 34 MMcf per day of high-sulfur-content gas. They also completed the West Welch plant, a 2.5-MMcf-

per-day refrigeration-absorption plant in Dawson County. El Paso Natural Gas. Co. completed a new plant southeast of Ft. Stockton in the Puckett field. Humble Oil & Refining Co. at Tomball completed the addition of 65-MMcf-per-day gas processing capacity. Hunt Oil Co. expanded capacity of the Fairway plant, Henderson County, by 28 MMcf per day.

Petroleum.—Crude oil production totaled 1,151,775,000 barrels, an increase of 1.6 percent over 1968. Average price of crude oil in Texas was $3.21 per barrel compared with $3.04 in 1968. Production statistics for 1969 showed very clearly that excess producing capacity; that is, the ability to respond to increased demand, was available only in very few States, notably Texas and Louisiana.

Crude-oil production was reported from 198 counties. The 10 leading counties in descending order were Andrews, Ector, Scurry, Crane, Gregg, Gaines, Yoakum, Refugio, Jackson, and Winkler. Andrews and Ector Counties produced more than 50 million barrels each; Crane, Scurry, Gregg, and Gaines produced more than 40 million barrels each; Yoakum and Refugio Counties more than 30 million each. Production in each of 71 counties was less than 1 million barrels. There were 183,141 producing oil wells and 9,969 oilfields at the end of 1969. Average production per well per day during the year was 17.2 barrels.

Table 11.—Oil and gas drilling in 1969, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Anderson	106	3	3	3	3	24	142
Andrews	82	-----	12	7	-----	10	111
Angelina	-----	1	-----	-----	-----	1	2
Aransas	8	7	7	2	4	17	45
Archer	76	-----	38	8	-----	23	145
Atascosa	42	3	8	1	-----	25	79
Austin	37	-----	1	-----	1	2	41
Bandera	-----	-----	-----	-----	-----	1	1
Bell	23	-----	20	5	-----	17	65
Baylor	4	-----	1	-----	-----	10	15
Bee	2	3	2	1	1	11	20
Bexar	49	-----	3	-----	-----	3	55
Borden	5	-----	2	2	-----	11	20
Bowie	-----	-----	2	1	1	10	14
Brazoria	22	-----	15	12	4	15	68
Brazos	4	2	2	-----	-----	1	9
Brewster	-----	-----	-----	-----	-----	2	2
Brooks	7	-----	5	2	5	8	27
Brown	7	4	14	-----	-----	3	28
Burleson	2	-----	-----	2	-----	-----	4
Caldwell	168	-----	10	1	-----	3	182
Calhoun	3	6	7	-----	1	18	35
Callahan	56	1	51	1	-----	19	128
Cameron	-----	-----	-----	-----	-----	9	9
Camp	7	-----	1	-----	-----	1	9
Carson	20	4	3	-----	-----	-----	27
Cass	2	-----	3	-----	-----	4	9
Chambers	18	6	10	2	1	25	62
Cherokee	1	1	-----	3	-----	22	27
Childress	-----	-----	-----	-----	-----	1	1
Clay	1	-----	1	1	-----	1	4
Cochran	28	-----	-----	-----	-----	3	31
Coke	14	-----	4	3	-----	13	34
Coleman	14	4	22	1	-----	6	47
Collingsworth	15	-----	1	-----	-----	-----	16
Colorado	2	9	4	1	8	28	52
Comanche	1	-----	2	-----	-----	1	4
Concho	-----	-----	1	-----	-----	7	8
Cooke	72	-----	33	1	-----	19	125
Coryell	-----	-----	-----	-----	-----	1	1
Cottle	-----	-----	2	1	-----	6	9
Crane	112	1	22	9	-----	20	164
Crockett	24	45	11	6	2	17	105
Crosby	-----	-----	-----	-----	-----	1	1
Culberson	2	-----	-----	1	-----	3	6
Dallam	-----	-----	-----	-----	-----	1	1
Dawson	40	-----	4	1	-----	15	60
Denton	-----	-----	-----	-----	1	1	2
DeWitt	-----	6	-----	-----	4	10	20
Dickens	10	-----	5	2	-----	6	23
Dimmit	6	1	7	1	-----	12	27
Donley	-----	-----	-----	-----	-----	1	1
Duval	28	12	30	4	4	33	111

Table 11.—Oil and gas drilling in 1969, by counties—Continued

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Eastland	10	3	6	-----	-----	3	22
Ector	161	2	3	2	-----	4	172
Edwards	5	-----	14	-----	-----	5	24
Ellis	1	-----	-----	-----	-----	3	4
Erath	5	2	-----	-----	1	3	11
Falls	21	-----	-----	-----	-----	9	30
Fannin	-----	-----	-----	-----	-----	1	1
Fayette	-----	-----	2	-----	-----	1	3
Fisher	11	-----	4	4	1	16	36
Foard	1	-----	1	-----	-----	5	7
Fort Bend	24	2	10	1	-----	2	39
Franklin	9	3	-----	1	1	6	20
Freestone	-----	3	-----	1	8	13	25
Frio	1	-----	1	-----	-----	17	19
Gaines	13	1	5	1	-----	11	31
Galveston	-----	2	1	1	2	9	15
Garza	17	-----	3	1	-----	5	26
Gillespie	1	-----	-----	-----	-----	-----	1
Glasscock	11	-----	4	2	-----	8	25
Goliad	9	13	6	1	4	11	44
Gonzales	3	1	2	3	-----	18	27
Gray	26	4	3	-----	-----	1	34
Grayson	9	-----	4	2	1	14	30
Gregg	16	8	2	1	-----	1	28
Grimes	-----	-----	-----	-----	-----	4	4
Guadalupe	65	-----	12	-----	-----	5	82
Hamilton	-----	-----	-----	-----	-----	1	1
Hansford	-----	8	12	-----	2	2	24
Hardeman	-----	-----	-----	-----	-----	6	6
Hardin	74	2	23	2	2	16	119
Harris	23	5	3	1	2	8	42
Harrison	8	5	5	2	2	8	30
Hartley	-----	-----	-----	-----	-----	1	1
Haskell	8	-----	13	1	-----	21	43
Hemphill	2	16	5	-----	3	1	27
Henderson	-----	3	-----	1	-----	7	11
Hidalgo	1	11	7	2	11	18	50
Hill	-----	-----	-----	-----	-----	1	1
Hockley	82	-----	4	2	-----	9	97
Hood	-----	1	-----	-----	-----	1	2
Hopkins	5	-----	1	-----	1	13	20
Houston	11	-----	-----	1	-----	7	19
Howard	79	-----	11	12	-----	7	109
Hudspeth	-----	-----	-----	-----	-----	1	1
Hunt	-----	-----	-----	-----	-----	7	7
Hutchinson	54	4	6	4	2	3	73
Irion	17	1	6	5	-----	9	38
Jack	60	18	21	8	3	21	131
Jackson	50	8	17	2	-----	27	104
Jasper	3	3	-----	2	1	11	20
Jefferson	21	6	8	1	3	13	52
Jim Hogg	2	2	9	1	4	18	36
Jim Wells	8	10	8	3	3	11	43
Jones	16	1	10	3	-----	19	49
Karnes	3	1	1	-----	1	17	23
Kaufman	1	-----	-----	-----	-----	9	10
Kenedy	1	10	2	-----	2	4	19
Kent	9	-----	7	2	-----	14	32
Kimble	-----	-----	-----	-----	-----	5	5
King	7	-----	5	3	-----	10	25
Kinney	-----	-----	-----	-----	-----	1	1
Kleberg	28	8	7	1	3	18	65
Knox	5	-----	7	-----	-----	11	23
Lamb	2	-----	-----	-----	-----	5	7
La Salle	4	14	5	2	1	23	49
Lavaca	1	5	3	-----	1	6	16
Lee	-----	-----	-----	-----	-----	2	2
Leon	2	2	1	-----	1	5	11
Liberty	88	2	22	3	1	10	126
Limestone	-----	4	-----	-----	6	8	18
Lipscomb	6	8	8	-----	4	2	28
Live Oak	2	6	7	2	6	39	62
Loving	-----	2	4	-----	-----	1	7
Lubbock	16	-----	-----	2	-----	10	28
Lynn	5	-----	-----	-----	-----	7	12
McCulloch	-----	-----	1	-----	-----	-----	1
McLennan	-----	-----	-----	-----	-----	2	2
McMullen	18	5	12	3	-----	27	65
Madison	1	-----	-----	-----	-----	4	5
Marion	24	2	12	2	-----	4	44
Martin	37	-----	-----	4	-----	1	42

Table 11.—Oil and gas drilling in 1969, by counties—Continued

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Matagorda	1	5	6	1	9	22	44
Maverick	64	-----	9	-----	-----	8	81
Medina	-----	-----	1	-----	-----	5	6
Menard	2	-----	4	-----	-----	6	12
Midland	18	1	1	-----	-----	2	22
Milam	7	-----	6	-----	-----	6	19
Mitchell	14	-----	-----	1	-----	5	20
Montague	15	-----	10	6	-----	14	45
Montgomery	2	-----	3	-----	-----	4	9
Moore	15	6	2	-----	-----	3	26
Morris	-----	-----	-----	-----	-----	5	5
Motley	-----	-----	-----	-----	-----	2	2
Nacogdoches	1	-----	-----	-----	2	9	12
Navarro	3	-----	-----	-----	4	11	18
Newton	-----	1	3	2	2	10	18
Nolan	19	-----	9	2	-----	12	42
Nueces	20	16	39	4	8	27	114
Ochiltree	41	7	10	-----	1	2	61
Oldham	2	-----	3	1	-----	6	12
Orange	4	-----	3	1	-----	9	17
Palo Pinto	6	13	8	2	4	11	44
Panola	4	11	9	-----	-----	2	26
Parker	-----	4	4	-----	1	3	12
Parmer	-----	-----	-----	-----	-----	2	2
Pecos	67	30	24	14	4	24	163
Polk	11	1	10	1	1	7	31
Potter	4	11	-----	1	-----	4	20
Rains	-----	-----	-----	-----	2	3	5
Randall	-----	-----	-----	-----	-----	2	2
Reagan	87	-----	2	1	-----	2	92
Red River	-----	-----	1	-----	-----	2	3
Reeves	10	12	3	1	4	7	37
Refugio	19	9	5	-----	1	14	48
Roberts	3	3	-----	-----	-----	4	10
Robertson	-----	-----	-----	-----	-----	4	4
Runnels	12	-----	10	15	1	28	66
Rusk	63	-----	2	-----	-----	11	76
Sabine	-----	-----	-----	-----	-----	2	2
San Augustine	-----	-----	-----	-----	-----	1	1
San Jacinto	1	-----	-----	-----	-----	9	10
San Patricio	7	10	17	4	6	39	83
Schleicher	7	4	5	1	1	11	29
Scurry	11	-----	5	1	-----	7	24
Shackelford	82	5	35	11	3	30	166
Shelby	-----	1	-----	-----	---	3	4
Smith	1	1	-----	1	-----	13	16
Somervell	-----	-----	1	-----	-----	-----	1
Starr	22	16	26	9	13	29	115
Stephens	16	3	6	4	-----	6	35
Sterling	15	-----	4	5	-----	9	33
Stonewall	8	-----	11	2	-----	13	34
Sutton	2	2	1	-----	3	7	15
Taylor	33	2	33	6	-----	15	89
Terrell	-----	-----	1	-----	-----	2	3
Terry	14	-----	2	1	-----	5	22
Throckmorton	56	-----	46	9	-----	19	130
Titus	13	-----	2	-----	1	3	19
Tom Green	8	-----	4	1	-----	8	21
Travis	-----	-----	1	-----	-----	2	3
Trinity	-----	-----	-----	-----	-----	3	3
Tyler	5	2	2	1	2	10	22
Upshur	3	8	1	-----	2	6	20
Upton	24	3	1	2	-----	6	36
Uvalde	-----	-----	-----	-----	-----	3	3
Val Verde	5	-----	1	-----	-----	4	10
Van Zandt	1	1	-----	-----	1	10	13
Victoria	14	15	14	1	2	15	61
Walker	-----	-----	-----	-----	-----	1	1
Waller	-----	4	-----	-----	2	2	8
Ward	197	6	6	2	7	11	229
Washington	5	-----	1	-----	-----	-----	6
Webb	9	37	17	1	16	80	160
Wharton	25	7	13	1	13	28	87
Wheeler	8	3	4	-----	-----	2	17
Wichita	204	-----	57	1	-----	4	266
Wilbarger	37	-----	29	4	-----	10	80
Willacy	2	5	1	-----	6	8	22
Williamson	6	-----	-----	-----	-----	1	7
Wilson	8	-----	6	2	-----	25	41
Winkler	36	2	15	1	2	2	58

Table 11.—Oil and gas drilling in 1969, by counties—Continued

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Wise	11	23	5	-----	2	4	45
Wood	6	-----	2	3	-----	18	29
Yoakum	94	-----	9	6	-----	8	117
Young	71	2	64	7	-----	20	164
Zapata	15	3	9	-----	3	20	50
Zavala	4	1	3	1	1	14	24
Offshore area:							
High Island Area	3	2	1	5	4	26	41
Matagorda Island Area	-----	1	-----	-----	-----	11	12
Galveston Area	-----	-----	-----	1	-----	18	19
Brazos Area	-----	-----	-----	-----	2	30	32
Mustang Island Area	-----	4	-----	-----	5	5	14
Total	3,926	639	1,373	330	264	2,124	8,656

Source: The American Association of Petroleum Geologists, Inc.

Table 12.—Crude petroleum production, indicated demand, and stocks in 1969, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Texas
January	93,110	91,226	102,267
February	83,605	87,307	98,565
March	94,038	99,022	93,581
April	93,776	87,870	99,487
May	99,355	96,604	102,238
June	101,501	97,232	106,507
July	98,792	99,761	105,538
August	97,430	103,062	99,906
September	94,279	95,898	98,287
October	97,985	97,710	98,562
November	94,497	94,823	98,236
December	103,407	103,140	98,503
Total:			
1969	1,151,775	1,153,655	XX
1968	1,133,380	1,129,757	XX

XX Not applicable.

Table 13.—Petroleum daily average production and refinery receipts

(Thousand 42-gallon barrels)

Month	1968		1969	
	Crude production	Refinery receipts	Crude production	Refinery receipts
January	3,156	3,162	3,004	2,977
February	3,271	3,227	2,986	3,106
March	3,266	3,274	3,034	3,160
April	3,191	3,093	3,126	3,014
May	3,153	3,184	3,205	3,120
June	3,101	3,179	3,383	3,259
July	3,125	3,173	3,187	3,300
August	3,157	3,119	3,143	3,303
September	3,012	3,016	3,143	3,206
October	2,975	3,029	3,161	3,090
November	2,980	2,888	3,150	3,169
December	2,930	3,068	3,336	3,373

Table 14.—Runs to stills and output of refineries in 1969, by months

(Thousand 42-gallon barrels)

Month	Runs		Output							
	Crude	Products	Rerun	Gasoline	Kerosine	Fuel oil		Jet fuel	Miscellaneous	Special naphtha
						Distillate	Residual			
January	77,912	12,152	−2,129	40,181	4,333	19,367	3,751	6,336	12,865	1,102
February	79,049	10,102	−3,135	39,056	4,809	18,915	3,638	5,667	12,573	1,358
March	86,229	11,693	−1,059	43,326	4,817	21,652	3,942	6,557	15,132	1,437
April	82,612	11,418	−4,946	39,912	2,947	19,482	3,690	7,354	14,503	1,198
May	88,514	12,418	−5,024	45,293	3,357	19,379	3,814	7,292	15,294	1,479
June	86,207	12,441	−2,176	44,616	3,904	20,088	3,359	7,403	15,564	1,638
July	89,470	12,122	−3,173	47,116	2,725	20,009	3,561	8,587	15,114	1,307
August	89,026	12,630	−2,159	47,874	3,498	19,468	2,561	8,175	16,500	1,421
September	83,797	12,690	−2,074	45,920	3,075	18,960	3,168	7,131	14,716	1,443
October	84,750	13,484	−3,044	46,540	3,319	18,918	2,858	6,772	15,480	1,303
November	82,495	13,381	+551	46,845	2,876	20,555	3,068	7,342	14,817	1,424
December	90,079	13,205	−3,045	48,107	3,478	21,132	2,947	8,065	15,042	1,468
Total:										
1969	1,020,140	147,736	−31,413	534,286	43,138	237,925	40,357	86,681	177,600	16,578
1968	997,367	140,900	−17,922	r 511,362	41,845	252,329	45,898	82,495	171,009	15,407

r Revised.

Table 15.—Stocks of crude petroleum at refineries, tank farms, and gathering systems in 1969, as of last day of each month

(Thousand 42-gallon barrels)

Month	Refineries	Tank farms and pipelines	Lease tanks	Total
January	15,880	68,679	5,862	90,421
February	15,671	65,310	5,862	86,843
March	15,607	60,296	5,959	81,862
April	16,553	65,120	5,672	87,345
May	16,220	67,759	5,882	89,861
June	16,792	71,268	6,134	94,194
July	16,463	70,376	5,581	92,420
August	16,041	64,596	6,116	86,753
September	15,869	64,194	6,032	86,095
October	15,819	65,077	5,348	86,244
November	14,993	64,730	5,811	85,534
December	15,149	64,896	5,788	85,833

Table 16.—Stocks of refined products held by refining and pipeline companies in 1969, by months

(Thousand 42-gallon barrels)

Month	Naphthas	Gasoline	Kerosine	Fuel oil		Jet fuel	Miscellaneous products	Total refined products
				Distillate	Residual			
January	1,853	37,318	2,949	16,394	6,570	5,071	33,558	103,713
February	2,094	39,760	2,825	13,695	7,018	4,934	33,590	103,916
March	2,461	40,029	3,324	11,468	6,156	4,622	33,170	101,230
April	2,129	33,961	3,128	11,064	6,441	4,875	35,675	97,273
May	2,263	31,187	3,300	13,311	6,399	5,459	37,556	99,475
June	2,514	30,689	4,149	16,002	6,221	4,926	38,156	102,657
July	2,431	29,988	3,905	17,924	5,750	5,425	36,977	102,400
August	2,267	29,923	4,870	21,154	6,449	6,452	35,217	106,332
September	2,463	30,598	5,032	23,679	6,316	6,443	34,503	109,034
October	2,462	32,719	5,053	26,544	5,857	6,115	35,067	113,817
November	2,349	35,853	4,516	26,146	6,085	6,101	34,188	115,238
December	2,501	37,800	4,159	22,545	5,934	5,079	35,644	113,662

According to AAPG, exploratory drilling resulted in 330 oil discoveries. Developmental drilling resulted in 3,926 oil well completions.

In the Panhandle (RRC District 10), there was drilling in 18 of the 26 counties. Hutchinson and Ochiltree Counties were the leading areas of drilling activity within the district. Wildcat acreage prices remained stable with the trend toward shorter term leases, which should lead to more rapid evaluation.

West Texas (RRC Districts 7C, 8, and 8A) remained one of the more active petroleum exploration areas in the United States. Most of the exploratory activity, however, was for deep gas reserves. Leasing was active, and at a University of Texas oil and gas lease sale held on May 15, $3,507,800 was received for 66,123 acres (average price $53.05 per acre). A similar sale held on December 16 totaled $1,736,500 for 37,636 acres (average price $46.14 per acre).

North central Texas (RRC Districts 7B and 9) had an increase in drilling activity. Exploratory drilling increased 19 percent with a success ratio of 22 percent. Production continued to decline and was down 5 percent.

In south Texas (RRC Districts 1, 2, and 4) producing trends generally parallel the Gulf of Mexico coast line. The most prolific discovery in 1969 was the Indian Creek field in Jackson County where a new Frio (Oligocene-Miocene) multipay oilfield was found.

In east Texas (RRC Districts 5 and 6) drilling activity was less than in 1968, a continuing decline. The Woodbine Formation (Upper Cretaceous) was the principal target of total drilling activity, but the Smackover Formation (Jurassic) was the objective of most of the exploratory wells. Leasing was down from last year, and drilling will probably continue to decline.

The Upper Gulf Coast (RRC District 3) had a pronounced increase in exploratory drilling (37 percent). The Eocene was the most actively explored trend. Miocene activity gained most compared with 1968 activity. Much of the increase was due to efforts to evaluate offshore tracts. No Federal offshore lease sales were held in 1969; however, two State sales were held. On July 1, lease bonus for 28,081 acres averaged $43.16 per acre, and on November 4, the bonus for 60,013 acres averaged $40.48 per acre.

The first, and one of the most successful, miscible-flood projects—Block 31 unit, in Crane County—produced its 100 millionth barrel of crude in mid-1969. The unusually good oil recovery was credited to the gas injected at hight pressure to form a miscible flood front.

The SACROC unit operators in Kelly-Snyder field made plans to inject carbon dioxide in conjunction with the water being injected for pressure-maintenance purposes. The gas will be piped 200 miles from wells in west Texas, where it is now vented. The SACROC unit contains 1,296 of the 1,327 wells in the field, and waterflooding has been underway since 1954. At present it has 72 injection wells, and this project will be the first to use carbon dioxide for oil recovery on such a large scale.

A reportedly successful Mobil Oil Corp. fireflood near Freer indicates the process may be used successfully on reservoirs previously considered uneconomic. The reservoir had a strong natural waterdrive and, prior to the start of the fireflood, had yielded 40 percent of the original oil in place. At startup, the project area was producing with a 98-percent water cut, and remaining oil saturation was estimated to be 800 barrels per acre foot. Since initiation of the thermal project, 500,000 barrels of oil has been produced.

Crude oil stocks above ground in Texas at yearend totaled 85,833,000 barrels, down 5.4 percent from the end of 1968. Refinery stocks were 15,149,000 barrels, 19.9 percent of the U.S. total. Stocks at tank farms and in pipelines were 64,896,000 barrels, and on leases 5,788,000 barrels. Refinery stocks were 12.6 percent less than at the end of 1968; tank farms and pipeline stocks declined 3.3 percent and on-lease stocks declined 7.5 percent.

Crude oil refinery receipts rose 1.8 percent to 1,018,207,000 barrels (30.3 percent of U.S. total). Intrastate receipts accounted for 75.3 percent of the Texas refinery receipts.

Capacity of the 47 active oil refineries was 3,394,300 barrels per stream-day (b/sd), an increase of 4.6 percent over that in 1968, according to the Oil & Gas Journal. Texas refineries had approximately 27 percent of the total U.S. refining capacity.

The additional capacity over 1968 was due entirely to expansion projects. Coastal States Petrochemical Co., at its Corpus Christi refinery, expanded crude capacity from 90,000 to 140,000 b/sd and vacuum capacity from 10,000 to 30,000 b/sd. This was the largest expansion in the United States during the year and, as a result, the company became the 18th ranked refiner in the Nation according to capacity.

Atlantic Richfield Co. at Houston expanded and modernized its refinery, and added air pollution control equipment.

Crown Central Petroleum Corp. neared completion of expansion and modernization of their Houston refinery. The previously existing 40,000-b/sd crude facilities were abandoned and new 80,000-b/sd facilities were installed. New units installed include an 11,000-b/sd reformer, a 9,500-b/sd delayed coker, a 31,500-b/sd fluid cat cracker, a 4,000-b/sd HF-alkylation unit, and a 20,000-b/sd increase in vacuum capacity. A 6,000-barrel-per-hour automatic gasoline blender was also added.

Cosden Oil and Chemical Co. at Big Spring opened a new 25,500-b/sd crude unit, boosting capacity to 56,000 b/sd. The company closed its Colorado City 13,000-b/sd refinery and consolidated all crude operations at its Big Spring complex.

American Oil Co., at Texas City, added a 40,000-b/sd ultracracker unit. This is a new process described by the company as a simplified version of hydrocracking based on improved catalysts; Chevron Oil Co. at El Paso added a 14,000-b/sd catalytic cracker and cycle stock pretreatment unit; Gulf Oil Corp. at Port Arthur completed delayed coking expansion. The new unit will yield approximately 700 tons of coke per day. Humble Oil & Refining Co. at Baytown installed a 35,000-b/sd hydrofiner and Mobil Oil Corp. at Beaumont increased capacity from 330,000 to 350,000 b/sd. Sinclair Oil Corp. at Houston added a 6,000-b/sd naphtha olefin saturation unit, and a 1,200-ton-per-day coking unit. Union Oil Co. of California at Beaumont added a hydrotreater and a fractionation unit.

Texaco, Inc., at Port Arthur was expanding capacity from 310,000 to 390,000 b/sd. Completion was expected in early 1971.

Petrochemicals.—The petrochemical industry remained one of the major contributors to the manufacturing economy of the State. Most of the industry was concentrated along the Gulf Coast from Corpus Christi, through Freeport, Bay City, Houston, and Beaumont, Tex., to the Louisiana border.

Amoco Chemicals Corp. at Texas City completed a 23-million-gallon-per-year polybutenes plant, a 500-million-pound-per-year styrene monomer expansion, and a 1,500-ton-per-day anhydrous ammonia plant. Celanese Chemical Co. at Clear Lake completed a 300-million-pound-per-year ethylene oxide unit and a 240-million-pound-per-year ethylene glycol unit. The Dow Chemical Co. at Freeport expanded its 20-million-pound-per-year glycerine capacity to 120 million pounds. Dow Badische Co. at Freeport built a 200-million-pound-per-year oxoalcohol plant. E. I. du Pont de Nemours & Co., Inc., at Beaumont completed a 200-million-gallon-per-year methanol plant. Petro-Tex Chemical Corp. at Houston completed a 45-million-pound-per-year chloroprene monomer plant and a 45-million-pound-per-year neoprene plant. Sinclair Petrochemicals, Inc., at Houston completed a 50-million-pound-per-year orthoxylene expansion to 200 million pounds per year. Sonford Chemical Co. at Port Neches completed new facilities to produce 10 million pounds per year of tetrachlorobenzene. Southern Petrochemicals Corp. at Houston completed a 40-million-pound-per-year polystyrene plant. Suntide Refining Co. at Corpus Christi completed a 20-million-pound-per-year pseudocumene plant. Union Carbide Corp. at Texas City completed a 1,200-million-pound-per-year ethylene unit. Gulf Oil Corp. continued work on their 900-million-pound-per-year ethylene unit at Port Arthur, and Shell Chemical Co. at Deer Park continued work on a 1,000-million-pound-per-year ethylene unit.

NONMETALS

Nonmetallic minerals constituted approximately 7.0 percent of the total mineral value in 1969. Nonmetals production had a total value of $404 million, a decrease of 5.6 percent from the 1968 value. The five principal nonmetallic commodities, in order of value, were cement, sulfur, stone, salt, and sand and gravel.

Increased production was reported for cement, gypsum, lime, salt, sulfur (table 25) talc and soapstone, and vermiculite.

Declines in output were registered for bromine, clay, graphite, magnesium compounds, pumicite, sand and gravel, stone, and sodium sulfate.

Barite.—No production of crude barite was reported. The State's only barite mine, located in the Seven Heart Gap area of Culberson County, remained inactive during 1969. Barite mined outside of Texas was processed at plants in Brownsville, Corpus Christi, and Houston for use chiefly as well-drilling-mud additive. In Houston, a second barite-grinding plant, IMC Drilling Mud, Inc., reported output for the first time in 1969. Total production of processed barite in the State increased sharply over 1968.

Bromine.—Production of bromine in Texas ceased in 1969. Ethyl-Dow Chemical Co. closed its Freeport plant on December 1 after 28 years of operation. During the final year of operation, production of ethylene dibromide at the Freeport plant was much lower than that of 1968. The facility was closed following development of a new plant near Magnolia, Ark., by Bromet (a firm formed in 1968 by Ethyl Corp. and Great Lakes Chemical Co.) to produce bromine and bromine compounds from Arkansas brines.

Cement.—With an increase of over 4 percent for the year, Texas cement producers achieved a new record high in shipments of portland cement. Average price per barrel was $3.27 compared with $3.12 in 1968.

Thirteen companies operated 19 cement plants in the State—five in the Houston area; three in the San Antonio area; three in the Dallas-Midlothian area; and one each in Amarillo, Corpus Christi, El Paso, Fort Worth, Maryneal, Odessa, Orange, and Waco. The plants had a combined total capacity of 45.3 million barrels per year and operated at about 82-percent capacity.

Table 17.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1965	30,771	30,820	$97,598
1966	31,487	30,827	97,188
1967	32,277	31,944	99,329
1968	34,161	34,499	107,532
1969	35,823	36,037	117,989

Several additions were made to facilities during 1969. Capitol Cement, Division of Capitol Aggregates (a subsidiary of H. B. Zachry Co.) completed expansion of its cement plant in San Antonio. Capacity was increased from 1 million to 1.5 million barrels per year. A 12-foot by 325-foot kiln was extended in length to 475 feet. Slurry tanks a 300-horsepower kiln drive, and an electrostatic precipitator were installed.

Gifford-Hill Portland Cement Co., Division of Gifford-Hill Co., Inc., began enlarging the capacity of its wet-process Midlothian plant to 3 million barrels per year. Completion was scheduled for late 1970. Plans included installation of a second kiln (12 by 450 feet), two grinding mills (a 10- by 28-foot raw mill and an 11- by 34-foot finish mill), and an 18-foot separator.

Longhorn Cement, Division of Kaiser Cement & Gypsum Corp., installed an electrostatic precipitator at their wet-process plant in San Antonio. The plant has three 11- by 250-foot kilns.

Universal Atlas Cement, Division of United States Steel Corp., began production of white cement at the company's plant southwest of Waco. The new facility contains a 350-foot kiln, two ball mills, a 14-foot air separator, 15 cement silos, and three clay-slip tanks.

Lone Star Cement Corp., a producer of portland cement, began construction of a new ready-mix concrete plant at Bayport Industrial Park in southeast Harris County. Design production capacity is 100 cubic yards per hour.

Clays.—Clay production was reported by 56 producers from 96 pits in 47 counties. Clay sold or used by producers declined during 1969. Tonnage dropped 6 percent, and total value dropped 2 percent. Output of miscellaneous clay, fire clay, and fuller's earth decreased; production of ball clay, bentonite, and kaolin registered gains for the year.

Bentonite, which was mined in Angelina, Fayette, Gonzales, and Walker Counties, increased 7.9 percent in output and 7.1 percent in total value. It constituted about 7.6 percent of the total value of clays sold or used. Bentonite was used as a drilling-mud additive, a filtering and decolorizing agent, a pottery-whiteware material, an animal-feed and insecticide filler, and a grease absorbent.

Table 18.—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
1965	114	$829	735	$1,999	3,605	$3,832	4,469	$6,865
1966	107	876	859	2,057	3,523	3,934	4,516	7,187
1967	97	660	748	1,862	3,598	4,882	4,497	8,081
1968	92	611	766	1,988	3,756	5,388	4,687	8,860
1969	100	655	635	1,669	3,593	5,402	4,407	8,664

[1] Includes ball, kaolin, and fuller's earth.

Fuller's earth was mined in Fayette County, ball clay was mined in Cherokee County, and kaolin was mined in Limestone County.

A sharp reduction in production of fire clay was reported by 11 producers from 19 pits in 10 counties. Over 88 percent of the output was used in the manufacture of building brick. Fire clay also was used to make firebrick, stoneware, and art pottery.

Several producers of fire clay expanded their facilities during the year. Henderson Clay Products, Inc., was enlarging its office space at Henderson in Rusk County to accomodate additional personnel and equipment. A. P. Green Refractories Co. (subsidiary of United States Gypsum Co.), a producer of fire clay in Hopkins and Wood Counties, added a tunnel kiln at its plant in Sulphur Springs. W. S. Dickey Clay Manufacturing Co. was reportedly planning a $3.7 million expansion to its vitrified clay-pipe plant at Saspamco in Wilson County.

Although output of miscellaneous clay decreased 4 percent, total value increased slightly in 1969. Average value was $1.50 per short ton. Over 39 percent of production was used in the manufacture of cement, and about 26 percent was used to make lightweight aggregate. Other uses were for making art pottery, building brick, floor and wall tile, and vitrified sewer pipe.

Texas Clay Products, Inc., added a new clay-storage shed at its plant in Malakoff, Henderson County, to provide space for a larger reserve supply of dry clay.

A new company, Bay Prairie Aggregate Corp., began production of miscellaneous clay northeast of Lane City in Wharton County. The clay was mined from an open pit by scrapers and was crushed, screened, and processed through a rotary kiln. The resulting aggregate was used as roadbase material in highway construction.

During the year, First Worth Corp., of Fort Worth, acquired Ferris Brick Co., a producer of miscellaneous clay and manufacturer of building brick in the Mesquite area of Dallas County. Acme Brick Co., Division of First Worth Corp., took over operation of the facility. The Acme Brick Co. plant at Ferris, southeast of Dallas in Ellis County, was closed during 1969.

Gem Stones.—Gem stones including rock and mineral specimens—having an estimated total value of $150,000—were collected by dealers and hobbyists. Materials collected included agate, calcite, jasper, cinnabar, fluorite, fossiliferous limestone, opal, petrified wood, tektites, topaz, and others.

Graphite.—Texas continued as the Nation's only producer of natural crystalline flake graphite. Southwestern Graphite Co., subsidiary of The Joseph Dixon Crucible Co., operated an open pit graphite mine in western Burnet County. Production was lower than in 1968, but sales and total value of the graphite registered gains. Natural crystalline flake graphite is used chiefly in crucibles, foundry facings, and pencils.

Gypsum.—Production of gypsum was reported by eight companies from open pits in Culberson, Fisher, Gillespie, Hardeman, Hudspeth, and Nolan Counties. Output increased 26 percent from that of the previous year; total value was up 22 percent. Average price was $3.35 per short ton in 1969 compared with $3.48 in 1968 and $3.63 in 1965.

Table 19.—Crude gypsum mined
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	1,045	$3,794
1966	899	3,258
1967	984	3,419
1968	1,039	3,616
1969	1,314	4,398

A large percentage of the crude gypsum was dehydrated to form calcined gypsum. Uses of the calcined material included manufacture of wallboard and other board products, plasters, and joint compounds. Uncalcined gypsum was used as portland cement retarder, as soil conditioner in agriculture, and in brewer's fixe.

A new producer, Elcor Chemical Corp., reported the mining of crude gypsum during 1969. The corporation was developing a plant in Culberson County to extract elemental sulfur from gypsum.

Lime.—Output and total value of lime in Texas increased 4 percent over 1969. Production was reported by 12 companies at 16 plants (11 companies at 15 plants in 1968) located in Bexar, Brazoria, Calhoun, Comal, Harris, Hill, Jasper, Johnson, Nueces, Travis, and Williamson Counties.

Table 20.—Lime sold or used by producers
(Thousand short tons and thousand dollars)

Year	Quick-lime	Hydrated lime	Total	
			Quantity	Value
1965	717	621	1,338	$19,663
1966	802	671	1,473	18,696
1967	854	711	1,564	20,713
1968	926	638	1,564	21,154
1969	887	746	1,633	22,107

Chemical uses including preparation of alkalies, for metallurgy, paper manufacture, water purification, and petro-chemical feedstocks consumed 69 percent of the total lime produced in the State. Construction uses, such as soil stabilization, masons lime, and finishing lime increased during the year. Other uses of lime were for agricultural purposes and for refractories.

Over 1.5 million short tons of limestone were used as raw material to prepare lime. Shell, dredged from shallow bays along the Gulf Coast, was used as the calcium carbonate source in some plants.

Announcement was made early in the year of a change in ownership of Southwestern Superior Products Corp., operator of the "Round Rock Lime Co.," with lime plants at Round Rock and Blum. The purchasers, Holly Corp., of Azusa, Calif., and Development Engineering, Inc., of Denver, Colo., planned to continue operation of the plants using the same name, "Round Rock Lime Co." Later in the year, the lime plant at Round Rock was closed because of excessive dust emission. Plans were announced for the construction of a new plant with a high-capacity vertical kiln that would reduce dust output.

Texas Lime Co., subsidiary of Rangaire Corp., added a 350-ton-per-day kiln at its plant about 12 miles west of Cleburne in Johnson County. The large kiln, 11 feet in diameter and 275 feet in length, required 3 MMcf of gas per day for fuel. With the installation of the kiln, plant production capacity was increased to 525 tons per day. The company installed special dust-reduction devices to prevent air pollution.

Magnesium Compounds (except for metal).—Magnesium compounds were recovered from sea water at the Freeport plants of The Dow Chemical Co. in Brazoria County. Output was less than in 1968. A. P. Green Refractories Co. and E. J. Lavino & Co. processed magnesium hydroxide supplied by The Dow Chemical Co., to obtain magnesium oxide. The compounds —oxides, hydroxides, and carbonates—were used in the following industries: Cement, rayon, insulation, refractories, rubber, ceramics, fertilizer, chemical, and paper.

Natural Sodium Sulfate.—Brines containing sodium sulfate were obtained through wells from strata underlying shallow alkali lakes in Gaines, Terry, and Ward Counties. The only producer, Ozark-Mahoning Co., processed the brines and prepared salt cake at plants in Brownfield, Monahans, and Seagraves. Sodium sulfate production was down from that of 1968.

Perlite.—No crude perlite was produced in Texas during 1969. The only perlite mine in the State, about 40 miles southwest of Marfa in Presidio County, remained inactive. The assets of the former operators of the mine, Perlite Producers, Inc., were acquired early in the year by General Energy Corp., of Allentown, Pa.

Perlite mined outside of Texas was expanded at seven plants, one each in Dallas, Fort Worth, Tomball, Irving, LaPorte, Midland, and Sweetwater. Total output was slightly less than that of the previous year. Expanded perlite was used as aggregate in concrete, plaster, and horticulture. It was also used as a component of formed products such as tile and wallboard, filler, filter aid, masonry and cavity-fill insulation, and for other purposes.

Pumicite (Volcanic Ash).—Pumicite was produced near Rio Grande City in Starr County by Nordmeyer, Inc., at the open

pit mine formerly operated by Pozzolana Corp. The output, which was less than that of 1968, was used chiefly as an admixture in oil-well cement.

Salt (Sodium Chloride).—The Texas salt industry reached a new high in production during 1969. Tonnage of salt was up 9 percent from that of 1968, up 33 percent from that of 1965, and up 105 percent from that of 1959. The continued rise in production reflects the growth of chemical and other industries that require large quantities of salt. Texas producers accounted for 21 percent of the Nation's total salt output.

Table 21.—Salt sold or used by producerss

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	6,964	$30,771
1966	7,724	33,797
1967	8,344	36,435
1968	8,534	42,663
1969	9,261	43,012

Average price per short ton of all salt produced in Texas was $4.64 in 1969, compared with $5 in 1968, $4.42 in 1965, and $3.87 in 1959.

Production consisted of rock salt, brine, and evaporated salt. Morton Salt Co. produced rock salt and evaporated salt in Van Zandt County, and United Salt Corp. produced rock salt in Harris County and evaporated salt in Fort Bend County. Most of the salt was obtained in the form of brine. Nine companies produced brine from wells in Brazoria, Chambers, Duval, Harris, Hutchinson, Jefferson, Matagorda, Ward, and Yoakum Counties.

Sand and Gravel.—Output of sand and gravel in Texas declined in 1969. Total tonnage was down 6 percent, and total value was down 4 percent for the year. Commercial production, which constituted 81 percent of the total, decreased over 13 percent in both quantity and value. Production was from 162 operations in 81 counties at an average price of $1.37 per short ton. Government-and-contractor (noncommercial) production of sand and gravel increased 46 percent in tonnage and 97 percent in total value. Noncommercial sand and gravel production was from 126 operations in 63 counties. Average price was $1.15 per short ton.

A new gravel pit went into production in the Eagle Lake area of Colorado County as Gifford-Hill & Co., Inc., opened a new $2.5 million facility with a work force of 30 persons. In Liberty County, a new facility was being developed by Southwest Towing & Shell Co. The $500,000 plant, on a 16-acre site at Fostoria, was designed to produce sand and multicolored gravel. The gravel was for use as exposed aggregate. In McLennan County, Waco Sand & Gravel Co. opened a new $250,000 facility near Waco. Designed capacity was 120 tons per hour. In Reeves County, Trans-Pecos Materials, Inc., purchased the Collier Spur sand and gravel pit from Trinity Concrete Products Co.

Stone.—Texas, the fourth leading State in stone production and value, registered a decline in stone output for the year. Total tonnage was down 4 percent, but total value increased 12 percent. Production of granite, graphitic schist, marl, and sandstone was up during 1969; output of basalt, dolomite, limestone, marble, metarhyolite, quartzite, and shell declined.

Crushed and dimension limestone constituted 76 percent of the total stone production and 75 percent of the total stone value. Production was reported from 136 operations in more than 61 Texas counties. Crushed limestone was used in the manufacture of cement and lime, as agricultural stone, bituminous aggregate, chemical stone, concrete aggregate, filler stone, flux stone, jetty stone, poultry grit, riprap, railroad ballast, roadbase stone, whiting, and for other purposes.

Table 22.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1965	27,488	$33,572	5,161	$2,503	32,649	$36,075
1966	23,089	28,947	3,133	2,366	26,222	31,313
1967	25,397	33,630	6,001	5,539	31,398	39,170
1968	27,919	38,183	3,924	3,363	31,843	41,546
1969	24,226	33,123	5,746	6,633	29,972	39,756

[1] Data may not add to totals shown because of independent rounding.

Table 23.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	5,788	$6,330	6,102	$6,151
Paving	4,284	4,493	4,141	4,742
Fill	879	643	927	624
Other [1]	1,448	5,006	1,121	4,765
Total [2]	12,399	16,472	12,292	16,283
Gravel:				
Building	7,807	11,369	5,488	7,981
Paving	6,788	9,114	5,728	8,056
Fill	338	261	280	162
Other [3]	587	967	439	640
Total	15,520	21,711	11,935	16,839
Total sand and gravel [2]	27,919	38,183	24,226	33,123
Government-and-contractor operations:				
Sand:				
Building	19	24	8	9
Paving	280	249	1,205	1,435
Fill	10	5	------	------
Other	1	1	------	------
Total [2]	310	279	1,214	1,444
Gravel:				
Building	25	32	3	4
Paving	3,547	3,026	4,515	5,179
Fill	42	26	12	6
Total [2]	3,614	3,084	4,531	5,189
Total sand and gravel [2]	3,924	3,363	5,746	6,633
Grand total	31,843	41,546	29,972	39,756

[1] Includes railroad ballast (1968) other construction sand and industrial sand (unground and ground).
[2] Data may not add to totals shown because of independent rounding.
[3] Includes miscellaneous and other construction gravel.

Table 24.—Stone sold or used by producers, by kinds
(Thousand short tons and thousand dollars)

Year	Limestone [1]		Sandstone [2]		Shell		Total [3]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1965	27,882	$31,095	881	$1,423	9,689	$15,356	39,520	$53,659
1966	32,373	39,591	1,257	1,729	9,365	12,839	43,578	56,659
1967	36,153	40,372	2,012	2,270	10,776	15,417	49,424	61,577
1968	36,121	38,957	1,222	1,773	7,851	10,785	48,480	58,006
1969	35,259	48,452	1,243	2,101	7,177	8,558	46,638	64,986

[1] Includes dolomite through 1967.
[2] Includes quartzite through 1967.
[3] Includes other stone to avoid disclosing individual company confidential data.

A spokesman for Round Rock Lime Co. announced in August that the company had obtained a lease to mine limestone on the Weir Ranch south of Georgetown in Williamson County.

Dimension limestone was quarried in Gillespie, Jones, Tarrant, and Williamson Counties. It was used as cut and sawed stone, flagging, rough blocks and rubble, and for other purposes.

Shell, obtained along the Gulf Coast, accounted for 15 percent of the total stone production in Texas and 13 percent of the total value. Almost one-half of the shell output was used in the manufacture of cement and lime; the remainder was used as roadbase material, concrete aggregate, and for other purposes. Shell production was down almost 9 percent for the year.

Sulfur.—World supplies of sulfur grew more rapidly than the market demand, resulting in a buildup of producer inventories and lower unit prices. Production of Frasch sulfur by Texas producers increased

3 percent during 1969, but shipments declined about 1 percent in amount and 35 percent in total value. By yearend, producers' stocks were 68 percent higher than at the start of 1969.

Value of Texas Frasch sulfur dropped from an average of $41.03 per long ton in 1968 to an average of $26.79 per long ton in 1969. At yearend, however, the actual price for Texas sulfur was far lower than the year's average.

Production of Frasch sulfur was reported by six companies at 12 operations in Culberson, Fort Bend, Galveston, Jefferson, Liberty, Matagorda, Pecos, and Wharton Counties. The sulfur was obtained from wells drilled into the caprock of Gulf Coast salt domes and into subsurface Permian strata in west Texas.

Table 25.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1965	2,534	3,674	$83,282
1966	2,916	3,703	96,820
1967	2,956	3,448	111,931
1968	3,203	2,571	105,482
1969	3,289	2,552	68,360

On the Texas Gulf Coast, Phelan Sulphur Co. closed its 150,000-ton-per-year plant at Nash dome in Brazoria County in early November. The plant had been in operation since 1966. A new producer, Pan American Petroleum Corp., subsidiary of Standard Oil Co. of Indiana, began operations at High Island salt dome about 35 miles northeast of Galveston in Galveston County.

In west Texas, Duval Corp. began production of sulfur in Culberson County and announced recoverable reserves of over 57 million long tons. Located near Rustler Springs about 18 miles southwest of Orla, the new Frasch plant has a capacity of 1.5 million long tons per year. The completion of a 30-mile railroad spur from the plant to the Santa Fe line in Eddy County, New Mexico, enables molten sulfur to be moved by tank cars from the plant to Galveston—a distance of over 900 miles.

Sinclair Oil Corp., a producer of Frash sulfur northeast of Fort Stockton in Pecos County, merged with Atlantic Richfield Co. in 1969. Production continued at the sulfur facility under the new company.

Elcor Chemical Co., which in 1968 constructed the Rock House plant in Culberson County to extract elemental sulfur from gypsum, delayed the beginning of operations in order to modify some equipment.

Geology, exploration, and production of west Texas sulfur deposits were discussed in a new publication, "Sulfur in West Texas: Its Geology and Economics," issued as Geological Circular 69-2 of the Bureau of Economic Geology of the University of Texas at Austin.

Exploration for native sulfur extended into Central Texas during the year. Cores from test holes drilled by Roland K. Blumberg Co. on the Hughson Ranch northeast of San Marcos in Hays County revealed the presence of sulfur in the Edwards Formation (Lower Cretaceous).

Although not included in table 1, additional elemental sulfur was obtained from sour gas and oil at 45 recovery plants located in 24 Texas counties. Shipments from the plants totaled 728,978 long tons of sulfur, an increase of 13 percent. Total value of shipments was $19,810,573. Average price was $27.18 per long ton, compared with $39.47 in 1968.

Talc and Soapstone.—With five companies reporting output in 1969, mined production of talc and soapstone increased 30 percent, and total value increased 29 percent. The output was used in ceramics, roofing material, insecticides, paint, and for other purposes.

Most talc production was from Hudspeth County from open pits in the Allamoore area west of Van Horn. Pioneer Talc Co., Inc., operated a talc-grinding mill at Allamoore. Production commenced in a second west Texas county in 1969 as Continental Minerals opened a mine in Culberson County. The new operation is at Tumbledown Mountain on the McVay Ranch north of Van Horn. The company was converting its barite-grinding mill east of Van Horn into a talc-grinding facility.

In central Texas, United Sierra, Division of Cyprus Mines Corp., mined soapstone from the open pit Stein Mine in Gillespie County and Llano Mine in Llano County. The company also mined talc in Hudspeth County and operated a talc-grinding mill at Llano.

Vermiculite.—The assets of Perlite Producers, Inc., operators of the State's only

vermiculite mine, were acquired in 1969 by General Energy Corp., of Allentown, Pa. A subsidiary of the new owners, Lanmont, Inc., took over operations of the mine in Llano County and the exfoliating plant in Llano. Output was used chiefly as roofing aggregate.

Crude vermiculite, mined outside of Texas, was exfoliated at plants in Dallas, Houston, and San Antonio for use as lightweight aggregate in concrete, soil conditioner, horticultural material, additive in plaster, and other purposes. Total output of exfoliated vermiculite in the State was up 33 percent for the year.

METALS

Metal mining remained a minor factor in the 1969 mineral economy, accounting for $43 million, less than 1 percent of the State's total mineral value. Three of the four minerals produced—mercury, uranium ores, and magnesium metal (from sea water and underground brines)—were important in their own metal markets. All of these metals except iron and steel were largely consumed by markets outside Texas. There was an important and diversified metals extractive and processing industry in the State. This industry smelted or refined primary aluminum, antimony, copper, iron, lead, magnesium, manganese, tin, zinc, and byproducts such as cadmium, gold, and silver. Metal scrap for re-use in manufacturing was also processed and refined. Another industry segment (foundries) processed and fabricated metals into various shapes and products. The combined metals industries contributed to State payrolls, to local and State taxes, and made large investments in plant sites, capital expenditures, materials, and supplies during 1969.

Primary Metal Extraction.—There were 19 metal smelters, refineries, and reduction plants operating in 1969. A new electrolytic magnesium plant began shakedown operations; a steel mill was under construction, and a number of plants were undergoing capacity expansions or process modification. Aluminum Company of America installed a 50,000-ton pot line at its Rockdale Smelting Works. The company continued a $1 million expansion of its casting facilities at the Point Comfort Smelting Works with installation of additional furnaces and direct-chill casting units. Reynolds Metals Co. was adding 250-ton-per-day capacity to its Sherwin alumina facility in San Patricio County after completing a similar expansion in 1968. Copper refining capacity of Phelps Dodge Refining Corp. El Paso plant was increased by 95,000 tons per year to a total of 420,000 tons per year, and a new rod mill was added to the complex. Armco Steel Corp. continued installation of a 120-inch-wide structural unit at its Houston works in Harris County. The company completed a $2.25 million waste-gas cleaning unit on its two electric furnace units. In order to meet State and Federal pollution limits, Lone Star Steel Co. was testing equipment designed to remove dust-laden air from steelmaking facilities.

The Texas City tin smelter was sold to Gulf Chemical and Metallurgical Corp. by Fred H. Lenway & Co., Inc. The new owners plan to renew tin recovery from low-grade, complex Bolivian ores. Benilite Corp. of America was building a titanium dioxide processing facility in Corpus Christi, Nueces County.

There were 20 secondary (scrap) processors in Texas in 1969. Most of the plants were in or near metropolitan areas because their material supply was largely generated in these areas. A major accessory industry segment, composed of 55 gray iron foundries, 19 steel foundries, and 12 malleable iron foundries, was dispersed over the State.

Iron Ore.—Brown iron ores were produced in Cass, Morris, and Nacogdoches Counties. Total output was greater than in 1968. Ore markets were the integrated steel mill of Lone Star Steel Co. and a number of portland cement plants. Limonite (iron oxide) and siderite (iron carbonate), were recovered from open pits and trucked to a mill where they were crushed, washed, sized, and sintered. Sintered ore was used as a component of blast furnace feed. Portland cement plants used iron ore when the limestone rock and clay of the raw material mix were deficient in iron content.

Magnesium Chloride (for metal).—Magnesium chloride for metal was recovered from sea water at The Dow Chemical Co.'s Freeport plants in Brazoria County, and from underground brines in Scurry County. Output was greater than in 1968.

Table 26.—Smelters, refineries, and reduction plants in 1969

Product, company, and plant	Location (county)	Material treated
Aluminum:		
Aluminum Company of America:		
Point Comfort (alumina)	Calhoun	Bauxite.
Point Comfort (reduction)	do	Alumina.
Rockdale (reduction)	Milam	Do.
Reynolds Metals Co.:		
Sherwin Works (alumina)	San Patricio	Bauxite.
San Patricio (reduction)	do	Alumina.
Antimony:		
National Lead Co.: Laredo smelter	Webb	Ore.
Cadmium:		
American Smelting & Refining Company: Electrolytic.	Nueces	Flue dust.
Copper:		
American Smelting & Refining Company: El Paso smelter	El Paso	Ore and concentrates.
Phelps Dodge Refining Corp.: Nichols refinery	do	Blister and anode.
Iron:		
Lone Star Steel Co.: Daingerfield plant	Morris	Ore and scrap.
Armco Steel Corp.: Houston plant	Harris	Do.
Lead:		
American Smelting & Refining Company: El Paso smelter.	El Paso	Ore and concentrates.
Magnesium:		
The Dow Chemical Co.: Freeport plants, Electrolytic.	Brazoria	Sea water.
Manganese: Tenn-Tex Alloy Chemical Corp	Harris	Ore.
Tin-Tungsten:		
Gulf Chemical & Metallurgical Corp.: Texas City smelter	Galveston	Do.
Zinc:		
American Smelting & Refining Company:		
Amarillo retort smelter	Potter	Ore and concentrates.
Corpus Christi electrolytic	Nueces	Do.
El Paso fuming plant	El Paso	Dusts and residues.
American Zinc Co.:		
Dumas retort smelter	Moore	Concentrates and fumes.

Table 27.—Secondary metal recovery plants

County and company	Material	Products
Dallas:		
ABASCO, Inc	Aluminum scrap	Aluminum ingots, dioxidizing bars and shot.
American Smelting & Refining Company	Lead and zinc scrap	Lead and zinc ingots, pigs, alloys.
Dixie Lead Co	Lead scrap	Lead pigs, alloys, chemicals.
National Lead Co., Southwestern Branch	Battery plates	Lead products.
Southern Lead Co	do	Lead pigs, alloys.
El Paso: Border Steel Mills, Inc	Steel scrap	Steel shapes, reinforcing bars.
Gregg: R. G. LeTourneau, Inc	do	Heavy mobile equipment.
Guadalupe: Structural Metals, Inc	do	Structural steel reinforcing bars.
Harris:		
A & B Metal & Smelting Co	Aluminum, lead scrap	Lead pigs, ingots, aluminum ingots, alloys.
Federated Metals	Various metals	Lead products, alloys of copper, lead, zinc, magnesium, tin.
Gulf Reduction Corp	Aluminum, zinc scrap	Aluminum and zinc ingots, alloys.
Houston Lead Co	Lead scrap	Lead pigs, ingots, alloys.
Houston Fishing Tackle Co	Soft lead scrap	Lead products.
Lead Products, Inc	Lead scrap	Lead pigs, ingots, alloys.
Magnus Metal	Various metal scrap	Lead, brass, bronze bearing metal.
Southwest Saw Corp	Steel scrap	Steel alloys.
Sterling Type, Rule, & Metals Co	Type metal	Type metal.
Vulcan Detinning Co	Tinned scrap	Refined tin, baled detinned steel.
Tarrant:		
National Metal & Smelting Co	Battery lead and aluminum scrap.	Lead pigs, ingots, battery metal, aluminum ingots.
Texas Steel Co	Steel scrap	Carbon and alloy steel bars and shapes, reinforcing bars.

The Dow Chemical Co. completed a 25,000-ton-per-year expansion of its Freeport magnesium plant late in 1968 and started a 30,000-ton-per-year expansion in 1969.

American Magnesium Co., at its new 30,000-ton-per-year plant 10 miles west of Snyder in Scurry County, attained partial production in 1969. The plant recovers about 2½ pounds of marketable chlorine for each pound of magnesium produced. Magnesium metal is used in aluminum and magnesium alloys as a reducing agent for beryllium, hafnium, titanium, uranium, and zirconium; as a deoxidizer and a scavenger.

Mercury.—The 1969 production of two producers in Brewster and Presidio Counties was considerably greater than 1968 output. One of the producers prepared to suspend operations in 1970.

Uranium.—Exploration and development of uranium deposits in Texas continued at an accelerated rate in 1969, with 40 drill rigs and 20 logging units active in the field in late 1969. Over 1 million acres were under lease in nine counties. Sixteen major mining, oil, gas, and chemical companies, and a host of independent operators were involved to some degree in these activities.

Texas ranked second in surface drilling for uranium in 1969 with a total of 6,411,708 feet of hole out of 29,854,882 feet for the United States. According to the U.S. Atomic Energy Commission, Texas ranked fourth in ore reserves with 3,812,529 tons based on an average grade of 0.18 percent U_3O_8 (and an $8-per-pound price).

Susquehanna-Western, Inc., began construction of a 1,000-ton-per-day uranium mill to treat the calcareous ores from Live Oak and Duval Counties. Completion was scheduled for mid-1970. The new facility will process ores from the J. C. Felder lease of Humble Oil and Refining Co., from a 1,000-acre lease of Tenneco Oil Co., and from the new Kopplin mine of Susquehanna. The mill site is located 5 miles northeast of Three Rivers on State Highway 72. Atlantic Richfield Co. announced discovery of a multimillion-pound ore body on the J. E. Lyne Ranch, 6 miles southwest of George West. Continental Oil Co. and partners reported that an extensive drilling campaign on 82 leases in the "uranium trend" had indicated important mineralization on 15.

Table 28.—Principal producers

Commodity and company	Address	Type of Activity	County
Asphalt (native):			
Uvalde Rock Asphalt Co	P.O. Box 531 San Antonio, Tex. 78206	Mine	Uvalde.
White's Uvalde Mines, Inc	P.O. Box 499 San Antonio, Tex. 78206	----do	Do.
Barite:			
Dresser Minerals	P.O. Box 6504 Houston, Tex. 77005	Grinding plant.	Cameron.
The Milwhite Co., Inc	P.O. Box 15038 Houston, Tex. 77020	----do	Harris.
National Lead Co	P.O. Box 1675 Houston, Tex. 77001	----do	Nueces.
Bromine: Ethyl-Dow Chemical Co	Midland, Mich. 48640	Plant	Brazoria.
Carbon black:			
Ashland Chemical Co	P.O. Box 1503 Houston, Tex. 77005	Furnace	Aransas and Wheeler.
Cabot Corp	125 High St. Boston, Mass. 02110	Channel	Carson.
Do	----------	Furnace	Gray and Howard.
Columbian Carbon Co	380 Madison Ave. New York, N.Y. 10017	----do	Montgomery and Terry.
Do	----------	Channel	Gaines.
Continental Carbon Co	P.O. Box 22085 Houston, Tex. 77027	Furnace	Moore.
J. M. Huber Corp	P.O. Box 831 Borger, Tex. 79006	----do	Harris and Hutchinson.
Phillips Petroleum Co	Bartlesville, Okla. 74003	----do	Hutchinson and Orange.
Sid Richardson Carbon & Gasoline Co.	1200 Ft. Worth National Bank Bldg. Ft. Worth, Tex. 76102	Channel	Ector.
Do	----------	Furnace	Howard.
Cement:			
Alpha Portland Cement Co	15 South Third St. Easton, Pa. 18042	Quarry and plant.	Orange.
Capitol Aggregates, Inc., Capitol Cement Div.	Route 13, Box 412 San Antonio, Tex. 78209	Plant	Bexar.
Centex Cement Corporation	P.O. Box 9294 Corpus Christi, Tex. 78408	----do	Nueces.
General Portland Cement Co., Trinity Div.	2800 Republic Bank Tower Dallas, Tex. 75201	Quarry and plant.	Dallas, Harris, Tarrant.
Gifford-Hill Portland Cement Co	P.O. Box 520 Midlothian, Tex. 76065	----do	Ellis.
Gulf Coast Portland Cement Co., Div. of McDonough.	P.O. Box 262 Houston, Tex. 77001	Plant	Harris.
Ideal Cement Co., Texas Portland Cement Div.	420 Ideal Cement Bldg. Denver, Colo. 80202	----do	Do.
Kaiser Cement & Gypsum Corp	Permanente Rd. Permanente, Calif. 95014	Quarry and plant.	Bexar.
Lone Star Cement Corp	P.O. Box 47327 Dallas, Tex. 75247	----do	Harris and Nolan.
San Antonio Portland Cement Co	P.O. Box 6925 San Antonio, Tex. 78209	----do	Bexar.
Southwestern Portland Cement Co., Southwest Div.	P.O. Box 392 El Paso, Tex. 79943	----do	Ector, El Paso, Potter.
Texas Industries, Inc	P.O. Box 146 Midlothian, Tex. 76065	----do	Ellis.
Universal Atlas Cement Div., U.S. Steel Corp.	Chatham Center P.O. Box 2969 Pittsburgh, Pa. 15230	----do	McLennan.
Clay and shale:			
Acme Brick Co	P.O. Box 425 Ft. Worth, Tex. 76101	Mine and plant.	Denton, Ellis, Guadalupe, Nacogdoches, Parker, Wise.
Alpha Portland Cement Co	15 South 3d St. Easton, Pa. 18042	----do	Orange.
Dresser Minerals	P.O. Box 6504 Houston, Tex. 77005	----do	Angelina and Limestone.
Elgin Butler Brick Co	4000 East Ave. Austin, Tex. 78767	----do	Bastrop.
Featherlite Corp	P.O. Box 141 Ranger, Tex. 76470	----do	Bexar and Eastland.
General Portland Cement Co	P.O. Box 2698 Dallas, Tex. 75201	----do	Dallas, Harris, Limestone.
General Refractories Co	1520 Locust St. Philadelphia, Pa. 19102	----do	Cherokee.
Gulf Coast Portland Cement Co., Div. of McDonough.	P.O. Box 262 Houston, Tex. 77001	----do	Chambers.
Henderson Clay Products Co	P.O. Box 1251 Henderson, Tex. 75652	----do	Rusk.

Table 28.—Principal producers—Continued

Commodity and company	Address	Type of Activity	County
Clay and shale—Continued			
Lone Star Cement Corp	P.O. Box 47327 Dallas, Tex. 75247	Mine and plant.	Fisher and Harris.
The Milwhite Co., Inc	P.O. Box 15038 Houston, Tex. 77020	Mine	Fayette and Walker.
Reliance Clay Products Co	P.O. Box 20237 Dallas, Tex. 75221	Mine and plant.	Ellis, Palo Pinto, Smith.
Southern Clay Products, Inc	P.O. Box 44 Gonzales, Tex. 78629	----do	Cherokee and Gonzales.
Texas Clay Products, Inc	P.O. Box T Malakoff, Tex. 75148	----do	Henderson.
Texas Industries, Inc	8100 Carpenter Freeway Dallas, Tex. 75247	----do	Dallas, Eastland, Ellis, Fort Bend.
Coal (lignite):			
Atlas Chemical Indust., Inc	P.O. Box 790 Marshall, Tex. 75670	Strip mine	Harrison.
Industrial Generating Co	P.O. Box 1111 Rockdale, Tex. 76567	----do	Milam.
Graphite: Southwestern Graphite Co	Burnet, Tex. 78611	Mine	Burnet.
Gypsum:			
The Celotex Corporation	1500 North Dale Mabry Tampa, Fla. 33607	Mine and calcining plant.	Fisher.
Elcor Chemical Corp	Wilco Bldg. Midland, Tex. 79701	Mine	Culberson.
The Flintkote Co	Building Products Group-East 480 Central Ave. East Rutherford, N.J. 07073	Mine and calcining plant.	Nolan.
Fredericksburg Gypsum Co	P.O. Box 22204 Houston, Tex. 77027	Mine	Gillespie.
Georgia-Pacific Corp	900 SW 5th Portland, Oreg. 97204	Mine and calcining plant.	Hardeman.
National Gypsum Co	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Fisher.
Southwestern Portland Cement Co	P.O. Box 392 El Paso, Tex. 79943	Mine	Hudspeth.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	Plant	Harris.
Do	----------	Mine and calcining plant.	Nolan.
Texas Gypsum Co., Inc	P.O. Box 768 Irving, Tex. 75060	Plant	Dallas.
Iron ore:			
Arkansas Cement Corp	P.O. Box 398 Foreman, Ark. 71836	Open pit	Cass.
Lone Star Steel Co	P.O. Box 12226 Dallas, Tex. 75225	----do	Morris.
Mathis & Mathis Mining & Exploration Co.	P.O. Box 452 Silver City, N.M. 88061	----do	Cass.
Tex-Iron, Inc	Cushing, Tex. 75760	----do	Nacogdoches.
Lime:			
Aluminum Co. of America	1028 Alcoa Bldg. Pittsburgh, Pa. 15219	Plant	Calhoun.
Armco Steel Corp	P.O. Box 1367 Houston, Tex. 77001	----do	Harris.
Austin White Lime Co	General Delivery McNeil, Tex. 78651	----do	Travis.
Champion Papers, Inc	P.O. Box 872 Pasadena, Tex. 77501	----do	Harris.
The Dow Chemical Co	2020 Dow Center Midland, Mich. 48640	----do	Brazoria.
Eastex, Inc	P.O. Box 816 Silsbee, Tex. 77656	----do	Jasper.
McDonough Bros., Inc	Fredericksburg Rd. Route 8, Box 222 San Antonio, Tex. 78228	----do	Bexar.
PPG Industries, Inc	P.O. Box 4026 Corpus Christi, Tex. 78408	----do	Nueces.
Round Rock Lime Co	P.O. Box 218 Round Rock, Tex. 78664	----do	Hill and Williamson.
Texas Lime Co	P.O. Box 851 Cleburne, Tex. 76031	----do	Johnson.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	----do	Comal and Harris.
Magnesium compounds:			
The Dow Chemical Co	Midland, Mich. 48640	----do	Brazoria.
A. P. Green Refractories Co	Freeport, Tex. 77541	----do	Do.
E. J. Lavino & Co	Three Penn Center Plaza Philadelphia, Pa. 19102	----do	Do.

Table 28.—Principal producers—Continued

Commodity and company	Address	Type of Activity	County
Mercury:			
Butte Mining Corp	P.O. Box 3 Terlingua, Tex. 79852	Mine	Brewster and Presidio.
Study Butte Mining Co	300 Union Commerce Bldg. Cleveland, Ohio 44115	do	Brewster.
Mica: Western Mica Company, Div. United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	Plant	Tarrant.
Perlite:			
Filter Media, Inc	P.O. Box 19156 Houston, Tex. 77024	Expanding plant.	Harris.
Perlite of Houston, Inc	P.O. Box 8386 Houston, Tex. 77004	do	Do.
Perlite Industries, Inc	P.O. Box 6216 Midland, Tex. 79701	do	Midland.
Perlite Products Co	2651 Manila Dallas, Tex. 75212	do	Dallas.
Sil-Flo Corp	3405 North Sylvania Ave. P.O. Box 7086 Ft. Worth, Tex. 76111	do	Tarrant.
Texas Lightweight Products Co	117 North Britain Rd. Irving, Tex. 75060	do	Dallas.
United States Gypsum Co	101 South Wacker Dr. Chicago, Ill. 60606	do	Nolan.
Roofing granules: H. B. Reed & Co., Inc.	6937 Kennedy Ave. Hammond, Ind. 46323	Plant	Milam.
Salt:			
Diamond Shamrock Chemical Co	300 Union Commerce Bldg. Cleveland, Ohio 44115	Brine wells	Chambers.
The Dow Chemical Co	Midland, Mich. 48640	do	Brazoria.
Montex Chemical Co	104 East 3d Monahans, Tex. 79756	do	Ward.
Morton Salt Co	110 North Wacker Dr. Chicago, Ill. 60606	Underground mine and brine wells.	Van Zandt.
PPG Industries, Inc	P.O. Box 4026 Corpus Christi, Tex. 77704	Brine wells	Duval.
Phillips Petroleum Co	Bartlesville, Okla. 74003	do	Hutchinson.
Texas Brine Corp	4614 Montrose Blvd. Houston, Tex. 77006	do	Harris, Jefferson, Matagorda.
United Salt Corp	do	Underground mine and brine wells.	Fort Bend and Harris.
Vulcan Materials Co	P.O. Box 1060 Denver City, Tex. 79323	Brine wells	Yoakum.
Sand and gravel:			
Barrett Industries	2718 SW Military Dr. San Antonio, Tex. 78221	Stationary	Bexar.
Capitol Aggregates, Inc	Route 13, Box 412 San Antonio, Tex. 78209	do	Bexar, Guadalupe, Travis.
Dresser Minerals	Kosse, Tex. 76653	do	Limestone.
The Fordyce Co	P.O. Box 1981 San Antonio, Tex. 78206	do	Hidalgo, San Patricio, Victoria.
Ft. Worth Sand & Gravel Co	P.O. Box 400 Arlington, Tex. 76010	do	Dallas, Denton, Tarrant.
Gifford-Hill & Co., Inc	P.O. Box 47127 Dallas, Tex. 75247	do	Brazos, Dallas, Henderson, McLennan, Tarrant, Wharton, Wichita.
Horton & Horton	P.O. Box 1669 Houston, Tex. 77001	Portable and dredge.	Colorado, Harris, Victoria.
R. E. Janes Gravel Co., Inc	P.O. Box 2155 Austin, Tex. 78767	Stationary	Borden, Howard, Stonewall, Taylor.
Janes-Prentice, Inc	do	do	Crosby.
Panhandle Gravel West, Inc	P.O. Box 807 Amarillo, Tex. 79105	do	Armstrong.
Parker Bros. & Co., Inc	P.O. Box 107 Houston, Tex. 77001	Stationary and dredge.	Colorado and Harris.
Pennsylvania Glass Sand Corp	Berkeley Springs, W. Va. 25411	Stationary	McCulloch.
Texas Construction Materials Co	P.O. Box 86 Houston, Tex. 77001	Stationary, portable, dredge.	Colorado and Liberty.
Texas Mining Corp	2510 Fidelity Union Tower Dallas, Tex. 75200	Stationary	McCulloch.
Thorstenberg Materials Co	1435 Bank of the Southwest Bldg. Houston, Tex. 75247	Stationary, portable, and dredge.	Colorado and San Jacinto.

Table 28.—Principal producers—Continued

Commodity and company	Address	Type of Activity	County
Sand and gravel—Continued			
Trinity Concrete Products Co	P.O. Box 47524 Dallas, Tex. 75247	Stationary	Dallas and Johnson.
Wesco-Wamix, Inc	105 Empire Center 8383 Stemmons Freeway Dallas, Tex. 75247	do	Dallas, Denton, Navarro, Tarrant.
Shell:			
Bauer Dredging Company	P.O. Box BB Port Lavaca, Tex. 77979	Dredge	Calhoun.
General Dredging Corp	P.O. Box 9294 Corpus Christi, Tex. 78408	do	Nueces.
Heldenfels Brothers	P.O. Box 4957 Corpus Christi, Tex. 78408	do	Aransas and Nueces.
Horton & Horton	P.O. Box 1669 Houston, Tex. 77001	do	Calhoun.
Lone Star Cement Corp	P.O. Box 86 Houston, Tex. 77001	do	Do.
Parker Bros. & Co., Inc	5303 Navigation Bldg. P.O. Box 107 Houston, Tex. 77001	do	Do.
Sodium sulfate (natural):			
Ozark-Mahoning Co	1870 South Boulder Tulsa, Okla. 74119	Plant	Gaines, Terry, Ward.
Stone:			
General Portland Cement Co	2800 Republic Bank Tower Dallas, Tex. 75201	Quarry	Dallas and Tarrant.
Gifford-Hill & Co., Inc	P.O. Box 47127 Dallas, Tex. 75247	do	Wise.
Lone Star Cement Corp	P.O. Box 47327 Dallas, Tex. 75247	do	Burnet, Nolan, Wise.
McDonough Bros., Inc	Fredericksburg Rd. Route 8, Box 222 San Antonio, Tex. 78228	do	Bexar.
Olmos Rock Products Corp	P.O. Box 7776 San Antonio, Tex. 78200	do	Do.
Texas Crushed Stone Co	P.O. Box 9345 Austin, Tex. 78717	do	Llano and Williamson.
Texas Industries, Inc	P.O. Box 146 Midlothian, Tex. 76065	do	Ellis and Wise.
Trinity Concrete Products Co	P.O. Box 47524 Dallas, Tex. 75247	do	Johnson and Wise.
White's Mines, Inc	P.O. Box 500 Brownwood, Tex. 76801	do	Brown, Taylor, Uvalde.
Sulfur (native):			
Atlantic Richfield Co	P.O. Box 2819 Dallas, Tex. 75221	Frasch process	Pecos.
Duval Corp	1906 First City National Bank Bldg. Houston, Tex. 77002	do	Fort Bend and Pecos.
Jefferson Lake Sulphur Co	P.O. Box 1185 Houston, Tex. 77001	do	Fort Bend.
Pan American Petroleum Co	P.O. Box 591 Tulsa, Okla. 74102	do	Galveston.
Texas Gulf Sulphur Co	200 Park Ave. New York, N.Y. 10017	do	Jefferson, Liberty, Matagorda, Wharton.
Sulfur (byproduct):			
Cities Service Oil Co	P.O. Box 300 Tulsa, Okla. 74102	Secondary recovery.	Gaines and Van Zandt.
Elcor Chemical Corp	Wilco Bldg. Midland, Tex. 79701	do	Atascosa, Cochran, Cass, Crane.
Getty Oil Co	P.O. Box 8 Scroggins, Tex.	do	Franklin and Freestone.
Gulf Oil Corp	P.O. Box 701 Port Arthur, Tex. 77640	do	Jefferson.
Pan American Petroleum Corp	P.O. Box 591 Tulsa, Okla. 74102	do	Andrews, Ector, Hockley, Van Zandt, Wood.
Phillips Petroleum Co	Bartlesville, Okla. 74003	do	Brazoria, Crane, Ector, Hutchinson.
Shell Oil Co	P.O. Box 2099 Houston, Tex. 77001	do	Cass and Karnes.
Warren Petroleum Corp	P.O. Box 1589 Tulsa, Okla. 74101	do	Crane, Hopkins, Karnes.
Talc and soapstone:			
Dallas Ceramic Co	Allamoore, Tex. 79829	Mine and plant.	Hudspeth.
Pioneer Talc Co	Chatsworth, Ga. 30705	do	Do.
Southern Clay Products, Inc	Box 44 Gonzales, Tex. 78629	do	Do.

Table 28.—Principal producers—Continued

Commodity and company	Address	Type of Activity	County
Talc and soapstone—Continued			
The United Sierra Div., Cyprus Mines Corp.	P.O. Box 1201 Trenton, N. J. 08606	Mine	Gillespie and Hudspeth.
Do		Mine and plant.	Llano.
Westex Talc Co	P.O. Box 15038 Houston, Tex. 77020	----do	Hudspeth.
Uranium: Susquehanna-Western, Inc	P.O. Box 217 Falls City, Tex. 78113	Mine and mill	Karnes.
Vermiculite:			
Lanmont, Inc	503 Bessimer St. Llano, Tex. 78643	Mine and exfoliating plant.	Llano.
Texas Vermiculite Co	2651 Manila Rd. Dallas, Tex. 75200	Exfoliating plant.	Bexar and Dallas.
Vermiculite Products, Inc	P.O. Box 7327 Houston, Tex. 77008	----do	Harris.
Volcanic ash (pumicite):			
Nordmeyer, Inc	P.O. Box 949 Mission, Tex. 78572	Mine and plant.	Starr.

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 S. R. Wilson [1] and William C. Henkes [2]

Mineral production in Utah for 1969 was valued at $542.5 million, a record high for the State. This total value was 28 percent greater than that for 1968 and 21 percent more than in 1966, the previous record year. Increases were recorded in all three commodity groups—metals, mineral fuels, and nonmetals; metals had the greatest gain.

The total value of the 11 commodities in the metals group was 37 percent greater than that of 1968. Silver, uranium, and vanadium decreased in total value; all others increased.

Production of mineral fuels increased 6 percent in total value. Asphalt and related bitumens, carbon dioxide, coal, and petroleum showed gains. The value of marketed natural gas, liquefied petroleum gases, and natural gasoline declined slightly, although the volume of LP gases and natural gas produced increased modestly.

[1] Mining engineer, Bureau of Mines, Salt Lake City, Utah.

[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in Utah [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Carbon dioxide (natural)—thousand cubic feet	57,747	$4	64,839	$5
Clays—thousand short tons	[2] 160	[2] 476	179	1,286
Coal (bituminous)—do	4,316	24,893	4,657	29,396
Copper (recoverable content of ores, etc.)—short tons	228,245	191,027	296,699	282,066
Fluorspar—do	8,762	213	6,667	207
Gem stones	NA	83	NA	85
Gold (recoverable content of ores, etc.)—troy ounces	334,419	[3] 13,129	433,385	[3] 17,990
Iron ore (usable)—thousand long tons, gross weight	1,764	11,281	1,921	12,552
Lead (recoverable content of ores, etc.)—short tons	45,205	11,945	41,332	12,313
Lime—thousand short tons	174	3,439	191	3,947
Natural gas (marketed)—million cubic feet	46,151	7,292	46,733	7,197
Petroleum (crude)—thousand 42-gallon barrels	23,504	62,826	23,295	65,320
Pumice—thousand short tons	8	19	10	21
Salt—do	405	3,756	481	4,439
Sand and gravel—do	10,293	9,364	19,151	16,042
Silver (recoverable content of ores, etc.)—thousand troy ounces	5,121	10,982	5,954	10,661
Stone—thousand short tons	1,953	4,312	2,582	4,434
Tungsten concentrate (60-percent WO_3 basis)—short tons	W	W	3	6
Uranium (recoverable content U_3O_8)—thousand pounds	1,712	[4] 13,175	1,140	[4] 6,824
Vanadium—short tons	563	2,010	W	W
Zinc (recoverable content of ores, etc.)—do	33,153	8,951	34,902	10,191
Value of items that cannot be disclosed: Asphalt and related bitumens, cement, clays (halloysite 1968), gypsum, magnesium chloride, molybdenum, natural gas liquids, phosphate rock, potassium salts, pyrites (1968), and value indicated by symbol W	XX	[5] 44,774	XX	[6] 57,507
Total	XX	423,951	XX	542,489
Total 1967 constant dollars	XX	[r] 404,327	XX	[p] 479,753

[p] Preliminary. [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 halloysite; included with "Value of items that cannot be disclosed."

[3] Based on average U.S. Treasury price ($35.00) through Mar. 15, 1968, and Engelhard selling quotations Mar. 20, 1968, through 1969.

[4] Value estimated based on $8.00 (1968) and $5.86 (1969) per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 (1968) and $6.10 (1969) per pound for commercial sales; includes value of U_3O_8 obtained from Utah ores processed at out-of-State mills.

[5] Value of metals and mineral fuels $24,306,000; value of nonmetals $20,468,000.

[6] Value of metals and mineral fuels $34,023,000; value of nonmetals $21,618,000.

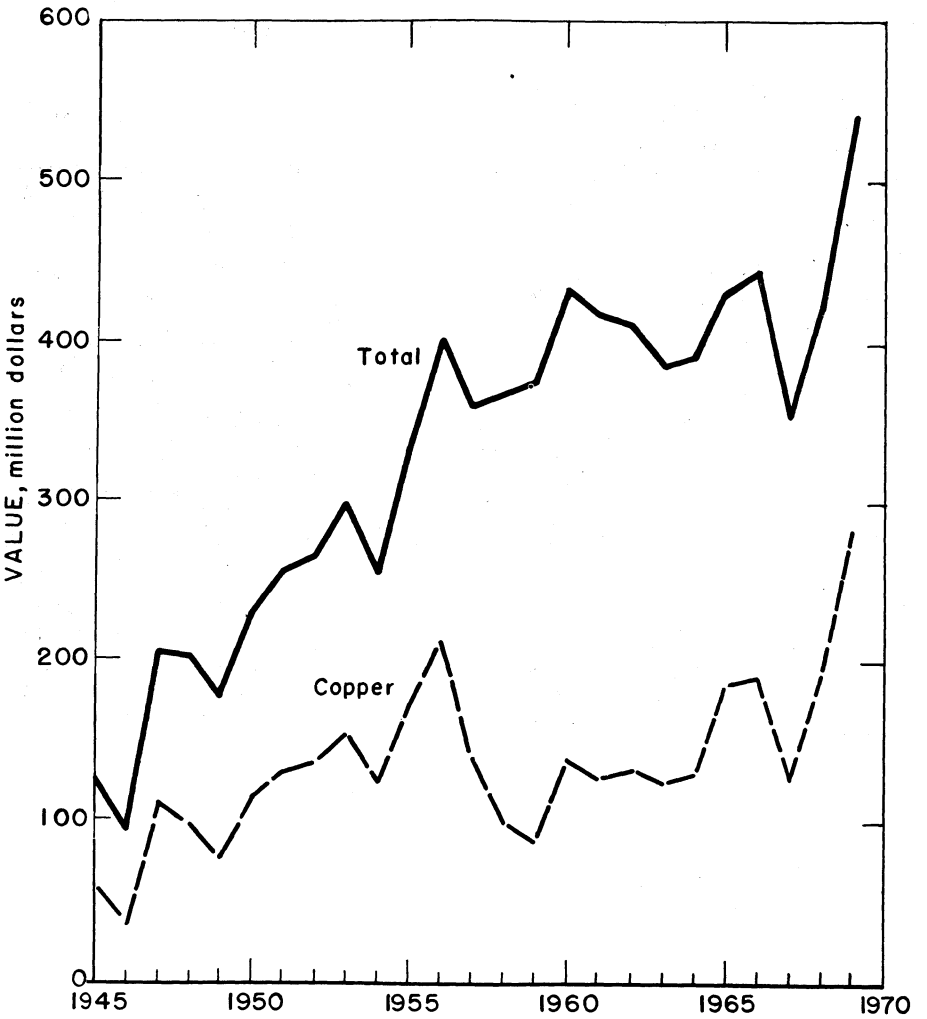

Figure 1.—Value of mine production of copper, and total value of mineral production in Utah.

Increased production values were recorded for 11 commodities in the nonmetallic group. Only clays, fluorspar, gypsum, and magnesium chloride declined in value.

Operators of metal and nonmetal mines handled a total of 141.9 million tons of material: 51.6 million tons of ore; 86.1 million tons of copper-bearing rock placed on dumps prepared for future leaching, and extraction of the copper; and 4.2 million tons considered waste. Underground mining operations yielded 3.1 million tons of the total tonnage handled. The average value of ores mined by surface methods was $7.21 per ton. Underground ores were valued at $17.40 per ton.

Great Salt Lake Minerals & Chemical Corp., operating the solar evaporation pond complex west of Ogden, produced salts for harvest and concentrating brines for future pond and plant operations. The potassium sulfate and sodium sulfate plants, scheduled for completion in October 1970, were approximately 30-percent complete at yearend.

National Lead Co. began construction of a chemical-industrial plant on the southwestern shore of the Great Salt Lake. The plant, to be completed in late 1971, will produce 45,000 tons of magnesium metal annually from the lake brine. Other products to be recovered are chlorine, lithium, calcium sulfate, and potassium sulfate.

Table 2.—Value of mineral production in Utah, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Beaver	$1,565	$336	Sand and gravel, perlite, pumice, lead, zinc, silver, gold, copper.
Box Elder	1,421	2,910	Stone, sand and gravel, salt, lime, tungsten.
Cache	W	W	Stone, sand and gravel, lime.
Carbon	18,621	21,382	Coal, natural gas, sand and gravel, carbon dioxide.
Daggett	132	250	Natural gas, stone, sand and gravel, petroleum.
Davis	651	1,593	Sand and gravel.
Duchesne	2,358	4,298	Petroleum, sand and gravel, stone, natural gas.
Emery	6,694	8,344	Coal, uranium, sand and gravel, natural gas, vanadium, petroleum.
Garfield	2,844	4,525	Petroleum, sand and gravel, copper, uranium, vanadium, silver.
Grand	7,876	7,145	Potassium salts, natural gas, petroleum, uranium, vanadium, sand and gravel.
Iron	11,679	13,115	Iron ore, sand and gravel, coal, pumice, stone.
Juab	1,532	1,399	Clays, fluorspar, silver, sand and gravel, lead, stone, gold, copper, zinc.
Kane	104	W	Sand and gravel, coal.
Millard	30	172	Sand and gravel, stone.
Morgan	W	W	Cement, sand and gravel, stone.
Piute	425	1,027	Zinc, silver, lead, copper, gold, uranium, sand and gravel, clays.
Rich	W	W	Phosphate rock, sand and gravel.
Salt Lake	238,831	348,583	Copper, molybdenum, gold, silver, lead, sand and gravel, zinc, cement, salt, lime, stone, tungsten.
San Juan	58,464	51,288	Petroleum, uranium, natural gas, LP gases, vanadium, copper, natural gasoline, sand and gravel.
Sanpete	130	116	Salt, sand and gravel, clays, natural gas.
Sevier	1,585	1,524	Gypsum, coal, sand and gravel, clays, salt, silver, gold, zinc.
Summit	8,096	9,053	Petroleum, zinc, lead, sand and gravel, silver, stone, clays, copper, coal, natural gas, gold.
Tooele	6,980	12,159	Sand and gravel, lime, salt, stone, potassium salts, lead, zinc, silver, magnesium chloride, copper, clays, gold, tungsten.
Uintah	26,615	27,274	Petroleum, gilsonite, natural gas, phosphate rock, natural gasoline, sand and gravel, LP gases.
Utah	8,971	6,846	Zinc, lead, silver, stone, sand and gravel, lime, gold, copper, clays.
Wasatch	6,607	7,346	Gold, lead, silver, zinc, copper, stone, sand and gravel.
Washington	122	131	Sand and gravel, petroleum, pumice.
Wayne	W	16	Sand and gravel.
Weber	774	844	Sand and gravel, stone.
Undistributed [1]	10,843	10,811	
Total [2]	423,951	542,489	

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.
[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Utah business activity

	1968	1969 [p]	Change, percent
Employment and labor force, annual average:			
Total labor force—thousands	408.1	419.1	+2.7
Employment—do	386.8	397.2	+2.7
Unemployment—do	21.3	21.9	+2.8
Agricultural employment—do	13.2	12.2	−7.6
Nonagricultural employment—do	373.6	385.0	+3.1
Mining—do	10.9	12.4	+13.8
Construction—do	13.7	13.9	+1.5
Manufacturing—do	50.3	51.6	+2.6
Government—do	98.8	98.8	------
All other—do	199.9	208.3	+4.2
Payroll:			
Agriculture (income of farm proprietors and farm workers' wages) millions	$63.0	$77.0	+22.2
Mining (total wages)—do	$87.2	$105.8	+21.3
Construction (total wages)—do	$100.2	$109.4	+9.2
Manufacturing (total wages)—do	$352.2	$379.6	+7.8
Government (total wages)—do	$606.9	$646.0	+6.4
All other—do	$772.5	$846.6	+9.6
Personal income:			
Total—do	$2,885.0	$3,129.0	+8.5
Per capita	$2,798	$2,994	+7.0
Construction activity:			
Total construction valuation—do	$237.7	$292.6	+23.1
Residential—do	$77.4	$87.4	+12.9
Nonresidential—do	$97.4	$117.8	+20.9
Nonbuilding—do	$62.9	$87.4	+39.0
Highway construction contracts awarded—do	$39.9	$58.9	+47.6
Cement shipments to and within the State thousand 376-pound barrels	2,057.3	2,444.3	+18.8
Business receipts:			
Retail sales—millions	$1,663.4	$1,546.2	−7.0
Farm marketing receipts—do	$197.5	$212.3	+7.5
Mineral production—do	$424.0	$542.5	+28.0
Utility production and consumption:			
Production of electric energy utilized—million kilowatt hours	6,340.1	6,941.1	+9.5
Natural gas consumption—billion cubic feet	126.8	122.6	−3.3

[p] Preliminary.

Sources: Bureau of Economic and Business Research, University of Utah; Engineering News-Record, v. 184, No. 16, Apr. 30, 1970, pp. 12–13; U.S. Dept. of Commerce, Bureau of the Census; U.S. Bureau of Mines.

Employment and Injuries.—Final employment and injury data, as compiled by the Bureau of Mines for 1968, with preliminary data for 1969, are shown in table 4. Information presented excludes all mineral fuels, except the coal and asphalt-gilsonite industries.

Legislation and Government Programs.—The Office of Minerals Exploration granted loans on two properties in Utah during

Table 4.—Worktime 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
1968:								
Coal	1,156	224	259	2,034	2	110	55.07	16,651
Metal	5,194	260	1,351	10,812	3	219	20.53	2,598
Native asphalt	237	247	59	470	--	15	31.92	730
Nonmetal	981	272	270	2,159	--	136	62.98	1,054
Sand and gravel	589	192	113	931	--	20	21.48	7,030
Stone	375	259	97	775	1	5	7.74	7,883
Total [1]	8,532	251	2,148	17,181	6	505	29.74	4,495
1969: [p]								
Coal	1,220	232	283	2,172	1	99	46.04	4,814
Metal	5,280	303	1,598	12,790	2	221	17.44	1,726
Native asphalt	262	276	72	578	--	23	39.80	744
Nonmetal	870	275	239	1,914	1	70	37.10	4,133
Sand and gravel	725	194	140	1,146	2	21	20.08	10,868
Stone	445	266	118	959	--	14	14.61	628
Total [1]	8,795	279	2,450	19,558	6	448	23.21	2,757

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

1969. Interstate Resources, Inc., was awarded a contract totaling $47,000 to explore uranium claims in Emery County. Western States Minerals, Inc., received a contract which authorized an expenditure of $238,230 to search for gold, silver, and copper on the Crown Point and East Crown Point properties in the Tintic district, Utah County.

The Office of Coal Research, U.S. Department of the Interior, awarded $843,860 to the University of Utah, College of Mines and Mineral Industries, to assist in development of techniques for converting coal to liquid fuel.

Bureau of Mines personnel at the Salt Lake City Metallurgy Research Center have constructed a smokeless incinerator for burning junked cars. In a typical burning operation two cars are stripped of tires, radiator, and battery, and placed on their sides on a cart. The cart is pushed into the refractory-brick-lined incinerator burning chamber which measures 22-feet long, 14-feet wide, and 9-feet high. A small quantity of liquid fuel is splashed on the upholstery and ignited. The products of combustion are drawn by stack draft through a flameport into a checkerworked afterburner chamber, where the gases are heated to above 1,450° F to oxidize the carbonaceous matter. The hot gases then pass through a 54-foot stack and are released to the atmosphere. In preliminary tests virtually smokefree burning resulted during more than 90 percent of the burning period. The smokeless incineration, together with about 20-minute burning periods should aid in speeding the recycle of automotive steel scrap without adverse effect on the environment. The incinerator is designed to burn 48 cars in an 8-hour operation.

A process for extracting SO_2 and producing sulfur from smelter gases has been developed by Bureau of Mines metallurgists at Salt Lake City. The process involves removal of SO_2 from the gas stream by scrubbing with suitable aqueous salt solutions or high-boiling organic fluids. The SO_2-laden liquor is then reacted with H_2S; high-purity sulfur is precipitated instantly. Magma Copper Co. is constructing a pilot plant at its San Manuel smelter in Arizona based on the Bureau of Mines process; the pilot plant will be in operation during the latter part of 1970.

The State awarded $58.9 million for highway construction during 1969—$44.2 million for interstate contracts, $12.2 million for Federal-Aid Primary and Secondary (ABC) contracts, and $2.5 million for 100-percent State-financed contracts. The 1970 plans indicate a 12 percent increase in total contract value to $66.2 million—$51.0 million for Interstate, $10.2 million for ABC, and $5.0 million for State-financed contracts.[3]

Utah has 349.18 miles of freeway open to traffic under the National System of Interstate and Defense Highways, according to the Federal Highway Administration.[4] A total of 48.88 miles of highway were opened during 1969.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—The Brush Beryllium Co. completed construction of a new milling plant 10 miles north of Delta. Processing of bertrandite ore from the Roadside open pit mine at Spor began in August. The beryllium hydroxide product from the mill was shipped to the company plant at Elmore, Ohio, for additional processing.

Topaz Beryllium Co., a subsidiary of The Anaconda Company, also continued investigations of Spor Mountain beryllium properties. Experimental mining was conducted to determine suitable methods for extracting ores from underground deposits. No decision concerning establishment of a mining and milling operation at Spor Mountain has been announced by Topaz Beryllium Co.

Copper.—The quantity of copper produced in Utah increased 30 percent, with a 48 percent rise in total value during 1969. The average selling price was 47.5 cents per pound, compared with 41.8 cents for the previous year. Kennecott Copper Corp. at Bingham was again the largest single producer in the United States. In addition to

[3] Engineering News-Record, State Highway Departments' Construction Contracting Plans for 1970 and Budgets for Maintenance. V. 184, No. 16, April 30, 1970, pp. 12–13.

[4] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1969. Press Release FHWA–422, Feb. 9, 1970.

Kennecott, leading copper producers in Utah were the U.S. and Lark mine, United States Smelting Refining and Mining Co. (USSR&M Co.); the Mayflower mine, operated by Hecla Mining Co.; Micro Copper Corp.; Ophir mine, operated by McFarland & Hullinger; Basinere Metals; and Big Indian mine, operated by Cliffs Copper Corp. Nineteen mines in 10 counties contributed to the total copper production.

Kennecott Copper Corp. is constructing a pilot leaching plant on the Verona dump at Bingham to investigate further possible commercial recovery of uranium from the huge dumps now leached for the contained copper. An attempt will be made to isolate the Verona dump from the other dumps.

Kennecott also began construction of a new sulfuric acid plant at its copper smelter near Garfield. The plant, with a rated daily capacity of 500 tons of acid, will increase Kennecott's total daily production to 1,900 tons.

A 400-ton-per-day oxygen plant at Garfield, completed during 1969, will supply oxygen to the Kennecott Copper Corp. smelter to enrich the air blast for direct smelting of copper concentrate and precipitate in the converters. The new plant is operated by Linde Division, Union Carbide Corp.

Late in the year, Shield Development Co., Ltd., Toronto, Canada, completed an agreement with Toledo Mining Co. involving the OK Copper mine and other properties in the Milford area, Beaver County. Plans were made for mill installation and operation of the OK mine to begin in 1970.

Gold.—Nearly all gold produced in Utah was a byproduct of base-metal ores. Eighteen mines in nine counties yielded 30 percent more gold than in 1968. Total value was up 37 percent because of higher average market prices and larger gold yield. Kennecott's open pit copper mine at Bingham, again the principal gold source, accounted for virtually all the increase for the year. The Mayflower mine in the Blue Ledge district was second in gold production.

Toward yearend Newmont Mining Corp. conducted diamond-drilling exploration in the Mercur gold district, Tooele County.

Iron Ore.—As in previous years, all iron ore produced in Utah, was mined in Iron County. The iron ore was extracted from six open pit mines—the Blowout, Comstock, and Duncan mines, owned by CF&I Steel Corp. (CF&I), mined under contract by Utah Construction & Mining Co.; the Desert Mound mine of United States Steel Corp. (USS); and the Iron Springs and McCahill-Thompson Alluvial mines of Utah Construction & Mining Co. Overall iron ore production increased 9 percent and total value 11 percent.

Table 5.—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)
1965	34	----------	32,887	426,299	$14,921	5,636	$7,287
1966	33	----------	34,459	438,736	15,356	7,755	10,028
1967	22	1	21,537	288,350	10,092	4,875	7,556
1968	32	----------	29,501	334,419	13,129	5,121	10,982
1969	25	----------	39,493	433,385	17,990	5,954	10,661
1864–1969	NA	NA	[3] 1,235,529	19,260,178	578,579	857,142	673,399

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	259,138	$183,470	37,700	$11,762	27,747	$8,102	$225,542
1966	265,383	191,978	64,124	19,385	37,323	10,824	247,571
1967	168,609	128,905	53,813	15,068	34,251	9,483	171,104
1968	228,245	191,027	45,205	11,945	33,153	8,951	236,034
1969	296,699	282,066	41,332	12,313	34,902	10,191	333,221
1864–1969	10,230,834	4,677,719	5,477,073	785,877	1,819,993	355,261	7,070,835

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer operations), or milled, old tailings or slimes retreated; and ore, old tailings or copper precipitates shipped to smelters.
[2] Does not include gravel washed or tonnage of precipitate shipped.
[3] Figures estimated for certain years before 1901.

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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 (thousands)	Troy ounces	Value (thousands)
Beaver	1	108	4	[3]	834	$1
Garfield	1	[4] 110,010	[4] 1,379	[4] $57	[4] 702,850	[4] 1,259
Juab	3	25,824	961	40	87,924	157
Piute	1	[4]	[4]	[4]	[4]	[4]
Salt Lake	3	39,039,251	377,294	15,661	3,911,844	7,005
San Juan	3	70,510				
Sevier	1	[4]	[4]	[4]	[4]	[4]
Summit	2	98,908	1,093	45	389,614	698
Tooele	5	27,777	123	5	162,352	291
Utah	3	[4]	[4]	[4]	[4]	[4]
Wasatch	2	120,292	52,531	2,181	698,149	1,250
Total [5]	25	39,492,680	433,385	17,990	5,953,567	10,661

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Beaver	[3]	[3]	12	$4	7	$2	$7
Garfield	[4] 83	[4] $79	[4] 8,087	[4] 2,409	[4] 10,299	[4] 3,007	[4] 6,811
Juab	28	27	293	87	1	[3]	312
Piute	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Salt Lake	294,724	280,188	19,636	5,850	12,600	3,679	312,383
San Juan	565	538					538
Sevier	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Summit	124	118	5,061	1,507	6,841	1,998	4,366
Tooele	140	133	2,135	636	1,590	464	1,529
Utah	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Wasatch	1,035	984	6,108	1,820	3,564	1,041	7,275
Total [5]	296,699	282,066	41,332	12,313	34,902	10,191	333,221

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines.
[2] Does not include gravel washed or tonnage of precipitates shipped.
[3] Less than ½ unit.
[4] Production of Garfield, Piute, Sevier, and Utah Counties combined to avoid disclosing individual company confidential data.
[5] Data may not add to totals shown because of independent rounding.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1969, 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 (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode ore:							
Dry gold-silver	1	142,738	1,156	10,355	968		
Dry silver	3	2,842	544	73,062	2	71	23
Total [2]	4	145,580	1,700	83,417	969	71	23
Copper	5	38,720,855	370,632	3,009,099	473,439		
Copper-lead-zinc	1	117,452	52,499	686,972	2,063	11,927	6,735
Lead	5	2,116	32	13,124	8	1,045	182
Lead-zinc and zinc [3]	14	450,071	7,541	2,065,309	2,824	68,334	59,772
Total [2]	25	39,290,494	430,704	5,774,504	478,333	81,305	66,689
Other lode material:							
Silver tailings	1	25,809	959	87,057	57	581	
Copper cleanup	[4]	21	7	126	8		[5]
Copper precipitates	1	69,225			113,977		
Lead cleanup	[4]	30	2	320	[5]	22	1
Lead tailings, lead-zinc mill cleanup, zinc-slag [3]	[4]	30,746	13	8,143	53	685	3,091
Total [2]	2	125,831	981	95,646	114,096	1,288	3,092
Total lode material [2]	25	39,561,905	433,385	5,953,567	593,398	82,664	69,804

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Data may not add to totals shown because of independent rounding.
[3] Combined to avoid disclosing individual company confidential data.
[4] From properties not classed as mines.
[5] Less than ½ unit.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1969, by types of materials processed and methods of recovery, in terms of recoverable metals

Method of recovery and type of material processed	Gold (troy ounces)	Silver (troy ounces)	Copper (thousand pounds)	Lead (thousand pounds)	Zinc (thousand pounds)
Lode:					
Concentration and smelting of concentrates	430,484	5,660,161	477,165	78,516	65,565
Ore leached and lead-zinc mill cleanup	2	487	1,132	19	13
Total	430,486	5,660,648	478,298	78,535	65,577
Direct smelting:					
Ore	1,920	197,760	1,006	2,860	1,147
Copper cleanup, lead cleanup, lead-zinc cleanup, and zinc slag [1]	19	7,811	61	678	3,073
Copper precipitates	------	------	113,977	------	------
Tailings	960	87,348	57	590	7
Total [2]	2,899	292,919	115,100	4,128	4,227
Grand total [2]	433,385	5,953,567	593,398	82,664	69,804

[1] Combined to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.

Table 9.—Usable iron ore shipments

(Thousand long tons and thousand dollars)

Year	Quantity	Value
1965	2,139	$14,229
1966	1,956	13,478
1967	1,708	11,916
1968	1,764	11,281
1969	1,921	12,552
1906–69	80,112	391,172

Ores and concentrates shipped during the year contained an average content of 52.9 percent iron. The iron and steel industry utilized 99 percent of the total iron ore and concentrate shipments; one percent was used in making cement and paint.

Research in briquetting the iron product from the beneficiation plant of Utah Construction & Mining Co. was conducted during the year. The overall objective is to briquet the concentrate for use in the open hearth furnaces at the Geneva steel plant near Provo.

Lead.—The value of the lead output in in Utah increased 3 percent because of a higher average selling price per pound; total production, however, declined 9 percent. The principal producers in order of output were the U.S. and Lark mine of USSR&M Co.; the Burgin mine, Tintic Division, Kennecott Copper Corp.; the Mayflower mine, operated by Hecla Mining Co.; United Park City Mines, United Park City Mines Co.; and the Ophir mine, operated by McFarland & Hullinger. Lead production from the Mayflower mine and United Park City Mines Co. was greater than that of 1968; the other mines reported decreased production.

Shell Canadian Exploration Co. started diamond drilling in November in the Dugway district, Tooele County. A search is being made for lead-zinc-silver-copper ore bodies in the area of the Four Metals property.

The flotation plant at the Burgin mine, Kennecott Copper Corp., was completed in early 1969 with the objective to mill 800 tons of ore per day. Kennecott also completed an 862-foot shaft in the Trixie area, 1½ miles south of the Burgin mine. Lateral exploration and diamond drilling from the shaft revealed mineralized zones. Some development ores were shipped during the year.

Molybdenum.—All molybdenum produced in Utah was recovered from concentration of copper ore mined by Kennecott Copper Corp. at Bingham. Output increased 58 percent; total value increased 65 percent.

Selenium.—Kennecott Copper Corp. recovered selenium as a byproduct of electrolytic refining of blister copper at the Garfield plant. Output of selenium increased 50 percent, all from Kennecott.

Silver.—Produciton of silver in Utah was up 16 percent, but because of a slightly lower selling price per ounce, the total value was 3 percent less than in 1968. The principal silver source was the Kennecott Copper Corp. mine at Bingham; the second, also in the Bingham district, was USSR&M Co. from lead-zinc ore. Twenty-two mines in ten counties recorded silver production.

Tungsten.—Small quantities of tungsten concentrates, approximately 115 units of WO_3, were recovered from three operations during 1969.

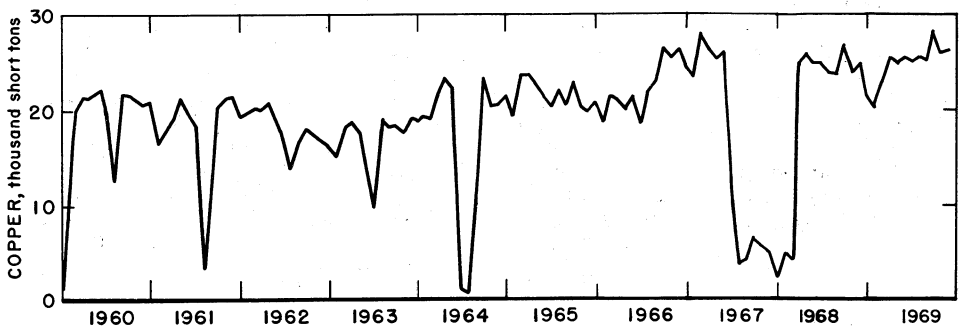

Figure 2.—Mine production of copper in Utah, by months in terms of recoverable metals.

The Sun Uranium Co. mine in the Newfoundland Range, Box Elder County, was under lease during part of the year. Scheelite ore was mined and trucked to a small mill near Lucin. East Antelope Corp. processed a minor tonnage of scheelite tailing at the inactive tungsten plant of Minerals Engineering Co. in Salt Lake City. Silver Star Queens Mines, Inc., late in 1969, began mining operations on the Yellow Hammer tungsten-copper property in the Clifton district near Gold Hill, Tooele County. The ore was milled in a small gravity plant at Gold Hill.

Western Materials, a Utah corporation, conducted considerable geologic mapping and diamond-drilling exploration on tungsten deposits in the House Range, Millard County. A large part of the work was done on property of New Klondike Mining Co. The company officials hope to develop sufficient tungsten ore reserves to warrant construction of a concentrator in the vicinity of the properties.

Uranium.—Fewer uranium mines were in operation in the State during the year —71 operations compared with 134 operations during 1968. Production was 33 percent less; and total value declined 48 percent, calculated on a basis of $5.86 per pound recoverable content (U_3O_8) marketed through the U.S. Atomic Energy Commission and $6.10 per pound handled through commercial outlets. The average grade of the ores mined was 0.20 percent U_3O_8, compared with the 1968 average of 0.23 percent U_3O_8.

Rio Algom Corp., wholly owned subsidiary of Rio Algom Mines Ltd., began shaft sinking on the Humeca property in San Juan County. By yearend approximately 1,500 feet of sinking was completed in a ventilation shaft and 400 feet in a production shaft.

The Atlas Minerals Division, Atlas Corp., mill at Moab resumed production of uranium oxide after a shutdown of 6 months resulting from a fire in December 1968.

Vanadium.—Mines in four counties yielded vanadium-bearing ores that were processed at two mills in Colorado. No mills in Utah treated vanadium ores during the year.

Zinc.—Production of zinc, increasing 5 percent, was reported from 18 mines in nine counties. Value was up 14 percent, partly because of higher average selling price (14.6 cents per pound). The largest zinc producer in the State was the U.S. and Lark mine. USSR&M Co., at Bingham. Other significant zinc producers in order of rank were the Burgin mine, Tintic Division, Kennecott Copper Corp.; United Park City mines of United Park City Mines Co.; Mayflower mine, operated by Hecla Mining Co.; Deer Trail mine, operated by Arundel Mining Co.; and Ophir mine, operated by McFarland & Hullinger.

Table 10.—Mine production of uranium (U_3O_8), by counties, in terms of recoverable content

County	1968			1969		
	Number of operations	Pounds	Value [1] (thousands)	Number of operations	Pounds	Value [2] (thousands)
Emery	15	[3] 36,453	[3] $285	8	49,844	$293
Garfield	19	11,521	92	4	523	3
Grand	22	68,333	514	10	45,989	274
Piute	4	[3]	[3]	1	842	5
San Juan	73	1,595,332	12,284	48	1,043,143	6,249
Wayne	1	[3]	[3]	----	----------	-----
Total	134	1,711,639	13,175	71	1,140,341	6,824

[1] Value estimated, based on $8.00 per pound for sales to the Atomic Energy Commission and an assumed price of $6.50 per pound for commercial sales; includes value of U_3O_8 obtained from Utah ores processed at out-of-State mills.

[2] Value estimated, based on $5.86 per pound for sales to the Atomic Energy Commission and an assumed price of $6.10 per pound for commercial sales; includes value of U_3O_8 obtained from Utah ores processed at out-of-State mills.

[3] Emery, Piute, and Wayne Counties combined to avoid disclosing individual company confidential data.

MINERAL FUELS

Asphalt and Related Bitumens.—Total output from the three gilsonite-producing companies was slightly higher than that of the previous year.

Major Oil Co., the Salt Lake City firm which claimed a discovery for the economical extraction of oil from oil-sands, continued construction of its refinery near Roosevelt and its plant at White Rocks. Operations were to commence about mid-1970.

Carbon Dioxide.—The one-well Farnham Dome field, Carbon County, continued to yield carbon dioxide; output increased 12 percent.

Coal (Bituminous).—Coal output from 21 properties in six counties increased 8 percent in quantity and 18 percent in total value. As in past years, the combined production from Carbon and Emery Counties was predominant, accounting for 98.1 percent of the State total.

The U.S. Department of the Interior authorized Resources Co. to use ultimately 102,000 acre-feet of water from Lake Powell annually for a steam-electric power-generating plant to be constructed in Utah, 14 miles northwest of Page, Ariz. The water service contract—to be in effect for 40 years, with provisions for renewal—provides for 3,825 acre-feet of water in 1977 and to increase progressively to 102,000 acre-feet after 1989. Coal for the plant would be mined in the Kaiparowits Plateau field, a short distance north of the proposed plant site. Exploration completed by Resources Co. indicated a substantial tonnage of high-quality coal. The company plans, however, to conduct additional exploration on the coalbeds before plans for the mine and powerplant are completed.

Properties of Carbon Fuel Co. at Helper were contracted for purchase by Glen Explorations, Inc.

Unit trains are being used more frequently for transporting coal, particularly from the Sunnyside area, and from Colorado, to steel plants at Geneva, Utah, and Fontana, Calif., and to west coast ports for shipment to Japan. Kaiser Steel Corp. arranged shipment of 80,000 tons of coal from its mines at Sunnyside to Japan for testing. The first unit train with coal destined for Japan was dispatched from Sunnyside to San Pedro, Calif., on April 12, 1969; the coal was then loaded into vessels for transporting to Japan.

Natural Gas.—Marketed natural gas increased 1 percent from the 46.2 billion cubic feet marketed in 1968. The State Division of Oil and Gas Conservation [5] reported production of 73.8 billion cubic feet of gas. Of this output, however, 26.9 billion cubic feet was injected into reservoirs for storage. San Juan County was the main gas source with output of 37.5 billion cubic feet; of this quantity, the output of Lisbon field—23.2 billion cubic feet—was processed for liquids removal and returned to the reservoir for pressure maintenance. Uintah County ranked second with output of 23.6 billion cubic feet; 3.7 billion cubic feet was injected into the reservoir of the Red Wash field. Grand County, with output of 8.0 billion cubic feet, ranked third.

Royalty receipts by State and Federal government agencies from natural gas production totaled $851,832 during the year. Of this amount, $336,111 was from production on Indian lands, $462,294 from public domain, and $53,427 from State lands. Com-

[5] Utah Department of Natural Resources, Division of Oil and Gas Conservation. Monthly Oil and Gas Production Reports, 1969.

Table 11.—Coal (bituminous) sold or used,[1] by counties

County	1968		1969	
	Number of mines operating (all underground)	Thousand short tons	Number of mines operating (all underground)	Thousand short tons
Carbon	11	3,062	10	3,367
Emery	8	1,167	7	1,200
Iron	1	3	1	4
Kane	1	2	1	2
Sevier	1	70	1	72
Summit	1	13	1	12
Total [2]	23	4,316	21	4,657

[1] Excludes mines producing less than 1,000 short tons.
[2] Data may not add to totals shown because of independent rounding.

parable figures in 1968 were, respectively, $309,393, $557,219, and $51,546.[6] The State receives 37.5 percent of the royalties paid on production from public domain, under the provisions of the Mineral Leasing Act of 1920. Royalties paid on production from privately owned lands are not included in the preceding figures.

Natural gas reserves for the State, as of December 31, 1969, were estimated by the American Petroleum Institute (API) and the American Gas Association, Inc. (AGA) to be 1.09 trillion cubic feet, a decline of 65.8 billion cubic feet from 1968. New fields and new pools added 114 million cubic feet; revisions, however, subtracted 13.2 billion.[7]

Sixteen development gas wells were completed during the year—nine in Unitah County, five in Grand County, and one each in Daggett and Duchesne Counties.

The U.S. Supreme Court ruled that the agreement between El Paso Natural Gas Co. and Colorado Interstate Corp. was unsatisfactory and returned the case to District Court in Denver for further study. The 12-year-old case involves a previous court order for El Paso to divest itself of facilities of Pacific Northwest Pipeline Corp.; the agreement for Colorado Interstate to acquire the facilities was to have resolved the matter.

Natural Gas Liquids.—Production of natural gas liquids decreased 2 percent. According to estimates by API and AGA, reserves of gas liquids decreased 1.7 million barrels to 38.8 million barrels at yearend.[8]

Petroleum.—Although petroleum produced during the year was 1 percent less than that of the previous year, the value of production increased 4 percent because of a slight increase in wellhead prices. San Juan and Uintah Counties, with 55 and 27 percent, respectively, of the output, continued to rank first and second in the State. A twofold increase in production of the Upper Valley field, Garfield County, and of the Bluebell field, Duchesne County, brought those counties to third and fourth rank, respectively.

As in the past, the Greater Aneth area, San Juan County, was the largest field with a total of 8.6 million barrels of oil; largest individual fields within the area were Aneth, McElmo Creek, and Ratherford. The Greater Red Wash area, Uintah County, again ranked second with 5.8 million barrels of oil; its largest fields were Wonsits Valley, Red Wash Unit, and Walker Hollow. Lisbon field, San Juan County, was third with output of 2.9 million barrels. Upper Valley field, Garfield County, was fourth with 1.6 million barrels, displacing Bridger Lake field, Summit County, which yielded 1.0 million barrels. Bluebell field, Duchesne County, with 1.2 million barrels was fifth.

The Bluebell and Upper Valley fields were sites of extensive development drilling programs, accounting for their increased output. Bluebell had 10 new wells, bringing the total producers to 16; the additions extended the field 3 miles east and 1 mile north. Five new producers were drilled at Upper Valley, extending that field 2 miles.

[6] Utah Department of Natural Resources, Division of Oil and Gas Conservation. Monthly Royalty Report, December 1969.

[7] American Gas Association, Inc., American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids and Natural Gas in the United States and Canada as of Dec. 31, 1969, v. 24, May 1970.

[8] Reference cited in footnote 7.

Table 12.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1968	1969	Principal fields in 1969 in order of production
Daggett	3	3	Clay Basin.
Duchesne	725	1,356	Bluebell, Duchesne, Monument Butte.
Emery	9	6	Grassy Trail, Ferron.
Garfield	897	1,564	Upper Valley.
Grand	135	126	Salt Wash, Long Canyon, Agate.
San Juan	13,604	12,887	McElmo Creek, Lisbon, Aneth, Ratherford.
Summit	1,301	1,026	Bridger Lake.
Uintah	6,830	6,326	Wonsits Valley, Red Wash, Walker Hollow, Ashley Valley.
Washington	(1)	1	Anderson Junction.
Total	23,504	23,295	

[1] Less than ½ unit.

Source: Utah Oil & Gas Conservation Commission.

Table 13.—Oil and gas well drilling, by counties

County	Oil	Gas	Dry	Total	Footage
1968:					
Exploratory completions:					
Carbon	--	--	8	8	41,269
Daggett	--	--	1	1	2,047
Duchesne	--	--	2	2	8,235
Emery	--	--	2	2	12,835
Garfield	--	--	2	2	13,322
Grand	--	--	6	6	5,957
Kane	--	--	1	1	6,425
Millard	--	--	4	4	22,414
San Juan	2	--	15	17	103,340
Sevier	--	--	1	1	3,050
Summit	--	--	3	3	39,510
Uintah	--	--	7	7	30,800
Washington	1	--	2	3	12,642
Wayne	--	--	1	1	6,026
Total	3	--	55	58	307,872
Development completions:					
Duchesne	5	--	--	5	54,509
Garfield	6	--	--	6	41,870
Grand	--	3	15	18	36,597
San Juan	8	--	15	23	91,373
Summit	2	--	--	2	31,525
Uintah	24	5	6	35	181,894
Washington	--	--	1	1	750
Total	45	8	37	90	438,518
Total all drilling	48	8	92	148	746,390

County	Oil	Gas	Dry	Total	Footage
1969:					
Exploratory completions:					
Duchesne	2	--	1	3	26,610
Emery	--	--	5	5	19,719
Garfield	--	--	6	6	19,901
Grand	--	--	11	11	57,094
Kane	--	--	2	2	12,586
Millard	--	--	2	2	7,025
San Juan	--	--	9	9	44,296
Uintah	--	--	10	10	40,991
Utah	--	--	2	2	973
Washington	--	--	1	1	5,606
Wayne	--	--	4	4	11,124
Total	2	--	53	55	245,925
Development completions:					
Daggett	--	1	1	2	12,996
Duchesne	13	1	1	15	104,662
Garfield	5	--	2	7	49,159
Grand	1	5	4	10	15,712
San Juan	14	--	5	19	38,057
Summit	1	--	--	1	17,910
Uintah	17	9	6	32	149,281
Washington	1	--	--	1	4,124
Total	52	16	19	87	391,901
Total all drilling	54	16	72	142	637,826

Sources: Petroleum Information Corp., 1968 and 1969 Resumés, Oil and Gas Operations in the Rocky Mountain Region.

In the Bridger Lake field, Summit County, the eighth producing well was completed. Phillips Petroleum Co., the field operator, announced plans for a secondary recovery project in the field using high pressure natural gas which will be obtained from Mountain Fuel Supply Co. Ultimate recovery will be 39.8 million barrels, approximately 63 percent of the original oil in place, during a 30-year life.

Proved crude oil reserves in the State as of December 31, 1969, were 195.3 million barrels, an increase of 15.3 million; additional reserves of 35.3 million barrels are considered available by fluid injection. New fields added 260,000 barrels and revisions and extensions added 37.7 million barrels.[9]

State and Federal Government agencies received a total of $8,530,712 in royalties paid on crude oil production, an increase of $1,030,201 (13.7 percent) from the $7,500,511 received in 1968. Of the total received in 1969, $5,171,354 was from production on Indian lands, $2,959,485 was from public domain, and $399,873 was from State lands. These figures do not include royalties paid on production from private lands; as with natural gas, 37.5 percent of the royalties paid on public domain is returned to the State.

Drilling activity during 1969 declined slightly—6 wells less than during the previous year; the decline was divided equally between exploratory and development wells. Uintah, San Juan, and Duchesne Counties had the largest number of successful development well completions. Walker Hollow and Wonsits Valley fields accounted for most of the Uintah County development drilling; Boundary Butte field for the San Juan County activity; and Bluebell field for that in Duchesne County.

Although Grand and Uintah Counties were the leaders in exploratory drilling, the only successes were in Duchesne County. Exploratory success ratio was a low 3.6 percent, compared with 5.2 percent in 1968 and 12.7 percent in 1967. Of the two discoveries, the more significant in initial production was that of Mountain Fuel Supply Co. The well, Cedar Rim No. 2, SW¼ NE¼ sec 20, T3S, R6W, (UPM), was completed for an initial flow gage of 888 barrels of 44° API oil from the Wasatch formation (Tertiary). Completion was from the depth interval 8,580 to 8,670 feet. Four other zones, all in the Green River formation (Teritiary), indicated production on

[9] Reference cited in footnote 7.

tests. The second discovery was the Gulf Oil Corp., Ute Tribal-Cottonwood Wash No. 1, SE¼ NW¼ sec 7, T1N, R3W, (UPM). The well was completed for an initial potential pumping of 195 barrels of oil per day from Basal Tertiary at 9,894 to 9,904 feet.

The State's five oil refineries processed 39.3 million barrels of crude oil. Utah fields provided 10.1 million barrels; 29.2 million came from out of State. Colorado and Wyoming were the principal sources of out-of-State crude oil, with 16.8 million and 12.2 million barrels, respectively; out-of-State shipments were chiefly to California (11.0 million barrels) and to Texas (2.5 million barrels).

Husky Oil Co. added, during the year, vacuum distillation capacity of 3,750 barrels per day to its refinery at North Salt Lake. Chevron Oil Co. added a 6,000-barrel-per-day pretreating catalytic reforming unit at its Salt Lake City refinery. The American Oil Co. announced, late in the year, plans for expanding its refinery at Salt Lake City; plans include expansion and upgrading of crude oil distillation facilities and addition of a 21,000-barrel-per-day catalytic cracking unit. Daily capacity of the refinery will be increased to 49,000 barrels.

NONMETALS

Barite.—No mines in Utah reported production of crude barite during 1969. However, Yuba Minerals & Milling Co., at Salt Lake City, processed barite for well drilling mud. The barite was mined at several properties in Lander County, Nevada.

Cement.—Output of portland cement increased 17 percent in quantity and 22 percent in value. Small increases also were recorded in production of masonry cement. Two companies were active—Ideal Cement Co., a division of Ideal Basic Industries, Inc., with a plant near Devil's Slide, Morgan County, and Portland Cement Company of Utah at Salt Lake City. Less than 0.3 percent of the total cement production was masonry cement. Sixty-seven percent of the portland cement was purchased by the ready-mixed-concrete companies; highway construction utilized 9 percent; and other important tonnages of cement were sold to companies manufacturing concrete products and to dealers in building materials.

Clays.—Production of materials classified as clays decreased in quantity and in value, compared with 1968. The major producing companies were Utelite Corp., Interstate Brick Co., Filtrol Corp., Redmond Clay & Salt Co., and Western Clay & Metals Co. The principal materials listed as clays included shale, common clay, kaolin, bentonite, fuller's earth, and fire clay. Most of the clays were used as expanded material in making lightweight aggregate, in manufacturing building brick, and as catalysts in oil refining.

Fluorspar.—All fluorspar produced in the State was mined in the Spor Mountain area, Juab County. Nearly all ores, produced from four mines, were sold to steel companies for use as flux. Output was down 24 percent, with a 3 percent decrease in total value.

Gem Stones.—Total production value of gem stones recovered in the State during 1969 was estimated at $85,000, a slight increase over that of the previous year.

Gypsum.—Georgia-Pacific Corp., Gypsum Division, and United States Gypsum Co. were the only companies reporting gypsum production. Both companies operated open pits and plants near Sigurd, Sevier County. The tonnage produced declined 10 percent, and the value of crude gypsum dropped 26 percent. Most of the output was calcined. Small tonnages were sold for use as a portland cement retarder and for agricultural requirements.

Lime.—Of six operators reporting production, five utilized quick lime in their own chemical and industrial plants. Tonnage output was 10 percent greater than in 1968; total value increased 15 percent. Lime was used in the concentration of copper ore and in sugar refining. Other uses included preparation of alkalies, steel manufacture (basic oxygen converters and open-hearth furnaces), water treatment, and petroleum refining. Utah Marblehead Lime Co. produced dead-burned dolomite at the company plant northwest of Grantsville, Tooele County.

Magnesium Chloride.—Magnesium chloride, produced by Kaiser Aluminum & Chemical Corp. at its Bonneville plant near Wendover, Tooele County, was used in sugar refining and as an anti-freezing reagent; output decreased 3 percent.

Perlite.—Bradshaw Pumice & Perlite Co. was the only producer of crude perlite.

Property of this company is in the Mineral Range, 14 miles east of Milford, Beaver County. Two plants, Acme Lite Wate Products, Inc., Salt Lake City, and Georgia-Pacific Corp., Gypsum Division, at Sigurd, expanded perlite for use as a plaster aggregate and in building plaster. No crude perlite production was reported in 1968.

Phosphate Rock.—Two mines operated by Stauffer Chemical Co. yielded phosphate rock during the year. The Vernal Unit open pit mine and flotation plant resumed production in June, after a 14-month shutdown. The Cherokee mine, an open pit-underground property in Rich County, was operated throughout the year. Phosphate rock from this mine was processed in the company plant at Leefe, Wyo. Marketable production for the State increased 9 percent; total value was up 6 percent.

Potash.—Production of potash salts, was reported by Texas Gulf Sulphur Co. near Moab, Grand County, and by Kaiser Aluminum & Chemical Corp., Bonneville, Ltd. Division, at Wendover, Tooele County. The output increased 22 percent in quantity and 5 percent in total value. No production was reported by the Kaiser plant during 1968.

Improved underground mining methods and machinery have not overcome the severe problems created by the undulations in the potash-bearing beds at the Cane Creek mine, Texas Gulf Sulphur Co. Experimental solution mining is being conducted to find a more economical method for extraction and recovery of the potash.

Pumice.—Four mines in three counties of southwestern Utah produced pumice and related volcanic materials for use as concrete aggregate, in preparing lava building blocks, and as cinders in road construction. Total tonnage mined and used was up 25 percent; however, the average value of the commodity per ton was 12 percent less than in 1968.

Salt.—Salt production increased 19 percent; the value of the output was 18 percent greater. Evaporated salt was produced by five companies with ponds in three counties. Two mines in Sanpete and Sevier Counties yielded all rock salt tonnages. The salt was sold for use in many industries, principally to the chemical and animal feed processing industries.

Sand and Gravel.—All counties in Utah produced sand and gravel, with Salt Lake County having the greatest number of operations; however, Tooele County was the leader in total quantity and value because of large Government-contract production. A total of 181 operations yielded sand and gravel. Quantity produced was up 86 percent, with an average value of $0.84 per ton. The total value of the sand and gravel was greater than any other nonmetallic commodity produced in Utah.

Stone.—Thirty-nine quarries produced stone. Principal producing companies in order of output were Southern Pacific Railroad Co., USS, Portland Cement Company of Utah, Utah Marblehead Lime Co., and W. W. Clyde and Co. Tonnage output was 32 percent greater with a 3-percent increase in total value. The average value per ton was $1.72.

Vermiculite.—No vermiculite production was reported during 1969. One plant, located in Salt Lake City, exfoliated vermiculite mined from properties outside the State. The product was sold and used principally as concrete aggregate and as block and loose fill insulation. Some other uses included plaster aggregate, soil conditioning, and insulation for packing and pipe covering.

Table 14.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Beaver	22	$31	313	$311
Box Elder	873	842	819	801
Cache	385	483	134	171
Carbon	95	92	38	40
Daggett	6	6	26	26
Davis	795	642	1,939	1,593
Duchesne	455	376	459	349
Emery	250	262	267	277
Garfield	350	354	112	124
Grand	36	43	W	W
Iron	361	369	466	530
Juab	(1)	(1)	111	96
Kane	116	94	132	121
Millard	30	30	172	172
Morgan	W	W	W	W
Piute	39	37	8	4
Rich	W	W	2	2
Salt Lake	3,034	2,809	4,417	4,024
San Juan	53	53	305	305
Sanpete	62	63	53	40
Sevier	119	118	182	247
Summit	397	394	735	918
Tooele	1,008	521	6,761	4,214
Uintah	135	146	326	306
Utah	538	536	371	290
Wasatch	132	120	10	15
Washington	76	99	82	127
Wayne	7	3	16	16
Weber	865	774	813	826
Undistributed	54	67	83	96
Total [2]	10,293	9,364	19,151	[3] 16,042

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

[1] Less than ½ unit.

[2] Data may not add to totals shown because of independent rounding.

[3] This figure supersedes the sand and gravel value figure shown in the 1969 sand and gravel chapter of V. I-II, Minerals Yearbook 1969 and the statistical summary chapter of V. I-II and V. III, Minerals Yearbook 1969.

Table 15.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	799	$876	859	$933
Paving	352	395	681	627
Railroad ballast	115	166	------	------
Fill	83	36	119	66
Other	(1)	(1)	24	62
Industrial:				
Blast	(1)	(1)	(2)	(2)
Engine	(1)	(1)	(2)	(2)
Foundry (ground)	(1)	(1)	(2)	(2)
Other	(1)	(1)	(2)	(2)
Total [3]	1,349	1,473	1,683	1,689
Gravel:				
Construction:				
Building	1,074	1,012	1,204	1,348
Paving	2,051	2,061	2,417	2,648
Railroad ballast	15	6	1	1
Fill	442	225	287	148
Other	------	------	34	40
Miscellaneous	73	79	24	39
Total [3]	3,655	3,383	3,966	4,223
Total sand and gravel [3]	5,004	4,856	5,649	5,911
Government-and-contractor operations:				
Sand:				
Building	12	12	1	2
Paving	1,108	1,080	2,279	1,975
Fill	50	25	80	40
Other	19	17	24	24
Total [3]	1,189	1,134	2,384	2,040
Gravel:				
Building	154	181	2	3
Paving	3,653	3,045	10,264	7,484
Fill	292	147	853	604
Other	1	1	------	------
Total [3]	4,100	3,374	11,118	8,091
Total sand and gravel [3]	5,289	4,510	13,503	10,131
All operations:				
Sand	2,538	2,607	4,067	3,729
Gravel [3]	7,755	6,757	15,084	12,313
Total	10,293	9,364	19,151	[4] 16,042

[1] "Other (construction)," blast, engine, foundry, and "Other (industrial)" sand combined with railroad ballast sand to avoid disclosing individual company confidential data.

[2] Blast, engine, foundry, and "Other (industrial)" sand combined with "Other (construction)" sand to avoid disclosing individual company confidential data.

[3] Data may not add to totals shown because of independent rounding.

[4] This figure supersedes the sand and gravel value figure shown in the 1969 sand and gravel chapter of V. I-II, Minerals Yearbook 1969 and the statistical summary chapter of V. I-II and V. III, Minerals Yearbook 1969.

Table 16.—Stone sold or used by producers, by counties

County	1968		1969	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Box Elder	3,544	$92	1,460,368	$1,563
Cache	111,882	294	184,487	279
Daggett	---	---	34,290	66
Davis	4,026	9	---	---
Duchesne	---	---	21,302	92
Iron	W	W	44	(1)
Juab	W	W	6,000	W
Millard	---	---	5	(1)
Morgan	W	W	W	W
Salt Lake	W	W	W	W
San Juan	28,522	57	---	---
Summit	82,714	178	112,062	466
Tooele	312,992	748	242,479	774
Utah	W	W	W	W
Wasatch	346	8	48,350	56
Washington	W	W	---	---
Weber	---	---	4,077	18
Undistributed	1,409,074	2,926	468,843	1,120
Total	1,953,100	4,312	2,582,307	4,434

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Less than ½ unit.

Table 17.—Stone sold or used by producers, by uses

Use	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension stone:				
Irregular-shaped stone, short tons	346	$8	W	W
Rough blocks, do.	W	W	5	(1)
Rubble, do.	W	W	---	---
Rough flagging, cubic feet	---	---	64	(1)
Sawed stone, do.				
House stone veneer, do.	19,209	74	11,115	$26
Cut stone, do.				
Dressed flagging, do.	7,301	25	W	W
Total (approximate), short tons	4,400	122	2,200	69
Crushed and broken stone:				
Riprap and jetty stone, short tons	83,802	166	1,598,816	2,088
Roofing aggregates, do.	1,228	8	W	W
Concrete aggregate, do.	1,097	23	---	---
Dense graded roadbase, do.	41,422	82	131,820	147
Surface treatment aggregate, do.	75,794	176	W	W
Lime, do.	343,564	776	296,898	709
Other, do.	[2] 1,401,817	[2] 2,959	[3] 487,770	[3] 1,278
Total, do.	1,948,724	4,190	2,580,080	4,365
Total stone (approximate), do.	1,953,100	4,312	2,582,300	4,434

W Withheld to avoid disclosing individual company confidential data; included in "Totals."
[1] Less than ½ unit.
[2] Includes stone used in cement, flux, landscaping, mine dusting, other fillers, poultry grit, refractories, terrazzo, whiting, and unspecified uses.
[3] Includes stone used in cement, flux, mine dusting, poultry grit, refractories, roofing aggregates, stone sand, surface treatment aggregates, and terrazzo.

Table 18.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Kind of stone	1965		1966		1967		1968		1969	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dolomite and limestone [1]	1,852	$3,734	1,943	$3,573	1,767	$3,843	1,817	$3,816	899	$2,195
Granite	W	W	-----	-----	-----	-----	-----	-----	-----	-----
Marble	(2)	11	W	W	-----	-----	-----	-----	-----	-----
Quartz, quartzite, sandstone	202	499	202	447	54	162	126	400	172	491
Quartz and quartzite	NA	NA	NA	NA	NA	NA	65	172	3	71
Sandstone	NA	NA	NA	NA	NA	NA	62	227	169	420
Slate	2	82	1	43	W	W	W	W	-----	-----
Traprock	(2)	1	(2)	(2)	(2)	(2)	(2)	(2)	-----	-----
Other stone	101	225	101	206	10	102	10	96	1,511	1,748
Total [3]	2,158	4,552	2,246	4,269	1,831	4,108	1,953	4,312	2,582	4,434

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Other stone."

[1] Excludes dimension limestone; included with "Other stone."

[2] Less than ½ unit.

[3] Data may not add to totals shown because of independent rounding.

Table 19.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt and related bitumens: American Gilsonite Co	Suite 1150, Kennecott Bldg. Salt Lake City, Utah 84110	Underground mine	Uintah.
Beryllium: The Brush Beryllium Co	67 W. 2950 S. Salt Lake City, Utah 84115	Refinery Open pit mine Chemical processing plant	Mesa. Juab. Millard.
Carbon dioxide (natural): Equity Oil Co	806 American Oil Bldg. Salt Lake City, Utah 84101	Well and plant, Farnham Dome field	Carbon.
Cement: Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Wet process, 2-rotary-kiln plant	Morgan.
Clays:			
Filtrol Corp	3250 E. Washington Blvd. Los Angeles, Calif. 90023	Open pit-underground mine	Juab.
Interstate Brick Co	Box 6239 Salt Lake City, Utah 84106	Open pit mine ----do ----do	Sevier. Summit. Tooele.
Utelite Corp	R.F.D. Coalville, Utah 84017	Open pit mine and expanding plant	Summit.
Western Clay & Metals Co	1200 S. Atlantic Blvd. Alhambra, Calif. 91803	2 open pit mines	Sevier.
Coal (bituminous):			
Kaiser Steel Corp	Sunnyside Coal Mines Sunnyside, Utah 84539	3 underground mines and cleaning plant	Carbon.
The North American Coal Corp	12800 Shaker Blvd. Cleveland, Ohio 44120	Underground mine and cleaning, thermal drying, and oil treatment plant.	Do.
United States Fuel Co	1910 University Club Bldg. Salt Lake City, Utah 84111	Underground mine Cleaning, crushing, and oil treatment plant	Carbon, Emery. Carbon.
United States Steel Corp., Western District	Box 807 Dragerton, Utah 84520	Underground mine Cleaning, thermal drying, and crushing plant.	Carbon, Emery. Carbon.
Copper:			
Hecla Mining Co	Box 320 Wallace, Idaho 83873	See Gold	Wasatch.
Kennecott Copper Corp., Utah Copper Division	Box 11299 Salt Lake City, Utah 84111	Open pit mine, crusher, 2 flotation mills, precipitation plant, smelter, and electrolytic refinery.	Salt Lake.
United States Smelting Refining and Mining Co	136 E. South Temple St. Salt Lake City, Utah 84111	See Lead	Do.
Fluorspar:			
Chesley & Black, Inc	Delta, Utah 84624	Open pit mine	Juab.
Willden Fluorspar Co	Box 536 Delta, Utah 84624	Underground mine	Do.
Gold:			
Hecla Mining Co	Box 320 Wallace, Idaho 83873	Underground mine and flotation mill	Wasatch.
Kennecott Copper Corp., Utah Copper Division	Box 11299 Salt Lake City, Utah 84111	See Copper	Salt Lake.
United Park City Mines Co	Star Rte. 1, Box 40 Heber City, Utah 84032	See Zinc	Summit.
United States Smelting Refining and Mining Co	136 E. South Temple St. Salt Lake City, Utah 84111	See Lead	Salt Lake.

Gypsum:			
Georgia Pacific Corp., Gypsum Division	900 SW Fifth Portland, Oreg. 97204	Open pit mine; crushing, grinding, and screening plant; calcining equipment; wallboard plant.	Sevier.
United States Gypsum Co	101 S. Wacker Drive Chicago, Ill. 60606	----do	Do.
Iron ore:			
CF&I Steel Corp	Box 1920 Pueblo, Colo. 80201	3 open pit mines	Iron.
United States Steel Corp., Western Ore Operations	Lander, Wyo. 82520	Open pit mine	Do.
Utah Construction & Mining Co	Box 649 Cedar City, Utah 84720	2 open pit mines, mobile crushing and screening plant, and benefication plant.	Do.
Lead:			
Deer Trail Mines & Arundel Mining Co	1834 S. Woodside Dr. Salt Lake City, Utah 84172	See Zinc	Piute.
Hecla Mining Co	Box 320 Wallace, Idaho 83873	See Gold	Wasatch.
Kennecott Copper Corp., Tintic Division	Box 250 Eureka, Utah 84628	See Zinc	Utah.
United Park City Mines Co	Star Route 1, Box 40 Heber City, Utah 84032	----do	Summit.
United States Smelting Refining and Mining Co	136 E. South Temple St. Salt Lake City, Utah 84111	Underground mine and custom flotation mill.	Salt Lake.
United States Smelting Refining and Mining Co. (McFarland & Hullinger, lessee).	-----do	Underground mine	Tooele.
Lime:			
The Flintkote Co., U.S. Lime Division	2244 Beverly Blvd. Los Angeles, Calif. 90057	2-shaft-kiln plant	Do.
Utah Marblehead Lime Co	300 W. Washington St. Chicago, Ill. 60606	Rotary-kiln plant	Do.
Magnesium Chloride: Kaiser Aluminum & Chemical Corp., Bonneville, Ltd., Division.	300 Lakeside Drive Oakland, Calif. 94612	Solar evaporation	Do.
Molybdenum: Kennecott Copper Corp., Utah Copper Division	Box 11299 Salt Lake City, Utah 84111	See Copper	Salt Lake.
Natural gas and petroleum:			
American Oil Co	Box 898 Salt Lake City, Utah 84110	Refinery	Do.
Atlantic Richfield Co	717 Fifth Ave. New York, N.Y. 10022	Crude oil wells, Boundary Butte field	San Juan.
		Natural gas wells, San Arroyo field	Grand.
Belco Petroleum Corp	630 Third Ave. New York, N.Y. 10017	Crude oil wells, White River field	Uintah.
		Natural gas wells, Chapita Wells field	Do.
Chevron Oil Co., Western Division	Box 599, 1700 Broadway Denver, Colo. 80201	Crude oil wells and gas processing plant, Red Wash field.	Uintah.
		Crude oil wells, Bluebell field	Duchesne.
		Natural gas wells, Powder Springs and Horseshoe Bend fields.	Uintah.
Continental Oil Co	Box 2197 Houston, Tex. 77001	Crude oil wells, White Mesa and Bluff fields	San Juan.
El Paso Natural Gas Co., Northwest Division	Box 1526 Salt Lake City, Utah 84110	Gas processing plant, Aneth field	Do.
Gulf Oil Corp	Gulf Bldg. Pittsburgh, Pa. 15230	Crude oil wells, Wonsits Valley field	Uintah.
		Indian Ridge field	Duchesne.
Humble Oil & Refining Co., Central Division	2000 Classen Center North Oklahoma City, Okla. 73106	Crude oil and natural gas wells, Walker Hollow field.	Uintah.
Husky Oil Co	Box 380 Cody, Wyo. 82414	Refinery	Salt Lake.

Table 19.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Natural gas and petroleum—Continued			
Monsanto Co., Hydrocarbons & Polymers Division	800 N. Lindbergh Blvd. St. Louis, Mo. 63166	Crude oil wells, McElmo Mesa field	San Juan.
Phillips Petroleum Co	431 S. 3d East Salt Lake City, Utah 84111	Crude oil wells, Ratherford field	Do.
		Bridger Lake field	Summit.
		Refinery	Salt Lake.
The Superior Oil Co	Box 1521 Houston, Tex. 77001	Crude oil wells, McElmo Creek field	San Juan.
Tenneco Oil Co	Box 251 Houston, Tex. 77001	Crude oil wells, Upper Valley field	Garfield.
		Natural gas wells, Clear Creek field	Carbon.
Texaco Inc	Box 2100 Denver, Colo. 80201	Crude oil wells, Aneth, Ismay and Flodine Park fields.	San Juan.
		Natural gas wells, Fence Canyon field	Uintah.
Union Oil Company of California, Western Region	Box 7600 Los Angeles, Calif. 90054	Crude oil wells and gas processing plant, Lisbon field.	San Juan.
Warren Petroleum Corp	Box 1589 Tulsa, Okla. 74101	Gas processing plant	Uintah.
Perlite: Bradshaw Pumice & Perlite Co	Milford, Utah 84751	Open pit mine	Beaver.
Phosphate rock: Stauffer Chemical Co	636 California St. San Francisco, Calif. 94119	Open pit-underground mine	Rich.
		Open pit mine and benefication plant	Uintah.
Potassium salts: Texas Gulf Sulphur Co	200 Park Ave. New York, N.Y. 10017	Underground mine and flotation refinery	Grand.
Pumice: Thompson Block Co	620 N. 400 W. Cedar City, Utah 84720	Open pit mine and crushing and screening plant.	Beaver.
		----do	Iron.
Pyrites: United Park City Mines Co	Star Route 1 Heber City, Utah 84032	See Zinc	Summit.
Salt:			
Morton Salt Co., a division of Morton International, Inc	110 N. Wacker Drive Chicago, Ill. 60606	Lake brine processing plant	Salt Lake.
Solar Salt Co	270 Crossroad Square Salt Lake City, Utah 84115	----do	Tooele.
Sand and gravel:			
Construction Materials Corp., Savage Bros., Inc., Division	R.F.D. 4, Box 611 American Fork, Utah 84003	Pit and plant	Davis.
Dan R. Fogle Sand & Gravel Products	350 Hartwell Ave. Salt Lake City, Utah 84115	Pit and 3 plants	Salt Lake.
Gibbons & Reed Co., Concrete Products Co. Division	41 W. Central Ave. Murray, Utah 84107	Pit and plant	Davis.
		----do	Salt Lake.
		----do	Weber.
Pioneer Sand & Gravel	3200 W. 5400 S. Granger Dr. Salt Lake City, Utah 84118	----do	Salt Lake.
Utah Sand & Gravel Products Corp	Box 537 Salt Lake City, Utah 84110	3 pits and plants	Do.
Walker Sand & Gravel Co	21 S. Tenth W. Salt Lake City, Utah 84104	Pit and plant	Do.
Selenium: Kennecott Copper Corp., Utah Copper Division	Box 11299 Salt Lake City, Utah 84111	See Copper	Do.

Silver:			
Deer Trail Mines & Arundel Mining Co	1834 S. Woodside Dr. Salt Lake City, Utah 84172	See Zinc	Piute.
Hecla Mining Co	Box 320 Wallace, Idaho 83873	See Gold	Wasatch.
Kennecott Copper Corp., Tintic Division	Box 250 Eureka, Utah 84628	See Zinc	Utah.
Kennecott Copper Corp., Utah Copper Division	Box 11299 Salt Lake City, Utah 84111	See Copper	Salt Lake.
Kennecott Copper Corp. (Ben Dixon & Christie, lessee)	----do	Underground mine	Do.
McFarland & Hullinger	Box 238 Tooele, Utah 84074	Tailings dump	Juab.
United Park City Mines Co	Star Route 1, Box 40 Heber City, Utah 84032	See Zinc	Summit.
United States Smelting Refining and Mining Co	136 E. South Temple St Salt Lake City, Utah 84111	See Lead	Salt Lake.
United States Smelting Refining and Mining Co. (McFarland & Hullinger, lessee).	----do	----do	Tooele.
Stone:			
Portland Cement Company of Utah	Box 1469 Salt Lake City, Utah 84110	Quarry and plant	Salt Lake.
Southern Pacific Railroad Co	65 Market St. San Francisco, Calif. 94105	2 quarries	Box Elder.
United States Steel Corp., Western Ore Operations	Lander, Wyo. 82520	Quarry and plant	Utah.
Utah Marblehead Lime Co	300 W. Washington St. Chicago, Ill. 60606	----do	Tooele.
W. W. Clyde & Co	Box 350 Springville, Utah 84663	----do	Daggett.
		Quarry	Duchesne.
		Quarry and plant	Summit.
Uranium:			
Atlas Corp., Atlas Minerals Division	Box 1207 Moab, Utah 84532	Underground mine	Emery.
		Moab custom mill	Grand.
		14 underground mines	San Juan.
Homestake Mining Co	Box 563 Moab, Utah 84532	Underground mine	Do.
Climax Uranium Co., American Metal Climax, Inc	Box 1629 Grand Junction, Colo. 81501	3 underground mines	Do.
Vanadium: Climax Uranium Co., American Metal Climax, Inc	----do	See Uranium	Do.
Zinc:			
Deer Trail Mines & Arundel Mining Co	1834 S. Woodside Dr. Salt Lake City, Utah 84172	Underground mine	Piute.
Hecla Mining Co	Box 320 Wallace, Idaho 83873	See Gold	Wasatch.
International Smelting and Refining Co	R.F.D. 1 Tooele, Utah 84074	Slag dump	Salt Lake.
Kennecott Copper Corp., Tintic Division	Box 250 Eureka, Utah 84628	2 underground mines	Utah.
United Park City Mines Co	Star Route 1, Box 40 Heber City, Utah 84032	----do	Summit.
United States Smelting Refining and Mining Co	136 E. South Temple St. Salt Lake City, Utah 84111	See Lead	Salt Lake.
United States Smelting Refining and Mining Co. (McFarland & Hullinger, lessee).	----do	See Lead	Tooele.

The Mineral Industry of Vermont

By Harold F. York [1]

Vermont mineral production during 1969 was valued at $27.8 million, 3 percent less than that of the previous year. A 15-percent reduction in the output of stone was the principal factor in the decline, although the unit price for stone increased. The output of sand and gravel likewise declined, but an improved price per ton was reflected in an overall value increase of nearly 8 percent compared with 1968. The output and value of asbestos and talc increased during the year. Clay and lime output and value declined. Peat production also declined.

During 1969 the total labor force was 184,300 persons, up 2.1 percent over that of 1968. Unemployment declined from 3.6 to 3.2 percent of the work force. Manufacturing employment was relatively unchanged. Nonmanufacturing employment increased 5 percent to 101,500 principally in the area of construction activity. Employment in mining and quarrying declined nearly 5 percent, from 1,050 to 1,000 during a year that showed a general increase in business activity. According to the Vermont Development Department, Economic Development Division, average weekly earnings increased from $108.00 to $114.54. The Survey of Current Business reports an increase in personal income in Vermont from $1,306 million to $1,434 million. Per capita income rose from $3,043 to $3,267.

Six counties in Vermont had mineral production valued in excess of $1 million. Rutland continued to lead in mineral production although, compared with the previous year, the total value declined 16 percent. Washington and Orleans Counties were next in value of production with increases of 12 percent and 8 percent, respectively over that of 1968. Windsor County, in fourth place, had a decline of 12 percent. The value of mineral output in Chittenden County more than doubled. Orange County experienced a 22-percent decrease in value of mineral output. Grand Isle remained the only county in Vermont without significant mineral production, but during the year another attempt was made to discover petroleum. A single exploratory test was abandoned as a dry hole after drilling to a depth of 3,500 feet, according to the American Association of Petroleum Geologists.

[1] Supervisory physical scientist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Vermont [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Lime—short tons	W	W	1,500	$25
Peat—do	W	W	180	4
Sand and gravel—thousand short tons	3,587	$2,806	3,336	3,028
Stone—do	2,536	21,401	2,151	19,810
Value of items that cannot be disclosed: Asbestos, clays, gem stones, and talc	XX	4,508	XX	4,892
Total	XX	28,715	XX	27,759
Total 1967 constant dollars	XX	28,458	XX	p 27,016

p Preliminary. 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 Vermont, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Addison	W	W	Sand and gravel.
Bennington	W	W	Do.
Caledonia	W	W	Do.
Chittenden	$566	$1,314	Sand and gravel, stone, lime, clay.
Essex	W	W	Sand and gravel.
Franklin	W	W	Stone, sand and gravel.
Lamoille	W	W	Talc, sand and gravel.
Orange	W	W	Stone, sand and gravel.
Orleans	W	W	Asbestos, sand and gravel, stone.
Rutland	W	W	Stone, sand and gravel.
Washington	W	W	Do.
Windham	W	W	Sand and gravel, talc.
Windsor	W	W	Stone, talc, sand and gravel, peat.
Undistributed	28,149	26,444	
Total	28,715	[2] 27,759	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Grand Isle County is not listed because no production was reported.
[2] Data does not add to total shown because of independent rounding.

Table 3.—Indicators of Vermont business activity

		1968	1969 [p]	Change, percent
Employment, and labor force, annual average: [1]				
Total labor force		[r] 180,550	184,300	+2.1
Unemployment (percent work force)		[r] 3.6	3.2	−11.1
Employment:				
Manufacturing		[r] 43,700	43,650	− .1
Durable goods		[r] 29,750	29,550	− .7
Nondurable goods		[r] 13,950	14,100	+1.1
Nonmanufacturing		[r] 96,600	101,500	+5.1
Mining and quarrying		1,050	1,000	−4.8
Payroll—average weekly earnings: [1]				
Manufacturing		[r] $108.00	$114.54	+6.1
Personal income: [2]				
Total	millions	[r] $1,306	$1,434	+9.8
Per capita		$3,043	$3,267	+7.4
Construction activity:				
Total construction [1]	millions	$145.4	$182.7	+25.7
Nonresidential buildings	do	$57.3	$66.3	+15.7
Residential buildings	do	$45.0	$62.3	+38.4
Nonbuilding	do	$43.1	$54.0	+25.3
Cement shipments to and within Vermont	thousand 376-pound barrels	723	692	−4.3
Mineral production value	thousands	$28,715	$27,759	−3.3

[p] Preliminary. [r] Revised.
[1] Economics Development Div., Vermont Development Dept.
[2] Survey of Current Business.

Table 4.—Worktime 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
1968:								
Nonmetal and peat	317	281	89	717	---	26	36.27	823
Sand and gravel	262	194	51	442	---	8	18.11	373
Stone	1,717	244	419	3,434	---	110	32.03	3,267
Total	2,296	243	559	4,593	---	144	31.35	2,607
1969: p								
Nonmetal and peat	320	283	91	734	---	19	25.87	296
Sand and gravel	190	174	33	300	---	5	16.66	177
Stone	1,315	255	335	2,780	2	101	37.05	7,352
Total	1,825	252	459	3,814	2	125	33.29	5,429

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Asbestos.—GAF Corporation, Building & Industrial Floor Products Division, produced chrysotile asbestos from its Lowell Mine near Lowell, Orleans County. Output was 9 percent greater than in 1968, but the average price per ton was unchanged. The several grades produced, depending on quality and length of fiber, were sent out of the State for processing into heat-resistant products.

Clays.—The production of common clay and shale declined in both tonnage and value compared with that of 1968. The Densmore Brick Co., Inc., at Essex Junction, Chittenden County, produced clay for the manufacture of building brick. The output was slightly less than that of the previous year.

Gem Stones.—At various locations throughout the State, hobbyists and other collectors reported finds of miscellaneous gem materials and mineral specimens.

Lime.—Lime production in Chittenden County during 1969 totaled 1,500 tons of both hydrated and quicklime. Vermont Associated Lime Industries, Inc., at Winooski, produced quicklime for chemical purposes and hydrated lime for construction and chemical uses. Average price per ton was $10.88 for quicklime an $22.86 for hydrated lime.

Mica, Reconstituted.—At Rutland, Samica Corporation processed delaminated mica scrap to form reconstituted sheet mica for use in electrical insulation.

Peat.—During 1969, Windsor County was the site of the only peat production in Vermont. Although production has remained small over the past several years, a limited market prevails for reed-sedge peat. Kirks Green Mountain Peat was the only operator, producing from a bog near Barnard. Sold in plastic bags, the f.o.b. price ranges from $25 per cubic yard when packaged in four-quart containers to $14.50 per cubic yard in either 1 or 1-½ bushel bags. The material is used for general soil improvement.

Sand and Gravel.—Production of sand and gravel, both commercial and noncommercial, totaled 3.3 million tons valued at over $3 million. Output was 7 percent less in tonnage, but improved unit prices were reflected in an almost 8-percent increase in total value.

Commercial production of sand and gravel was 2,643,000 tons valued at $2,781,000 for an average value per ton of $1.05. This represents a 14-percent increase in output and a 21-percent increase in value caused by the per-ton price increase from $0.99 in 1968. Chittenden County was the leading producer of sand and gravel followed by Bennington, Orange, Washington, Rutland, and Addison—all of which produced over 100,000 tons. In addition to several incidental operations, 26 producers maintained stable production. The principal uses were for building and paving, fill, sanding of roads, engine sand, turkey grits, and for use in the manufacture of concrete products. All of the reported transporta-

tion was by truck. Eleven each of stationary and portable plants, for washing and screening, were reported in use during the year.

Noncommercial production of sand and gravel by Government-and-contractor operations totaled 694,000 tons valued at $247,000, or $0.36 per ton. Compared with 1968, this is a decline of 579,000 tons and $263,000. Rutland County was the leading producer, followed by Orleans, Windsor, and Washington, all of which produced over 75,000 tons. Grand Isle and Lamoille were the only counties which experienced no commercial sand and gravel production. The U.S. Forest Service, Green Mountain National Forest, contracted for gravel for road surfacing purposes. The Vermont State Highway Department, Maintenance Division, purchased sand and gravel from commercial producers, or contracted for the production as a part of the work project. The Highway Department produced sand for ice control and gravel for paving, using its own crews. Portable plants, for washing and screening, were in use by both the State and Federal agencies.

Table 5.—Sand and gravel production by Government-and-contractor operations, by counties

(Thousand short tons)

County	1968	1969
Addison	26	7
Bennington	43	3
Caledonia	2	29
Chittenden	18	7
Essex	15	31
Franklin	33	61
Lamoille	6	---
Orange	4	2
Orleans	18	170
Rutland	233	203
Washington	53	75
Windham	43	25
Windsor	779	81
Total	1,273	694

Stone.—Stone production in Vermont during 1969 was valued in excess of $19.8 million, 7 percent less than that of 1968. Orleans and Washington Counties reported an increase in the value of stone output over the preceding year; all other counties reported a decline. Rutland was the principal stone producing county, followed by Washington, Windsor, and Orange—all with production valued in excess of $1 million.

Dimension granite was the most valuable stone type, and most of the production occurred in Washington County. Significant production of dimension granite, about 14 percent of the output, was in Orange County; the remainder was produced in Windsor County. The average value per ton of dimension granite was $106.47. Most of the crushed granite, valued at $1.59 per ton, was produced in Windsor County, with Washington County contributing the rest. Compared with 1968, the value of dimension granite increased 8 percent. A substantial increase was noted in crushed granite for road base stone and for bituminous aggregate.

Almost 90 percent of the dimension granite was used as rough monumental stone and was valued at $109.44 per ton. Dressed architectural granite was valued at $173.20 per ton, and rough architectural granite sold for $41.72 per ton, average. Rough granite for construction purposes sold for an average price of $36.81 per ton, and rubble sold for $1.37. A small amount of granite for use as curbing sold at $63.89 per ton. Crushed granite was sold for construction purposes, including concrete aggregate, bituminous aggregate, road base, and miscellaneous other uses.

Limestone and dolomite production was 531,527 tons of crushed material valued at $2,957,850. Compared with 1968, the value per ton was 5 percent greater, selling for $5.56. Franklin County was the principal producer, followed by Rutland and Chittenden Counties. Most of the crushed and broken stone was used for bituminous aggregate, road base stone, and for the treatment of road surfaces. Some crushed material was used for agricultural purposes and the manufacture of lime. Riprap and other uses consumed the remainder.

Rutland County was the leading producer of both dimension and crushed marble; a small amount of dimension material was produced in Windsor County. Substantial improvement was noted in the price per ton in 1969 compared with that of 1968. The principal use for dimension marble was for dressed architectural stone, followed by dressed monumental stone, flagging, and rough architectural stone. Crushed and broken marble was used for construction aggregate and miscellaneous other purposes.

The output of dimension slate was 9 percent less than that of 1968, but the value declined only 6 percent because of an increase in price per ton from $73.72 in 1968 to $76.72 in 1969. No crushed slate was valued at $31.72 per ton; architecural production was in Rutland County. Most of the dimension slate was used for flagging, with additional large amounts used for floor tile, mill stock, sculpings, and other purposes. Slate for roofing and for structural and sanitary purposes were other important uses. Some slate was used as dressed architectural stone. A small amount was used in the construction of electrical equipment. In terms of unit value, dimension slate for electrical purposes lead all others and sold for $445 per ton. Slate for structural and sanitary uses was of significantly high unit value, at $152 per ton. Curbing and flagging slate was valued at $31.72 per ton; architectural slate was valued at $19.34 per ton. Roofing slate sold for $110.70 per ton, average, during 1969.

GAF Corporation, Building & Industrial Floor Products Division, produced miscellaneous stone (serpentine) for use as aggregate. Wilk Bros., Inc., at Center Rutland, Rutland County, produced miscellaneous stone for bituminous aggregate.

During the year, Caledonia Sand & Gravel Co., Inc., did not operate the Plainfield Quarry (Washington County), the Ryegate Quarry (Orange County), and the Waterford Quarry (Caledonia County). All three quarries had previously produced miscellaneous stone. Perini Corp. did not operate its Sharon Quarry during 1969. Located in Windsor County, this operation had previously produced basalt. Green Mountain Marble Division, The Georgia Marble Co., has temporarily abandoned its two underground marble quarries. Involved are the Dorsit Quarry, Bennington County, and the Meadow Quarry, Rutland County. Also idled was the Company's finishing plant located at West Rutland. High operating costs have been cited as the basis for closing these operations. Vermont Marble Company also idled its Pittsfield Valley Quarry in Rutland County. The Isle La Motte Quarry, Grand Isle County, remained inactive.

Vermont Light Aggregate Corp., Castleton, Vermont, did not operate its lightweight aggregate plant. The Little Purple Plant operated by C. R. Beach Slate Co. remained idle during the year. The Taran Stone Quarries were also idle. No production was reported from the No. 11 Plant of the Rising & Nelson Slate Co., Inc. These operations are all in Rutland County.

No quartzite was produced during 1969.

Talc.—The production of talc was 10 percent greater in tonnage and 12 percent greater in value when compared with that of 1968. Windsor County led in production, followed by Lamoille and Windham Counties. Windsor Minerals, Inc., a division of Johnson & Johnson, mined crude talc at the Hammondville No. 3 underground mine located at Reading. The recovered material was processed by grinding at the plant at Brownsville. Eastern Magnesia Talc Co., subsidiary of Engelhard Minerals and Chemicals Corp. of Menlo Park, Edison, New Jersey, operated the No. 4 Johnson mine at Johnson. Vermont Talc Company a subsidiary of Vermont Marble Company, operated the Windham Mine at Windham, and a mill at Chester, Windham County.

In addition to that which was exported, ground talc was used in the manufacture of insecticides, paint, paper, roofing, rubber, textiles, plastics, joint cement, insulated wire, and miscellaneous other uses.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
GAF Corporation Bldg.: Industrial & Floor Products Division.[1]	140 West 51st St. New York, N.Y. 10020	Pit	Orleans.
Clays:			
Miscellaneous:			
Densmore Brick Co., Inc	Hanover St. Lebanon, N.H. 03766	Pit	Chittenden.
Lime:			
Vermont Associated Lime Industries, Inc.[2]	25 Airport Drive Winooski, Vt. 05404	Plant	Do.
Peat:			
Kirks Green Mountain Peat	P.O. Box 456 Woodstock, Vt. 05091	Bog	Windsor.
Sand and gravel:			
Brattleboro Sand & Gravel, Inc	P.O. Box 358 Brattleboro, Vt. 05301	Pit	Windham.
Caledonia Sand & Gravel Co., Inc	Box 428 St. Johnsbury, Vt. 05819	Pit	Caledonia, Washington.
Calkins Construction, Inc	Danville, Vt. 05828	Pit	Orleans.
J. P. Carrara & Sons, Inc	N. Clarendon, Vt. 05759	Pit	Rutland.
William E. Dailey, Jr	N. Bennington, Vt. 05257	Pit	Bennington.
S. T. Griswold, Inc	P.O. Box 8 Williston, Vt. 05495	Pit	Chittenden.
Albert S. Nadeau	Johnson, Vt. 05656	Pit	Lamoille.
Lawrence Sangravco, Inc	138 Portland St. Johnsbury, Vt. 05819	Pit	Essex.
Vermont Sand & Gravel Corp	Box 429 Bellows Falls, Vt. 05101	Pit	Rutland.
Stone:			
Granite (dimension):			
Rock of Ages Corp	Barre, Vt. 05641	Quarry	Orange, Washington, Windsor.
Wells-Lamson Quarry Co., Inc	102 N. Main St. Barre, Vt. 05641	do	Washington.
Woodbury Quarries, Inc	State St. Concord, N.H. 03301	Processing plant.	Do.
Granite (crushed):			
Kelley Construction, Inc	102 N. Main St. Barre, Vt. 05641	Crushing plant	Do.
Perini Corp.[3]	Framingham, Mass. 01701	do	Windsor.
Limestone (crushed and broken):			
L. A. Demers Crushed Rock Co	Upper Main St. Winooski, Vt. 05404	Quarry	Chittenden.
Swanton Lime Works, Inc	Swanton, Vt. 05488	do	Franklin.
Vermarco Ground Products Division of Vermont Marble Co.	W. Rutland, Vt. 05777	do	Rutland.
White Pigment Corp	Proctor, Vt. 05765	do	Do.
Marble (dimension):			
Vermont Marble Co.[4]	Proctor, Vt. 05765	do	Grand Isle, Rutland, Windsor.
Marble (crushed):			
F. W. Whitcomb Const. Corp	Box 429 Bellows Falls, Vt. 05101	do	Rutland.
Slate (dimension):			
Fair Haven Slate Co., Inc.[5]	Fair Haven, Vt. 05743	do	Do.
Green Mountain Slate Corp	Granville, N.Y. 12832	do	Do.
John G. Hadeka	25 College St. Poultney, Vt. 05764	do	Do.
Hilltop Slate Co	Middle Granville, N.Y. 12849	do	Do.
Rising & Nelson Slate Co., Inc	West Pawlet, Vt. 05775	do	Do.
Somich Brothers	Granville, N.Y. 12832	do	Rutland.
Taran Brothers, Inc	No. Poultney, Vt. 05764	do	Do.
Tatko Brothers Slate Co	Middle Granville, N.Y. 12849	do	Do.
Vermont Structural Slate Co., Inc.	Prospect St. Fair Haven, Vt. 05743	do	Do.
Talc:			
Eastern Magnesia Talc Co	Johnson, Vt. 05656	Underground	Lamoille.
Vermont Talc Co	Chester, Vt. 05143	do	Windham.
Windsor Minerals, Inc	P.O. Box 680 Windsor, Vt. 05089	do	Windsor.

[1] Also miscellaneous stone.
[2] Also crushed limestone.
[3] Production from Rock of Ages Corp. quarry.
[4] Also crushed marble.
[5] Also crushed slate.

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]

The value of 1969 mineral producion in Virginia rose to a new high of $317.5 million, 7 percent greater than the $295.7 million reported in 1968. Value increases of three commodities accounted for 98 percent of the $22 million increase in total output value; coal (63 percent), stone (24 percent), and sand and gravel (11 percent). While the output of coal declined 4 percent, the output value rose 8 percent due to a 12 percent increase in the average unit value. Eleven commodities gained in output and 13 gained in output value. Of the total 1969 mineral production value, approximately 61 percent was contributed by fuels, 2 percent by metals, and 37 percent by nonmetals.

[1] Chemist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Virginia [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	1,462	$1,714	1,677	$1,504
Coal (bituminous)—do	36,966	178,946	35,555	192,802
Gem stones	NA	7	NA	7
Lead (recoverable content of ores, etc.)—short tons	3,573	944	3,358	1,000
Lime—thousand short tons	919	11,138	1,072	13,653
Natural gas—million cubic feet	3,389	1,013	2,846	845
Petroleum (crude)—thousand 42-gallon barrels	3	W	1	W
Sand and gravel—thousand short tons	10,859	13,644	12,140	15,954
Soapstone—short tons	3,928	10	4,600	12
Stone—thousand short tons	31,217	53,533	33,461	58,713
Zinc [2] (recoverable content of ores, etc.)—short tons	19,257	5,199	18,704	5,462
Value of items that cannot be disclosed: Aplite, cement (portland and masonry), feldspar, gypsum, iron ore (pigment material), kyanite, salt, titanium concentrate (ilmenite, rutile 1968), and data indicated by symbol W	XX	29,515	XX	27,575
Total	XX	295,663	XX	317,527
Total 1967 constant dollars	XX	292,258	XX	p 297,661

p Preliminary. 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.

Table 2.—Value of mineral production in Virginia, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Accomack	W	$22	Sand and gravel.
Albemarle	W	W	Stone, sand and gravel.
Alleghany	W	W	Stone.
Amherst	W	W	Titanium concentrate, sand and gravel.
Appomattox	$75	75	Stone.
Augusta	5,610	952	Stone, sand and gravel.
Bath	-------	1	Sand and gravel.
Bedford	W	W	Feldspar.
Bland	13	W	Stone.
Botetourt	W	W	Cement, stone, clays.
Brunswick	W	W	Stone, clays.
Buchanan [2]	77,251	83,180	Coal, sand and gravel.
Buckingham	4,650	4,501	Stone, kyanite.
Campbell	1,275	W	Stone.
Caroline	172	213	Sand and gravel.
Carroll	14	3	Stone.
Charles City	W	W	Sand and gravel.
Chesapeake (City)	W	W	Cement.
Chesterfield	W	3,162	Sand and gravel, stone, clays.
Clarke	W	W	Stone.
Craig	-------	W	Do.
Culpeper	W	W	Do.
Dickenson	45,479	45,630	Coal.
Dinwiddie	W	W	Stone, clays.
Essex	W	-------	
Fairfax	5,285	5,381	Stone, sand and gravel.
Fauquier	W	W	Stone.
Floyd	W	36	Do.
Fluvanna	W	W	Do.
Franklin	10	12	Soapstone.
Frederick	4,529	5,537	Stone, lime, sand and gravel, clays.
Giles	W	W	Lime, stone.
Gloucester	W	-------	
Goochland	2,824	2,404	Stone.
Grayson	W	W	Stone, sand and gravel.
Greensville	W	W	Stone, clays.
Halifax	W	W	Stone, sand and gravel.
Hampton (City)	W	W	Sand and gravel, stone.
Hanover	W	W	Aplite, stone.
Henrico	3,168	3,367	Sand and gravel.
Henry	W	W	Stone.
Highland	W	W	Stone, sand and gravel.
Isle of Wight	102	223	Sand and gravel, lime, stone.
King George	-------	W	Sand and gravel.
King William	W	W	Do.
Lee [3]	4,770	3,695	Coal, stone, petroleum.
Loudoun	3,590	4,569	Stone.
Louisa	W	W	Do.
Lynchburg (City)	W	W	Do.
Madison	W	W	Do.
Mecklenburg	W	W	Do.
Middlesex	W	W	Sand and gravel.
Montgomery	546	823	Stone, clays, coal.
Nansemond	W	W	Stone, clays, sand and gravel.
Nelson	W	W	Stone, aplite.
New Kent	W	W	Sand and gravel.
Newport News (City)	218	W	Do.
Northampton	W	5	Do.
Northumberland	6	8	Do.
Nottaway	W	W	Stone.
Orange	W	W	Clays.
Page	84	W	Sand and gravel.
Patrick	W	W	Gravel, stone.
Pittsylvania	W	W	Stone, sand and gravel.
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	W	Stone.
Roanoke	W	W	Stone, clays.
Rockbridge	1,014	901	Stone, sand and gravel, clays.
Rockingham	1,323	1,529	Stone, sand and gravel.
Russell	10,988	14,071	Coal, stone, clays.
Scott	1,287	1,178	Stone, coal.
Shenandoah	W	W	Lime, stone.
Smyth	W	W	Salt, lime, stone, sand and gravel, clays.
Spotsylvania	W	W	Sand and gravel, stone.
Stafford	W	W	Sand and gravel.
Tazewell [4]	1,379	2,022	Coal, stone, clays, lime.

See footnotes at end of table.

Table 2.—Value of mineral production in Virginia, by counties [1]—Continued

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Virginia Beach (City)	$991	$1,018	Sand and gravel.
Warren	W	W	Cement, stone, sand and gravel.
Washington	1,483	2,006	Stone, gypsum.
Westmoreland	W	W	Sand and gravel.
Wise [4]	39,828	45,456	Coal, stone.
Wythe	W	W	Zinc, stone, lead, sand and gravel.
York	W	W	Sand and gravel, stone.
Undistributed [5]	77,697	85,552	
Total [6]	295,663	317,527	

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, Charlotte, Cumberland, Greene, James City, King and Queen, Lancaster, Lunenberg, Mathews, Powhatan, Richmond, Southampton, Surry, and Sussex.

[2] Excludes sand and gravel; included with "Undistributed."

[3] Excludes stone and petroleum; included with "Undistributed."

[4] Excludes stone; included with "Undistributed."

[5] Includes sand and gravel that cannot be assigned to specific counties, gem stones, natural gas, and values indicated by symbol W.

[6] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Virginia business activity

		1968	1969 [p]	Change, percent
Employment and labor force, annual average:				
Civilian work force	thousands	1,742.7	1,798.6	+3.2
Workers on strike	do	0.5	1.4	+180.0
Unemployment	percent of work force	2.7	2.7	-------
Total employment	thousands	1,695.0	1,748.6	+3.2
Agriculture	do	88.1	86.5	−1.8
Nonagriculture	do	1,606.9	1,662.1	+3.4
Manufacturing	do	362.2	370.4	+2.3
Nonmanufacturing	do	1,019.7	1,063.9	+4.3
Mining	do	13.8	14.2	+2.9
Other [1]	do	225.0	227.8	+1.2
Personal income:				
Total	millions	$14,100.0	$15,377.0	+9.1
Per capita		$3,062.0	$3,294.0	+7.6
Construction activity:				
Building permits	millions	$429.9	$330.8	−23.1
Residential construction (total valuation) [2]	do	$524.2	$508.4	−3.0
New housing units authorized		42,218.0	37,991.0	−10.0
Portland cement shipments to and within Virginia	thousand 376-pound barrels	8,921.0	9,117.0	+2.2
Farm marketing receipts:				
Livestock and products	millions	$290.3	$316.0	+8.9
Crops	do	$230.1	$248.0	+7.8
Government payments	do	$17.8	$19.6	+10.1
Total	do	$538.3	$583.6	+8.4
Forest resources, total value attributable	do	$710.9	$735.8	+3.5
Mineral production	do	$295.7	$317.5	+7.4

[p] Preliminary.

[1] Includes self-employed, unpaid family workers and domestics, and Federal Government workers in the Virginia portion of Washington, D.C., metropolitan area.

[2] New series.

Sources: U.S. Department of Agriculture; U.S. Department of Commerce; U.S. Department of the Interior, Bureau of Mines; U.S. Department of Labor; Virginia Department of Agriculture; Virginia Division of Forestry; Virginia Employment Commission; and Federal Reserve Bank of Richmond.

Table 4.—Worktime 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
1968:								
Coal	10,251	210	2,156	17,233	12	906	53.27	6,403
Metal	319	263	84	672	------	42	62.48	1,764
Nonmetal	628	263	165	1,314	------	31	23.58	778
Sand and gravel	553	246	136	1,228	------	17	13.84	370
Stone	3,955	265	1,050	8,629	3	201	23.64	2,693
Total [1]	15,706	229	3,591	29,077	15	1,197	41.68	4,686
1969: [p]								
Coal	10,605	216	2,291	18,174	16	960	53.70	7,501
Metal	285	257	73	587	1	45	78.37	11,266
Nonmetal	600	267	160	1,273	------	35	27.49	1,031
Sand and gravel	555	249	139	1,275	------	23	18.04	388
Stone	3,740	263	985	8,053	5	190	24.21	4,581
Total	15,785	231	3,648	29,362	22	1,253	43.42	6,186

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

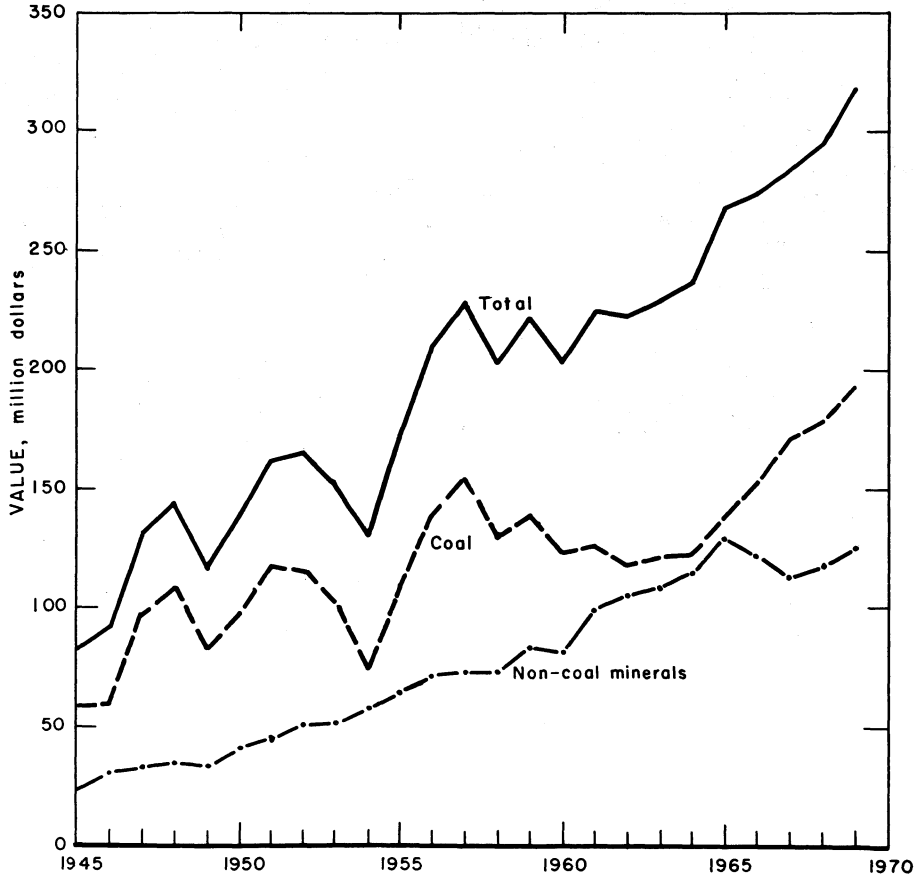

Figure 1.—Value of non-coal minerals, value of coal, and total value of all mineral production in Virginia.

Studies of the geology and mineral resources of Virginia included reports of the geology of several Virginia quadrangles [2] [3] and of magnetic and gravity surveys of two Virginia Counties.[4] A directory of the mineral industry in Virginia is issued annually by the Virginia Division of Mineral Resources.[5] The 1969 edition of this publication lists 236 companies and individuals, exclusive of coal producers, on record as of April 15, 1969. The listing includes portable crushing plants, some captive and intermittent operations, and some processors of out-of-State or imported materials. The names of producers and processors are arranged by county or city under the appropriate raw material or commodity. The locations of the various operations are given with respect to a nearby city or town. An alphabetical listing of the names of companies and individuals is provided as a reference index.

Trends and Developments.—Of direct mineral related significance were announcements in 1969 of plans to locate a new lightweight aggregate plant and a new glassmaking facility in Virginia. Hercules Incorporated of Wilmington, Del., will mine slate from a quarry near Snowden, Amherst County, and convert the crushed material into a lightweight aggregate for use by producers of ready-mix concrete, concrete blocks, and other concrete products. The plant, now under construction, is expected to be in production by late 1970. Thatcher Glass Manufacturing Co. of New York City announced plans for construction of a large glass manufacturing facility for container glass in Fredericksburg. Major glass-batch ingredients for container glass are high purity silica (glass sand), limestone or lime, and soda ash.

A Virginia-based concern, Deepsea Ventures, Inc., of Newport News, a newly formed subsidiary of Tenneco, Inc., has announced a global program for economic exploitation of mineral deposits on the Outer Continental Shelf and on the deep ocean floor. The 298-ton research vessel, "Prospector," is equipped to conduct investigations of sea-floor deposits in depths up to 18,000 feet. The company plans construction of permanent headquarters near Newport News.

Bituminous coal (including a small output of semianthracite coal) mined in eight southwestern Virginia counties was the leading mineral commodity produced. It contributed 61 percent of the State's total value of mineral production; in 1968 Virginia was sixth in rank among the 23 bituminous coal-producing States and accounted for 7 percent of the National output. Important coal-mining developments in 1969 included: The completing stage of development of Island Creek Coal Co.'s Virginia Pocahontas No. 3 Mine in Buchanan County; the opening of Westmoreland Coal Co.'s Bullitt Mine in Wise County; and the addition of two mines by Clinchfield Coal Co.'s Jewel Ridge Division. The Island Creek Coal Co.'s Virginia Pocahontas No. 4 Mine, under development in Buchanan County was expected to be in full production in 1972. Virginia Pocahontas No. 3 and No. 4 mines will have an ultimate annual capacity of more than 1 million tons each. Employment in the State's coal mines rose almost 4 percent in 1969, due primarily to the beginning of production of several new mines in coal-producing areas of southwestern Virginia. Coal mining is by far the most important section of Virginia's mining industry, accounting for more than three-quarters of all mine employment. All mine employment in 1969 was 14,200, a gain of 3 percent over that of last year.

A special issue of the publication, "Virginia Minerals," describes the storm damage (as an aftermath of Hurricane Camille) incurred by several Virginia counties late in the summer of 1969.[6] The areas suffering severest damage were Nelson and Amherst Counties, but adjoining counties were also affected; flood damage extended through Richmond eastward. A number of mineral operations incurred damage, such

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[2] Bick, Kenneth F., and Nicholas K. Coch. Geology of the Williamsburg, Hog Island, and Bacons Castle Quadrangles, Virginia. Virginia Div. Miner. Res. (Charlottesville, Va.), Rept. of Inv. 18, 1969, 28 pp.

[3] Rader, Eugene K. Geology of the Stokesville and Parnassus Quadrangles, Virginia. Virginia Div. Miner. Res. (Charlottesville, Va.), Rept. of Inv. 19, 1969, 30 pp.

[4] Johnson, Stanley S., and Palmer C. Sweet. Magnetic and Gravity Surveys of Albermarle and Fluvanna Counties, Virginia. Virginia Div. Miner. Res. (Charlottesville, Va.), Rept. of Inv. 20, 1969, 10 pp.

[5] LeVan, D. C. Directory of the Mineral Industry of Virginia. Virginia Div. Miner. Res. (Charlottesville, Va.), 1969, 41 pp.

[6] Virginia Minerals (Virginia Div. of Miner. Res., Charlottesville, Va.). Natural Features Caused by a Catastrophic Storm in Nelson and Amherst Counties, Virginia. Special issue, October 1969.

as the Alberene Stone Division of the Georgia Marble Co. (dimension soapstone) in Nelson County and the American Cyanamid Co., Pigments Division (ilmenite) in Amherst and Nelson County.

Legislation and Government Programs.—A contractual agreement between the U.S. Department of the Interior, Bureau of Mines, and the Commonwealth of Virginia, Department of Conservation and Economic Development, Division of Mineral Resources, was executed July 23, 1969. The agreement provides for cooperative endeavor in the investigation and evaluation of the State's mineral resources.

A number of mineral producers participated in the annual National Safety Competition, jointly sponsored by the Federal Bureau of Mines and the American Mining Congress. A Certificate of Achievement in Safety for outstanding safety records in 1969 was awarded companies whose mines or quarries operated during the year without a disabling work injury. Among Virginia mineral operations receiving awards were Chemstone Corp., a subsidiary of Engelhard Minerals and Chemicals Corp. (Strasburg Quarry); M. J. Grove Lime Co., Division of the Flintkote Co. (Stephens City Quarry); Liberty Limestone Corp. (Rocky Point Quarry); Penn-Dixie Cement Corp. (Speers Ferry Quarry); and United States Gypsum Co. (Plasterco No. 6 Mine).

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Coal, the State's leading mineral commodity in terms of both output and output value, accounted for 61 percent of the value of Virginia's mineral production in 1969. Mine output declined 4 percent but the output value rose 8 percent, establishing 1969 as the peak value year. An average increase of $0.58 per ton over the unit value of $4.84 in 1968 was responsible for the rise in total coal output value. Production data include coal produced from deposits within Virginia, whether the mine opening is or is not inside the State boundary, and exclude operations producing less than 1,000 tons per year. Consequently, production data published by the Federal Bureau of Mines differ somewhat from data published by the State.

Both high- and low-volatile bituminous coals were produced, for electric-power generation, industrial and domestic heating, other industrial uses, coke feedstock, and export. A small quantity of semianthracite coal, mined in Montgomery County, was produced for domestic heating.

Four of the right southwestern counties in which coal was mined accounted for 96 percent of the total output. These counties were Buchanan (41 percent), Wise (26 percent), Dickenson (23 percent), and Russell (6 percent). Of the total coal production, 85 percent was from underground mines, 10 percent from strip mines, and 5 percent from auger mines. Coal was produced by underground mines in all of the eight coal-producing counties and also by strip and auger mines in six counties. In order of output, Buchanan, Dickenson, Wise, and Russell Counties led in underground mine tonnage; Wise, Dickenson, and Buchanan Counties in strip mine output; and Buchanan, Wise, and Dickenson in auger mine production.

The average value per ton for underground-mined coal was $5.74 ($5.07 in 1968); for strip-mined coal, $3.64 ($3.55 in 1968); for auger-mined coal, $3.43 ($3.48 in 1968); and for the combined output by all three mining methods, $5.42 ($4.84 in 1968). Seams mined included the Blair, Bolling, Clintwood, Darby, Eagle, Hagy, Harlan, High Splint, Imboden, Jawbone, Jewell, Kelly, Lyons, Norton, Parsons, Pocahontas No. 3, Red Ash, Splash Dam, Taggart, Tiller, Upper and Lower Banner, Upper and Lower Standiford, and Widow Kennedy seams.

Of the total underground output, 92 percent was mechanically loaded, an increase of 6 percent above the 1968 figure and 35 percent above the 1965 figure. These increases reflected the trend toward modernization and mechanization in the State's underground mines.

A total of 365 mobile loading machines (30 more than in 1968) accounted for 53 percent of the mechanically loaded tonnage; and 118 continuous mining machines (20 more than in 1968) accounted for 41 percent; long-wall machines and hand-loaded face conveyors accounted for the re-

Table 5.—Coal (bituminous) production [1] by counties

(Thousand short tons and thousand dollars)

County	1968					1969				
	Number of mines			Total production		Number of mines			Total production	
	Underground	Strip	Auger	Quantity	Value [2]	Underground	Strip	Auger	Quantity	Value [2]
Buchanan	430	21	27	15,804	$77,251	402	19	39	14,748	$83,180
Dickenson	58	18	12	9,062	45,479	54	6	8	8,399	45,630
Lee	34	10	9	1,227	4,770	23	13	11	883	3,695
Montgomery [3]	1	------	------	W	W	1	------	------	W	W
Russell	21	3	2	2,010	10,297	19	1	1	2,026	12,847
Scott	1	------	------	W	W	1	------	------	W	W
Tazewell	6	2	1	298	1,268	12	1	1	356	1,974
Wise	107	32	14	8,554	39,828	86	36	22	9,141	45,456
Undistributed	-----	------	------	11	53	------	------	------	3	20
Total	658	86	65	36,966	178,946	598	76	82	[4] 35,555	192,802

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Excludes mines producing less than 1,000 short tons.
[2] Value received or charged for coal, f.o.b. mine, including seiling 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.
[3] Semianthracite coal; quantity and value included in bituminous coal total.
[4] Data may not add to total shown because of independent rounding.

mainder. Of the total coal mined, 60 percent was mechanically cleaned in 33 plants. Wet washing, other than with jigs, was the principal method of cleaning and accounted for 85 percent of the cleaned coal. Forty-eight percent of the cleaned coal was thermally dried. Of the total coal mined, 46 percent was crushed. Fourteen percent of the total coal output was treated with dust-allaying and antifreezing preparations, of which oil predominated (98 percent).

Coke.—A relatively small tonnage of coal was converted to coke in beehive and Mitchell-type ovens; no byproduct recovery was made. In 1969 coke was produced in three plants (three companies), one in Buchanan County and two in Wise County.

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 of natural gas for commercial use was 2,846 million cubic feet, 16 percent less than that of 1968. According to the Virginia Department of Labor and Industry, Division of Mines and Quarries, natural gas was produced in four southwestern counties. Buchanan (810 million cubic feet); Dickenson (424 million cubic feet); Tazewell (1,603 million cubic feet); and Wise (9 million cubic feet). At yearend 111 gas wells were operating, the same number as operated in 1968. Reserves of natural gas were 31,438 million cubic feet, as reported by The American Gas Association. This was 2,903 million cubic feet less than reported in 1968. There were no facilities for the underground storage of natural gas in Virginia; however, the Washington Gas Light Co. operated an underground facility in Fairfax County for the storage of liquefied petroleum gases.

During 1969 production of crude petroleum in Virginia totaled 1,000 barrels, compared with 3,000 barrels in 1968. All production was from Lee County. At yearend, five oil wells were operating; the same number as in 1968. A coking and catalytic cracking and reforming refinery was operated by the American Oil Co., at Yorktown, York County. Operating capacity was 43,600 barrels per calendar day.

NONMETALS

Aplite.—Output and value of aplite increased substantially. Production of this commodity, chiefly for use in glassmaking, was from two operations, one in Nelson County (International Minerals & Chemical Corp., Industrial Minerals Division) and one in Hanover County (The Feldspar Corp., formerly M and T Chemicals, Inc.). A limited quantity of the material from operations in Amherst and Nelson Counties was produced by Dominion Stone Plant, Inc., for use chiefly as aggregate.

Cement.—Production and shipments of portland cement were substantially lower,

due to the discontinuance of Lehigh Portland Cement Co.'s production at Fordwick, Augusta County, at yearend 1968. The plant shutdown reduced the number of active portland cement plants in Virginia from three to two. Shipments of masonry cement rose only slightly, but the value increased substantially, due to an average increase of $0.48 per 280-pound-barrel. Of the total cement shipments (portland and masonry), portland cement accounted for 85 percent of shipment tonnage and 78 percent of value of shipments.

Portland cement plant capacity (two plants) was virtually unchanged during the year. Three plants manufactured cement; one made both portland and masonry cement, one made only portland cement, and one (Riverton Lime & Stone Co., Inc.) made only masonry cement. One company (Lone Star Cement Corp.) operated both portland cement plants; the dry process for manufacturing portland cement was used in one plant, the other plant used the wet process. During 1969 cement was produced in Botetourt and Warren Counties and in the city of Chesapeake.

Cement producers mined low magnesian limestone, shale, clay, and calcareous marl for their own use. Ingredients purchased for use in cement manufacture included sand, gypsum, iron ore, mill scale, various air-entraining compounds, and a variety of grinding aids. All of the electrical energy used was purchased.

General use and moderate heat types (Types I and II) comprised the bulk of portland cement produced and marketed; a limited quantity of high-early-strength cement (Type III) was produced and shipped. Both air-entrained and non-air-entrained types were produced; the latter accounted for most of the output. Most of the shipments were in bulk, and by railroad, but sizable shipments were also made by truck. Shipments of cement in containers (94-pound paper bags) were sizable and were made by railroad and truck.

Distribution of portland cement for various consumer uses in 1969 was as follows: 57 percent to ready-mixed concrete companies; 17 percent to concrete products manufacturers; 13 percent to highway and other contractors; and 13 percent to other users, including building material dealers, Federal, State, and local government agencies, and miscellaneous customers.

Of the State's portland cement output, 75 percent of shipments terminated within Virginia; the remainder, in order of decreasing shipments went to North Carolina, South Carolina, West Virginia, and Maryland. Masonry cement shipments went to 32 States, chiefly Virginia, North Carolina, Maryland, District of Columbia, and South Carolina; 60 percent of the shipments terminated in Virginia.

Clays.—Clay output was substantially higher in 1969, but a lower average unit value caused a substantial drop in total output value. Fifty-six percent of the output was consumed in brick manufacture, compared with 67 percent in 1968, reflecting the lower pace of residential construction in 1969. The pricipal uses for the balance of clay and shale were as lightweight aggregate and in the manufacture of portland cement. Some were also consumed in the making of vitrified sewer pipe, flue linings, pottery, clay dummies (shot-hole tampers), and miscellaneous clay products.

Clay production was reported from 30 pits in 15 counties, compared with 21 pits in the same number of counties in 1968. In order of output the chief producing counties were Botetourt, Russell, Orange, Chesterfield, and Nansemond; in order of output value they were Botetourt, Orange, Nansemond, Chesterfield, and Russell. Five counties produced over three-quarters of the State output and five accounted for over three-quarters of the output value.

Table 6.—Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	1,415	$1,657
1966	1,486	1,813
1967	1,382	1,623
1968	1,462	1,714
1969	1,677	1,504

Feldspar.—Output and value of crude feldspar declined sharply. Northwestern Feldspar Corp. produced feldspar from two mines in Bedford County. Mixed feldspar (soda and potash) was processed at the company's processing and grinding mill in Bedford. The mill output was marketed chiefly to pottery and ceramic enamel manufacturers.

Gem Stones.—Hobbyists and mineral fanciers collected a variety of semiprecious

gems and mineral specimens in various areas in Virginia.

Gypsum.—Output and value of crude gypsum increased substantially. The raw gypsum, mined at Plasterco, Washington County, was calcined or otherwise processed and manufactured into plasterboard and other gypsum products by United States Gypsum Co. at its Plasterco plant. The company also processed imported gypsum at a plant in Norfolk for use in its products. Borden, Inc., Chemical Division/Smith-Douglas; Charles W. Priddy & Co., Inc.; and Royster Company processed imported gypsum in Chesapeake for agricultural use.

Kyanite.—Output of crude kyanite ore was greater than in 1968; sales of the refined material were moderately higher in 1969. Shipments were primarily to manufacturers of refractories and other ceramic products. Two mines and three processing plants were operated by Kyanite Mining Corp. in adjacent Buckingham and Prince Edward Counties. The company also operated a grinding and bagging plant in the latter county.

Only a small part of the beneficiated kyanite (Al_2SiO_5) is used in the raw state; the bulk of production is calcined to mullite, one of the most important refractory materials used in the ceramic industry. Quartzite sand, recovered during the milling of kyanite, was marketed by a subsidiary organization for industrial and construction applications. Virginia is North America's leading producer of kyanite.

Lime.—New highs in output and value of lime were set in 1969; lime output and value were 17 and 23 percent higher, respectively, than in 1968, the previous record year. The gain in output was due to the increasing demand for industrial lime by the chemical and allied industries and especially for use as a metallurgical flux in the rapidly growing basic oxygen steelmaking process. The decline in output of agricultural lime was offset by a corresponding gain in building lime output. All but 4 percent of lime sold or used was consumed in industrial applications.

In 1969, primary lime output was reported by eight companies from six counties and was produced in eight plants. No production was reported from an aglime operation, active in 1968, in the independent city of Chesapeake. Maintaining this ranking since 1962, Giles, Smyth, and Shenandoah Counties were the chief-producing counties in order of output and value. Eighty-six percent of the State's 1969 output and value of lime was accounted for by these three counties.

Processing equipment used in limemaking included pot, shaft, and rotary kilns and batch and continuous hydrators. Raw materials included high-calcium limestone (predominately), dolomitic limestone, and oystershell. Approximately 2 million tons of limestone, were calcined to produce the total lime output. Fuels included bituminous coal, coke, and natural gas.

Virtually the entire output was high-calcium lime of which 93 percent was used or marketed as quicklime and the remainder as the hydrated product. Uses for lime were in the manufacture of alkalies, calcium carbide, and paper; as a flux in steelmaking and electrometallurgical operations; in sewage and trade-wastes treatment; in the purification and treatment of water; for agricultural purposes and leather tanning; for construction; and in miscellaneous applications. Of the State's output, 39 percent was sold or used within Virginia and the remainder was shipped principally to Pennsylvania, West Virginia, Ohio, Kentucky, Maryland, North Carolina, South Carolina, and Georgia.

Nitrogen Compounds.—Allied Chemical Corp., Nitrogen Division, Hopewell, Prince George County, produced nitrogen compounds such as ammonia, urea, and ammonium sulfate for use chiefly as fertilizer or fertilizer ingredients.

Salt.—Chlorine, caustic soda, soda ash, and other chemicals were produced by Olin Corp., Saltville, Smyth County, using brine recovered from nearby captive salt wells. Production of salt was substantially higher.

Sand and Gravel.—Accelerated highway construction in Virginia in 1969 increased the demand for aggregates; sand and gravel output and value rose 12 percent and 17 percent, respectively. Commercial output comprised more than 99 percent of total production and value; the remainder was State and local Government output, mainly for use in highway maintenance. Eighty-eight percent of the commercial output was used as coarse and fine construction aggregates in building (53 percent) and paving (35 percent).

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

(Thousand short tons and thousand dollars)

Year	Agricultural		Building		Chemical and other industrial		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1965	W	W	W	W	809	$10,080	847	$10,584
1966	26	$343	10	$142	805	10,001	[1] 840	10,486
1967	28	324	8	118	793	9,903	829	10,345
1968	31	306	10	129	878	10,704	919	[1] 11,138
1969	29	300	12	173	1,031	13,181	1,072	[1] 13,653

W Withheld to avoid disclosing individual company confidential data; included with "Total."
[1] Data may not add to total shown because of independent rounding.

Sand comprised 68 percent of the commercial sand and gravel output and 58 percent of the total commercial value. While less than one-tenth of the sand output was marketed as special industrial silica sands used for glassmaking, engine sand, filler, and other nonconstruction uses, almost two-tenths of the value of sand output was attributed to these uses.

Eighty-two percent of the total commercial sand and gravel output was screened, washed, or otherwise processed at 42 stationary, 10 portable, and three dredging installations. Seventy-five commercial sand and gravel operations were active in 1969, compared with 85 in the previous year. Seventy-one percent of the commercial tonnage was shipped by truck and the remainder by waterway (21 percent) or by rail (8 percent).

Production of sand and gravel fom all operations was reported from 37 counties and one independent city. In order of output the principal sand-and-gravel producing areas were Henrico County, the independent city of Virginia Beach, and Fairfax, Chesterfield, Charles City, and Stafford Counties. Seventy percent of the total output and output value were contributed by these six producing areas.

Thirty-seven of the 75 commercial sand and gravel operations had an annual output range of up to 50,000 tons and accounted for 6 percent of the total commercial tonnage; 30 operations had an output range of from 50,000 to 500,000 tons and accounted for 41 percent; six had an output range of from 500,000 to 1,000,000 tons and accounted for 35 percent; and two had an output range over 1,000,000 tons and accounted for 18 percent. The bulk of sand and gravel recovery was by dredging and open pit mining; a sizable tonnage of industrial silica sand was produced from crushed sandstone and quartzite, and a limited amount was obtained in the processing of kyanite.

Soapstone and Talc.—Crushed and ground soapstone was produced by Blue Ridge Talc Co., Inc., near Henry, principally for use in insecticides and foundry facings. Output and value increased substantially. Soapstone used as a dimension stone is included with miscellaneous stone in the Stone section of this chapter.

Stone.—Stone, after coal the most important mineral commodity produced in Virginia, accounted for 18 percent of the State's total value of mineral production in 1969. Total stone output and value rose 7 percent and 10 percent, respectively; the total value was only 1 percent lower than that reported in 1965, the record high year in both output and value. A substantial increase in crushed stone output, coupled with a slightly higher average unit value for the crushed material, more than offset a substantial decline in the output value of dimension stone. Heightened road building activity in Virginia in 1969 was largely responsible for the increased demand for crushed stone as construction aggregate.

Varied types of stone were mined or quarried in the State; in order of output value they were limestone (including dolomite), granite, traprock (basalt and diabase), slate, miscellaneous stone (including amphibolite, schist, soapstone, and "Virginia Greenstone"), sandstone (including quartzite and quartz), calcareous marl, and marble. Both crushed or broken stone and dimension stone were produced. Marine shell (oystershell) for use as aglime was produced in limited quantity as a coproduct of oyster processing.

Table 8.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,552	$3,006	3,852	$4,762
Paving	2,948	2,348	2,999	2,516
Fill	357	215	571	320
Other [1]	621	1,321	748	1,607
Total	6,478	6,890	8,170	[2] 9,206
Gravel:				
Building	1,806	3,152	2,501	4,569
Paving	1,934	2,769	1,271	1,940
Other [3]	556	802	119	207
Total	4,296	6,723	[2] 3,892	6,716
Total sand and gravel	10,774	13,613	12,062	15,922
Government-and-contractor operations:				
Sand:				
Paving	26	9	26	9
Fill	41	14	42	15
Total	67	23	68	24
Gravel:				
Paving	18	8	3	1
Fill	------	------	7	7
Total	18	8	10	8
Total sand and gravel	85	31	78	32
All operations:				
Sand	6,545	6,913	8,238	9,230
Gravel	4,314	6,731	3,902	6,724
Grand total	10,859	13,644	12,140	15,954

[1] Includes railroad ballast, glass, fire or furnace (1969), filtration (1968), engine, ground sand, and sand for other construction and industrial uses.
[2] Data may not add to total shown because of independent rounding.
[3] Includes fill and gravel for miscellaneous and other uses.

Crushed stone was produced from all the stone varieties and comprised virtually all of the total stone output (99.8 percent) and the major share of the total value (93.0 percent). Of the total crushed stone output, 75 percent or 25 million tons was used as construction aggregates; this use accounted for 70 percent of the total (crushed and dimension) stone output value. In addition, 10 percent of the total stone output was used in cement and lime manufacture (limestone and calcareous marl), and the remaining 15 percent, was used as agstone, fluxstone, railroad ballast, riprap, stone sand, and for miscellaneous and unspecified applications. Crushed stone output and value rose 7 percent and 13 percent, respectively. Increases in output value were reported for limestone, granite, basalt, and sandstone. Their combined output value accounted for most of the total crushed stone value.

In addition, dimension stone products, in order of value, were produced from slate, miscellaneous stone (principally soapstone), limestone and dolomite, traprock (diabase) and sandstone. The output value of dimension stone was substantially lower than reported in 1968, principally because of flood damage to dimension soapstone production facilities in Nelson County as a result of the aftermath of Hurricane Camille (August 1969). Whereas dimension stone is a low-output commodity in terms of tonnage (0.2 percent of total stone production), it accounted for 7 percent of the total stone output value.

Commercial output of stone accounted for virtually all of the State's total output

and value. Production of stone, including marine shell, was reported from 58 counties and two independent cities. In terms of tonnage, the principal stone-producing counties were Loudoun (diabase), Botetourt (limestone), Frederick (limestone), Fairfax (diabase and granite), and Goochland (granite). In terms of output value, the most important counties were Loudoun, Botetourt, Fairfax, Frederick, and Dinwiddie. Twenty-nine percent of the total stone output was contributed by five counties, and five counties accounted for 29 percent of the output value.

In 1969, production of limestone (including dolomite) was reported from 26 counties, granite from 18, traprock (basalt and diabase) from eight, slate from one, miscellaneous stone from two, sandstone (including quartz and quartzite) from 13 calcareous marl from two, and marble from one. In addition, production of calcareous marl was reported from one independent city, and production of miscellaneous stone was also reported from one independent city. The number of counties listed exceeds the number of counties in which all types of stone was produced because of duplication of counties when considering each variety produced.

Twelve counties produced more than 1 million tons of stone each, and 23 counties had output valued in excess of $1 million each. Crushed stone was produced in all the counties reporting stone output. Dimension stone was produced in five counties and in one independent city.

Sulfur.—Hydrogen sulfide, recovered from fuel gas, was converted to elemental sulfur by the American Oil Co. at its Yorktown refinery. Shipments were higher than in 1968, but the value of shipments was lower due to a lower average unit value in 1969.

Table 9.—Stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Kind and use	1968		1969	
	Quantity	Value	Quantity	Value
Dimension stone	69	$5,011	72	$4,082
Total [1]	69	5,011	72	4,082
Crushed and broken stone:				
Traprock (basalt, diabase):				
Aggregates [2]	3,586	6,207	4,665	8,556
Granite:				
Aggregates [3]	9,126	14,182	8,751	15,820
Riprap [4]	251	372	267	430
Railroad ballast	W	W	175	264
Limestone and dolomite:				
Aggregates [3]	9,702	13,517	10,700	15,494
Railroad ballast	381	426	386	501
Agricultural	1,196	2,160	1,275	2,304
Riprap	14	18	W	W
Miscellaneous [5]	5,286	9,098	5,467	8,970
Sandstone, quartz and quartzite:				
Aggregates [6]	497	723	627	975
Miscellaneous [7]	68	162	114	251
Undistributed [8]	1,041	1,656	960	1,066
Total	31,148	[9] 48,522	[9] 33,388	54,631
Grand total	31,217	53,533	[9] 33,461	58,713

W Withheld to avoid disclosing individual company confidential data.

[1] Includes limestone, sandstone, quartz and quartzite, traprock (diabase), slate, and miscellaneous stone.

[2] Includes riprap, railroad ballast (1969), dense graded road base stone, and concrete, bituminous, macadam, and surface treatment aggregates, unspecified construction aggregates and roadstone (1969), and other uses (1968).

[3] Includes dense graded road base stone, concrete, bituminous, macadam, surface treatment aggregates, and unspecified construction aggregates and roadstone (1969).

[4] Includes railroad ballast (1968), and other uses.

[5] Includes riprap (1969), flux, and other uses.

[6] Includes dense graded road base stone, concrete, bituminous, surface treatment aggregates, and unspecified construction aggregates and roadstone (1969).

[7] Includes riprap, railroad ballast (1968), flux (1968), stone sand (1968), and other uses.

[8] Includes miscellaneous stone, calcareous marl, marble, shell, and slate.

[9] Data may not add to total shown because of independent rounding.

METALS

Iron Ore (Pigment Material).—Natural iron-oxide pigments were produced by Hercules, Inc., Imperial Color & Chemical Dept. at Hiwassee, Pulaski County, from local deposits of earthy forms of hydrous and anhydrous iron oxides including ocher, sienna, and umber. Manufactured iron oxides, also for use in pigment manufacture and (largely) for other purposes, also were produced at the company's Pulaski facilities. Natural iron-oxide pigments were also produced by Blue Ridge Talc Co., Inc., at Henry, Henry County, from hematite obtained out of State. The finished iron-oxide pigments are used in cement, printing inks, and paint manufacture, and in other products. Total marketed output of both natural and manufactured finished iron-oxide pigments was substantially higher than in the previous year.

Lead and Zinc.—Lead and zinc were recovered from two mines in Wythe County, operated by The New Jersey Zinc Co. The ratio of zinc recovery to that of lead was about 5.5 to 1. Both the lead and zinc output was moderately lower than in 1968, but output values were higher due to a higher yearly average unit price for both metals.

Titanium Concentrates.—Production of ilmenite in 1969 was limited to one company (American Cyanamid Co.) in Amherst County. Another firm (M and T Chemicals, Inc.) in Hanover County discontinued production of both ilmenite and rutile in midsummer 1968. Output of ilmenite from the Amherst County operation was lower than that reported in 1968; the decline was largely due to flood damage (Hurricane Camille) to production facilities. The ilmenite is used in the manufacture of titanium dioxide pigments.

Table 10.—Mine production of recoverable lead and zinc

Year	Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value [1] (thousands)
1965	3,651	$1,139	20,491	$5,942
1966	3,078	930	17,666	5,123
1967	3,430	960	18,846	5,088
1968	3,573	944	19,257	5,199
1969	3,358	1,000	18,704	5,462

[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.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Aplite (crude):			
International Minerals & Chemical Corp., Industrial Minerals Div.	Piney River, Va. 22964	Quarry	Nelson.
Cement:			
Lone Star Cement Corp.[1]	3315 W. Broad St. Richmond, Va. 23230	Pits and plant	Botetourt.
Lone Star Cement Corp.[2]	do	Plant	Chesapeake (City).
Riverton Lime & Stone Co., Inc.[3]	Riverton, Va. 22651	Quarry and plant.	Warren.
Clays (miscellaneous and shale):			
Brick and Tile Corp. of Lawrenceville.	P.O. Box 45 Lawrenceville, Va. 23868	Pit and plant Pit	Brunswick. Greensville.
Daniels Brick and Tile Co., Inc	P.O. Box 4237 Richmond, Va. 23224	Pit and plant (City of Richmond).	Chesterfield.
Do	do	Pit	Dinwiddie.
General Shale Prod. Corp	Box 3547 Johnson City, Tenn. 37601	Pit and plant (City of Richmond).	Chesterfield.
Clinchfield Coal Company Div. of The Pittston Co.[4]	Dante, Va. 24237	Plant	Russell.
Locher Brick Co., Inc	Route 1, Box 1	Pit and plant	Rockbridge.
Do	Glasgow ,Va. 24555	Pit	Botetourt.
Old Virginia Brick Co., Inc	P.O. Box 508	Pit and plant	Roanoke.
Do	Salem, Va. 24153	Pit	Montgomery.
Redford Brick Co	Box 4096 Richmond, Va. 23224	Pit and plant (City of Richmond).	Chesterfield.
Weblite Corp	Box 780 Roanoke, Va. 24004	Pit and plant	Botetourt.
Webster Brick Co., Inc	do	Pit	Do.
Do	do	Pit	Nansemond.
Do	do	Pit	Orange.
Woodbridge Clay Products Co	Rt. 3, Box 240 Manassas, Va. 22110	Pit	Prince William.
Coal (bituminous):			
Betty B. Coal Co.[5]	Clintwood, Va. 24228	Underground mine.	Dickenson.
Clinchfield Coal Co.[6]	Dante, Va. 24237	do	Buchanan.
Clinchfield Coal Co.[7]	do	do	Dickenson.
Clinchfield Coal Co.[8]	do	do	Russell.
Coal Processing Corp	Box 497, Norton, Va. 24273	do	Wise.
Harman Mining Corp.[6]	Harman, Va. 24618	do	Buchanan.
Island Creek Coal Co.[9]	Box 113 Keen Mountain, Va. 24624	do	Do.
Westmoreland Coal Co.[10]	P.O. Box 229 Big Stone Gap, Va. 24219	do	Wise.
Big Six Corp	Box 430 Clintwood, Va. 24228	Strip mine	Dickenson.
Contracting Enterprises, Inc	Clintwood, Va. 24228	do	Do.
Stamack Mining Corp.[11]	P.O. Drawer 389 Appalachia, Va. 24216	do	Wise.
Flat Gap Mining Co., Inc	Box 387, Norton, Va. 24273	Auger mine	Do.
Coke:			
Christie Coal and Coke Co., Inc	P.O. Box 409 Norton, Va. 24273	Plant	Do.
Jewell Smokeless Coal Corp	Jewell Valley, Va. 24623	do	Buchanan.
Westmoreland Coal Co., Stonega Div.	Box 229 Big Stone Gap, Va. 24219	do	Wise.
Feldspar (crude):			
Northwestern Feldspar Corp	P.O. Box 706 Custer, S.D. 57730	Mine	Bedford.
Gypsum:			
United States Gypsum Company[12]	101 S. Wacker Drive Chicago, Ill. 60606	Plant	Chesapeake (City).
United States Gypsum Company[13]	do	Mine	Smyth.
United States Gypsum Company	do	Mine and plant	Washington.
Iron-oxide pigments (crude):			
Hercules, Inc., Imperial Color & Chemical Dept.[14]	Hiwassee, Va. 24347	do	Pulaski.
Iron-oxide pigments (finished):			
Blue Ridge Talc Co., Inc	P.O. Box 7 Henry, Va. 24102	Plant	Franklin.
Kyanite:			
Kyanite Mining Corp.[15]	Dillwyn, Va. 23936	Mine and plants	Buckingham.
Do	do	do	Prince Edward.
Lime:			
Battery Park Fish & Oyster Co.[16]	Battery Park, Va. 23304	Plant	Ilse of Wight.
Blue Grass Lime Co.[17]	Route 3 Tazewell, Va. 24651	do	Tazewell.

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Lime—Continued			
Chemstone Corporation [17]	Menlo Park Edison, N.J. 08817	Plant	Shenandoah.
Foote Mineral Co.[17]	Rt. 100, Exton, Pa. 19341	----do	Giles.
W. S. Frey Co., Inc.[17]	257 E. Market St. York, Pa. 17403	----do	Frederick.
M. J. Grove Lime Co., Div. of The Flintkote Co.[17]	Lime Kiln, Md. 21763	----do	Do.
National Gypsum Co.[17]	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Giles.
Natural Gas:			
Ashland Oil and Refining Co	Box 67, Vansant, Va. 24656	Gas wells	Buchanan.
Cabot Corp	P.O. Box 1473 Charleston, W. Va. 25325	Gas well	Do.
Clinchfield Coal Co., Div. of the Pittston Co.	Dante, Va. 24237	Gas wells	Dickenson.
Consol-Ray Corp	Pocahontas, Va. 24635	----do	Tazewell.
P and S Oil and Gas Corp	305 Nelson Bldg. Charleston, W. Va. 25301	----do	Buchanan.
United Fuel Gas Co	P.O. Box 1273 Charleston, W. Va. 25325	----do	Do.
Do	----do	----do	Tazewell.
Petroleum:			
Trans State Oil Ltd	Ewing, Va. 24248	Oil wells	Lee.
Frank and Grover Neal	----do	----do	Do.
Wilshire Oil Co. of Texas	Suite 717, Fidelity Nat'l. Bldg. Oklahoma City, Okla. 73102	Oil well	Do.
Petroleum refineries:			
American Oil Company [18]	Yorktown, Va. 23490	Plant	York.
Salt:			
Olin Corp.[19]	120 Long Ridge Rd. Stamford, Conn. 06905	Brine wells	Smyth.
Sand and gravel:			
Commonwealth Sand & Gravel	P.O. Box 7598 Richmond, Va. 23231	Pit	Henrico.
Fredericksburg Sand & Gravel Co	Rt. 4, Box 57 Fredericksburg, Va. 22401	Pit	Stafford.
Friend Sand & Gravel Co., Inc	209 River St. Petersburg, Va. 23801	Pit	Prince George.
Hilltop Sand & Gravel Co., Inc	7950 Telegraph Rd. Alexandria, Va. 22310	Pit	Fairfax.
Locher Silica Corp.[20]	Glasgow, Va. 24555	Pit	Rockbridge.
Massaponax Sand & Gravel Corp	P.O. Box 270 Fredericksburg, Va. 22401	Pit	Spotsylvania.
Jobe Newton	Box 412 Fredericksburg, Va. 22401	Pit	Stafford.
Sadler Materials Corp	P.O. Box 5417 Virginia Beach, Va. 23455	Pit	Henrico.
Southern Materials Co., Inc.[21]	2125 Kimball Terrace Norfolk, Va. 23504	Pit and dredge	Chesterfield.
Southern Materials Co., Inc	2125 Kimball Terrace Norfolk, Va. 23504	Dredge	Henrico.
Do	----do	Pit	Prince George.
Do	----do	Pit	Isle of Wight.
Virginia Glass Sand Corp.[20]	P.O. Box 445 Winchester, Va. 22601	Pit	Frederick.
Virginia Concrete Co., Inc	P.O. Box 666 Springfield, Va. 22150	Pit	Fairfax.
West Sand & Gravel Co., Inc	P.O. Box 6008 Richmond, Va. 23222	Pit	Henrico.
E. V. Williams Co., Inc	P.O. Box 938 Norfolk, Va. 23501	Pit	Virginia Beach.
Williams Paving Co., Inc	----do	Pit	Hampton (City).
Soapstone (talc):			
Blue Ridge Talc Co., Inc.[22]	P.O. Box 8 Henry, Va. 24102	Mine and plant	Franklin.
Stone:			
Granite—crushed and broken:			
Boscobel Granite Corp	Box 1755 Richmond, Va. 23221	Quarry	Goochland.
Burkeville Stone Corp	----do	----do	Nottoway.
The General Crushed Stone Co	712 Drake Bldg. Easton, Pa. 18042	----do	Hanover.
Martinsville Stone Corp	Route 2, Box 31 Martinsville, Va. 24113	----do	Henry.
Rockville Stone Co	Box 7155 Richmond, Va. 23221	----do	Goochland.
Salem Stone Corp	P.O. Box 1121 Roanoke, Va. 24153	----do	Do.
		----do	Do.

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Granite—crushed and broken—Continued			
Southern Materials Co., Inc	2125 Kimball Terrace Norfolk, Va. 23501	Quarry	Brunswick.
Do	do	do	Chesterfield.
Do	do	do	Dinwiddie.
Superior Stone Co., Div. Martin Marietta Corp.	Box 2568 Raleigh, N.C. 27602	do	Albemarle.
Do	do	do	Pittsylvania.
Tidewater Crushed Stone & Asphalt Co., Inc.	Deepwater Terminal Rd. Richmond, Va. 23234	do	Chesterfield.
Trego Stone Corp	P.O. Box 2459 Roanoke, Va. 24010	do	Greensville.
Vulcan Materials Co	P.O. Box 7506 Winston-Salem, N.C. 27106	do	Brunswick.
Do	do	do	Fairfax.
Do	do	do	Goochland.
Do	do	do	Halifax.
Do	do	do	Pittsylvania.
Limestone—crushed and broken:			
Ararat Rock Products Co	P.O. Box 988 Mt. Airy, N.C. 27030	do	Montgomery, Wythe.
Blue Ridge Stone Corp	Box 2459 Roanoke, Va. 24010	do	Botetourt.
Do	do	do	Campbell.
Foote Mineral Co	Duffield, Va. 24244	Underground mine.	Scott.
James River Limestone Co	Box 355 Buchanan, Va. 24066	Quarry	Botetourt.
Liberty Limestone Corp	Box 458 Buchanan, Va. 24066	do	Do.
Penn-Dixie Cement Corp	P.O. Box 152 Nazareth, Pa. 18064	do	Scott.
Stuart M. Perry, Inc	Box 738 Winchester, Va. 22601	do	Clarke, Frederick.
Pounding Mill Quarry Corp	Box 2459 Roanoke, Va. 24010	do	Tazewell.
Radford Stone Corp	Route 1, Box 235 Radford, Va. 24141	do	Pulaski.
Rockydale Stone Service Corp.	Rt. 8, Box 635 Roanoke, Va. 24004	do	Campbell.
Rockydale Quarries Corp	do	do	Roanoke.
Salem Stone Corp	P.O. Box 1121 Roanoke, Va. 24153	do	Montgomery.
Do	do	do	Roanoke.
Superior Stone Corp	Box 2568 Raleigh, N.C. 27602	do	Louisa.
Vulcan Materials Co	Box 7 Knoxville, Tenn. 37901	do	Washington.
Marble—crushed:			
Jamison Black Marble Co	P.O. Box 1198 Roanoke, Va. 24006	do	Rockingham.
Marl, calcareous:			
J. C. Digges & Sons	White Post, Va. 22663	Pit	Clarke.
Wm. M. Rice & Son	29 Harris Creek Rd. Hampton, Va. 23360	Pit	Hampton (City).
O. D. Zook	Route 238 Yorktown, Va. 23490	Pit	York.
Miscellaneous stone—dimension:			
Alberene Stone, Div. of the Georgia Marble Co. [23]	Schuyler, Va. 22969	Quarry and plant.	Nelson.
Virginia Greenstone Co., Inc. [24]	Box 897 Lynchburg, Va. 24505	Quarry	Lynchburg (City).
Wade and Griffith	Route 1, Floyd, Va. 24091	do	Patrick.
Miscellaneous stone—crushed:			
Dominion Stone Plant, Inc	Piney River, Va. 22964	do	Amherst and Nelson
Newman Brothers Quarry, Inc.	Route 3 Hillsville, Va. 24343	do	Floyd.
Oystershell:			
Battery Park Fish & Oyster Co.	Battery Park, Va. 23304	Plant	Isle of Wight.
Quartz and quartzite—crushed and broken:			
H. D. Crowder & Sons	Route 1 Austinville, Va. 24312	Quarry	Carroll.
The Economy Cast Stone Co. [25]	P.O. Box 3-P Richmond, Va. 23207	do	Albemarle.
Lone Jack Limestone Co., Inc.	P.O. Box 752 Lynchburg, Va. 24505	do	Rockbridge.
Quartzite—dimension:			
Leesville Stone Corp	Leesville, Va. 24571	do	Campbell.

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Quartzite—dimension—Continued			
Lofton Lambert	The Plains, Va. 22171	Quarry	Fauquier.
Musselman Bros	110 White Oak Rd. Fredericksburg, Va. 22401	----do	Do.
Sandstone—crushed and broken:			
Castle Sands Co	New Castle, Va. 24127	----do	Craig.
Culpeper Stone Co., Inc	Box 650 Culpeper, Va. 22701	----do	Culpeper.
Ironto Sand Corp	P.O. Box 235, Rt. 1 Radford, Va. 24141	----do	Montgomery.
Newman Brothers Quarry, Inc	Route 3 Hillsville, Va. 24343	----do	Wythe.
Slate—crushed:			
Solite Corp. [26]	Box 9138 Richmond, Va. 23227	Plant	Buckingham.
Slate—dimension:			
Arvonia-Buckingham Slate Co., Inc. [27]	Arvonia, Va. 23004	Quarry and plant.	Do.
Le Sueur-Richmond Slate Corp. [27]	----do	----do	Do.
Traprock (diabase)—dimension:			
Buena Black Granite Corp	Box 74, Rapidan, Va. 22733	Quarry	Culpeper.
Virginia Granite Corp	P.O. Box 250 Elberton, Ga. 30635	----do	Do.
Traprock (diabase)—crushed and broken:			
Arlington Stone Co	2633 Shirlington Rd. Arlington, Va. 22206	----do	Loudoun.
Bull Run Stone Co., Inc	Box 469 Manassas, Va. 22110	----do	Do.
Chantilly Crushed Stone, Inc	Box 112 Chantilly, Va. 22021	----do	Do.
Fairfax Quarries, Inc	Box 7155 Richmond, Va. 23211	----do	Fairfax.
Loudoun Quarries, Inc	Box 110 Chantilly, Va. 22021	----do	Loudoun.
Sanders Quarry, Inc	335 Waterloo St. Warrenton, Va. 22816	----do	Fauquier.
Virginia Trap Rock, Inc	Box 705 Leesburg, Va. 22075	----do	Loudoun.
Vulcan Materials Co	P.O. Box 7506 Winston-Salem, N.C. 27106	----do	Prince William.
Traprock (basalt)—crushed:			
Charlottesville Stone Corp	Box 7155 Richmond, Va. 23221	----do	Albemarle.
Titanium concentrate:			
American Cyanamid Co. [28]	Wayne, N.J. 07470	Mine and plant	Amherst.
Zinc:			
The New Jersey Zinc Co. [29]	160 Front St. New York, N.Y. 10038	Underground mine and plant.	Wythe.

[1] Portland and masonry cement—also captive production of limestone and shale.
[2] Portland cement only—also captive production of marl and clay in Nansemond County.
[3] Masonry cement only—also produce limestone.
[4] Shale obtained from coal preparation plant as a coproduct.
[5] 3 mines.
[6] 2 mines.
[7] 6 mines.
[8] 2 mines—shale obtained from coal preparation plant as a coproduct.
[9] 4 mines—some production is captive.
[10] 11 mines.
[11] 4 mines.
[12] Process imported gypsum.
[13] Inactive in 1969.
[14] Also finished iron oxide pigments.
[15] Coproduct: quartz sand.
[16] Calcine oystershell.
[17] Also captive production of limestone.
[18] Coproducts: sulfur and coke.
[19] Various chemicals manufactured from salt and lime at plant—captive limestone converted to lime for use in chemical manufacturing.
[20] Mainly industrial silica (crushed sandstone).
[21] Also produced crushed granite.
[22] Also process out-of-State hematite at plant for pigment manufacture.
[23] Stone variety is soapstone.
[24] Plant and quarry operations discontinued as of midsummer 1969.
[25] Vein quartz.
[26] Lightweight aggregate.
[27] Also crushed slate produced.
[28] Ilmenite (pigment material).
[29] Coproducts: lead and limestone (dolomitic).

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 William N. Hale,[1] Mary Anne McComb,[2] Paul McIlroy [3]

Washington's mineral production was valued at $88.6 million in 1969, an increase of almost 9 percent compared with the 1968 total, but below the 1966 record value of $89.1 million. The value of zinc output fell 24 percent, in spite of an increase in the annual average price. Copper production value also declined slightly. These decreases were more than offset by increases in the values for lead (72 percent), partially due to a rise in the annual average price, and for sand and gravel and stone production. Fifty-nine percent of the total mineral value was attributed to sand and gravel and stone, an increase of 4 percent over the previous year.

Twenty-six percent of all aluminum produced in the United States came from Washington plants. Bureau of Mines figures showed total U.S. aluminum production increased 18 percent, and Washington production increased 29 percent when compared with 1968 figures. Alumina, an intermediate product in the production of aluminum, was shipped into the State for final processing.

[1] Geologist, Bureau of Mines, Albany, Oreg.
[2] Economist, Bureau of Mines, Albany, Oreg.
[3] Mining engineer, Bureau of Mines, Albany, Oreg.

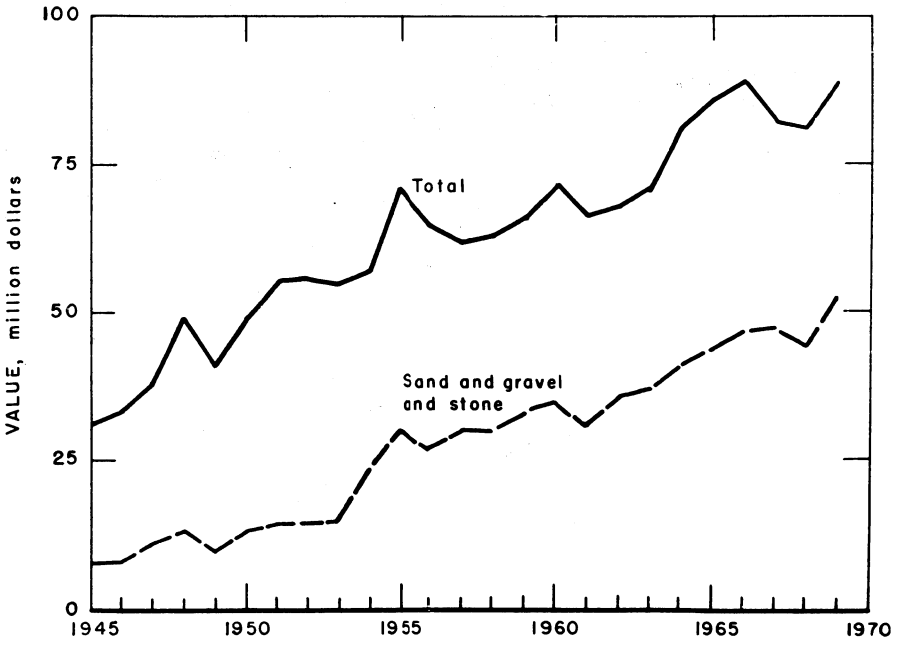

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Washington.

Table 1.—Mineral production in Washington [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	6,328	$23,030	6,356	$22,724
Masonry—thousand 280-pound barrels	56	175	58	204
Clays [2]—thousand short tons	r 255	r 253	230	434
Coal (bituminous)—do	178	823	58	480
Copper (recoverable content of ores, etc.)—short tons	22	18	18	17
Gem stones	NA	100	NA	150
Lead (recoverable content of ores, etc.)—short tons	5,655	1,494	8,649	2,577
Peat—do	40,440	159	32,684	134
Sand and gravel—thousand short tons	31,432	27,839	34,245	31,046
Stone—do	14,331	16,690	15,742	21,069
Talc and soapstone—short tons	W	W	4,228	W
Zinc (recoverable content of ores, etc.)—do	13,884	3,749	9,738	2,843
Value of items that cannot be disclosed: Diatomite, gold, gypsum, lime, magnesite (1968), mercury (1968), olivine, pumice, silver, and values indicated by symbol W	XX	7,095	XX	6,948
Total	XX	r 81,425	XX	88,626
Total 1967 constant dollars	XX	r 79,899	XX	p 85,160

p Preliminary. r Revised. 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 fire clay; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Washington, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	$506	W	Sand and gravel, stone.
Asotin	64	$3	Sand and gravel.
Benton	452	W	Stone, sand and gravel.
Chelan	W	595	Do.
Clallam	W	760	Sand and gravel, clays, stone.
Clark	1,173	1,417	Sand and gravel, stone, clays.
Columbia	W	W	Stone.
Cowlitz	945	968	Stone, sand and gravel, clays.
Douglas	W	W	Sand and gravel, clays.
Ferry	W	W	Gold, silver, stone, sand and gravel, copper, lead, zinc.
Franklin	W	W	Sand and gravel, stone.
Garfield	188	1,030	Stone, sand and gravel.
Grant	2,068	2,265	Diatomite, lime, stone, sand and gravel.
Grays Harbor	743	1,162	Sand and gravel, stone.
Island	W	271	Sand and gravel.
Jefferson	W	W	Stone, sand and gravel.
King	19,691	21,592	Cement, sand and gravel, stone, coal, clays, peat.
Kitsap	455	460	Sand and gravel, stone, peat.
Kittitas	1,054	1,179	Stone, sand and gravel, clays, pumice.
Klickitat	203	428	Stone, sand and gravel.
Lewis	1,374	1,505	Sand and gravel, stone, coal, clays.
Lincoln	508	542	Sand and gravel, stone.
Mason	125	330	Stone, sand and gravel, peat.
Okanogan	181	1,041	Sand and gravel, stone, gypsum.
Pacific	266	308	Stone.
Pend Oreille	5,645	7,815	Cement, lead, zinc, stone, sand and gravel, silver, copper.
Pierce	4,938	6,036	Sand and gravel, lime, stone, clays, peat.
San Juan	618	W	Sand and gravel, stone.
Skagit	5,189	2,375	Cement, olivine, sand and gravel, stone, soapstone, silver, lead, zinc.
Skamania	528	303	Stone, sand and gravel, pumice.
Snohomish	3,709	5,191	Stone, sand and gravel, clays, peat, copper, gold, silver, lead.
Spokane	2,776	1,917	Sand and gravel, stone, clays, peat.
Stevens	4,021	3,750	Zinc, stone, sand and gravel, lead, silver, clays, copper, gold.
Thurston	627	1,058	Sand and gravel, stone, peat, coal.
Wahkiakum	W	W	Stone, sand and gravel.
Walla Walla	526	437	Sand and gravel, stone.
Whatcom	W	W	Cement, sand and gravel, stone, clays.
Whitman	5,947	7,459	Sand and gravel, stone.
Yakima	1,378	1,798	Sand and gravel, lime, stone.
Undistributed [1]	r 15,527	14,631	
Total	r 81,425	88,626	

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.

Atlantic Richfield Hanford Co. drilled a 7,500-foot exploratory well at the Atomic Energy Commission Hanford complex searching for subsurface permeable rock formations that might be utilized to store radioactive liquid wastes.

Economic Activity and Employment.—The State's record employment growth of the past few years ended in 1969. Job totals for the year were at record high levels, but the rate of growth declined, and unemployment rose, compared with previous years. However, the unemployment rates for 1968 (4.3 percent) and 1969 (4.8 percent) were still below the 1964 (6.5 percent) and 1960 (6.4 percent) rates.

At the end of the year, total employment remained high owing to a broad expansion in the manufacturing sector, including metals and machinery. Employment in the production of basic metals increased by 1,400 jobs; nearly 400 of the jobs were due to recovery from labor disputes. With national policy aimed at slowing the economy, improvement in the Washington economy was not likely in the short run.

Decreases in employment in Washington's two major industries, aerospace and lumber and wood products, slowed the State's economy faster than the rest of the Nation's. From a peak employment reached in mid-1968 to the end of 1969, the aerospace industry cut 23,000 jobs. At the end of the year, aerospace accounted for 31 percent of manufacturing employment and 6 percent of total employment in the State. The lumber and wood products industry also experienced a downturn owing to the national construction trend. However, as this sector was not affected negatively until the end of 1969, the State enjoyed its third best year in its homebuilding history, and the biggest year for total construction.

The impact that the aerospace and lumber and wood products industries have had on the Washington economy becomes apparent when either of these two sectors falter. The true meanings of specialization as well as its pros and cons were reviewed in an article published by the University of Washington.[4]

Another article reviewed the accumulated income impact of exports by 54 different industries, including mining, cement, and several metals on an individual basis.[5]

[4] Wheatley, John J., and Gary B. Randall. Industrial Specialization in Washington. Univ. of Wash. Bus. Rev., Summer 1969, pp. 25–35.

[5] Bourque, Phillip J. Income Multipliers for the Washington Economy. Univ. of Wash. Bus. Rev., Winter 1969, pp. 5–15.

Table 3.—Indicators of Washington business activity

		1968	1969 p	Change, percent
Annual average labor force and employment:				
Total labor force	thousands	1,370.9	1,404.3	+2.4
Unemployment	do	58.7	67.7	+15.3
Employment:				
Construction	do	58.8	58.8	------
Aerospace	do	104.5	91.1	−12.8
Lumber and wood products	do	46.0	45.2	−1.7
Food processing	do	29.5	30.4	+3.1
All manufacturing	do	286.9	279.3	−2.6
All industries	do	1,309.7	1,335.7	+2.0
Factory payrolls	million dollars	$5,752.9	$6,180.4	+7.4
Personal income:				
Total	do	$12,081.0	$13,046.0	+8.0
Per capita		$3,665.0	$3,835.0	+4.6
Construction activity:				
Heavy engineering awards	million dollars	$289.9	$308.1	+6.3
State highway commission:				
Value of contracts awarded	do	$69.7	$126.2	+81.1
Value of contract work performed	do	$104.2	$85.7	−17.8
Cement shipments to and within Washington	thousand 376-pound barrels	6,686.0	6,151.2	−8.0
Farm marketing receipts	million dollars	$784.9	$813.3	+3.6
Mineral production	do	$81.4	$88.6	+8.8

p Preliminary.

Sources: Survey of Current Business, Construction Review, Pacific Builder & 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	1968		1969	
	Employment	Wages (thousands)	Employment	Wages (thousands)
Mining:				
Metal mining	414	$3,245	443	$3,721
Bituminous coal, crude petroleum, and natural gas	79	530	77	679
Nonmetallic mining and quarrying	1,091	9,726	1,099	10,428
Total [1]	1,584	13,501	1,619	14,827
Stone, clay, and glass products:				
Cement, hydraulic	482	4,110	406	3,944
Structural clay products	308	1,869	296	1,927
Concrete, gypsum, and plaster products	4,026	34,665	4,244	38,525
Other	1,063	8,481	1,188	10,264
Total [1]	5,879	49,125	6,134	54,660
Smelting, refining, and casting:				
Blast furnaces, steel works, rolling and finishing mills	1,785	14,283	1,976	16,947
Iron and steel foundries	1,137	9,027	1,311	11,221
Smelting, refining, and casting of nonferrous metals, except aluminum	1,157	9,014	1,451	11,704
Smelting, rolling, drawing, and casting of aluminum	9,192	81,863	9,873	94,135
Miscellaneous	394	3,719	487	4,736
Total [1]	13,665	117,906	15,098	138,744
Industrial chemicals [2]	4,612	45,292	4,375	45,073
Petroleum refining and related industries	1,246	11,524	1,078	11,304
Grand total [1]	26,986	237,347	28,304	264,608

[1] Data may not add to totals shown because of independent rounding.
[2] 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.

Table 5.—Worktime 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
1968:								
Coal	55	204	11	89	-------	-------	--------	-------
Peat	27	147	4	31	-------	-------	--------	-------
Metal	198	255	53	426	-------	42	98.55	2,335
Nonmetal	98	94	9	74	-------	3	40.75	1,453
Sand and gravel	1,403	205	287	2,297	2	57	25.68	9,329
Stone	1,221	209	255	2,045	3	21	11.74	9,190
Total [1]	3,002	206	620	4,962	5	123	25.80	8,328
1969: [p]								
Coal	60	211	12	95	-------	-------	--------	-------
Peat	21	140	3	23	-------	-------	--------	-------
Metal	220	244	54	429	-------	26	60.67	3,110
Nonmetal	85	144	13	101	-------	1	9.87	237
Sand and gravel	1,480	207	306	2,462	-------	54	21.93	604
Stone	1,125	215	242	1,943	-------	29	14.93	794
Total [1]	2,990	211	630	5,053	-------	110	21.77	868

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Table 6.—Office of Minerals Exploration contracts active during 1969

County and contractor	Commodity	Contract		
		Date	Total amount	Government participation, percent
Chelan: Three F Mining Co., Inc. (Three F mine).	Gold	June 16, 1969	$5,800	75
Ferry: Sidney Mining Co. (Burbank)	Gold and silver	Apr. 4, 1969	$17,200	75
Pierce: B & J Properties (Mashel River mercury prospects).	Mercury	Oct. 2, 1968	$41,200	75

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives.—Carborundum Co., Vancouver, manufactured silicon carbide for abrasive, chemical, and refractory purposes. Abrasive-grade material was shipped to sizing and treatment plants in the Eastern States for further 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 refractory plant in Perth Amboy, N.J.

Cement.—Portland cement shipments by four firms operating five plants totaled 6.4 million barrels valued at $22.7 million, down slightly from 1968. Cement was distributed from the plants and from seven distribution terminals to consumers in the State (71 percent) and to other Pacific Northwest States and Alaska. Of the total cement shipped, 67 percent was transported by truck, 24 percent by rail, and 9 percent by boat. The ratio of bulk to paper bag shipments was about 14 to 1.

About 76 percent of the portland cement produced was distributed to firms manufacturing commercial concrete products, such as ready-mixed concrete companies (62 percent), concrete product manufacturers (9 percent), and building material dealers (5 percent). The remaining 24 percent was sold to highway (8 percent) and other contractors (6 percent), and to Federal, State, and local government agencies (8 percent), and miscellaneous customers (2 percent).

Operations of the Ideal Basic Industries, Inc., (formerly Ideal Cement Co.) Seattle plant were described.[6] This plant serves, by deep-water boats and barges, and by rail and truck, the coastal area and inland points in Idaho, Montana, Oregon, and Washington, as well as supplying company cement distribution terminals at Vancouver, at Eugene, Oreg., and at Anchorage, Alaska. Five major elements of the Lone Star Cement Corp. management program were reviewed.[7]

Clays.—The tonnage of clays sold or used by Washington producers declined 10 percent from the 1968 total.

Fire clay was mined from six pits in three counties. International Pipe & Ceramics Corp. produced firebrick from material dug at the Blum, Harris, and Renton pits in King County. Clay dug by the firm from the Mica pit and the Sommer lease in Spokane County was used for manufacturing fire clay refractories at the Mica plant. Wenatchee Silica Sand, Inc., sold fire clay from a pit in Douglas County.

Miscellaneous clay for making heavy clay products (building brick and vitrified pipe), lightweight aggregate, and for manufacturing cement, came from 16 pits in 11 counties. International Pipe & Ceramics Corp. produced clay for manufacturing building brick and vitrified pipe from the Palmer and Pit 55 pits (King County), Bliessner pit (Spokane County), and Lande pit (Stevens County). Mutual Materials Co. produced clay for use in making building brick from the Elk and Newcastle pits (King County) and the Clay City pit (Pierce County). Palmer Coking Coal Co., Inc., dug clay for use in making building brick from the Lake Boron pit (King County). Raw material for manufacturing building brick also came from operations of Chehalis Brick & Tile Co. (Lewis County), R. L. Fleshman (Cowlitz County); Hidden Brick Co. (Clark County), and Lowell Brick Co. (Snohomish County). Clay and shale for making lightweight aggregate came from operations of Cle Elum Cement Products, Inc. (Kittitas County). Clay used in manufacturing cement was dug from the Twin River pit (Clallam County) by Ideal Basic Industries, Inc., from the Squallicum pit (Whatcom County) by Lind Gravel Co., and from the Jim Hoy Co. property near Bellingham (Whatcom County).

Diatomite.—Production of diatomite declined 7 percent from the 1968 total. Kenite Corp. continued to mine and process diatomite in Grant County. Prepared diatomite was marketed as a filtering aid and as a filler.

Gypsum.—Agro Minerals, Inc., mined gypsite (a mixture of gypsum, quartz, and clay) from the Poison Lake deposit and

[6] Trauffer, Walter E. Ideal's Seattle Plant. Pit and Quarry, v. 62, No. 1, July 1969, pp. 108–119.

[7] Pit and Quarry. Lone Star Cement's Management Action Program Yields Early Beneficial Results. V. 62, No. 1, July 1969, pp. 137–140.

processed the material at Tonasket into material suitable for agricultural purposes. Kaiser Gypsum Co., Inc., made building products at Seattle from gypsum mined in Baja California, Mexico. Some gypsum from the foreign source was calcined and marketed by the firm as a portland-cement retarder and as a filler. Greenacres Gypsum Co., Inc., Spokane, sold gypsum imported from Canada for agricultural purposes.

Lime.—Lime production increased 18 percent above the 1968 total. Domtar Chemicals, Inc. (formerly Pacific Lime, Inc.), Tacoma, manufactured lime for construction and agricultural purposes; for use in tanning and in water and sewage treatment; and for use by the metallurgical, paper, and petroleum industries. Limestone for the operation was received by barge from company quarries at Texada Island, British Columbia, Canada. Limestone from Lime, Oreg., was calcined to lime for use in sugar refining at Utah-Idaho Sugar Co. plants at Moses Lake, Grant County, and at Toppenish, Yakima County.

Magnesian Minerals.—No magnesite was produced. The former Northwest Magnesite Co. operations, Chewelah, shut down in 1968 when demand for magnesite dropped owing to changing technology in the steel industry, was purchased by Fibco Corp. The firm planned to construct a particle board plant at the site of the idle magnesite operation and announced that industrial liquidation specialists would sell former Northwest Magnesite Co. machinery not needed for the Fibco Corp. operations. Plans for developing the defunct Northwest Magnesite properties were published.[8]

Olivine production, near that of 1968, was from the Twin Sisters Mountain quarry (Skagit County) of Northwest International and from the Cypress Island quarry (Skagit County) of Olivine Corp. Crude material from the Northwest International operation was processed at Hamilton, Skagit County; that from the Cypress Island quarry went to Bellingham, Whatcom County, for processing.

Pumice.—Output of pumice and pumiceous materials for roofing and landscaping purposes was by W. L. Marenakos Co. from a pit near Easton, Kittitas County; material for construction purposes was dug by Weyerhaeuser Co. from a pit near Cougar, Skamania County.

Sand and Gravel.—Sand and gravel output increased 9 percent over the 1968 total. Increased requirements for sand and gravel by the U.S. Army Corps of Engineers at dam construction projects partially offset a decline in demand for the materials by the State highway department.

Sand and gravel was produced in 37 of the State's 39 counties. Commercial firms operated 127 plants—82 stationary and 45 portable. Output from Government-and-contractor operations, largely production by Federal, State, and local government agencies for roadbuilding and dam construction projects, was from 71 plants—24 stationary and 47 portable.

Sand and gravel output was valued at over $6.4 million in King County, $4.6 million in Whitman County, $3.1 million in Pierce County, $2.3 million in Snohomish County, and over $1.0 million each in Lewis, Spokane, and Yakima Counties.

Distribution of ouput by use was as follows: Roadbuilding and maintenance, 40 percent; building construction, 22 percent; fill, 34 percent; railroad ballast, 1 percent; and miscellaneous, 3 percent. Included under miscellaneous were small but important quantities of special industrial silica sands used for glass manufacturing, grinding, polishing, sandblasting, and foundry applications.

A large part of the commercial sand and gravel output (43 percent) continued to come from operations in King and Pierce Counties, within the Puget Sound drainage system. The three largest commercial sand and gravel firms operating in the State, all producing over 1 million tons annually, were the Pioneer Sand & Gravel Co. and Glacier Sand & Gravel Co. operations, both near Steilacoom in Pierce County, and the Renton operation of Stoneway Concrete, Inc., King County.

Operations of Glacier Sand & Gravel Co., a subsidiary of Kaiser Cement & Gypsum Co., and Pioneer Sand & Gravel Co., a subsidiary of Lone Star Cement Corp, were described.[9]

Stone.—Output of stone increased 10 percent from the 1968 total. Less requirements for stone by the U.S. Army Corps of Engineers at dam construction projects were offset by greater usage by the State highway department in road maintenance and con-

[8] O'Brien, J. Chewelah Bounces Back. Progress, published quarterly by Washington State Department of Commerce and Economic Development, August 1969, pp. 2–5.

[9] Rock Products. 100 Largest Sand and Gravel Plants. V. 72, No. 10, October 1969, pp. 50, 53.

Table 7.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	7,410	$8,032	7,386	$9,325
Road material	7,786	7,861	7,407	8,623
Fill	2,594	1,570	1,966	1,358
Railroad ballast	167	115	501	341
Other [1]	754	1,244	770	1,098
Total	18,711	18,822	18,030	20,745
Government-and-contractor operations:				
Building	2	2	(2)	1
Road material	5,699	4,512	6,242	5,274
Fill	6,394	3,789	9,780	4,903
Other [1]	626	714	193	123
Total	12,721	9,017	16,215	10,301
All operations:				
Building	7,412	8,034	7,386	9,326
Road material	13,485	12,373	13,649	13,897
Fill	8,988	5,359	11,746	6,261
Railroad ballast	167	115	501	341
Other [1]	1,380	1,958	963	1,221
Grand total	31,432	27,839	34,245	31,046

[1] Includes special sand for construction and industrial uses and sand and gravel for miscellaneous unspecified purposes.
[2] Less than ½ unit.

struction. Stone was quarried in 36 counties and transported by truck, 88 percent; railroad, 6 percent; and waterway, 6 percent. King, Pierce, Snohomish, Stevens, and Whitman Counties each had production valued at over $1 million. Output from King, Pierce, Snohomish, and Whitman Counties was used largely for construction purposes such as roadbase, riprap for jetties, and fill in dam construction. Production from Stevens County was largely limestone, marble, and sandstone for industrial purposes.

Traprock, commonly basalt or other dark, fine grained igneous rock, accounted for 92 percent, or 14.4 million tons, of the total stone output and came from operations in 33 counties. The traprock was used for concrete aggregate, roadstone, riprap, fill, and ballast.

Limestone production, totaling 748,588 tons valued at $1.2 million, came from operations in King, Okanogan, Pend Oreille, San Juan, Snohomish, Stevens, and Whatcom Counties. Much of the limestone was used by the cement industry; some was used in manufacturing lime and for roadstone and agricultural purposes, and by the pulp and paper, sugar refining, and metallurgical industries. Large tonnages of limestone were imported for use in manufacturing cement, lime, and paper.

Output of 185,185 tons of industrial silica valued at $1.2 million came from sandstone, quartz, and quartzite operations in Chelan, Okanogan, Stevens, Spokane, and Whatcom

Table 8.—Stone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Dimension stone (building)	13	$330	8	$252
Concrete and roadstone	7,429	9,226	8,356	11,763
Riprap	978	1,622	1,647	3,152
Other [1]	5,911	5,512	5,731	5,902
Total	14,331	16,690	15,742	21,069

[1] Used at cement, paper, metallurgical, and chemical plants, for railroad ballast, and miscellaneous unspecified purposes.

Counties. The crushed and sized material was marketed for use in manufacturing abrasives, cement, ferrosilicon, glass, and roofing granules, and for use as filtration and foundry sand. Dimension sandstone was produced in Ferry and Pierce Counties.

Dimension marble came from Stevens County. Crushed and sized marble from Stevens County was used for terrazzo and for roofing granules.

Granite from King, Okanogan, Skagit, Whitman, and Yakima Counties was used for poultry grit, riprap, and roadstone.

The geology, rock units, and mineral commodities, such as quartzite, feldspar, and others of economic interest, of the Loon Lake Quadrangle, Stevens and Spokane Counties were studied.[10] Mines, rock units, and mineral deposits, such as limestone, coal, and others of economic interest in Whatcom County, were described.[11]

Talc and Soapstone.—Soapstone was mined at two operations near Marblemount, Skagit County, by Herman Smith and Scheel Stone Co. Some of the crude material was sold for sculpturing purposes; most was ground at plants at Northwest Talc & Magnesium Co., Clear Lake, and Stauffer Chemical Co., Portland, Oreg. The ground material was used as a carrier in insecticides and fertilizers.

Vermiculite.—Crude vermiculite from a Montana mining operation was exfoliated at the Vermiculite Northwest, Inc., Spokane plant. Output of the expanded product, increasing 59 percent over the 1968 total, was marketed for loose fill insulation; for lightweight concrete, plaster, and roofing aggregate; and for agricultural purposes.

METALS

Aluminum.—The quantity of aluminum produced increased 29 percent, and the value increased 37 percent over that of 1968. Production was 1,003,116 tons valued at $541.8 million compared with 775,419 tons valued at 394.3 million in 1968. Installed capacity increased 2.9 percent to 1,017,000 tons per year from 988,000 tons.

Reynolds Metals Co. acquired bauxite properties in Cowlitz County and in Oregon from the Aluminum Company of America.

Antimony.—Fargo Mining Corp. continued development work at the Wells Fargo mine in Stevens County. A 500-foot crosscut exposed an 18-inch vein of stibnite and zinkenite. The vein assayed as high as 46 percent antimony. Diamond drilling was being undertaken to further explore the vein.

Cadmium.—The price of cadmium increased from $2.70 per pound in 1968 to $4 in 1969. More than 60,000 pounds of cadmium was contained in the zinc concentrate shipped to smelters. No value was assigned in table 1 because smelter recovery is unknown.

Copper.—Copper production decreased 18 percent to 36,000 pounds compared with 44,000 pounds produced in 1968. No primary copper production was reported; however, most of the lead and zinc concentrate contained minor amounts of copper which were recovered by smelter operations.

Arco Industries, Inc., of Spokane announced purchase of the Kelly Camp mines in the Colville National Forest. The property consisted of eight claims; preliminary assays were reported to indicate 3 to 11 percent copper with traces of gold and silver. The company also undertook limited development and mining at the Daisy and Bluebird mines in Stevens County and at the Wasco prospect in Okanogan County.

Westland Mines, Ltd., reported continuation of development at its Middle Fork

[10] Miller, F. K. Preliminary Geologic Map of the Loon Lake Quadrangle, Stevens and Spokane Counties, Washington. U.S. Geol. Survey Map GM–6, 1969, 7 pp.

[11] Moen, Wayne S. Mines and Mineral Deposits of Whatcom County, Washington. Washington Department of Natural Resources, Division of Mines and Geology, Bull. No. 57, 1969, 134 pp.

Table 9.—Primary aluminum plant capacity and production data

Year	Rated primary capacity (thousand short tons)	Primary production			Average U.S. ingot price per pound, cents
		Thousand short tons	Percent of national total	Value (thousands)	
1965	524	535	19	$262,702	24.5
1966	676	598	20	294,115	24.5
1967	770	746	23	370,287	25.0
1968	988	775	24	394,261	25.1
1969	952	1,003	26	541,829	26.5

property 50 miles east of Seattle. Several potential mining targets reportedly had been delineated.

Brenmac Mines, Ltd., initiated an underground exploration program on a copper-molybdenum property covering about 30 square miles in Sultan Basin, Snohomish County. Plans included driving a 4,000-foot adit and doing up to 40,000 feet of underground drilling at the Sunrise property.

Cominco American, Inc., diamond drilled on the Billy Goat claims in Eight Mile Creek in Okanogan County.

Nickel Hill Mines, Ltd., was exploring a copper-nickel prospect near Everett, Snohomish County. Plans included 600 feet of drifting and geologic mapping. Selected samples from one of the adits were claimed to assay 0.97 to 1.75 percent copper and 0.43 to 0.51 percent nickel. Falconbridge Nickel Mines Ltd. conducted geochemical and geophysical surveys at the Lone Star mine and surrounding areas in Ferry County.

Gold-Silver.—Production of gold decreased 13.1 percent and silver decreased 22.4 percent compared with that of 1968. Average yearly prices for gold and silver followed contrasting trends compared with 1968—gold increased 5.7 percent to $41.51 per troy ounce, and silver decreased 16.4 percent to $1.79 per troy ounce.

Most of the gold and silver production came from the Republic district, Ferry County. According to the Day Mines, Inc., third quarter report, production from the gold-silver mines at Republic was suspended from mid-May through most of July while major repairs were made in the mill. This loss in production contributed significantly to the decreased output in the State.

Day Mines, Inc., was reported to have leased some of its holdings in the Republic district of Columbian Cascade Minerals Corp., 51 percent owned by Naturizer, Inc., of Norman, Okla.

Hillside Mines, Inc., of Spokane did soil sampling and trenching at the Flag Hill, Morning Glory, and El Caliph properties, Ferry County, which may have developed a target for a diamond-drilling program.

Sidney Mining Co. of Kellogg, Idaho, started exploration in the Republic district aided by a loan from the Office of Minerals Exploration.

Iron Ore.—Allison Pass Mining, Ltd., diamond drilled the Stafford Creek iron-nickel deposit in Kittitas County.

Lead-Zinc.—Production of lead increased 53 percent to 8,649 tons, while zinc production decreased 30 percent to 9,738 tons from the production levels recorded in 1968. Most of the production came from the Pend Oreille mine (Pend Oreille County) and the Van Stone mine (Stevens County).

After resuming operations in mid-1969, the Van Stone property of American Smelting and Refining Co. contributed significantly to total zinc production, although not at a rate required to compensate for the loss sustained by the closure in late 1968 of the Calhoun mine, Stevens County, by the American Zinc Co.

Increase in lead output resulted primarily from a higher grade of ore mined at the Pend Oreille mine and a slight increase in tonnage produced over that of 1968.

Minex Corp. was to begin exploration in Pend Oreille County on a copper-silver-gold-lead prospect. The property, located about 10 miles east of Usk, was reported to have a vein structure from 2 to 3 feet wide which had been exposed for 150 feet.

Pend Oreille Mines & Metals Co. reported staking over 200 claims along the International Boundry in Pend Oreille and Stevens Counties. The property, south of the new discovery made by Reeves MacDonald Mines, Ltd., in British Columbia, Canada, was to be owned equally by Reeves MacDonald and Pend Oreille Mines.

A. G. Lotze did extensive dozer trenching at the Gladstone mine in Stevens County in an effort to uncover new chimney deposits of lead.

Lead-silver ore was produced in exploratory work at the Pomulus mine in Ferry County.

Silver King Mining and Milling Co. continued exploration and development work near Parker Lake in Pend Oreille County. A 300-foot crosscut was driven to explore newly discovered lead-zinc-silver veins.

Union Pacific Railroad diamond drilled at the Ramcore mine in eastern Okanogan County in search of lead and silver.

Magnesium.—The Dow Chemical Co. announced plans for a $20 million plant near Dallesport to produce magnesium and chlorine. Plant capacity was expected to be 48,000 tons of magnesium and 100,000 tons of chlorine per year. Markets in the Northwest—aluminum producers for the magnesium; and pulp, paper, and food processing for the chlorine—were to consume most of the output. Raw material requirements

were to be supplied partially by a Dow processing plant to be built near Ogden, Utah.

Mercury.—According to the firm's annual report, Midnite Mines, Inc., acquired an option to purchase the Little Giant mercury property near Yakima and was to do soil sampling, trenching, and diamond drilling during a geologic study.

Uranium.—No production of uranium was reported for 1969. However, Midnite Mines, Inc., stockpiled ore from its mine on the Spokane Indian Reservation to supply the Dawn Mining Co. mill at Ford. The mill started metallurgical testing in December and was to be in production by Jan 1, 1970. Capacity of the mill was to be 500 tons per day.

Western Nuclear, Inc., of Denver postponed indefinitely the construction of a proposed uranium mining and milling operation on the Spokane Indian Reservation. The high cost of money and weakness in the uranium market were cited as reasons for the postponement. Some exploration work was to continue on the properties.

Eastern Star Mining Co. of Wallace Idaho, announced plans to explore property located between the Midnite mine and the Western Nuclear leases.

MINERAL FUELS

Coal.—Coal output from five mines in three counties in the Puget Sound area of western Washington totaled 58,487 tons. Coal from underground mines in King and Thurston Counties was cleaned mechanically, and 18 percent of the washed material was rejected as refuse. Strip mining firms in King and Lewis Counties marketed coal directly from the mine without processing. Unit value of coal sold in the open market was $8.21 per ton.

Work was about 10 percent completed by Morrison-Knudsen Co., Inc., on the coal-fired steam-electric generating plant being constructed for Pacific Power & Light Co. and Washington Water Power Co. at Hanaford Valley near Centralia. Construction of an earthfill dam located 11 miles northeast of Centralia on the Skookumchuck River was begun in May by Lockheed Shipbuilding & Construction Co. The reservoir was to provide a year-round supply of water for operating the power plant and washing the coal. Water, released at the dam into the Skookumchuck River, flows 12 miles downstream for pumping through a 3-mile pipeline to a storage pond at the power plant.

The Pacific Northwest thermal power potential was elevated listing the Centralia project as the first plant in the thermal power series, and the second plant in the projected series was to be the Portland General Electric Co. nuclear power plant scheduled for service in 1974 at Prescott, Oreg.[12]

Geology and coal resources and other mineral commodities of economic importance were described for the Cumberland, Hobart, and Maple Valley Quadrangles, King County, 11 to 32 miles southeast of Seattle.[13]

Peat.—Production of peat totaled 32,684 tons of which 19,685 tons was unprepared, and 12,999 tons was shredded before marketing. The average unit value of peat was $4.11 per ton. Humus, moss, and reed-sedge peat was produced, and most was sold in bulk. Thurston County led in peat production, followed by Spokane, Snohomish, King, Pierce, Kitsap, and Mason Counties.

Petroleum.—No exploratory holes for oil or gas were drilled in Washington in 1969. The first major lease sale of State land since 1962 occurred in October when 96,000 acres of offshore and upland leases was offered. Of 75 tracts offered, 66 containing 92,983 acres were leased for $253,293. There were 52 offshore tracts leased in the Grays Harbor area, and 23 onshore tracts offered north of Grays Harbor. Nine onshore tracts received no bids. Thes most expensive tract acquired, 4 miles southeast of Copalis Beach, was leased with a bonus offer of $15.25 per acre. Shell Oil Co. obtained the bulk of the leases at the sale with high bonus offers on 75,305 acres. Some other high bidders were Mobil Oil Co., Inc., on 8,575 acres; Standard Oil Co. of California on 3,520 acres; Texaco, Inc., on 1,830 acres; and Union Oil Co. of California on 1,815 acres.

A 10-year boom in construction of oil refineries in the Puget Sound area was forecast by Atlantic Richfield Co. The firm maintained that markets for petroleum imported from the North Slope of Alaska

[12] Gillespie, G. Entering the Era of Thermal Power. Greater Portland Commerce, v. 53, No. 31, August 1969, pp. 16–17.
Snyder, G. R. Nuclear Power. Greater Portland Commerce, v. 53, No. 31, August 1969, pp. 22–26.

[13] Vine, James D. Geology and Coal Resources of the Cumberland, Hobart, and Maple Valley Quadrangles, King County, Washington. U.S. Geol. Survey Prof. Paper 624, 1969, 67 pp.

would require construction of a 100,000-barrel-per-day oil refinery each 2 or 3 years. The cost of delivering oil from the North Slope of Alaska to Western United States was estimated.[14]

Construction continued on the Atlantic Richfield Co. 100,000-barrel-per-day petroleum refinery scheduled for completion in 1971 in Whatcom County. Standard Oil Co. of California announced plans to construct and complete by 1973 a 75,000-barrel-per-day petroleum refinery in Whatcom County. The firm holds approximately 1,000 acres of industrial land near Cherry Point where water depths of 60 feet, capable of handling supertanker shipments of up to 225,000 deadweight tons (dwt.), would require pier works extending 1,500 to 2,500 feet from shore. The firm also has 2,200 acres of industrial land near Picnic Point in Snohomish County. The area lies approximately three-quarters of a mile from the deep tidal waters of Possession Sound, and channel depths of 60 feet or better can be reached approximately 500 feet from shore. Other industrial land in the Puget Sound area for potential pertoleum refineries includes sites held by Mobil Oil Co. (approximately 1,000 acres) near Neptune Beach, Whatcom County; Atlantic Richfield Co. (approximately 500 acres) at McKees Beach, Snohomish County; and Union Oil Co. (approximately 1,500 acres) at Spee-Bi-Dah, Snohomish County. The Whatcom County site has access to the Strait of Georgia, and water depths of 60 feet would also require pier works extending 1,500 to 2,500 feet from shore. Channel depths of 60 feet or more can be reached approximately 500 feet directly from shore at the two Snohomish County sites.

Washington Water Power Co., Washington Natural Gas Co., and El Paso Natural Gas Co. continued development on a natural gas storage reservoir at Jackson Prairie, Lewis County. One well was drilled in Lewis County to allow injection of gas to the reservoir. A severe cold period in the Pacific Northwest in January brought the first large test in taking gas from underground storage that had been 5 years in development at Jackson Prairie south of Chehalis. The underground storage reservior, having received 11.5 billion cubic feet of pipeline gas by the end of 1969, essentially increased the capacity of pipelines that supply this region from New Mexico and Alberta, Canada. Underground storage capacity was to be increased to 25 billion cubic feet within the next 4 years. About one-half of the gas pumped to the reservoir was required for cushion to maintain pressure on the reservoir; the remainder could be drawn out to meet peak demand, usually during winter months.

[14] Gonzalez, Richard J. Low-Cost Estimates for Oil From North Slope Misleading. Oil and Gas J., v. 67, No. 38, Sept. 22, 1969, pp. 104–105.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
NONMETALS			
Cement:			
Columbia Cement Co	Marietta Road, P.O. Box 37 Bellingham, Washington 98225	Plant	Whatcom.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colorado 80202	do	King.
Lehigh Portland Cement Co	718 Hamilton St. Allentown, Pennsylvania 18105	do	Pend Oreille.
Lone Star Cement Corp	P.O. Box 2047 Seattle, Washington 98111	do	King, Skagit.
Clay:			
Chehalis Brick & Tile Co	P.O. Box 868 Chehalis, Washington 98532	Pit and plant	Lewis.
Cle Elum Cement Products, Inc	P.O. Box 336 Cle Elum, Washington 98922	do	Kittitas.
R. L. Fleshman	2804 Spirit Lake Highway Castle Rock, Washington 98611	Pit	Cowlitz.
Hidden Brick Co	2610 Kauffman Ave. Vancouver, Washington 98660	Pit and plant	Clark.
Jim Hoy Co	1757 W. Bakerview Road Bellingham, Washington 98225	Pit	Whatcom.
Ideal Cement Co	420 Ideal Cement Bldg. Denver, Colorado 80202	Pit and plant	Clallam.
International Pipe & Ceramics Corp.:	2901 Los Feliz Blvd. Los Angeles, California 90039	do	King.
Blum		do	Do.
Harris		do	Do.
Palmer		do	Do.
Pit #55		do	Do.
Renton		do	Do.
Bliessner		do	Spokane.
Mica		do	Do.
Sommer		do	Do.
Lande		do	Stevens.
Lind Gravel Co	1530 State St. Bellingham, Washington 98225	Pit	Whatcom.
Lowell Brick Co	Box 3005 Everett, Washington 98201	Pit and plant	Snohomish.
Mutual Materials Co	P.O. Box 3547 Seattle, Washington 98124	do	Pierce, King.
Palmer Coking Coal Co., Inc	P.O. Box 8 Black Diamond, Washington 98010	Pit and plant	King.
Wenatchee Silica Sand	Box 1668 Wenatchee, Washington 98801	Pit	Douglas.
Diatomite: Kenite Corp	2 Overhill Road, Overhill Bldg. Scarsdale, New York 10583	Mine and plant	Grant.
Gypsum:			
Argo Minerals, Inc	Tonasket, Washington 98855	Mine	Okanogan.
Greenacres Gypsum Co., Inc	Greenacres, Washington 99016	Plant	Spokane.
Kaiser Gypsum Co., Inc	Seattle, Washington 98134	do	King.
Lime:			
Domtar Chemical, Inc	Tacoma, Washington 98421	do	Pierce.
Olivine:			
Northwest International	329 Kincaid Mount Vernon, Washington 98273	Mine and plant	Skagit.
Olivine Corp	1015 Hilton Bellingham, Washington 98225	do	Do.
Pumice and pumicite:			
Ewer Lumber Co., Inc	P.O. Box 448 Omak, Washington 98841	Pit and plant	Chelan.
W. L. Marenakos Co	Rt. 1, Box 921 Issaquah, Washington 98027	Plant	Kittitas.
Weyerhaeuser Co	Longview, Washington 98632	do	Skamania.
Roofing granules:			
Northwest Talc & Magnesium Co	P.O. Box 324 Clear Lake, Washington 98235	do	Skagit.
Sand and gravel:			
Ace Concrete Co	N. 302 Park Road Dishman, Washington 99206	Pit and plant	Spokane.
Associated Sand & Gravel Co	6300 Glenwood Ave. Everett, Washington 98202	do	Snohomish.
Cadman Gravel Co	Redmond, Washington 98052	do	King.
Central Pre-Mix Concrete	805 N. Division St. Spokane, Washington 99202	do	Spokane.
DeAtley Corp	Box 648 Lewiston, Idaho 83501	do	Okanogan, Pend Oreille, Spokane.
Edinger Gravel Co	Box 283 Kenmore, Washington 98028	do	Snohomish.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Sand and gravel—Continued			
Friday Harbor Sand & Gravel	Box 8 Bellingham, Washington 98225	Pit and plant	San Juan.
Glacier Sand & Gravel Co	5975 E. Marginal Way Seattle, Washington 98134	do	King, Pierce.
W. F. Herrett Co	1619 E. Linn St. Seattle, Washington 98102	do	King.
Holroyd Land Co., Inc	7216 Custer Road West Tacoma, Washington 98467	do	Pierce.
Klineline Sand & Gravel Co	1112 N.E. Hazel Dell St. Vancouver, Washington 98665	do	Clark.
Lakeside Gravel Co., Inc	Box 7, Bellevue, Washington 98004	do	King.
Marine Asphalt Co	Rt. 3, Box 735 Anacortes, Washington 98221	do	Various.
Miles Sand & Gravel	Box 130, Auburn, Washington 98002	do	King.
North Kitsap Gravel Asphalt Co	Rt. 2, Box 305 Poulsbo, Washington 98370	do	Kitsap.
North Star Sand & Gravel Corp	Box 398, Everett, Washington 98036	do	Snohomish.
Olympia Oil & Wood	State and Washington Streets Olympia, Washington 98501	do	Thurston.
Pacific Sand & Gravel Co	Box 699 Centralia, Washington 98531	do	Lewis.
Pioneer Sand & Gravel	Box 1881 Steilacoom, Washington 98111	do	Pierce.
Quigg Bros. McDonald, Inc	1500 Riverside Ave. Hoquiam, Washington 98550	do	Grays Harbor.
Reid Sand & Gravel Co	Box 922 Bellevue, Washington 98004	do	King.
Stoneway Concrete, Inc	Box 509, Renton, Washington 98055	do	Do.
D. A. Sullivan Co	Parkwater Station, Box 37 Spokane, Washington 99211	do	Various.
S & S Sand & Gravel Co	Box 938 Ephrata, Washington 98823	do	Do.
Verbeck Bros., Inc	Tonasket, Washington 98855	do	Yakima.
Ray Weist Constr. Co	Box 191, Yakima, Washington 98901	do	Do.
Western Sand & Gravel Co	Rt. 2, Box 1205 Maple Valley, Washington 98038	do	King.
Yakima Cement Products Co	1202 S. First St. Yakima, Washington 98901	do	Yakima.
Silicon carbide: The Carborundum Co	P.O. Box 423 Niagara Falls, New York 14302	Plant	Clark.
Stone:			
Associated Sand & Gravel Co., Inc	6300 Glenwood Ave. Everett, Washington 98202	Quarry and plant.	Skagit, Snohomish.
Carl Carbon, Inc	Box 5153 N. Central Station Spokane, Washington 99205	do	Spokane, Whitman.
Cascade Asphalt Paving Co	6328 S. Tacoma Way Tacoma, Washington 98409	do	Pierce.
Columbia Cement Co	Marietta Road Bellingham, Washington 98225	do	Whatcom.
Crow Rock Products	1384 Walenla Drive Moscow, Idaho 83843	do	Whitman.
Erickson Paving Co	14446 Sunset Blvd. Bellevue, Washington 98004	do	Garfield.
General Construction Co	Box 3845 Seattle, Washington 98124	do	Jefferson, Wahkiakum.
Roy L. Houck Sons	1158 Chemeketa N.E. Salem, Oregon 97301	do	Various.
Peter Kiewit Sons' Co	Box 1777 Vancouver, Washington 98463	do	Whitman.
Lehigh Portland Cement Co	718 Hamilton St. Allentown, Pennsylvania 18105	do	Pend Oreille.
Lockheed Shipbuilding & Const	12020 E. Marshall Way Seattle, Washington 98168	do	Granite.
Materne Bros	Box 0—Rosewood Station Spokane, Washington 99208	do	Various.
Murphy Bros., Inc	E. 3812 Broadway Spokane, Washington 99202	do	Grant, Whitman.
Sather & Sons, Inc	Box 326, Parkwater Station Spokane, Washington 99211	do	Benton, Columbia, Garfield.
Steelman-Duff, Inc	1411 N.E. Columbia Blvd. Portland, Oregon 97217	do	Garfield, Whitman.
Stoen Constr. Co	2210 E. 95th St. Seattle, Washington 98115	do	Snohomish.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Stone—Continued			
Stewart-Erickson	14446 Sunset Highway Bellevue, Washington 98004	Quarry and plant.	Kittitas, Whitman.
Vinnell-Mannix-Fuller-Dillingham	Star Route Pomeroy, Washington 99347	----do----	Whitman.
R. Wamberg Constr. Co	7404 S. Tacoma Way Tacoma, Washington 98408	----do----	Grays Harbor.
Weyerhaeuser Co	Longview, Washington 98632	----do----	Clark, Cowlitz, Lewis, Pacific.
Woodworth & Co., Inc	1200 East D Tacoma, Washington 98421	----do----	Pierce.
Sulfuric acid:			
American Smelting & Refining Co	Box 1605 Tacoma, Washington 98401	Smelter	Do.
General Chemical Division, Allied Chemical Corp.	Anacortes, Washington 98221	Plant	Skagit.
Talc and soapstone:			
Northwest Talc & Magnesium Co	Clearlake, Washington 98235	----do----	Do.
Scheel Stone Co	3314 Harbor Ave. Seattle, Washington 98126	Mine	Do.
Herman Smith	Marblemount, Washington 98267	----do----	Do.
Vermiculite (exfoliated):			
Vermiculite-Northwest, Inc	P.O. Box A Auburn, Washington 98002	Plant	Spokane.
METALS			
Aluminum:			
Aluminum Company of America	Vancouver, Washington 98600	----do----	Clark.
	Wenatchee, Washington 98801	----do----	Chelan.
Intalco Aluminum Corp	Bellingham, Washington 98225	----do----	Whatcom.
Kaiser Aluminum & Chemical Corp	Spokane, Washington 99200	----do----	Spokane.
	Tacoma, Washington 98400	----do----	Pierce.
Reynolds Metals Co	Longview, Washington 98632	----do----	Cowlitz.
Copper:			
American Smelting & Refining Co	Box 1605 Tacoma, Washington 98401	Smelter	Pierce.
Kromona Consolidated Mines, Inc	Lloyd Bldg., Sixth and Stewart Seattle, Washington 98101	Mine and mill	Snohomish.
Ferroalloys:			
Foote Mineral Co	Wenatchee, Washington 98801	Plant	Douglas.
Ohio Ferro-Alloys Corp	Tacoma, Washington 98400	----do----	Pierce.
Gold:			
Day Mines, Inc	Wallace, Idaho 83873	Mine	Ferry.
Knob Hill Mines, Inc	160 Sansome St. San Francisco, California 94104	Mine and mill	Do.
Lead-zinc: Pend Oreille Mines & Metals Co.	923 Old National Bank Bldg. Spokane, Washington 99201	----do----	Pend Oreille.
Steel:			
Bethlehem Steel Co., Pacific Coast Division.	Seattle, Washington 98134	Plant	King.
Northwest Steel Rolling Mills, Inc	Seattle, Washington 98134	----do----	Do.
Zinc: American Smelting and Refining Co.	Wallace, Idaho 83873	Mine and mill	Stevens.
MINERAL FUELS			
Coal:			
Black Prince Coal Co	Rt. 2, Box 59 Centralia, Washington 98531	Mine	Lewis.
Palmer Coking Coal Co., Inc	P.O. Box 8 Black Diamond, Washington 98010	----do----	King.
Stoker Coal Mining Co	Rt. 2, Box 299 Centralia, Washington 98531	----do----	Thurston.
Peat:			
Cunningham Sand & Gravel Co., Inc.	N. 6315 Cedar St. Spokane, Washington 99208	Bog	Spokane.
Harbor Heights Humus Co	Gig Harbor, Washington 98335	----do----	Pierce.
Kildow Bros. Inc	Olympia, Washington 98501	----do----	Thurston.
Maple Valley Humus	Renton, Washington 98055	----do----	King.
Plant Food Co	Bothell, Washington 98011	----do----	Snohomish.
Petroleum refining:			
Mobil Oil Corp	Ferndale, Washington 98248	Refinery	Whatcom.
Shell Oil Co	Anacortes, Washington 98221	----do----	Skagit.
Sound Refining, Inc	Tacoma, Washington 98400	----do----	Pierce.
Texaco, Inc	Anacortes, Washington 98221	----do----	Skagit.
Union Oil Co. of California	Edmonds, Washington 98020	----do----	Snohomish.
U.S. Oil & Refining Co	Tacoma, Washington 98400	----do----	Pierce.

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 Meherwan C. Irani [1]

During 1969 West Virginia maintained its position as the leading coal producing State in the Nation. Coal accounted for 85 percent of the State's mineral output value. Although production of 141 million tons was 3 percent lower than in 1968, the value increased by 4 percent. Fourteen new coal mines, each employing 20 men or more, were opened.

The value of total mineral output in the State increased by $30.7 million, a gain of 3 percent.

[1] Metallurgist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in West Virginia [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	193	$219	247	$348
Coal (bituminous) do	145,921	775,720	141,011	807,811
Lime do	207	2,848	269	3,648
Natural gas million cubic feet	236,971	62,086	231,759	62,575
Petroleum (crude) thousand 42-gallon barrels	3,312	13,149	3,104	11,888
Salt thousand short tons	1,308	4,971	1,309	4,978
Sand and gravel do	5,657	11,900	5,890	12,666
Stone [3] do	9,011	16,789	9,031	15,801
Value of items that cannot be disclosed: Cement (portland and masonry), fire clay, gem stones, natural gas liquids, and stone (dimension sandstone)	XX	30,026	XX	28,715
Total	XX	917,708	XX	948,430
Total 1967 constant dollars	XX	908,074	XX	p 877,518

p Preliminary. 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."

Table 2.—Value of mineral production in West Virgina, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Barbour	$14,871	$16,971	Coal.
Berkeley	W	W	Cement, stone, lime, clays.
Boone	51,831	W	Coal, stone.
Braxton	W	W	Stone, coal.
Brooke	3,817	W	Coal, sand and gravel.
Cabell	40	W	Clay, stone, sand and gravel.
Clay	W	W	Coal.
Doddridge	278	-------	
Fayette	24,507	W	Coal, stone.
Gilmer	W	255	Coal.
Grant	W	11,706	Coal, stone.
Greenbrier	5,385	4,368	Stone, coal.
Hancock	6,996	W	Clays, sand and gravel, coal.
Hardy	52	35	Stone.
Harrison	W	W	Coal, stone.
Jefferson	W	W	Stone, lime.
Kanawha	W	W	Coal, stone, clays.
Lewis	W	W	Coal, stone.
Lincoln	W	W	Clays.
Logan	80,531	84,699	Coal.
McDowell	116,459	118,837	Do.
Marion	70,198	55,651	Do.
Marshall	W	W	Coal, salt.
Mason	W	W	Coal, sand and gravel.
Mercer	W	W	Coal, clays.
Mineral	W	W	Coal, stone.
Mingo	24,539	22,628	Coal.
Monongalia	W	W	Coal, stone.
Monroe	W	W	Sand and gravel.
Morgan	W	W	Do.
Nicholas	W	W	Coal, stone, sand and gravel.
Ohio	W	W	Coal, sand and gravel.
Pendleton	W	W	Stone, lime.
Pleasants	W	W	Salt.
Pocahontas	W	394	Coal, stone.
Preston	W	10,087	Do.
Raleigh	W	W	Coal, stone, sand and gravel.
Randolph	W	3,344	Coal, stone.
Ritchie	8	-------	
Taylor	W	W	Coal, clays.
Tucker	W	W	Coal, stone.
Tyler	W	W	Salt.
Upshur	1,901	1,820	Coal.
Wayne	W	W	Coal, stone.
Webster	1,004	679	Coal.
Wetzel	W	W	Sand and gravel.
Wirt	16	W	
Wood	W	W	Sand and gravel.
Wyoming	W	W	Coal, sand and gravel.
Undistributed [2]	515,275	616,956	
Total	917,708	948,430	

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

[1] Calhoun, Hampshire, Jackson, Putnam, Roane, and Summers Counties are not listed because no production was reported.

[2] Includes gem stones, natural gas, natural gas liquids, and petroleum, that cannot be assigned to specific counties, and values indicated by symbol W.

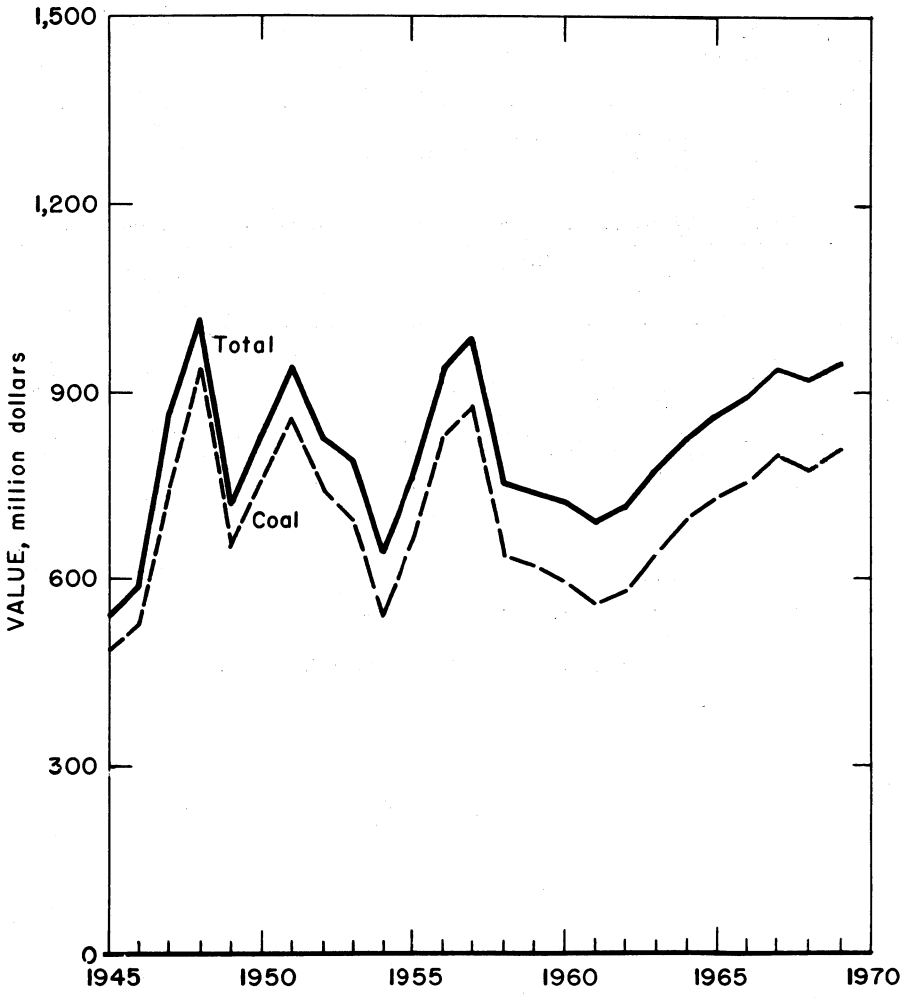

Figure 1.—Value of coal and total value of mineral production in West Virginia.

Table 3.—Indicators of West Virginia business activity

	1968	1969 p	Change, percent
Employment and labor force, annual average: [1]			
Total labor force—thousands	629.0	624.1	−0.8
Unemployment—percent of work force	6.4	5.5	−14.1
Employment:			
Manufacturing—thousands	132.4	131.1	−0.9
Durable goods—do	80.6	79.6	−1.3
Nondurable goods—do	51.8	51.5	−0.6
Nonmanufacturing—do	375.9	381.8	+1.6
Mining—do	45.5	47.0	+3.3
Bituminous coal mining—do	40.7	42.1	+3.4
Contract construction—do	26.0	25.8	−0.8
Payroll average weekly earnings: [1]			
Manufacturing	$122.43	$128.64	+5.1
Durable goods	$124.67	$131.13	+5.2
Nondurable goods	$118.04	$124.43	+5.4
Personal income: [2]			
Total—millions	$4,458	$4,748	+6.5
Per capita	$2,447	$2,610	+6.7
Construction activity:			
Cement shipments to and within West Virginia [3] thousand 376-pound barrels	2,601	2,512	−3.4
Mineral production [3]—thousands	$917,708	$948,431	+3.3

p Preliminary.
[1] Source: West Virginia Department of Employment Security.
[2] Source: Survey of Current Business, U.S. Department of Commerce.
[3] Source: U.S. Bureau of Mines.

Table 4.—Worktime 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
1968:								
Coal	42,121	218	9,180	72,618	150	3,743	53.61	15,437
Nonmetal	272	213	58	464	---	10	21.56	927
Sand and gravel	214	267	57	505	---	12	23.78	709
Stone	1,221	257	314	2,525	2	29	12.28	5,173
Total [1]	43,828	219	9,609	76,111	152	3,794	51.85	14,910
1969: p								
Coal	42,600	211	8,964	71,299	70	3,875	55.33	9,097
Nonmetal	245	235	57	457	---	10	21.86	490
Sand and gravel	180	254	46	416	---	17	40.85	1,322
Stone	1,125	266	299	2,330	---	40	17.16	291
Total [1]	44,105	212	9,366	74,503	70	3,942	53.85	8,725

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—West Virginia continued to be the leading coal producing State in the Nation. The total production of 141 million tons was 4.9 million tons less than in 1968, a decrease of 3 percent. The value of coal produced increased 4 percent to $807.8 million. The production of open-market coal totaled 121.2 million tons valued at $670.3 million, a decrease of 4 percent in quantity and an increase of 2 percent in value. Captive coal production, 19.8 million tons valued at $137.5 million, increased 3 percent in quantity and 13 percent in value. The average value per ton of coal rose to $5.73 from $5.32 in 1968. There were 1,207 active mines with production in excess of 1,000 tons, a decrease of 56. Of the total output, 86 percent was mined at 867 underground operations, a decrease of 67 mines; 10 percent at 229 strip mines, an increase of 9 mines, and 4 percent at 111 auger mines, an increase of 2. The value of coal produced was $716 million from underground operations, an increase of 2 percent; $68.9 from strip mining, an increase of 32 percent; $22.7 million from auger mining, an increase of 12 percent.

Equipment used at underground mines included 879 cutting machines, 91 fewer than in 1968; 842 hand-held and post-mounted drills, a decrease of 210; 250 mobile drills, an increase of nine; 1,014 rotary drills, an increase of 112; and 201 percussion drills, a decrease of 76.

Table 5.—Coal (bituminous) production
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1965	149,191	$726,096
1966	149,681	753,851
1967	153,749	800,683
1968	145,921	775,720
1969	141,011	807,811

Strip coal mining equipment included 273 power shovels, 39 draglines, 10 carryall scrapers, 303 bulldozers, 44 horizontal drills, and 94 vertical drills. Transportation of coal from strip pit to tipple, an average distance of 6 miles, was done by 482 trucks. The average capacity of trucks was 22 tons. Equipment at auger mines included 105 augers, 13 power shovels, two draglines, 94 bulldozers, seven horizontal drills, and eight vertical drills. Coal transportation from auger operation to tipple, an average distance of 5 miles, was done by 197 trucks, with an average truck capacity of 21 tons.

Of the total underground production, 98 percent was mechanically loaded. Of the total mechanically loaded, 41 percent was by 701 mobile loading machines, 588 loaded into shuttle cars, and 112 into mine cars or onto conveyors. Continuous mining machines produced 67.3 million tons, equal to 56 percent of the coal mechanically loaded. Of the 620 continuous mining machines in use (eight more than in 1968), 319 loaded into shuttle cars, and 129 onto conveyors. An additional 183 mobile loaders were used in conjunction with continuous miners. Of the remainder of the mechanically loaded tonnage, 1 percent was loaded by duckbills, scraper loaders, and hand-loaded face conveyors.

Of the total production, 36 percent was crushed. In 1969, 143 cleaning plants, six fewer than in 1968, cleaned 75 percent of total production, 4 percent less than in 1968. Of this amount, 30 percent was cleaned by jigs, 65 percent by wet washing, and 5 percent by pneumatic methods. Of the total coal cleaned, 29 percent was dried in 55 thermal drying plants and 5 percent was treated for dust control. Of the total treated for dust control, 80 percent was with oil and the balance with calcium chloride and oil or with other materials.

Of the total production, 96 percent was shipped by rail or water and the remainder by truck and other methods. The following coal mines employing over 20 men were opened during 1969:

County	Company	Mine
Barbour	Ohio Mining Company	Ruby No. 4.
Boone	Westmoreland Coal Company	Hampton No. 6.
Fayette	Beards Fork Coal Mining Corp	No. 5.
Do	Jack's Branch Coal Company	No. 4.
Kanawha	The Valley Camp Coal Company	V. C. No. 32.
Do	----do	V. C. No. 12.
Do	----do	V. C. No. 31.
Lewis	Appalantic Corp	Strip & Auger.
McDowell	Red Bird Mining Company	No. 9.
Do	Robinson & Phillips Coal Company	Angus.
Raleigh	Consolidation Coal Co., Rowland Div	No. 2.
Wyoming	Robinson Phillips Coal Company	No. 41.
Do	----do	No. 39.
Do	----do	No. 38.

At the Bureau of Mines Morgantown Coal Research Center, research was continued on improving methods of producing electrical energy and synthetic fuels from coal. Coals of various ranks were carbonized in hydrogen atmospheres to produce tar vapors that can be catalytically hydrogenated into chemicals needed for the production of non-leaded gasoline. Hydrogen and synthesis gas were produced by fluid-bed gasification of coal, with heat furnished by recirculated ceramic particles. Successful experiments were conducted with a fixed-bed reactor designed to convert strongly caking bituminous coal into pressurized industrial-quality gas. Improvements were made in a stack gas purification process that removes sulfur dioxide from the gas by reaction with ferrous sulfide derived from pyrite from coal wash-

ings. Techniques were developed to burn in power plants sulfur-free chars produced by flash carbonization of coal. Research was started to determine characteristics of coal ash that contribute to deposition and corrosion inside boilers fired with pulverized coal.

Methods for dry removal of pyrite from coal by means of centrifugal, electrostatic, and magnetic separators were investigated.

Methods were developed from rapid analysis of coal using radioisotopes. Fluid bed combustion was investigated as part of a program sponsored by the National Air Pollution Control Association. Minerals in coal ash and related materials were identified and classified to facilitate development of uses for these substances and to provide information that can help cut pollution from coal based processes. Utilization of fly ash for the reclamation of worked out strip mines was investigated. Fly ash was also investigated for uses in assisting the growth of trees, increasing crop yields, and in the manufacture of skid resistant tires.

During 1969, the Coal Research Bureau, West Virginia University School of Mines, conducted projects involving coal preparation and utilization, air and water pollution, operations research and mine safety. The projects were financed by annual appropriations of the West Virginia Legislature and by Federal grants and contracts. A semicommercial pilot plant, operated during the year, produced 800 bricks per day from coal ash. Potential for utilization of limestone-modified fly ash was investigated. Various possibilities of densifying sludge resulting from neutralization of acid mine drainage were investigated. Tests were conducted to develop information on the mechanism of ground water infiltration into coal mines. Under a grant from the Bureau of Mines, research was conducted to develop or design a coal crusher for use in underground mines. Such a crusher could be used to crush the entire production of the mine for subsequent pneumatic transport to the surface. Studies were conducted to develop methods of utilizing municipal incinerator fly ash residues, and to extract useful metallic constituents from these residues.

Consolidation Coal Co., a subsidiary of Continental Oil Co., continued operation of the pilot plant at Cresap, West Virginia, for production of gasoline from coal. The pilot plant, operated under a contract with the Department of the Interior, Office of Coal Research, utilized coal from the Pittsburgh seam.

Natural Gas Liquids.—Production of natural gas liquids in West Virginia was 5,688,000 barrels in 1969; reserves of all natural gas liquids at yearend were 81 million 42-gallon barrels, 2.4 million barrels less than in 1968.[2] There were 34 natural gas processing plants, including 26 small compression plants operated by Pennzoil United, Inc., in West Virginia.

Petroleum and Natural Gas.—Crude oil production in 1969 was 3.1 million barrels, a decrease of 6 percent from production in 1968. The price paid for Penn-grade crude in West Virginia was lowered from $3.85 to $3.75 per barrel in October 1969. The base price paid for newly developed gas at the well head was $0.27 per thousand cubic feet. Natural gas production, 231,759 million cubic feet, was 2 percent less than in 1968. The estimated number of producing wells in the State at yearend was 18,732 gas wells and 13,132 oil wells.

The total number of oil and gas wells completed increased 23 percent over the previous year. Well completions were reported in 40 of the 55 counties. According to the Oil and Gas Division, West Virginia State Department of Mines, during 1969 the State issued 1,123 permits to drill new wells and/or deepen old wells and 102 permits to reenter and fracture old wells. Total footage drilled was 2,869,617 compared with 2,433,051 [3] in 1968. There were 2,483,018 feet of development drilling and 386,599 feet of exploratory tests. The average depth of the wells drilled was 2,893 feet. A total of 992 wells was drilled in 1969, 187 more than in 1968. Of these, 653 were gas wells, 99 oil wells, 115 dry holes, 99 combination wells and 26 were miscellaneous wells (storage, injection, etc.). Although the total number of exploratory wells declined 9 percent, the number of new-field wildcats increased 267 percent. The exploratory wells included 24 new-field wildcats (nine successful), one successful new-pool wildcat, 24 deeper pool tests, one unsuccessful shallower pool test, and 33 outposts. One development well discovered a new pool and three others discovered shallower pools.

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[2] American Gas Association. Release 44–70. Mar. 31, 1970, 7 pp.
[3] Revised from 1968 Minerals Yearbook.

Table 6.—Coal (bituminous) production, by counties

(Thousand short tons and thousand dollars)

County	1968					1969				
	Number of mines			Total production		Number of mines			Total production	
	Underground	Strip	Auger	Quantity	Value	Underground	Strip	Auger	Quantity	Value
Barbour	25	17	3	3,518	$14,872	23	14	1	3,708	$16,971
Boone	42	12	19	10,290	51,831	41	12	17	10,587	56,082
Braxton	2	---	---	3	10	W	---	---	W	W
Brooke	3	4	1	806	3,051	2	6	---	863	3,818
Clay	3	1	---	W	W	W	---	---	W	W
Fayette	54	12	9	5,238	24,507	49	12	6	5,130	27,760
Gilmer	6	1	---	100	W	6	2	---	68	255
Grant	4	7	---	2,539	11,386	W	6	W	2,520	11,455
Greenbrier	33	---	---	684	3,632	18	1	---	482	1,982
Hancock	---	2	---	W	W	---	1	---	3	W
Harrison	23	21	2	6,578	29,083	15	25	1	7,175	35,263
Kanawha	57	8	13	11,682	56,706	55	18	20	11,390	61,036
Lewis	1	4	1	299	1,185	1	6	4	570	2,403
Logan	48	6	11	15,492	80,531	47	7	20	14,414	84,699
McDowell	184	25	9	16,975	116,424	177	17	7	16,431	118,837
Marion	10	5	2	13,530	70,005	10	4	---	10,110	55,651
Marshall	4	---	---	3,412	W	4	---	---	4,328	W
Mason	4	2	1	348	1,240	4	---	---	338	1,357
Mercer	17	3	2	1,317	9,013	13	5	2	1,232	8,795
Mineral	3	2	---	162	659	W	W	---	180	714
Mingo	52	3	8	4,637	24,539	43	5	8	3,867	22,628
Monongalia	27	9	1	10,228	48,688	24	13	---	10,919	53,851
Nicholas	64	10	3	7,392	41,512	67	W	W	6,767	40,729
Ohio	2	---	1	W	W	W	---	---	W	W
Pocahontas	9	---	---	134	538	6	---	---	54	233
Preston	43	17	---	2,245	8,456	45	23	---	2,501	9,802
Raleigh	62	23	8	8,540	52,381	67	16	11	8,886	61,717
Randolph	15	5	2	510	2,099	12	2	---	540	2,709
Taylor	9	5	---	119	453	8	3	---	176	775
Tucker	---	1	---	480	W	---	5	---	570	W
Upshur	8	8	1	556	1,901	7	4	1	505	1,820
Wayne	2	---	---	32	W	2	---	---	14	W
Webster	14	5	2	277	1,004	14	3	1	189	679
Wyoming	104	2	10	15,023	89,659	97	4	7	13,515	88,694
Undistributed	---	---	---	2,775	30,355	10	15	5	2,979	37,096
Total	934	220	109	145,921	775,720	867	229	111	[1]141,011	807,811

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Data does not add to total shown because of independent rounding.

According to the American Gas Association, at yearend the State had underground gas storage capacity of 338,363 billion cubic feet. The two refineries in the State located near Falling Rock and St. Marys, had a combined refining capacity of 8,800 barrels of crude oil per schedule day and refined most of the crude oil produced in the State. The refineries produced gasoline, lubricating oil, and waxes.

According to the Oil and Gas Journal, estimated proved reserves of crude oil at yearend were 53.5 million barrels, about the same as in 1968. Reserves of natural gas at the end of 1969 were 2,447 billion cubic feet, a decrease of 139 billion cubic feet from 1968 reserves.

Discoveries and extensions were made in most of the major producing trends and in many pay zones throughout the State. The Tuscarora Sandstone (Lower Silurian) is the oldest unit in which discovery was made and the Third Salt sand (Lower Pennsylvanian) the youngest. The most interesting exploratory test of the year, and the deepest well drilled in the State in several years, is the Sanford E. McCormick 1 Burley in Marshall County which was dry and abandoned at a total depth of 14,494 feet. For the third consecutive year Newburg (Williamsport Sandstone) exploration and development dominated deep drilling (Onondaga and deeper) in West Virginia. A Newburg deeper pool discovered in Groundhog Creek field, Meigs County, Ohio, in January 1969 was successfully extended into north-western Jackson County. Commonwealth Gas made a significant Newburg gas discovery in Jackson County midway between Ripley and Wheaton Run

Newburg fields late in 1969. The discovery sparked a flurry of activity in the area. Rocky Fork, the largest of the Newburg gas fields, approached total development in 1969, and the number of wells drilled there declined. However, large volume gas wells continued to be completed, particularly in the northeastern portion of the field. The largest gas well ever officially reported in the State was completed in the Cooper Creek field. The Oriskany Sandstone and contiguous units were the targets of exploratory tests in both the eastern and western producing areas of the State. No discoveries were made in the eastern producing trend in 1969, although a number of exploratory tests were drilled. Several small Oriskany gas discoveries were made in the western producing area of the State. With the possible exception of the Allen Beard 1 McMillion, apparently none of them discovered significant reserves. A number of scattered Tuscarora tests were drilled throughout the State in 1969, apparently stimulated by the discovery of commercial quality Tuscarora gas in Roane County last year.

Although numerous shallow discoveries were made in 1969, only two appear to have discovered significant reserves. The White Shield/Moss was completed as the discovery well for Ellamore field in northwestern Randolph County. A large flow of gas from the Gordon sand was reported late in the year at a new-field wildcat in Braxton County. The Big Injun remained the primary target of most shallow drilling, but there was also a significant increase in the number of Riley-Benson wells drilled. Several discoveries and extensions were made. Seismic crews logged 45 weeks in Cabell, Greenbrier, Hampshire, Hardy, Kanawha, Lewis, Mason, Nicholas, Preston, Ritchie, and Webster Counties.

At mid-year, a total of 2,575,000 acres in West Virginia was under lease by 15 large companies. Some additional acreage of large structures was also under lease by independent operators and lease brokers.

NONMETALS

Cement.—Shipments of portland cement increased 10 percent, and shipments of masonry cement increased 25 percent. The average price per barrel was slightly higher. The sole producer, Capital Cement Co. Division of Martin Marietta Corp., at Martinsburg, Berkeley County, operated three coal-fired rotary kilns. Most of the cement was used for ready-mix concrete, concrete products and building and highway construction. Shipments were made to Delaware, the District of Columbia, Flordia, Maryland, North Carolina, Pennsylvania, Virginia, and West Virginia.

Clays.—Production of miscellaneous clay increased 53,000 tons, miscellaneous clay was chiefly used in the manufacture of cement and building brick. Fire clay was mostly used for producing firebrick and block. Eleven mines were in operation, two less than in 1968. Eight of the mines were open pit and three were underground operations. The greatest production of miscellaneous clay was in Berkeley County.

Gem Stones.—Hobbyists collected mineral specimens.

Lime.—Total lime production was 269,000 tons compared with 207,000 tons in 1968. Chief uses were for steel production, refractory lime, and for pulp and paper manufacture. Three companies operated plants, one each in Berkeley, Jefferson, and Pendleton Counties.

Salt.—Production of salt from brines was slightly higher than in 1968. All of it was used by the producers for manufacture of chlorine and caustic soda. Production was reported in Marshall, Pleasants, and Tyler Counties and was from deep well solution mining.

Sand and Gravel.—Output of sand and gravel increased 4 percent in quantity and 6 percent in value. The average price increased by $0.05 to $2.15. Of the total output, 59 percent was sand and 41 percent was gravel. About 63 percent of the output was shipped by barge and the balance was shipped by railroad or truck.

Production was reported from 12 counties. Of the leading producing counties, Hancock was first in tonnage, followed in descending order by Morgan, Monroe, Wood, Ohio, Brooke, and Wetzel Counties. The sand and gravel was produced by seven stationary plants, one portable plant, and six dredges.

Slag.—Weirton Steel Division, National Steel Corp., produced air-cooled crushed blast furnace slag for aggregate use.

Stone.—Total crushed stone production (limestone and sandstone) was about the same as in 1968, although output of crushed limestone increased to 8.4 million

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,717	$2,258	1,764	$2,393
Paving	482	781	415	667
Fire or furnace	34	43	W	W
Gravel:				
Building	1,372	1,808	1,420	1,892
Paving	894	1,409	923	1,373
Undistributed [1]	1,158	5,601	1,367	6,340
Total sand and gravel	5,657	11,900	[2] 5,890	[2] 12,666

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes glass, molding, blast, fill, engine, filtration, ground and other industrial sands; railroad ballast; fill gravel; and items indicated by symbol W.
[2] Data does not add to totals shown because of independent rounding.

tons. Major uses for the limestone were construction aggregate, as flux in iron and steel production, cement manufacture, mine dusting, railroad ballast, lime manufacture, and agriculture. Berkeley, Greenbrier, Jefferson, and Monongalia Counties were the leading areas of limestone production.

Production of crushed sandstone which was mostly used for construction aggregate decreased to 626,000 tons valued at $1.5 million from 1,063,000 valued at $2.5 million in 1968. Leading sandstone processing counties were Braxton, Fayette, Lewis, Monongalia, Raleigh, and Wayne.

METALS

Aluminum.—The aluminum works of Kaiser Aluminum & Chemical Corp. at Ravenswood, Jackson County, operated at full capacity during 1969. The bauxite for the alumina manufacture was imported into Baton Rouge and Gramercy, La., where it was processed into alumina. The alumina was transported to Ravenswood by unit-train. Aluminum fluoride for the electrolytic cells was obtained from the company-owned plant in Gramercy La.; fluorspar for the manufacture of aluminum fluoride was imported from Mexico. Carbon electrodes were manufactured at Ravenswood from the calcined petroleum coke produced at Kaiser's calcining facilities at Gary, Ind., and Norco, La. Electric power for the plant was purchased from the Appalachian Electric Power Company's coal fired power plant at Graham Station, W. Va. The $55 million expansion program initiated in 1967 was continued during 1969.

Ferroalloys.—Union Carbide Corp.'s large ferroalloy plant at Graham Station, Mason County operated at full capacity. Except for the quartzite consumed, most mineral raw materials for the plant were

Table 8.—Crushed and broken stone sold or used by producers, by uses
(Thousand short tons and thousand dollars)

Use	1968		1969	
	Quantity	Value	Quantity	Value
Aggregates [1]	3,570	$6,556	3,398	$5,735
Railroad ballast	588	739	W	W
Mine dusting	123	428	213	954
Agriculture	127	311	118	290
Other uses [2]	r 4,604	8,755	5,302	8,822
Total	[3] 9,011	16,789	9,031	15,801

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes concrete, bituminous, macadam, surface treatment aggregates, dense graded road base stone, and unspecified construction aggregate and roadstone (1969).
[2] Includes stone sand, cement, lime, riprap, flux, dead burned dolomite, refractory materials, and other miscellaneous uses.
[3] Data does not add to total shown because of independent rounding.

obtained from other states or were imported. The company obtained 20 percent of its total quartzite from a leased property located within 20 miles of the plant. The quartzite, assaying 85 percent silica, was quarried and used in production of various ferroalloys. High-grade quartzite of 99 percent silica content was secured from North Carolina. The company-owned mines in the vicinity supplied 50 percent of the coal requirements; the remainder was purchased. The use of controlled-flow dump trucks for transporting the finished products to the market was accelerated. This method of transportation reduces the delivered cost when compared with that of shipment in boxes. To take advantage of this method of transportation, large users of ferroalloys have installed bulk-handling systems in their plants. Foote Mineral Corp.'s ferroalloy plant at Alloy, Fayette County, operated a total of five electric arc furnaces. The company made ferrochromium, ferrosilicon, ferrovanadium, foundry alloys, modular iron alloy, and 98-percent-pure silicon metal. The company manufactured their SOLVAN grade of ferrovanadium from ferrovandium slag imported from the Republic of South Africa.

Other raw materials included high-grade ferroalloy quality chrome and manganese ores, and mild-steel machine shop turnings. All coal consumed by the company was obtained from mines in West Virginia. All power requirements were purchased.

Nickel.—Huntington Alloy Products Division, International Nickel Company, Inc., rolled various types of high-nickel alloys at its Huntington operation. Production was curtailed because of the prolonged strike of workers of major international nickel producers. The Huntington plant is the largest plant in the world devoted exclusively to the production of nickel and high-nickel alloys. Principal products include nickel and high nickel alloys in mill forms such as strip, sheet, plate, tube, wire rod, bar, and welding products such as nickel and high-nickel bare welding filler wire, coated electrodes and welding fluxes.

Zinc.—Matthiessen & Hegeler Zinc Co. refined zinc in 20 vertical zinc retorts at their plant at Meadowbrook, West Virginia. The zinc bearing raw materials consisted of precalcined zinc sulfide concentrates imported from Canada, and zinc dross from galvanizing plants. Coal for the operation was obtained from mines in the vicinity of the plant. The plant produced zinc slabs, dust, and ball anodes.

Zirconium.—Amax Specialty Metals Division of American Metal Climax, Inc., produced zirconium sponge from zircon sand at their plant in Washington Township near Parkersburg, W. Va. Imported zircon from Australia was converted to zirconium carbonitride by fusing it with carbon in a 5,000 Kva arc type electric furnace. The zirconium carbonitride was chlorinated in fixed-bed water-cooled exothermic chlorinators. The crude zirconium tetrachloride was processed by selective solvent extraction to remove the small quantities of hafnium contained in the tetrachloride. The zirconium in the resulting aqueous solution of zirconium oxychloride was precipitated as oxide. The precipitated oxide was calcined, pelletized with sugar, the pellets carbonized, and then chlorinated to zirconium tetrachloride. The zirconium tetrachloride was reduced to sponge zirconium with metallic magnesium and shipped to the company's plant in Akron, N.Y., to be melted and cast as ingots. The ingots are rolled into sheets, plates and various shapes. The byproduct hafnium was converted into metallic hafnium.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Cement (portland and masonry):			
Capitol Cement Co., Div. of Martin Marietta Corp.[1]	Box 5618 Baltimore, Md. 21210	Plant	Berkeley.
Clays:			
Fire clay:			
Crescent Brick Co., Inc	Box 368 New Cumberland, W. Va. 26047	Underground	Hancock.
Globe Refractories, Inc	Box D Newell, W. Va. 26050	do	Do.
West Virginia Brick Co	442 Virginia St., East Charleston, W. Va. 25300	do	Kanawha.
Common clay and shale:			
Barboursville Clay Mfg. Co	Box 1048 Charleston, W. Va. 25324	Pit	Cabell.
Continental Clay Products Co.	931 Investment Bldg. 15th and K Sts., N.W. Washington, D.C. 20005	Pit	Berkeley.
Grafton Brick Co	1012 Grant Bldg. Pittsburgh, Pa. 15219	Pit	Taylor.
Lincoln Clay Product Co	West Hamlin, W. Va. 25571	Pit	Lincoln.
Sanders Dummy Co	Midkiff, W. Va. 25540	Pit	Do.
The United Clay Products Co.	931 Investment Bldg. Washington, D.C. 20005	Pit	Berkeley.
Virginia Brick & Tile Co	Box 983 Princeton, W. Va. 24740	Pit	Mercer.
Coal (bituminous):			
Amherst Coal Company[2]	Lundale, W. Va. 25631	Underground and auger.	Logan.
Amherst Coal Company	do	Auger	Wyoming.
Armco Steel Corp.[3 4]	Montcoal, W. Va. 25135	Underground	Boone, Raleigh.
Bethlehem Mines Corp.[5]	701 East Third St. Bethlehem, Pa. 18015	do	Barbour, Kanawha, and Marion.
Bethlehem Mines Corp.[6]	do	Underground, strip, and auger.	Raleigh.
Bishop Coal Co	Pocahontas, Va. 24635	Underground	McDowell.
Cannelton Coal Co.[6]	Cannelton, W. Va. 25036	Underground and strip.	Do.
Cannelton Coal Co.[5]	do	Underground, strip, and auger.	Kanawha.
Christopher Coal Co., Div. of Consolidation Coal Co.[7]	Box 100 Osage, W. Va. 26543	Underground	Monongalia.
Clinchfield Coal Co.[4]	Box 472 Clarksburg, W. Va. 26301	do	Harrison.
Eastern Associated Coal Corp.[7]	Koppers Bldg. Pittsburgh, Pa. 15219	do	Boone, McDowell, Marion, Monongalia, Raleigh, and Wyoming.
Island Creek Coal Co.[8]	Holden, W. Va. 25625	do	Grant, Logan, Mingo, Nicholas, Preston, and Wyoming.
Mountaineer Coal Co., Division of Consolidation Coal Co.[5]	Box 1632 Fairmont, W. Va. 26555	do	Harrison and Marion.
National Coal Mining Co	Drawer L Holden, W. Va. 25625	do	Mingo.
Ohio Valley Division Consolidation Coal Co.[9]	Moundsville, W. Va. 26041	do	Marshall.
Olga Coal Co.[3]	Box 900 Youngstown, Ohio 44500	do	McDowell.
Pocahontas Fuel Co., Division of Consolidation Coal Co.[10]	Pocahontas, Va. 24635	do	Mercer and Wyoming.
Pocahontas Fuel Co., Division of Consolidation Coal Co.[6]	do	Underground and strip.	McDowell.
Ranger Fuel Corporation [11]	Drawer V Beckley, W. Va. 25801	Underground, strip, and auger.	Boone and Raleigh.
Ranger Fuel Corporation [4]	do	Underground and strip.	Wyoming.
Semet-Solvay Division Allied Chemical Corp.[3 4]	40 Rector St. New York, N.Y. 10006	Underground	Fayette, McDowell, Wyoming.
Slab Fork Coal Co	Slab Fork, W. Va. 25920	do	Raleigh.

See footnotes at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Coal (bituminous)—Continued			
The Carbon Fuel Co	1310 Kanawha Valley Bldg. Charleston, W. Va. 25300	Underground	Boone.
Do.[5]	do	Underground and auger.	Kanawha.
The Carbon Fuel Co	do	Auger	Raleigh.
The Powellton Co.[5]	Mallory, W. Va. 25634	Underground	Logan.
The Valley Camp Coal Co.[2]	Shrewsbury, W. Va. 25184	Underground and strip.	Kanawha.
The Valley Camp Coal Co.[9]	Box 218 Triadelphia, W. Va. 26059	Underground	Ohio.
Union Carbide Corp., Ferro-alloys Division.[9]	Box 38 Mammoth, W. Va. 25132	Underground and auger.	Kanawha.
Union Carbide Corp., Ferro-alloys Division.	do	Underground	Mason.
United States Steel Corp.[3 12]	525 William Penn Place Pittsburgh, Pa. 15219	Underground and strip.	McDowell.
Westmoreland Coal Co.[4]	123 South Broad St. Philadelphia, Pa. 19109	Underground	Boone.
Winding Gulf Coals, Inc.[13]	Tams, W. Va. 25933	do	Fayette, Raleigh, and Wyoming.
Lime:			
Germany Valley Limestone Co., Division of Greer Limestone Co.[14]	Riverton, W. Va. 26814	Plant	Pendleton.
Jones & Laughlin Steel Corp., Blair Limestone Division.[14]	R.D. 3 Martinsburg, W. Va. 25401	do	Berkeley.
Standard Lime & Refractories Co., Division Martin-Marietta Corp.[15]	2000 First National Bank Bldg. Baltimore, Md. 21203	do	Jefferson.
Magnesium Compounds: Amax Specialty Metals, Inc.	Box 1728 Parkersburg, W. Va. 26101	do	Wood.
Petroleum refineries:			
Elk Refining Company	Falling Rock, W. Va. 25079	do	Kanawha.
Quaker State Oil Refining Corp.	St. Marys, W. Va. 26170	do	Pleasants.
Salt:			
Industrial Chemicals Division, Allied Chemical Corp.	Box 70 Morristown, N.J. 07960	do	Marshall.
Inorganic Chemical Division FMC Corp.	Box 8127 South Charleston, W. Va. 25303	Mine	Tyler.
Do	do	do	Pleasants.
PPG Industries, Inc., Chemical Division.	1 Gateway Center Pittsburgh, Pa. 15222	Plant	Marshall.
Sand and gravel:			
Delta Concrete Co	41st and Noble Sts. Bellaire, Ohio 43906	Pit	Ohio.
Dravo Corp., Keystone Division	Fifth and Liberty Avenues Pittsburgh, Pa. 15222	Dredge	Hancock.
Duquesne Sand Co	East Beaver St. Glenfield, Pa. 15115	do	Brooke.
Iron City Sand & Gravel Corp., Division of McDonough Co.	Box 538 Parkersburg, W. Va. 26100	Pit	Hancock.
Ohio River Sand & Gravel, Division of McDonough Co.	do	Dredge	Monroe.
Do	do	do	Wood.
Ohio Valley Sand Co., Inc	Box 99 New Martinsville, W. Va. 26155	Pit	Wetzel.
Pennsylvania Glass Sand Corp.	Berkeley Springs, W. Va. 25411	Pit	Morgan.
Pfaff & Smith Builders Supply Co.	Box 2508 Charleston, W. Va. 25329	Dredge	Wood.
Smelters:			
Kaiser Aluminum & Chemical Corp.	300 Lakeside Drive Oakland, Calif. 94626	Plant	Jackson.
Matthiessen & Hegeler Zinc Co.	Ninth and Sterling Sts. LaSalle, Ill. 61301	do	Harrison.
Stone:			
Limestone (crushed and broken):			
Acme Limestone Co	Fort Spring, W. Va. 24936	Mine and quarry	Greenbrier.
Aurora Stone Co., Inc	Route 3 Keyser, W. Va. 26726	Quarry	Mineral.
Appalachian Stone Div., Martin-Marietta Corp.	Box 120 Mercersburg, Pa. 17236	do	Berkeley.
R. H. Burns Co., Inc	Hillsboro, W. Va. 24946	do	Pocahontas.
Elkins Limestone Co	Elkins, W. Va. 26241	Mine	Randolph.
The H. Frazier Co., Inc	Box 1377 Richmond, Va. 23211	Quarry	Greenbrier.

See footnotes at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Limestone (crushed and broken) —Continued			
Green Bag Cement Co. Div. of Marquette Cement Mfg. Co.	20 North Wacker Drive Chicago, Ill. 60606	Mine	Monongalia.
Greer Limestone Co.[16]	Greer Building Morgantown, W. Va. 26505	Mine and quarry	Do.
Jones & Laughlin Steel Corp., Blair Limestone Division.	R.D. 3, Martinsburg W. Va. 25401	Quarry	Jefferson.
Terra Alta Limestone Co	Aurora, W. Va. 26705	----do	Preston.
United States Steel Corp	Millville, W. Va. 25432	----do	Jefferson.
Sandstone (dimension): Rhine Creek Stone Co.	Box 265 Eglon, W. Va. 26716	----do	Preston.
Sandstone (crushed):			
Fairfax Sand & Crushed Stone Co.	Thomas, W. Va. 26292	----do	Tucker.
Basil R. Heavner	French Creek, W. Va. 26218	----do	Lewis.
Mazzella Quarries, Inc	2087 Oakridge Dr. Charleston, W. Va. 25311	----do	Kanawha.
Meadows Stone & Paving, Inc	Box 518 Gassway, W. Va. 26624	----do	Braxton.
Do	----do	----do	Nicholas.
Raleigh Stone Co. of Beckley, West Va.	Box 1387 Roanoke, Va. 24001	----do	Raleigh.
Salerno Brothers, Inc	Shinnston, W. Va. 26431	----do	Harrison.
Stone Company, Inc	5347 Route 60E. Huntington, W. Va. 25705	----do	Boone, Cabell, Fayette, and Wayne.
Terra Alta Limestone Co	Box 727 Kingwood, W. Va. 26537	Quarry	Harrison.
Tony Pacifico Stone Quarry, Inc	1417 Camden Drive Charleston, W. Va. 25302	----do	Kanawha.

[1] Also limestone and shale. [2] 9 mines. [3] Captive. [4] 3 mines. [5] 6 mines. [6] 4 mines.
[7] 14 mines. [8] 24 mines. [9] 2 mines. [10] 8 mines. [11] 10 mines. [12] 7 mines. [13] 13 mines.
[14] Also limestone. [15] Also dolomite. [16] Also quartzite.

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 Wisconsin Geological Survey for collecting information on all minerals except fuels.

By Keith S. Olson [1] and Estelle E. Rand [2]

Wisconsin's 1969 mineral production was valued at $79.8 million, an increase of 11 percent over that of 1968 and an increase of nearly $200,000 over the previous record established in 1967. Greater production of sand and gravel and stone were the major factors contributing to the increase. Other mineral commodities registering increases in quantity and value were portland cement and lime. Production of abrasive stone, lead, and peat declined in quantity but increased in value. Decreases in both quantity and value were reported in production of masonry cement, clays, and zinc. Iron ore was produced in Wisconsin for the first time since 1965. The value of nonmetallic mineral production, which comprised about 90 percent of the total value of the 1969 mineral output, increased about 12 percent over that of 1968.

Production of mineral commodities was recorded from 71 of the State's 72 counties in 1969, the same as in 1968. Value of production increased in 44 counties, decreased in 26 counties, and remained unchanged in one county. Leading counties, in descending order of value of mineral production, were Waukesha, Milwaukee, Lafayette, Dane, and Marathon. Value of mineral production in these five counties was 33 percent of the State total. Mineral production exceeded $1 million in 22 counties.

[1] Industry economist, Bureau of Mines, Minneapolis, Minn.
[2] Statistical clerk, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Wisconsin [1]

Mineral	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	17	$34	12	$24
Iron ore (usable)—thousand long tons, gross weight	-----	-----	36	W
Lead (recoverable content of ores, etc.)—short tons	1,126	298	1,102	328
Lime—thousand short tons	224	3,620	244	4,080
Peat—short tons	1,902	153	1,761	155
Sand and gravel—thousand short tons	39,807	30,903	42,815	35,414
Stone—do	17,000	25,223	18,954	27,571
Zinc (recoverable content of ores, etc.)—short tons	25,711	6,942	22,901	6,687
Value of items that cannot be disclosed: Abrasive stone (grinding pebbles), cement, gem stones, and value indicated by symbol W	XX	4,522	XX	5,534
Total	XX	71,695	XX	79,793
Total 1957–59 constant dollars	XX	70,610	XX	p 76,229

p Preliminary. 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 Wisconsin, by counties [1]

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Adams	W	W	Sand and gravel.
Ashland	$166	$126	Sand and gravel, stone.
Barron	356	285	Sand and gravel.
Bayfield	179	197	Do.
Brown	1,444	1,705	Stone, lime, sand and gravel.
Buffalo	251	260	Stone, sand and gravel.
Burnett	133	157	Sand and gravel.
Calumet	381	234	Stone, sand and gravel.
Chippewa	W	230	Sand and gravel.
Clark	W	W	Do.
Columbia	W	2,271	Sand and gravel, stone.
Crawford	294	406	Do.
Dane	3,168	3,978	Do.
Dodge	1,776	1,706	Lime, stone, sand and gravel.
Door	343	330	Sand and gravel, stone.
Douglas	W	W	Lime, sand and gravel, stone.
Dunn	344	168	Sand and gravel, stone.
Eau Claire	W	W	Sand and gravel.
Florence	46	34	Do.
Fond du Lac	1,392	1,278	Stone, sand and gravel, lime, clays.
Forest	112	89	Sand and gravel.
Grant	3,001	2,778	Zinc, stone, lead, sand and gravel.
Green	W	696	Stone, sand and gravel.
Green Lake	540	603	Do.
Iowa	420	592	Stone, zinc.
Iron	25	16	Sand and gravel.
Jackson	714	W	Iron ore, sand and gravel, stone.
Jefferson	207	206	Sand and gravel, stone.
Juneau	W	W	Stone, sand and gravel.
Kenosha	285	124	Sand and gravel.
Kewaunee	451	589	Sand and gravel, stone.
La Crosse	540	332	Stone, sand and gravel.
Lafayette	5,586	5,239	Zinc, stone, lead.
Langlade	425	544	Sand and gravel.
Lincoln	359	457	Sand and gravel, peat.
Manitowoc	1,492	1,939	Sand and gravel, lime, cement, stone.
Marathon	3,762	3,682	Stone, sand and gravel.
Marinette	W	W	Do.
Marquette	W	W	Do.
Milwaukee	W	W	Cement, stone, sand and gravel.
Monroe	359	1,079	Stone, sand and gravel.
Oconto	420	583	Sand and gravel, stone.
Oneida	150	197	Sand and gravel.
Outagamie	652	811	Stone, sand and gravel.
Ozaukee	633	623	Sand and gravel.
Pepin	67	75	Stone, sand and gravel.
Pierce	314	446	Stone, sand and gravel, clays.
Polk	859	1,094	Stone, sand and gravel.
Portage	559	792	Sand and gravel, stone.
Price	W	72	Sand and gravel.
Racine	1,290	2,216	Stone, sand and gravel, clays.
Richland	352	240	Stone, sand and gravel.
Rock	2,302	2,115	Sand and gravel, stone.
Rusk	144	255	Sand and gravel.
St. Croix	548	586	Stone, sand and gravel.
Sauk	1,711	1,460	Stone, sand and gravel, abrasives.
Sawyer	92	98	Sand and gravel.
Shawano	240	279	Sand and gravel, stone.
Sheboygan	585	699	Do.
Taylor	426	487	Sand and gravel.
Trempealeau	126	242	Stone, sand and gravel.
Vernon	313	489	Do.
Vilas	202	202	Sand and gravel.
Walworth	897	1,128	Sand and gravel, stone.
Washburn	W	180	Sand and gravel.
Washington	1,333	2,062	Do.
Waukesha	7,670	8,032	Sand and gravel, stone, peat.
Waupaca	336	398	Sand and gravel, stone.
Waushara	93	185	Sand and gravel.
Winnebago	2,123	2,432	Stone, sand and gravel.
Wood	296	275	Sand and gravel, stone.
Undistributed [2]	18,405	18,710	
Total [3]	71,695	79,793	

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

[1] No production reported for Menominee County.

[2] Includes some sand and gravel and stone that cannot be assigned to specific counties, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Wisconsin business activity

		1968	1969	Change, percent
Employment and labor force, annual average: [1]				
Total labor force	thousands	r 1,853.9	1,899.4	+2.5
Agricultural employment	do	r 172.9	168.0	−2.8
Nonagricultural employment [2]	do	r 1,614.3	1,664.1	+3.1
Manufacturing	do	r 510.3	518.0	+1.5
Construction	do	r 65.9	66.9	+1.5
Mining and quarrying	do	r 2.4	2.6	+8.3
Stone, clay, and glass products	do	r 7.9	8.0	+1.3
Primary metal industries	do	r 29.9	31.0	+3.7
All other	do	r 1,035.7	1,076.6	+3.9
Payrolls, manufacturing [3]	millions	$3,796.6	p $4,140.0	+9.0
Personal income:				
Total	do	$14,197	p $15,437	+8.7
Per capita		$3,371	p $3,647	+8.2
Construction activity:				
Building permits: [4]				
Valuation of authorized residential construction	millions	r $371.0	p $296.5	−20.1
Number of private and public residential units authorized		r 26,428	p 20,025	−24.2
Contract construction work performed:				
Total	millions	$1,252	$1,216	−2.9
Nonresidential building	do	$553	$497	−10.1
Residential building	do	$493	$448	−9.1
Nonbuilding	do	$206	$271	+31.6
State highway commission contracts awarded	do	$85.2	$86.6	+1.7
Portland cement shipments to and within Wisconsin	thousand 376-pound barrels	8,967	9,611	+7.2
Retail sales	millions	$7,123	$7,326	+2.8
Farm marketing receipts	do	$1,458.7	p $1,557.5	+6.8
Mineral production	do	$71.7	$79.8	+11.3
Utility production and consumption:				
Production of electric energy by electric utilities	million kilowatt hours	22,914	p 25,755	+12.4
Natural gas consumption	million cubic feet	271,765	316,279	+16.4
International trade: [5]				
Value of exports through Wisconsin	millions	$132.9	$154.7	+16.4
Value of imports through Wisconsin	do	$116.0	$128.5	+10.8

p Preliminary. r Revised.
[1] Adjusted to March 1969 benchmark levels.
[2] Includes nonagricultural wage and salary, self-employed, unpaid family workers, and domestic workers in private households.
[3] Includes only workers covered under the Wisconsin Employment Security Law.
[4] Based on a Nationwide universe of 13,000 permit issuing places.
[5] Includes Milwaukee, Wis., Customs District.

Sources: Wisconsin Department of Industry, Labor, and Human Relations in cooperation with the U.S. Department of Labor, Survey of Current Business, Construction Reports, Statistical Abstract of the United States, Wisconsin Department of Transportation, Sales Management, Farm Income Situation, Federal Power Commission, and U.S. Department of Commerce.

Table 4.—Worktime 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
1968:								
Peat	10	226	2	18	--	---	-----	-----
Metal	215	228	49	394	--	21	53.36	2,866
Nonmetal	99	111	11	91	--	1	11.01	110
Sand and gravel	2,055	199	409	3,572	--	73	20.43	736
Stone	1,881	213	401	3,400	1	81	24.12	2,541
Total	4,260	204	872	7,475	1	176	23.68	1,660
1969: p								
Peat	8	170	1	11	--	---	-----	-----
Metal	215	276	60	482	2	21	47.78	26,426
Nonmetal	20	186	4	36	--	---	-----	-----
Sand and gravel	1,850	200	370	3,281	1	70	21.64	3,857
Stone	1,775	224	397	3,379	2	81	24.56	4,215
Total [1]	3,870	215	833	7,188	5	172	24.62	5,285

p Preliminary.
[1] Data may not add to totals shown because of independent rounding.

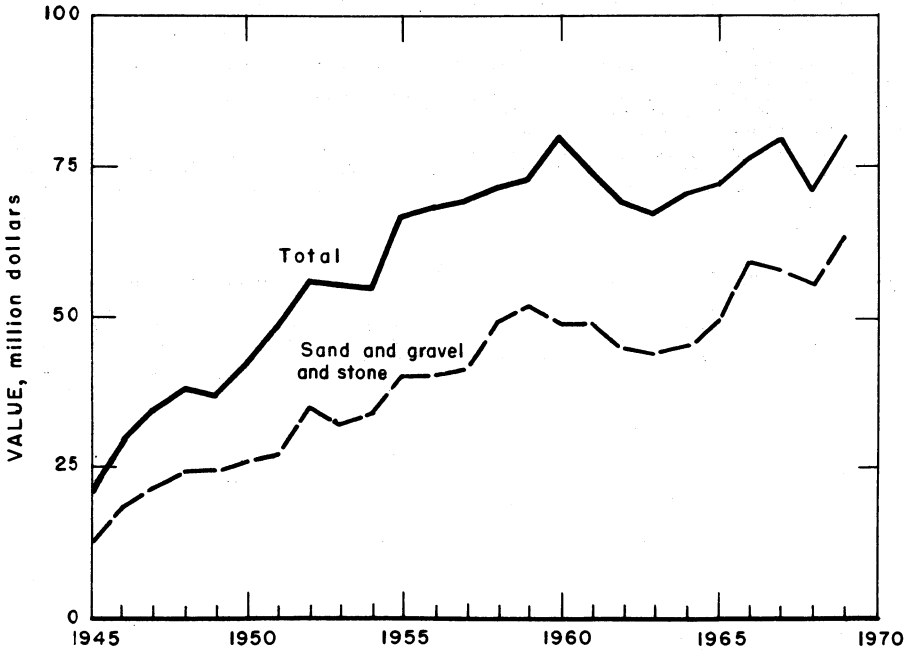

Figure 1.—Value of sand and gravel, stone, and total value of mineral production in Wisconsin.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stone.—Baraboo Quartzite Co., Inc., produced grinding pebbles from a quartzite deposit in Sauk County near Baraboo. Output decreased in quantity but increased in value over that of 1968.

Cement.—Medusa Portland Cement Co. began the production of white cement at its Manitowoc plant. Production of types I and II (general use and moderate heat) portland cement at that plant was terminated in late 1967 to allow for conversion of the facilities to the production of white cement. Raw materials used in the production of white cement included clay from Kentucky, limestone from Michigan, and silica sand from Wisconsin. Marquette Cement Manufacturing Co. operated the State's other cement plant at Milwaukee, producing types I and II and type III (high-early-strength) portland cement and masonry cement. Output of portland cement increased in quantity and value due to the beginning of white cement production in 1969. Most of the cement shipments were by truck in bulk form with lesser amounts shipped by truck in packaged form and by rail in both bulk and packaged forms. Shipments of masonry cement declined 10 percent in quantity and 11 percent in value.

Most of the cement shipments were to points in Wisconsin with lesser amounts to 21 other States. Owing to the production of white cement, Wisconsin cement was shipped to more States in 1969 than in previous years. Ready mixed concrete companies were the major users of Wisconsin portland cement; lesser amounts were consumed by building material dealers, concrete product manufacturers, and highway contractors.

Total shipments of portland cement into and within Wisconsin were 9.6 million barrels compared with 9.0 million barrels in 1968. In addition to cement produced and consumed within the State, shipments were received from nine other States. Principal States shipping portland cement into Wisconsin, in descending order, were Michigan, Indiana, and Iowa. Masonry cement shipments into and within Wisconsin were 469,000 barrels, a decrease of 6 percent from that of 1968. A decline in the housing market was cited as the major reason for this decline.

Clays.—Output of clay and shale in Wisconsin continued to decrease primarily because of the cessation of clay mining and brick manufacturing by the Red Cedar Brick Co. (formerly Menomonie Brick Co.) at Menomonie. Clay production declined 28 percent in both quantity and value from that of 1968. One company in Fond du Lac County produced shale for its own use in making brick. Another company in Racine County mined clay for its own use in manufacturing drain tile. In addition, a Minnesota manufacturer of vitrified sewer pipe consumed stockpiled clay, mined in previous years from Pierce County.

The Wisconsin Geological Survey continued its study of the industrial potential of clays from several areas in western and central Wisconsin.

Lime.—Wisconsin's 1969 lime output increased nearly 9 percent in quantity and 13 percent in value. Lime production in Wisconsin has increased in quantity and value each year for the past 8 years. Output of quicklime, which accounted for most of the lime sold or used in the State, increased 3 percent in quantity and 7 percent in value. Hydrated lime production increased 19 percent in quantity and 21 percent in value. Four companies operated two lime plants in Dodge County and one each in Brown, Douglas, Fond du Lac, and Manitowoc Counties. Both quicklime and hydrated lime were produced for sale by Cutler-LaLiberte-McDougall Corp. at Superior, Rockwell Lime Co. at Manitowoc, and the Western Lime & Cement Co. at Green Bay and Eden. Mayville White Lime Works produced quicklime for its own consumption at a plant near Mayville. Hydrated lime was produced for sale by the Western Lime & Cement Co. at its Knowles plant.

A major portion of Wisconsin's lime output was consumed for chemical and other industrial purposes. Principal uses, in descending order of tonnage, were paper manufacture, water purification, steelmaking, copper ore concentration, and sewage disposal. Nearly 33 percent of the total output was used for construction purposes, mostly mason's lime; the remainder was used for agricultural purposes. About 34 percent of the State's lime output went to Wisconsin consumers; the remainder was shipped to 14 other States

and to Canada. Most of the out-of-State shipments were to Illinois and Minnesota.

Perlite.—One company in Milwaukee County and another in Outagamie County produced expanded perlite from crude material mined outside the State. Sales increased both in quantity and value over those of 1968. Material was used for lightweight aggregate in concrete and plaster, insulation, horticultural purposes, paint additives, foundry purposes, and textured granules.

Sand and Gravel.—Production of sand and gravel was a record 42.8 million tons, an increase of nearly 300,000 tons over the previous record established in 1967. The 1969 output increased nearly 8 percent in quantity and 15 percent in value over that of 1968, when labor strikes and unfavorable weather conditions severely hampered the production of sand and gravel. Sand and gravel ranked number one in production among the mineral commodities produced in Wisconsin, representing 44 percent of the State total mineral value. The largest increase in sand and gravel production, nearly 1.8 million tons, occurred in output of road materials. Other uses for sand and gravel, in descending order of quantity, included building, fill, molding, railroad ballast, sandblasting, and other purposes.

Production of industrial sands increased substantially in quantity and value mainly because of a 13-percent quantity increase and a 14-percent value increase in output of molding sands. Other uses for industrial sands, in descending order of quantity, included sandblasting, glassmaking, filtration, engine sand, cement manufacture, and oil (hydrafrac) purposes. Industrial sands were produced in Columbia, Dane, Eau Claire, Green Lake, Pierce, and Rock Counties. The Wisconsin Geological Survey continued its study of the industrial potential of sands from various areas throughout the State.

Production of sand and gravel was reported in 69 of Wisconsin's 72 counties. Counties producing more than 1 million tons of sand and gravel, in descending order of quantity, were Waukesha, Washington, Dane, Rock, Walworth, Racine, and Columbia. These seven southeastern counties accounted for nearly 41 percent of the tonnage produced in 1969. Average value of the 1969 sand and gravel output, f.o.b. mine or plant, was $0.83 per ton compared with $0.78 per ton in 1968. Commercial operations supplied about 74 percent of the total output; the remainder was produced by, or under contract for, local, county, State, and Federal governmental agencies, mostly highway departments.

Stone.—Stone production in Wisconsin, consisting of basalt, granite, limestone and dolomite (hereafter referred to as limestone), sandstone, and quartzite, was nearly 19.0 million tons valued at $27.6 million, an increase of more than 11 percent in quantity and 9 percent in value over that of 1968. Output of stone in 1969 exceeded the previous tonnage record established in 1967 by nearly 2 million tons.

Stone ranked second in value among all mineral commodities produced in Wisconsin, representing nearly 35 percent of the State's mineral output value. Average value of stone produced in Wisconsin decreased from $1.48 per ton in 1968 to $1.45 in 1969 principally because of a 7-percent decrease in value of dimension stone production.

Production of crushed and broken stone comprised more than 99 percent in quantity and nearly 87 percent in value of all stone produced in the State. Commercial operators produced nearly 95 percent of the total output of crushed and broken stone in Wisconsin. The remainder was produced by 15 county governmental agencies, mostly highway departments. Trucks were used to transport 96 percent of all crushed and broken stone. The remainder was hauled by rail.

Crushed and broken limestone constituted 84 percent in tonnage of all crushed and broken stone produced in the State. Output increased 14 percent in quantity and 15 percent in value over that of 1968. A greater demand for roadstone and aggregates, production of which increased by 2.3 million tons, was the major reason for the increased output. Production of agricultural limestone decreased 13 percent. Other uses for crushed and broken limestone included barnlime, filler material, filter stone, flux stone, lime manufacture, railroad ballast, riprap and jetty stone, rockfill, and stone sand. Crushed and broken limestone was produced in 42 counties. Leading counties, in descending order of tonnage, were Waukesha, Winnebago, Dane, Milwaukee, and Grant. These five counties accounted for 38 percent of all crushed and broken limestone produced in the State.

About 1.2 million tons of crushed and

broken granite was produced in Juneau, Marathon, and Wood Counties, all of which was used for road construction and maintenance. Output decreased 9 percent in quantity but increased 1 percent in value compared with that of 1968.

Crushed and broken quartzite was produced in Marathon and Sauk Counties. Production decreased 11 percent in quantity and 10 percent in value from that of 1968. Uses for the material, in descending order, included roofing granules, railroad ballast, aggregate and roadstone, and abrasives.

Crushed and broken basalt was produced in Douglas, Marinette, and Polk Counties. Output increased in quantity and value mainly because of greater demand for material used for roadstone and aggregates. Other uses for the material were roofing granules, railroad ballast, and riprap.

Production of dimension stone decreased 9 percent in quantity and 7 percent in value. Types of dimension stone produced, in descending order of value, were granite, limestone, sandstone, and quartzite. Granite constituted 9 percent in quantity and 59 percent in value of all dimension stone produced in the State. Production of dimension granite decreased 26 percent in quantity and 7 percent in value from that of 1968. More than 99 percent of the output, in terms of value, was sold for monumental purposes; the remainder was sold for architectural purposes. Dimension

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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,583	$3,311	3,944	$3,751
Paving	3,460	2,277	2,443	2,023
Blast	34	125	68	236
Fill	1,525	779	2,030	1,043
Molding	812	2,209	916	2,516
Other [1]	102	153	145	349
Total [2]	9,516	8,854	9,546	9,917
Gravel:				
Building	4,074	3,853	4,236	4,145
Paving	13,754	11,167	16,123	13,355
Railroad ballast	192	114	157	107
Fill	1,672	852	1,693	981
Other	12	9	15	15
Total	19,704	15,995	22,224	18,603
Total sand and gravel [2]	29,220	24,849	31,771	28,521
Government-and-contractor operations:				
Sand:				
Paving	1,935	947	2,072	1,127
Fill	208	79	156	70
Other	124	51	238	119
Total	2,267	1,077	2,466	1,316
Gravel:				
Paving	7,767	4,698	8,035	5,319
Fill	553	279	538	253
Other	-----	-----	7	5
Total [2]	8,320	4,977	8,579	5,577
Total sand and gravel [2]	10,587	6,053	11,044	6,893
All operations:				
Sand	11,783	9,931	12,012	11,233
Gravel	28,024	20,972	30,803	24,180
Total [2]	39,807	30,903	42,815	35,414

[1] Includes foundry, railroad ballast, and other industrial sand, engine, filtration, glass, oil (hydrafrac), and other construction sand.

[2] Data may not add to totals shown because of independent rounding.

Table 6.—Production of sand and gravel, by counties

(Thousand short tons and thousand dollars)

County	1968		1969		County	1968		1969	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Adams	W	W	W	W	Marquette	62	W	12	$7
Ashland	184	W	160	W	Menominee	----	----	----	----
Barron	474	$356	385	$285	Milwaukee	314	$222	74	27
Bayfield	254	179	180	197	Monroe	W	W	185	96
Brown	646	W	561	W	Oconto	624	W	760	W
Buffalo	72	25	59	24	Oneida	198	150	259	197
Burnett	217	131	258	157	Outagamie	115	122	94	125
Calumet	189	170	W	W	Ozaukee	748	633	702	623
Chippewa	W	W	236	230	Pepin	W	W	7	3
Clark	W	W	W	W	Pierce	148	W	123	W
Columbia	665	W	1,002	2,151	Polk	449	W	738	W
Crawford	83	W	242	W	Portage	647	559	854	790
Dane	2,011	1,922	2,356	2,395	Price	W	W	118	72
Dodge	814	W	658	W	Racine	662	W	1,053	W
Door	349	W	309	W	Richland	W	W	77	W
Douglas	1,851	W	728	531	Rock	2,282	1,906	2,048	1,769
Dunn	W	W	W	W	Rusk	261	144	384	255
Eau Claire	W	W	W	W	St. Croix	468	W	421	275
Florence	56	46	39	34	Sauk	380	W	534	W
Fond du Lac	301	W	312	W	Sawyer	165	92	155	98
Forest	202	112	163	89	Shawano	294	209	314	248
Grant	151	122	59	47	Sheboygan	792	556	950	673
Green	12	W	49	31	Taylor	700	426	662	487
Green Lake	306	513	333	585	Trempealeau	33	14	28	14
Iowa	----	----	----	----	Vernon	W	W	49	23
Iron	43	25	27	16	Vilas	321	202	281	202
Jackson	720	714	146	123	Walworth	1,033	897	1,339	W
Jefferson	349	195	266	178	Washburn	107	W	261	180
Juneau	5	2	41	18	Washington	2,015	1,333	2,861	2,062
Kenosha	394	285	176	124	Waukesha	5,900	4,263	6,748	4,939
Kewaunee	483	451	571	W	Waupaca	468	306	508	359
La Crosse	137	W	73	W	Waushara	147	93	273	185
Lafayette	----	----	----	----	Winnebago	745	487	780	691
Langlade	650	425	820	544	Wood	313	150	356	178
Lincoln	515	359	569	457	Undistributed [1]	5,552	10,812	6,235	11,234
Manitowoc	971	676	934	629					
Marathon	513	483	538	520	Total [2]	39,807	30,903	42,815	35,414
Marinette	247	136	323	289					

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes production for which no county breakdown is available, and data indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

granite was produced in Ashland, Marathon, Marinette, and Marquette Counties.

Dimension limestone comprised 89 percent in quantity and 40 percent in value of all dimension stone produced in Wisconsin. Production decreased 7 percent in quantity and 5 percent in value from that of 1968. Major decreases occurred in the output of house stone veneer and sawed stone. Other types of dimension limestone, in decreasing order of value, included rubble, cut stone, flagging, irregular-shaped stone, and rough architectural stone. Thirty-two companies produced dimension limestone in seven counties. Waukesha and Fond du Lac Counties accounted for nearly 89 percent of the State total value. Wisconsin ranked second in quantity and third in value among the States in output of dimension limestone, with 12 percent of the total tonnage and 8 percent of the total value.

Output of dimension sandstone (including some quartzite) decreased 6 percent in quantity and 11 percent in value. Major uses for the material, in descending order of value, were house stone veneer, construction, flagging, cut stone, and rubble. Production was reported by five companies operating quarries in Marathon, Portage, Sauk, and Wood Counties.

Vermiculite.—Exfoliated vermiculite was produced at Milwaukee by Zonolite Division, W. R. Grace & Co. from crude material mined outside the State. The expanded material was used for loose fill insulation, lightweight aggregate in concrete and plaster, soil conditioning, and as a fire base. Output increased in quantity and value over that of 1968.

Table 7.—Limestone and dolomite sold or used by producers, by uses

Use	1968		1969	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rough architectural thousand cubic feet	60	$52	55	$45
Other rough construction:				
Irregular-shaped stone thousand short tons	7	81	5	(1)
Rubble do	24	239	21	[1] 294
Dressed architectural:				
Cut thousand cubic feet	37	127	39	143
House stone veneer do	315	797	249	667
Sawed do	18	66	10	37
Other dressed construction do	31	43	93	121
Flagging do	97	96	97	115
Total dimension approximate thousand short tons	76	1,501	71	[2] 1,421
Crushed and broken:				
Concrete aggregate and roadstone:				
Concrete aggregate thousand short tons	928	1,188	741	990
Bituminous aggregate do	1,188	1,380	1,080	1,459
Macadam aggregate do	929	1,128	1,082	1,455
Dense graded road base stone do	5,857	6,505	5,033	5,577
Surface treatment aggregate do	3,482	3,694	4,740	5,308
Unspecified aggregate and roadstone do	NA	NA	1,996	2,174
Total aggregate and roadstone [2] do	12,384	13,895	14,672	16,964
Agricultural limestone do	996	1,653	866	1,242
Flux do	36	52	36	54
Riprap and jetty stone do	W	W	156	234
Other [3] do	610	968	207	614
Total crushed and broken [2] do	14,026	16,568	15,937	19,108
Grand total [2] do	14,102	18,069	16,008	20,530

NA Not available.
W Withheld to avoid disclosing individual company confidential data; included with "Other".
[1] Value of irregular-shaped stone combined with rubble to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes stone used for asphalt filler and other fillers or extenders; filter stone; lime; railroad ballast; stone sand; other and unspecified uses; and item indicated by symbol W.

Table 8.—Stone production, by counties
(Thousand short tons and thousand dollars)

County	1968		1969		Kind of stone produced in 1969 [1]
	Quantity	Value	Quantity	Value	
Ashland	(2)	W	(2)	W	Granite.
Brown	552	$558	743	$766	Limestone.
Buffalo	193	226	217	236	Do.
Burnett	6	2	------	------	
Calumet	136	211	121	W	Do.
Clark	(2)	1	------	------	
Columbia	W	W	106	120	Do.
Crawford	W	W	211	W	Do.
Dane	1,043	1,246	1,303	1,583	Do.
Dodge	347	W	459	621	Do.
Door	14	W	25	W	Do.
Douglas	------	------	249	249	Basalt.
Dunn	193	260	58	W	Limestone.
Fond du Lac	491	1,088	422	985	Do.
Grant	940	856	773	789	Do.
Green	456	W	613	665	Do.
Green Lake	20	27	13	18	Do.
Iowa	298	293	376	374	Do.
Jackson	------	------	W	W	Do.
Jefferson	16	12	31	28	Do.
Juneau	W	W	W	W	Granite, limestone.
Kewaunee	------	------	W	W	Limestone.
La Crosse	W	W	221	W	Do.
Lafayette	542	498	517	383	Do.
Manitowoc	160	W	140	W	Do.
Marathon	1,684	3,279	1,605	3,162	Granite, quartzite, sandstone.
Marinette	W	W	W	W	Basalt, granite.
Marquette	W	W	26	W	Granite, limestone.
Milwaukee	W	W	W	W	Limestone.
Monroe	187	W	755	983	Do.
Oconto	W	W	W	W	Do.
Outagamie	520	530	539	686	Do.
Pepin	31	W	72	72	Do.
Pierce	W	W	311	300	Do.
Polk	312	W	354	W	Basalt, limestone.
Portage	------	------	(2)	2	Sandstone.
Racine	W	W	W	W	Limestone.
Richland	W	W	W	W	Do.
Rock	398	396	345	346	Do.
St. Croix	258	W	289	311	Do.
Sauk	W	W	648	845	Limestone, quartzite, sandstone.
Shawano	20	31	18	31	Limestone.
Sheboygan	17	29	4	26	Do.
Trempealeau	107	112	174	228	Do.
Vernon	298	W	398	466	Do.
Walworth	------	------	W	W	Do.
Waukesha	1,788	3,254	1,690	2,938	Do.
Waupaca	28	30	26	39	Do.
Winnebago	1,139	1,636	1,276	1,741	Do.
Wood	189	146	126	97	Granite, sandstone.
Undistributed [3]	4,616	10,500	3,701	8,480	
Total [4]	17,000	25,223	18,954	27,571	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] "Limestone" used generally to include dolomite.
[2] Less than ½ unit.
[3] Includes production for which no county breakdown is available, and data indicated by symbol W.
[4] Data may not add to totals shown because of independent rounding.

METALS

Iron Ore.—Jackson County Iron Co., a wholly owned subsidiary of Inland Steel Co., began producing taconite pellets at its 750,000-ton-per-year plant near Black River Falls late in 1969. The first shipment left the plant on December 10. All-rail shipments were scheduled on a daily basis to Inland's Indiana Harbor Works at East Chicago, Ind. Crude ore was hauled to the plant, by truck, from an open pit mine located on the nearby Seven Mile Mound. Primary crushing was done with a 54- by 74-inch gyratory crusher. Secondary and tertiary crushing was done by cone crushers. Equipment used to concentrate the crude ore included one 14- by 20-foot rod mill, and two circuits each containing two wet cobber magnetic separators, one ball mill, five wet rougher magnetic separators, 10 cyclones, one desliming hydroseparator, and three wet finisher magnetic separators. Green pellets are formed on two balling disks and fired at 2,500°F in a Dravo-Lurgi traveling grate furnace. Design capacity of the 10-foot-wide by 105-foot-long furnace is 95 tons per hour. About 97 percent of the water requirements for the plant was

supplied by water recycled from the tailings pond. Three wells near the plant supplied the remainder.

Shipments of 36,000 tons of iron ore represented the first output of that commodity in Wisconsin since 1965, when the Cary mine on the Gogebic Range was closed.

Lead and Zinc.—Wisconsin produced more than 4 percent of the Nation's mine production of zinc. Output decreased 11 percent in quantity and 4 percent in value. Lead production decreased 2 percent in quantity but increased 10 percent in value. Mine closings and a lower grade of ore at some operations contributed to the decrease in production.

Prices of lead and zinc increased during the year, reversing a 3-year trend of lower prices for these metals. Average yearly weighted prices of lead and zinc were 14.90 cents per pound for lead and 14.60 cents per pound for zinc, compared with 13.21 cents per pound for lead and 13.50 cents per pound for zinc in 1968.

Lead and zinc were produced by four companies operating mines in Grant, Iowa, and Lafayette Counties. All mines were accessible by truck haulage inclines. American Zinc Co. operated its Vinegar Hill mill and Bear Hole mine near Shullsburg and its Champion and Temperly-Thompson mines near New Diggings. The Temperly-Thompson was closed in June. Late in the year, the company began driving a new incline into the Crawhall ore body near the Champion mine. Eagle-Picher Industries, Inc., operated its Shullsburg mine and mill near Shullsburg and its Birkett-Bastian-Andrews mine near Hazel Green. Ores from the Shullsburg mine were treated at the Shullsburg mill; ores from the Birkett-Bastian-Andrews mine, which was closed in February, were processed at the company's mill near Galena, Ill.

The New Jersey Zinc Co. operated three mines and one mill. Most of the production was from the Elmo No. 1 mine in Grant County, with lesser amounts from the Elmo No. 2 mine in Lafayette County and the newly opened Kopp No. 3 mine in Grant County. All ores were treated at the company's Elmo mill. Ivey Construction Co. resumed production from its Graysville mine in May. Operations at the mine and at the company's mill in Mineral Point were temporarily discontinued in 1968, and a new incline into the Graysville ore body was started at that time.

Exploratory drilling was conducted by the above companies at various locations. In addition, some drilling was done by D. H. & S. Mining Co. in Green County.

The Wisconsin Geological and Natural History Survey published the results of geochemical prospecting for zinc ore bodies in the northern portion of the Upper Mississippi Valley lead-zinc district. Eighty-one sites were selected as having potential for further exploration.[3]

Other Metals.—Exploration activities, including drilling, were conducted by several companies near Ladysmith, in Rusk County.

Vulcan Materials Co., A & M Division, began operations in April at its secondary aluminum smelter in Milwaukee County near Oak Creek.

[3] De Geoffry, J. Geochemical Prospecting by Spring Sampling in the Southwest Wisconsin Zinc Mining Area. Wisconsin Geological and Natural History Survey. Inf. Circ. No. 10, 1969, 28 pp.

Table 9.—Mine production of lead and zinc, in terms of recoverable metals

Year	Mines producing	Ore treated (short tons)	Lead		Zinc		Total value [1] (thousands)
			Short tons	Value (thousands)	Short tons	Value (thousands)	
1965	16	967,083	1,645	$513	26,993	$7,882	$8,395
1966	16	936,432	1,694	512	24,775	7,185	7,697
1967	13	988,798	1,596	447	28,953	8,016	8,463
1968	11	923,308	1,126	298	25,711	6,942	7,239
1969	9	846,233	1,102	328	22,901	6,687	7,015

[1] Data may not add to totals shown because of independent rounding.

MINERAL FUELS

Peat.—Sales of peat decreased 7 percent in quantity but increased 1 percent in value over those of 1968. Decreases in sales were due to a lesser output of seed inoculant, which comprised nearly 95 percent of the output, and material for general soil improvement. The remainder was sold for packing shrubs and other plants. Humus peat was produced by one company in Waukesha County and moss and humus peat by another company in Lincoln County. Most of the peat was sold in packaged form.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone—Grinding pebbles:			
Baraboo Quartzite Co., Inc	Box 123 Baraboo, Wis. 53913	Quarry; stationary plant	Sauk.
Cement:			
Marquette Cement Mfg. Co	20 N. Wacker Dr. Chicago, Ill. 60606	Portland and masonry, dry process	Milwaukee.
Medusa Portland Cement Co	Box 5668 Cleveland, Ohio 44101	White, dry process	Manitowoc.
Clays and shale:			
Oakfield Shale Brick & Tile Co	Oakfield, Wis. 53065	Pit and plant	Fond du Lac.
Red Wing Sewer Pipe Corp	Red Wing, Minn. 55066	Processed stockpiled material	Pierce.
Union Grove Drain Tile Co	Box 348 Union Grove, Wis. 53182	Pit and plant	Racine.
Coke: Milwaukee Solvay Coke Div., Pickands Mather & Co	311 E. Greenfield Ave. Milwaukee, Wis. 53204	Coke ovens	Milwaukee.
Iron ore:			
Jackson County Iron Co	30 W. Monroe St. Chicago, Ill. 60603	Mine, concentrator, agglomerator. Began production late in 1969.	Jackson.
Inland Steel Co.: Black River Falls.			
Lead and zinc: [1]			
American Zinc Co.:			
Bear Hole	20 S. 4th St. St. Louis, Mo. 63101	Mine; ore treated at Vinegar Hill mill	Lafayette.
Champion		do	Do.
Crawhall		Development work only	Do.
Temperly-Thompson		Mine; ore treated at Vinegar Hill mill. Mine closed in June.	Do.
Vinegar Hill mill		Mill	Do.
Eagle-Picher Industries, Inc.:			
Birkett-Bastian-Andrews	Box 1040 Galena, Ill. 61036	Mine; ore treated at Graham mill, near Galena, Ill. Mine closed in February.	Do.
Shullsburg		Mine and mill	Do.
Ivey Construction Co.: Graysville.	128 High St. Mineral Point, Wis. 53565	do	Iowa.
The New Jersey Zinc Co.:			
Elmo No. 1	160 Front St. New York, N.Y. 10038	do	Grant.
Elmo No. 2		Mine; ore treated at Elmo mill	Lafayette.
Kopp No. 3		do	Grant.
Lime:			
Cutler-LaLiberte-McDougall Corp	12th Ave. & Waterfront Duluth, Minn. 55802	Quick and hydrated, two rotary kilns, one continuous hydrator.	Douglas.
Mayville White Lime Works	Box 25 Mayville, Wis. 53050	Quicklime, one shaft kiln	Dodge.
Rockwell Lime Co	228 N. LaSalle St. Chicago, Ill. 60601	Quick and hydrated, one rotary kiln, one continuous hydrator.	Manitowoc.
The Western Lime & Cement Co.:			
Green Bay plant	Box 2076 Milwaukee, Wis. 53201	Quick and hydrated, five shaft kilns, one batch hydrator.	Brown.

Knowles plant		Hydrated, five shaft kilns, one continuous hydrator.	Dodge.
Eden plant		Quick and hydrated, five shaft kilns, one batch hydrator.	Fond du Lac.
Peat: Demilco, Inc	3101 W. Custer Ave. Milwaukee, Wis. 53209	Bog, processing plant	Waukesha.
Expanded perlite:			
Midwest Perlite Co	912 College Ave. Appleton, Wis. 54911	Processing plant	Outagamie.
Zonolite Division, W. R. Grace & Co	72 Whittemore Ave. Cambridge, Mass. 02140	do	Milwaukee.
Sand and gravel:			
Eau Claire Sand & Gravel Co	104 Gibson St. Eau Claire, Wis. 54701	Pits; portable and stationary plants	Chippewa, Dunn, Eau Claire.
Genessee Sand & Gravel Co., Inc., Jaeger Sand & Gravel Co., Inc.	8532 W. Schlinger Ave. Milwaukee, Wis. 53214	Pit; portable and stationary plants	Waukesha.
Janesville Sand & Gravel Co	1110 Harding St. Janesville, Wis. 53545	Pit; stationary plant	Rock.
Johnson Sand & Gravel, Inc	22750 W. Bluemound Rd. Waukesha, Wis. 53186	Pits; portable plants	Waukesha.
Edward Kraemer & Sons, Inc	Plain, Wis. 53577	do	Douglas, Eau Claire, Ozaukee, Polk, Portage, Racine, Sauk, Sheboygan, Walworth, Washburn, Washington, Waukesha.
C. C. Linck, Inc	1226 N. Center St. Beaver Dam, Wis. 53916	do	Columbia, Dodge, Fond du Lac, Green Lake, Marinette, Ozaukee, Racine, Waukesha.
Manley Sand Division, Martin Marietta Corp	Rockton, Ill. 61072	Pit; stationary plant; industrial sand	Columbia.
Plautz Brothers, Inc	Route 1 Willard, Wis. 54493	Pits; portable plants	Clark, Polk.
Rein, Schultz & Dahl, Inc	6217 Nesbitt Rd. Madison, Wis. 53711	do	Dane, Jackson, Jefferson, Waukesha.
State Sand & Gravel Co	10833 W. Watertown Plank Rd. Milwaukee, Wis. 53326	Pits; stationary plants	Waukesha.
Wissota Sand & Gravel Co	313 One Half Eau Claire Eau Claire, Wis. 54701	do	Bayfield, Eau Claire, Jackson, Washington.

See footnote at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:			
Granite:			
Anderson Bros. & Johnson Co	Box 26 E. Manson St. Wausau, Wis. 54401	Quarries; stationary plant	Marathon, Marinette.
Lawrence Ladick, Inc	Route 1 Vesper, Wis. 54489	Quarry	Marathon.
Lake Wausau Granite Co	2d St., Box 397 Wausau, Wis. 54401	Quarry; stationary plant	Do.
Montello Granite Co	Montello, Wis. 53949	----do	Marquette.
Prehn Granite Quarries, Inc	1108 Hamilton Wausau, Wis. 54401	----do	Marathon.
Tony Schilling Granite Pit	Route 1, Box 214 Mosinee, Wis. 54455	Quarry	Do.
Limestone and dolomite:			
Courtney & Plummer, Inc	Box 351 Neenah, Wis. 54956	Quarries; stationary and portable plants	Calumet, Waupaca, Winnebago.
Daanen & Janssen	214 S. Huron St. De Pere, Wis. 54115	Quarries; portable plants	Brown.
Franklin Stone Products, Inc	7220 S. 68th St. Hales Corners, Wis. 53130	Quarry; stationary plant	Milwaukee.
Halquist Lannon Stone Co	Sussex, Wis. 53089	Quarries; stationary plant	Waukesha.
Edward Kraemer & Sons, Inc	Plain, Wis. 53577	Quarries; portable plants	Brown, Buffalo, Columbia, Crawford, Dunn, Jackson, Juneau, La Crosse, Marquette, Monroe, Pierce, Richland, Sauk, Trempealeau, Vernon.
Arthur Overgaard, Inc	Box 87 Elroy, Wis. 53929	Quarries; stationary and portable plants	Various counties.
Vulcan Materials Co., Midwest Division	29 N. Wacker Dr. Chicago, Ill. 60606	Quarries; stationary plants	Milwaukee, Racine, Waukesha, Winnebago.
Waukesha Lime & Stone Co	Box 708 Waukesha, Wis. 53186	Quarry; stationary and portable plants	Waukesha.
Wingra Stone Co., Inc. Stewart Watson Constr. Co.	Route 2, Box 4284 Madison, Wis. 53711	Portable plants	Dane.

Quartzite:			
Foley Bros., Inc.	450 Endicott Bldg. on 4th St. Paul, Minn. 55101	Quarry; stationary plant	Sauk.
Minnesota Mining & Mfg. Co.	2501 Hudson Rd. St. Paul, Minn. 55119	Quarries; stationary plant	Marathon.
Sandstone:			
Ellis Quarries, Inc.	Stevens Point, Wis. 54481	do	Marathon, Portage, Wood.
Hildebrandt Stone Co.	6824 University Ave. Middleton, Wis. 53562	Quarry; stationary plant	Sauk.
Traprock (basalt):			
Bryan Dresser Trap Rock, Inc.	Box 215 Shakopee, Minn. 55379	Quarry; stationary and portable plants	Polk.
GAF Corp.	Pembine, Wis. 54156	Quarry; stationary plant	Marinette.
McLean Construction Co.	314 Ogden Ave. Superior, Wis. 54880	Quarry; portable plant	Douglas.
Vermiculite, exfoliated:			
Zonolite Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Processing plant	Milwaukee.

[1] All lead-zinc mining was by underground methods.

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 Earl F. Brauch [1] and Charles A. Koch [2]

Wyoming ranked 11th nationally in value of mineral production during 1969. Since World War II the State has risen from 24th place. Continuing the increase that resumed 4 years ago, mineral production reached a new high of $647.4 million, a 12-percent gain over that of 1968. The four leading revenue producing minerals, in order of value, were petroleum, natural gas, sodium carbonate, and uranium—a change from 1968 when uranium was second, natural gas third, and sodium carbonate fourth. Increases in both quantity and value were recorded for most minerals. Fuels, comprising 78.5 percent of the total mineral value, increased 15 percent to $508 million. Making up 12 percent of the total, nonmetals increased 12 percent to $78.3 million; metals, with 9 percent of the total, decreased 4 percent to $61 million because of a price reduction for uranium. All other metals increased in value. Value increases occurred among six of the 11 nonmetals produced. The only fuel that slipped slightly in value was LP gases.

The petroleum industry (petroleum, natural gas, and natural gas liquids), with a value of $492.6 million and comprising 76 percent of the value of the total mineral industry for the State, again dominated the mineral industry, as it has since the mid-1930's. Energy minerals (mineral fuels and uranium) contributed $548.4 million, 85 percent of total mineral value. Advances were recorded in quantity of all metals produced (copper, gold, iron ore, silver, and uranium); however, copper, gold, and silver outputs were negligible. Uranium was the only metal that decreased in value as production increased.

Activity in almost all sectors of the industry was high. The largest construction project announced during the year for Wyoming was the $300 million, 1.5-million-kilowatt, coal-fired generating-plant complex to be built northeast of Rock Springs by Pacific Power & Light Co. (PP&L) and Idaho Power Co. The plant will be the second largest coal-fired steam-electric facility west of the Mississippi River. Allied Chemical Corp. went on stream with a 1,500-ton-per-day soda ash plant at Green River. Dedicated in September, another plant built near Green River was the $5 million Church & Dwight Co. bicarbonate of soda and sal soda facility. Near Gillette, two gas processing plants, with a combined daily capacity of 62 million cubic feet, went into production with Atlantic Richfield Co. as operator. Purvin & Gertz, Inc., began sulfur recovery near Worland from gas produced in the Big Horn basin. Northwestern Feldspar Corp. completed a feldspar mill at Bonneville. By June 1970, Stauffer Chemical Co. will expand its Green River plant from 800,000 to 950,000 tons of soda ash per year. Wyo-Ben Products, Inc., announced plans for constructing a new bentonite plant at Lovell. In uranium, Utah Construction & Mining Co. announced plans to construct a new mill in the Shirley basin; Petrotomics Co. will enlarge capacity of its Shirley basin mill by 50 percent.

Reynolds Mining Co. began constructing improved water storage and diversion facilities at Lake DeSmet and continued evaluation of nearby coal properties.

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[1] Mining engineer, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Laramie, Wyo.

Table 1.—Mineral production in Wyoming [1]

Mineral	1968 Quantity	1968 Value (thousands)	1969 Quantity	1969 Value (thousands)
Clays—thousand short tons	1,828	$17,275	1,992	$18,970
Coal (bituminous)—do	3,829	12,117	4,602	15,443
Gem stones	NA	127	NA	129
Iron ore (usable)—thousand long tons, gross weight	1,967	19,452	2,048	20,751
Lime—thousand short tons	28	W	27	W
Natural gas (marketed)—million cubic feet	248,481	36,278	303,517	44,617
Natural gas liquids:				
LP gases—thousand 42-gallon barrels	3,917	7,090	4,428	7,085
Natural gasoline and cycle products—do	2,331	6,501	2,523	7,051
Petroleum (crude)—do	144,250	380,589	154,945	433,846
Sand and gravel—thousand short tons	9,350	8,973	7,568	7,288
Stone—do	1,434	2,754	1,584	3,012
Uranium [2] (recoverable content U_3O_8) thousand pounds	5,928	44,343	6,716	40,318
Value of items that cannot be disclosed: Cement, copper (1969), feldspar (1968), gold (1969), gypsum, phosphate rock, pumice (1969), silver (1969), sodium carbonate, sodium sulfate, and values indicated by symbol W	XX	40,691	XX	48,932
Total	XX	576,190	XX	647,442
Total 1967 constant dollars	XX	574,958	XX	p 625,813

p Preliminary. 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] Value estimated based on $8.00 (1968) and $5.86 (1969) per pound for sale to the Atomic Energy Commission and an assumed price of $6.50 (1968) and $6.10 (1969) per pound for commercial sales.

Table 2.—Value of mineral production in Wyoming, by counties

(Thousands)

County	1968	1969	Minerals produced in 1969 in order of value
Albany	$7,147	$6,737	Cement, petroleum, iron ore, stone, sand and gravel, gypsum.
Big Horn	27,216	27,409	Petroleum, clays, natural gas, gypsum, stone, lime, sand and gravel.
Campbell	52,602	99,738	Petroleum, natural gas, coal, sand and gravel, LP gases, stone.
Carbon	21,117	21,402	Uranium, petroleum, natural gas, coal, LP gases, sand and gravel, natural gasoline, copper, stone, gold, silver.
Converse	14,426	15,435	Petroleum, coal, natural gas, sand and gravel, LP gases.
Crook	21,845	24,097	Petroleum, clays, natural gasoline, LP gases, natural gas, stone, sand and gravel.
Fremont	89,520	86,803	Uranium, petroleum, iron ore, natural gas, natural gasoline, sand and gravel, LP gases, stone.
Goshen	610	W	Sand and gravel, lime, petroleum, stone.
Hot Springs	42,792	44,207	Petroleum, natural gas, coal, natural gasoline, sand and gravel.
Johnson	18,705	17,395	Petroleum, clays, sand and gravel, natural gas, LP gases, natural gasoline, stone.
Laramie	3,329	3,023	Stone, petroleum, sand and gravel, natural gas.
Lincoln	8,174	10,518	Coal, natural gasoline, LP gases, phosphate rock, sand and gravel, stone.
Natrona	52,870	53,143	Petroleum, natural gas, LP gases, uranium, sand and gravel, natural gasoline, clays, sodium sulfate, stone.
Niobrara	1,993	1,820	Petroleum, natural gas, sand and gravel, LP gases.
Park	100,675	103,242	Petroleum, natural gas, LP gases, gypsum, sand and gravel, natural gasoline, stone.
Platte	3,760	4,445	Iron ore, stone, sand and gravel.
Sheridan	3,410	3,379	Coal, petroleum, sand and gravel, stone, natural gas.
Sublette	20,702	24,565	Petroleum, natural gas, sand and gravel, LP gases, stone.
Sweetwater	64,715	79,226	Sodium carbonate, petroleum, natural gas, sand and gravel, coal, LP gases, natural gasoline, stone, pumice.
Teton	281	W	Stone, sand and gravel.
Uinta	1,793	1,267	Natural gas, natural gasoline, petroleum, clays, sand and gravel, stone.
Washakie	9,107	9,914	Petroleum, natural gas, LP gases, lime, sand and gravel, stone.
Weston	9,180	8,697	Petroleum, clays, sand and gravel, natural gas, LP gases, stone.
Yellowstone National Park	92	151	Sand and gravel.
Undistributed [1]	127	828	
Total [2]	576,190	647,442	

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.

[2] Data may not add to totals shown because of independent rounding.

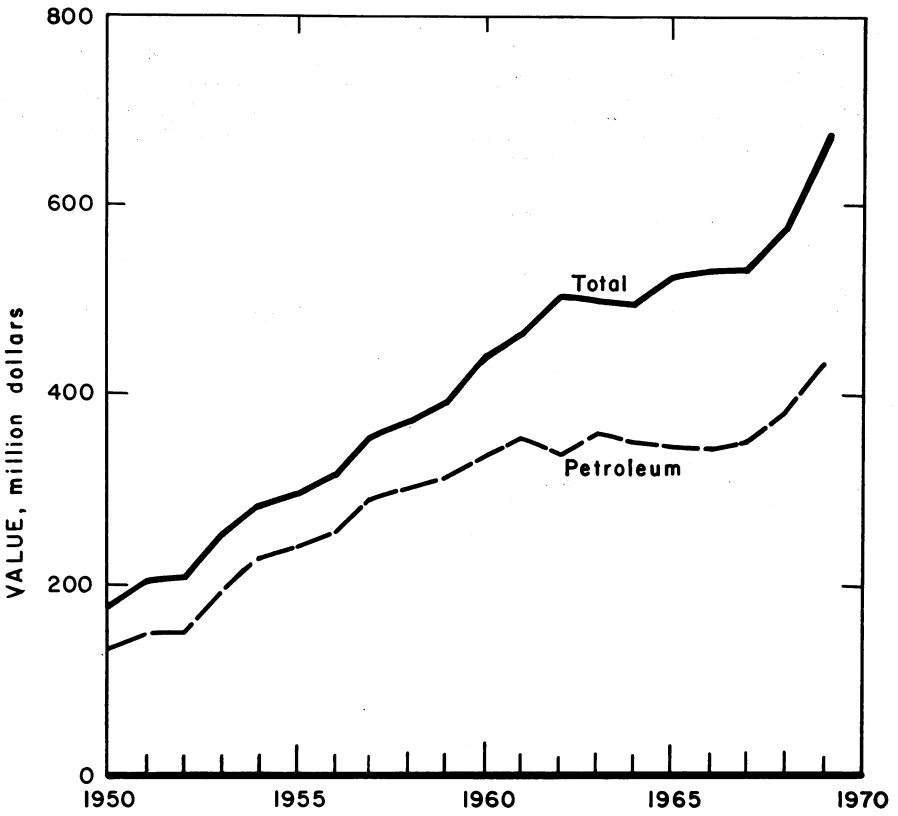

Figure 1.—Value of petroleum, and total value of mineral production in Wyoming.

Table 3.—Indicators of Wyoming business activity

		1968	1969 p	Change, percent
Employment and labor force, annual average:				
Total labor force	thousands	134.0	141.5	+5.6
Employment	do	128.5	135.7	+5.6
Unemployment	do	5.5	5.8	+5.5
Agricultural employment	do	25.9	29.3	+13.1
Nonagricultural employment	do	102.6	106.4	+3.7
Mining	do	10.2	11.5	+12.7
Contract construction	do	6.4	6.1	−4.7
Manufacturing	do	6.7	6.9	+3.0
Government	do	28.9	29.0	+.3
All other	do	50.4	52.9	+5.0
Payroll data:				
Agriculture	millions	$.8	$.9	+12.5
Mining	do	$88.1	$104.2	+18.3
Construction	do	$51.9	$52.0	+.2
Manufacturing	do	$43.0	$48.6	+13.0
Government	do	$1.5	$1.5	------
All other	do	$193.2	$213.2	+10.4
Personal income:				
Total	millions	$981.6	$1,054.8	+7.5
Per capita		$3,116	$3,446	+10.6
Construction activity:				
Total value of construction contracts	millions	$89.7	$137.3	+53.1
Residential	do	$15.2	$14.1	−7.2
Nonresidential	do	$74.5	$123.2	+65.4
Highway construction contracts awarded	do	$36.1	$47.7	+32.1
Cement shipments to and within the State	thousand 376-pound barrels	993.0	1,253.0	+26.2
Business receipts:				
Retail sales	millions	$930.0	$1,013.3	+9.0
Farm marketing receipts	do	$241.0	$252.0	+4.6
Mineral production	do	$576.2	$647.4	+12.4
Utility production and consumption				
Production of electric energy	million kilowatt hours	2,154.0	2,345.0	+8.9
Natural gas consumption	billion cubic feet	38.7	44.5	+15.0

p Preliminary.
Sources: Engineering News-Record, v. 184, No. 16, Apr. 30, 1970, pp. 12-13; Employment Security Commission of Wyoming; F. W. Dodge Division, McGraw-Hill Information Systems Co.; Wyoming Natural Resource Board; U. S. Bureau of Mines.

Uranium land leasing, exploration, and development continued at an accelerated rate. Ranked first in exploration drilling, Wyoming was the second largest uranium-producing State in the Nation. According to U.S. Atomic Energy Commission (AEC) figures, at yearend uranium companies held about one-sixth of the total State area or 10.2 million acres. The Gas Hills area continued as the main source of uranium. Exchange and acquisition of uranium claims remained high; major oil companies continued to be prominent purchasers.

Because of uranium mining, America's newest town, Shirley Basin, Wyo., came into being during 1969; population of 2,500 is planned.

The Open Cut Land Reclamation Act, passed by the 40th Wyoming Legislature, went into effect August 7. Operations completed or started before the effective date of the law were exempt. Others exempted are prospectors as well as pits and quarries under governmental reclamation regulations equal to or more stringent than the State laws. Permits will be issued by the State Commissioner of Public Lands for a fee of $50. Operators are required to post a bond equal to the cost of land restoration. Violations of the new law can cost up to $1,000 per day.

The National Science Foundation awarded the University of Wyoming $52,400 for a 2-year study of the chemical characteristics of beryllium.

Employment and Injuries.—Final data for 1968 and preliminary data for 1969 compiled by the Bureau of Mines for employment and injuries in the Wyoming mineral industries, excluding all mineral fuels except coal, are reported in table 4.

Government Programs.—Research programs continued on Wyoming resources through several projects. The U.S. Bureau of Mines, Laramie Energy Research Center, continued investigations of extraction, processing, and utilization of petroleum, as well as studies on oil shale.

Through a $600,000 U.S. Office of Coal Research contract, the University of Wyoming's Natural Resources Research Institute did research on converting coal to gas and petroleum products.

Table 4.—Worktime 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
1968:								
Coal	327	232	76	582	1	8	15.47	10,655
Metal	1,773	264	472	3,983	4	105	27.37	7,101
Nonmetal	1,252	286	358	2,894	1	46	16.24	2,841
Sand and gravel	810	188	152	1,252	1	23	19.18	5,666
Stone	249	251	62	500	--	14	28.02	766
Total [1]	4,411	253	1,121	9,210	7	196	22.04	5,448
1969:[p]								
Coal	345	240	83	621	3	7	16.09	29,253
Metal	1,845	238	441	3,740	--	85	22.73	486
Nonmetal	1,495	299	448	3,618	1	36	10.23	1,861
Sand and gravel	775	168	131	1,141	--	24	21.04	2,111
Stone	225	234	52	420	--	11	26.18	483
Total [1]	4,685	246	1,155	9,539	4	163	17.51	3,075

[p] Preliminary.
[1] Data may not add to totals shown because of independent rounding.

Reports on Wyoming mineral resources were published by the U.S. Bureau of Mines, U.S. Geological Survey, and the Wyoming Geological Survey.[3]

U.S. Bureau of Mines, State officials, and others met in Rock Springs to determine a method of remedying the 200-acre subsidence problem in that city. The Bureau of Mines recommended pumping fill material through drill holes into the abandoned coal mine workings.

According to Wyoming Department of Economic Planning and Development, the 1969 legislature passed what amounted to a 1-percent minerals severance tax which is in addition to about 5.5 percent production taxes paid by the industry. The new tax raised about $4 million in fiscal 1969.

[3] Anderson, P. C., P. M. Gardner, E. V. Whitehead, D. E. Anders, W. E. Robinson. The Isolation of Steranes From Green River Oil Shale. Geochimica et Cosmochimica Acta, 1969, v. 33, pp. 1304–1307.

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REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—A 20-percent increase in tonnage and a 27-percent increase in value marked a successful year for the 12 producing coal mines located in seven counties. Output has been on the upturn for the last 2 years; in 1969, 4.6 million tons, worth $15.4 million, were produced. The low point in production was 1.6 million tons in 1958, reached after more than a decade of decreasing output. Since then, coal production has had nearly uninterrupted growth.

Although coal totaled only about 3 percent of the value of the mineral fuels category, its production appears to have a sound future. The largest construction project announced during the year for Wyoming was the $300 million, 1.5-million kilowatt, Jim Bridger coal-fired generating-plant complex to be built about 25 miles northeast of Rock Springs by PP&L and Idaho Power Co. Coal for the plant will originate from Nine-Mile Draw northeast of Superior. The coal, occurring in the basal, Fort Union Formation, will be mined by open pit methods from a 30-foot seam that extends for over 15 miles. The subbituminous, B rank coal deposit contains 130 million tons that are minable with a strip ratio of 4 to 1 and 250 million tons with a strip ratio of 7 to 1. Plans call for complete restoration of the land surface where possible.

Construction of the plant, to be the second largest coal-fired steam-electric facility west of the Mississippi River, is scheduled to begin in 1971 and to be completed by 1978. Power production is expected in 1974 at part capacity. At full capacity the plant will add 50 percent more electrical energy to present State production. Water purchased from the State and stored in Fontenelle Reservoir will be used at the plant. Plant life is estimated at 35 to 40 years.

Commonwealth Edison Co., Kansas City Power and Light Co., and other midwest customers began receiving coal in late 1969 by unit trains from Sheridan. The increase in shipments is credited to coal quality and reduced freight rates.

Energy Development Co., a subsidiary of Iowa Public Service Co., was successful bidder on 8,683 acres of federal coal leases near Hanna. Following field and economic studies, coal is to be shipped to the Sargent Bluff powerplant near Sioux City, Iowa.

During the fall, Black Hills Power & Light Co. completed a 20-megawatt expansion of the Wyodak generating plant near Gillette. The new plant design, first of this type in the United States, has created widespread interest in areas of short water

Table 5.—Coal (bituminous) sold or used [1] by producers, by counties

Year and county	Number of mines operating			Sold or used (thousand short tons)		
	Underground	Strip	Total	Underground	Strip	Total
1968:						
Campbell	------	1	1	------	540	540
Carbon	------	2	2	------	477	477
Converse	------	2	2	------	1,390	1,390
Hot Springs	3	------	3	10	------	10
Lincoln	------	2	2	------	952	952
Sheridan	------	2	2	------	354	354
Sweetwater	1	------	1	106	------	106
Total [2]	4	9	13	117	3,713	3,829
1969:						
Campbell	------	1	1	------	559	559
Carbon	------	1	1	------	615	615
Converse	------	2	2	------	1,501	1,501
Hot Springs	3	------	3	9	------	9
Lincoln	------	2	2	------	1,459	1,459
Sheridan	------	2	2	------	346	346
Sweetwater	1	------	1	113	------	113
Total	4	8	12	122	4,480	4,602

[1] Excludes mines producing less than 1,000 short tons.
[2] Data may not add to totals shown because of independent rounding.

supply because of the use of air-cooled condensers.

At Lake DeSmet, Reynolds Mining Co. began constructing improved water-storage and diversion facilities, scheduled for completion by the end of 1970. The company acquired coal and water rights in the area for future development. Evaluation of coal properties has been in progress for several years.

Natural Gas.—Marketed natural gas reached 303.5 billion cubic feet, an increase of 22 percent over the figure for 1968. The 297.6 billion cubic feet produced in 1969, according to the Wyoming State Board of Equalization, continued the record-setting pace of natural gas production. Forty-nine fields each yielded over 1 billion cubic feet of gas. The Big Piney-LaBarge area, which includes 16 fields, again led with 76.5 billion cubic feet, 25.7 percent of the State output. Next leading source was the five-field Patrick Draw-Desert Springs area with 39.1 billion cubic feet. Other leaders were Elk Basin, 17.9 billion cubic feet; Beaver Creek, 16.9 billion cubic feet; Worland, 14.4 billion cubic feet; and Table Rock, 10.4 billion cubic feet.

Seven gas discoveries were reported during the year, one less than in 1968: three in Sweetwater County, two in Fremont County, and one each in Campbell and Carbon Counties.

The most significant discovery was the Higgins field by Davis Oil Co. Davis Oil's No. 1 Higgins-Federal, SE SW sec 2, T 17 N, R 99 W, Sweetwater County, was completed in the Almond formation (Cretaceous) as a shut-in gas well after a production test showed a potential of 56 million cubic feet from the 6,714 to 6,979-foot interval.

Other significant discoveries were the Leucite Hills and Shoshoni fields. The Leucite Hills field discovery well, No. 1 Leucite Hills Unit, NW SE sec 29, T 22 N, R 103 W, Sweetwater County, was drilled by Mountain Fuel Supply Co. with an initial daily production of 7 million cubic feet from the Dakota formation (Cretaceous) at the interval 7,277 to 7,293 feet. Diamond Shamrock Co. found Fort Union (Tertiary) gas production at the No. 1 Shoshoni Unit, NW SE sec 21, T 38 N, R 93 W, Fremont County. The Shoshoni field discovery was completed, and gas flows at a rate of 4.8 million cubic feet daily from the interval 10,348 to 10,485 feet.

Work is underway at two nuclear-stimulation projects in Sublette County: one in Merna field, the other in Pinedale field. The Merna field evaluation well, A–1 Wasp, NE SW sec 28, T 36 N, R 112 W, for Project Wasp, was drilled by International Nuclear Corp. to 14,363 feet and then shut in for study of the sand conditions. The Pinedale field evaluation well, No. 1 Wagon Wheel, SE NW sec 5, T 30 N, R 108 W, for Project Wagon Wheel, being drilled by El Paso Natural Gas Co. to 19,000 feet, will test the Blair formation (upper Cretaceous).

Construction of two natural gas pipelines was begun during the year, one by McCulloch Gas Transmission Co. and the other by Montana-Dakota Utilities. McCulloch Gas Transmission began constructing a new 60-mile line from Kitty Field in Campbell County to Billy Creek field in Johnson County. This line will deliver 43.8 billion cubic feet of natural gas over a 20-year period to Northern Utilities. Montana-Dakota Utilities Co. was authorized by the Federal Power Commission to build a pipeline from the McCulloch Oil Corp. gas plant in Ute field to existing lines in Montana.

Natural Gas Liquids.—Natural gas liquids output increased 11.2 percent to 6.95 million barrels; value increased only 4 percent to $14.1 million. Production of liquid petroleum gas and natural gasoline was up by 511,000 and 192,000 barrels, respectively. Average monthly output of the gas plants was 22.8 billion cubic feet, up 929.8 million cubic feet.

Work on nine gasoline plants was either planned or under construction during the year. Two plants, Atlantic Richfield Co's Kitty field plant and McCulloch Oil Corp.'s Gas Draw field plant, went on stream during 1969. Atlantic Richfield's plant went on stream in March with an average monthly intake of 118.5 million cubic feet of gas. McCulloch's plant went on stream in October with an average monthly intake of 97.6 million cubic feet of gas. At yearend, McCulloch was planning to expand the plant.

McCulloch Oil Corp. had four other plants in various stages of construction during 1969. The Oedekoven and Ute field plants are to go on stream in January 1970; the Hilight and Kitty field plants later in 1970. Because the Oedekoven plant will also receive natural gas

from Collums and Southeast Recluse fields, McCulloch is already planning to enlarge the plant.

N. C. Ginther, operator of the Rozet field plant, plans to lay a 6-inch pipeline from the plant to Springen Ranch field. Natural gas from the field is to be on stream in the summer of 1970.

Phillips Petroleum Co. and Panhandle Eastern Pipe Line Co. are planning to build a plant at Douglas, Wyo., and process natural gas from the Hilight field.

Two gas plants, Garland field and Salt Creek field, were shut down during the year. Chem-Gas Products Co. shut down the Garland field plant in July after operating since March 1964; Pan American Petroleum Corp. shut down the Salt Creek field plant in October after operating since May 1958.

Chem-Gas Products Co. put its Worland field sulfur-extraction plant on stream in July 1969. Average monthly production was 139 long tons of sulfur and no natural gas liquids.

Oil Shale.—Construction of a 150-ton-batch retort was completed late in 1969 at the Bureau of Mines Laramie Energy Research Center. A trial run to check retort equipment and operations was made at yearend.

At the Center's Rock Springs, Wyo., site, an in situ oil shale retorting experiment was conducted in a shallow bed of Green River oil shale. Eleven wells were included in the experiment, the center well being the point of ignition. Although daily production rates of 4½ barrels of oil were recorded, little is known about the recovery efficiency.

Petroleum.—Crude petroleum production of 154.9 million barrels, the most since 1961, was 7 percent above 1968 production; value increased 14 percent. The increase was primarily because of successful exploration and development drilling in the Powder River basin.

According to State records, 27 fields yielded a million or more barrels of oil during the year, accounting for 107.4 million barrels or 69.3 percent of the total production. This year's ranking of the top five fields has changed from 1968. In descending order they were Elk Basin, Park County—15 million barrels; Oregon Basin, Park County—14.6 million barrels (third in 1968); Salt Creek, Natrona County—13.2 million barrels (second in 1968); Hamilton Dome, Hot Springs County—5.4 million barrels; and Lost Soldier, Sweetwater County—5.2 million barrels (not in the top five in 1968). Field development in Campbell County of the Powder River basin increased markedly: Five fields were added to the million-barrel category, bringing the county total to eight fields.

The nine refineries in the State processed 46.4 million barrels of crude petroleum: 45.3 million barrels were from intrastate; 1.1 million barrels were from interstate sources. Wyoming crude petroleum shipped out of State totaled 120.6 million barrels; 33.6 million barrels went to Indiana, 16.5 million barrels to Montana, 13.9 million barrels to Kansas, 12.2 million barrels to Utah, and 10.7 million barrels to Illinois. Daily throughput for the nine refineries increased slightly (2.9 percent) to 136,730 barrels.[4]

Empire Oil Co. announced the closing of its Thermopolis refinery as soon as current commitments were fulfilled. The plant has 20 employees and a daily maximum capacity of 5,000 barrels of crude oil.

According to the American Petroleum Institute and the American Gas Association,[5] oil reserve estimates as of January 1, 1970, gave total proved reserves of 996.6 million barrels, a decline of 104.7 million barrels. Changes because of extensions and revisions added 24.9 million barrels; new fields and production zones added 21.6 million barrels; while production during the year amounted to 151.2 million barrels.

With 1,562 wells drilled, a drilling record was set in the State for the second consecutive year, 306 or 24 percent more than in 1968, and about 35 percent of all wells drilled in the Rockies. Exploratory drilling increased by 32 wells with a new record of 552 wells. Development drilling increased by 36 percent, compared with 48 percent in 1968. Footage drilled also recorded a new high: Average well depth was 6,381 feet, an increase of 152 feet over the 1968 average. The wildcat success ratio was 9.4 percent: There were 45 oil and seven gas discoveries.

Accounting for 48.5 percent of the wells drilled in the State, drilling in Campbell County increased 38 percent. The wildcat success ratio in the county was 14.6 per-

[4] Oil and Gas Journal. V. 68, No. 14, Apr. 6, 1970, p. 116.
[5] Oil and Gas Journal. V. 68, No. 15, Apr. 13, 1970, p. 44.

Table 6.—Oil and gas well drilling, by counties

County	Oil	Gas	Dry	Total	Footage
1968:					
Exploratory completions:					
Albany	---	--	2	2	2,182
Big Horn	---	--	5	5	35,001
Campbell	25	1	218	244	1,927,926
Carbon	---	4	16	20	110,086
Converse	2	--	11	13	80,708
Crook	2	--	56	58	194,256
Fremont	2	1	19	22	113,876
Goshen	---	--	12	12	75,790
Hot Springs	---	--	9	9	41,309
Johnson	---	--	5	5	32,799
Laramie	---	--	13	13	108,660
Lincoln	---	--	1	1	5,877
Natrona	1	--	31	32	170,700
Niobrara	---	--	14	14	89,565
Park	---	--	9	9	49,106
Sheridan	2	--	11	13	119,181
Sublette	1	--	3	4	13,009
Sweetwater	---	1	19	20	96,184
Uinta	---	1	2	3	48,761
Washakie	2	--	9	11	85,134
Weston	1	--	9	10	59,199
Total	38	8	474	520	3,459,309
Development completions:					
Albany	1	--	---	1	5,968
Big Horn	24	--	7	31	104,799
Campbell	196	2	108	306	2,377,010
Carbon	---	12	4	16	76,761
Converse	5	1	5	11	75,354
Crook	8	--	7	15	64,405
Fremont	23	6	14	43	178,760
Hot Springs	3	--	1	4	16,661
Johnson	1	--	---	1	9,150
Laramie	1	--	4	5	38,786
Lincoln	---	2	---	2	8,703
Natrona	47	2	10	59	167,411
Niobrara	1	--	2	3	11,742
Park	54	--	5	59	250,926
Sheridan	4	--	---	4	32,895
Sublette	6	9	4	19	98,147
Sweetwater	44	7	9	60	338,506
Washakie	23	--	6	29	284,217
Weston	36	1	31	68	224,651
Total	477	42	217	736	4,364,852
Total all drilling	515	50	691	1,256	7,824,161

County	Oil	Gas	Dry	Total	Footage
1969:					
Exploratory completions:					
Albany	---	--	1	1	1,705
Big Horn	2	--	17	19	83,220
Campbell	28	1	170	199	1,560,433
Carbon	---	1	7	8	65,978
Converse	4	--	20	24	195,196
Crook	1	--	30	31	133,706
Fremont	1	2	17	20	96,371
Goshen	---	--	28	28	161,762
Hot Springs	1	--	5	6	32,450
Johnson	1	--	8	9	57,650
Laramie	1	--	27	28	224,521
Lincoln	1	--	3	4	22,791
Natrona	1	--	44	45	221,193
Niobrara	---	--	31	31	162,940
Park	---	--	13	13	69,231
Platte	---	--	5	5	14,638
Sheridan	---	--	16	16	149,840
Sublette	1	--	20	21	98,524
Sweetwater	---	3	12	15	89,425
Teton	---	--	1	1	9,148
Uinta	---	--	3	3	26,590
Washakie	2	--	15	17	123,820
Weston	1	--	7	8	35,798
Total	45	7	500	552	3,636,930
Development completions:					
Albany	---	--	1	1	6,940
Big Horn	21	1	15	37	94,701
Campbell	385	5	169	559	4,264,382
Carbon	1	6	1	8	45,801
Converse	5	--	9	14	104,203
Crook	8	--	9	17	115,199
Fremont	37	4	10	51	184,547
Hot Springs	5	--	4	9	16,586
Johnson	5	--	2	7	28,260
Laramie	---	--	3	3	23,114
Lincoln	1	3	4	8	39,229
Natrona	39	2	10	51	219,079
Niobrara	3	--	3	6	24,624
Park	44	--	5	49	135,941
Sheridan	3	--	3	6	47,307
Sublette	20	15	19	54	271,537
Sweetwater	11	7	6	24	109,944
Uinta	---	--	1	1	15,771
Washakie	27	--	7	34	348,550
Weston	43	--	28	71	233,899
Total	658	43	309	1,010	6,329,614
Total all drilling	703	50	809	1,562	9,966,544

Source: Adapted from Petroleum Information Corp., 1968 and 1969 Résumés, Oil and Gas Operations in the Rocky Mountain Region.

Table 7.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1968	1969	Principal fields in 1969 in order of production
Albany	424	347	Quealy Dome.
Big Horn	8,012	7,426	Garland, Byron, Torchlight, Bonanza, Sage Creek.
Campbell	19,326	34,541	Recluse, Kitty, Ute, Gas Draw, Hilight.
Carbon	2,544	2,377	Wertz, Rock River.
Converse	3,740	3,635	Glenrock South, Big Muddy, Cole Creek South, Flat Top.
Crook	4,144	4,139	Coyote Creek, Wood, Donkey Creek, Moorcroft West.
Fremont	11,295	10,511	Winkleman, Steamboat Butte, Beaver Creek, Big Sand Draw.
Goshen	5	7	Torrington.
Hot Springs	16,102	15,668	Hamilton Dome, Grass Creek, Little Buffalo, Murphy Dome.
Johnson	5,949	5,195	Sussex, Meadow Creek, North Fork, Sussex West-Dugout, Reno.
Laramie	680	463	Golden Prairie, Horse Creek.
Natrona	18,474	17,147	Salt Creek, Cole Creek, Poison Spider West, Grieve.
Niobrara	646	595	Lance Creek.
Park	35,912	34,598	Elk Basin, Oregon Basin, Frannie, Pitchfork.
Sheridan	428	554	Ash Creek South, Fence Creek, Ash Creek.
Sublette	3,915	4,640	Hogsback, Big Piney Shallow, Birch Creek, McDonald Draw, Green River Bend.
Sweetwater	7,590	7,934	Lost Soldier, Patrick Draw, Arch Unit.
Uinta	[1] 55	[1] 50	Church Buttes.
Washakie	2,064	2,396	Cottonwood Creek, No Water Creek, Rattlesnake, Hidden Dome.
Weston	2,945	2,722	Osage, Fiddler Creek, Skull Creek, Mush Creek.
Total	144,250	154,945	

[1] Represents 90 percent of production from Church Buttes field; remainder of production included in Sweetwater County.

Source: Wyoming Ad Valorem Tax Division, State Board of Equalization.

Table 8.—Principal oil and gas discoveries in 1969

County and field	Well	Operator	Location			Producing formation	Total depth (feet)	Initial production		Remarks
			Section	Township	Range			Barrels of oil per day	Thousand cubic feet of gas per day	
Big Horn:										
Homestead	No. 23-26 Beall	Sierra Trading Co.-Rapp Oil Co.	26	57 N	97 W	Tensleep	4,450	170	-----	Pumping.
Campbell:										
Payne	No. 1 Thornburg	Champlin Petroleum Co	14	42 N	70 W	Sussex	10,340	211	-----	Do.
Payne, North	No. 1 Federal	Woods Petroleum Corp	34	43 N	70 W	----do-----	7,373	185	-----	Flowing.
Grady, South	No. 1 Kenwood-Federal	Sun Oil Co	3	45 N	71 W	Muddy	9,844	195	-----	Pumping.
Hilight	No. 1 Isenberger et al	International Nuclear Corp.-Royal Resources Corp.-Felmont Oil Corp.	26	45 N	71 W	----do-----	10,028	1,008	-----	Flowing.
Jayson	No. 1 Deaver-Federal	Woods Petroleum Corp	15	46 N	70 W	----do-----	8,905	78	-----	Do.
Grady	No. 1 Grady et al	International Nuclear Corp	28	46 N	71 W	----do-----	11,028	487	-----	Do.
Tholson	No. 1 Tholson	W. B. Osborn, Jr.-Petroleum, Inc.	2	49 N	70 W	Minnelusa	8,966	349	-----	Pumping.
S-Bar	No. 1 Wyoming	Midwest Oil Corp	16	49 N	73 W	Muddy	9,660	175	-----	Do.
Lazy B	No. 2 Barlow-A	Anschutz Oil Corp., Inc	12	49 N	74 W	----do-----	9,790	224	-----	Do.
Mill	No. 1 Miller	Davis Oil Co	15	50 N	72 W	----do-----	8,300	140	-----	Do.
Springen Ranch	No. 1 Tanner	Pan American Petroleum Corp.	25	51 N	71 W	Minnelusa	9,310	180	-----	Pumping. New Pay.
Thomas	No. 1 Thomas-Federal	Davis Oil Co.-Midwest Oil Corp.	7	52 N	73 W	Muddy	8,459	133	-----	Pumping.
Apostolos	No. 1 Apostolos-Federal	Davis Oil Co.-National Cooperative Refinery Association-Midwest Oil Corp.	17	52 N	73 W	----do-----	8,355	231	-----	Flowing.
Wildcat	No. 1 Government-Chevron.	Anderson Oil Co	4	53 N	72 W	----do-----	7,150	1,344	-----	Flowing. Combined with Gas Draw.
Carson	No. 1 Government-Sims	Texaco Inc	18	54 N	73 W	----do-----	9,702	330	-----	Flowing.
Pinnacle	No. 1 Jones-Federal	National Cooperative Refinery Association.	10	55 N	72 W	----do-----	6,959	454	-----	Pumping.
Rogers	No. 1 Rogers-Federal	Davis Oil Co	31	55 N	72 W	----do-----	7,250	383	-----	Do.
Collums	No. 1 Collums-Federal	----do	14	55 N	73 W	----do-----	7,555	473	-----	Flowing.
Oedekoven	No. 1 Oedekoven-A Tract 45.	Anschutz Corp.-Petroleum, Inc.-Phillips Petroleum Co.	30	55 N	73 W	----do-----	7,796	1,263	-----	Do.
Store	No. 1 Oedekoven-E Lot 1	Anschutz Corp	13	55 N	74 W	----do-----	7,865	168	-----	Do.
Rocky Point	No. 1 State	Love Oil Co	4	56 N	69 W	----do-----	3,875	300	-----	Flowing. New pool.
Chan, Southeast	No. 1-27 Snoddy	Clyde G. Kissinger-Pan American Petroleum Corp.	27	56 N	73 W	----do-----	7,388	216	-----	Flowing.
Border	No. 1 Goodstein-MKM Government.	Goodstein Oil & Gas Co	35	58 N	73 W	----do-----	6,947	148	-----	Pumping.

Table 8.—Principal oil and gas discoveries in 1969—Continued

County and field	Well	Operator	Location			Producing formation	Total depth (feet)	Initial production		Remarks
			Section	Township	Range			Barrels of oil per day	Thousand cubic feet of gas per day	
Converse:										
Kaye	No. 1 Government-Kaye	International Nuclear Corp.-King Resources Co.	4	36 N	67 W	Teapot	9,782	288	-----	Do.
Carter	No. 1 Government-Carter	International Nuclear Corp.	1	37 N	68 W	Turner	10,140	454	-----	Flowing.
Crook:										
Kummerfeld	No. 1 Goodstein-Mobil-Government.	Goodstein Oil & Gas Co.	29	51 N	68 W	Minnelusa	7,705	350	-----	Pumping. New pay.
Fremont:										
Riverton	No. 1 Tribal	R. E. Hudson-Lawrence Materi.	30	1 S	5 E	Wind River	2,742	164	-----	Flowing. New pay.
Shoshoni	No. 1 Shoshoni Unit	Diamond Shamrock Oil and Gas Co.	21	38 N	93 W	Ft. Union	11,744	-----	4,750	Flowing.
Sublette:										
Ruben	No. 1 Ruben-Government	Chandler & Associates, Inc.	24	30 N	113 W	Almy	3,570	250	-----	Do.
Sweetwater:										
Higgins	No. 1 Higgins-Federal	Davis Oil Co.	2	17 N	99 W	Almond	7,052	-----	56,000	Do.
Stage Stop	No. 7 Stage Stop Unit	El Paso Oil & Gas Co.	24	18 N	99 W	----do-----	6,761	-----	2,875	Flowing. New pay.
Leucite Hills	No. 1 Leucite Hills Unit	Mountain Fuel Supply Co.	29	22 N	103 W	Dakota	8,160	-----	7,016	Flowing.
Washakie:										
Tuffy	No. 1 Tuffy-Federal	Tenneco Oil Co.	13	45 N	92 W	Phosphoria	11,082	207	-----	Pumping.
Banjo Flats	No. 1 Caster-Federal	----do-----	10	46 N	92 W	do-----	10,988	350	-----	Do.
Weston:										
Mush Creek	No. 1-36 State	Sierra Trading Co.	36	45 N	64 W	Greenhorn	3,756	110	-----	Pumping. New pay.

Source: Petroleum Information Corp., 1969 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

cent. Second in wildcat activity was Natrona County with 44 dry holes and one discovery.

Development drilling was at a record-setting pace; many fields had very successful infield drilling programs. Kitty field had the most successful—93 of 105 wells completed as producing wells from the Muddy sand. Another strong program was in Ute field where 61 of 82 wells produced from the Muddy sand. In the Gas Draw field, the program resulted in 47 productive wells of 62 drilled. In southwestern Wyoming development drilling resulted in 15 successful wells out of 17 completions. Rattlesnake field in Washaki County had producers in 13 of 14 wells drilled.

Because of the continued interest in the Muddy formation in the Powder River basin—site of the most significant discoveries—this area was the most active in the Rocky Mountain region.

The Hilight field discovery well, 35 miles southeast of Kitty field, was completed in February by Inexco Oil Co. (formerly International Nuclear Corp.), Felmont Oil Corp., and Royal Resources Corp. The discovery well, No. 1 Isenberger, SE SW sec 26, T 45 N, R 71 W, Campbell County, flowed 1,008 barrels of oil daily from the Muddy sand at 9,575 to 9,578 feet. During 1969, the well yielded 174,000 barrels of oil and 200 million cubic feet of gas; in December it had a daily flow rate of 650 barrels of oil. Field development is on 160-acre spacing; no dry holes were reported in the more than 40 wells drilled. This discovery is significant because it moved the Muddy exploration into the deeper and sparsely drilled portion of the Powder River basin.

Collums field was discovered in February by Davis Oil Co., one of the more active operators in the Powder River basin. The discovery well, No. 1 Collums Federal, SW SE sec 14, T 55 N, R 73 W, Campbell County, flowed 473 barrels of oil and 5 barrels of water daily from the Muddy sand at 7,168 to 7,180 feet. Development drilling resulted in 37 of 45 successful wells. The field yielded 1.3 million barrels of oil in 1969, with a daily production of 4,740 barrels in December.

Jayson field, about 7 miles northeast of Hilight field, was discovered by Woods Petroleum Corp. in November. The discovery well, No. 1 Deaver-Federal, SW SW sec 15, T 46 N, R 70 W, Campbell County, flowed 78 barrels of oil on a 21-hour test from the Muddy sand at 8,609 to 8,618 feet. Woods had staked five offset wells and was drilling a west offset at the end of the year.

Although Muddy exploration was most predominant in the Powder River basin, Minnelusa (Pennsylvanian) exploration was still of interest. W. B. Osborn, Jr., and Petroleum, Inc., discovered the Tholson field in October. The discovery well, No. 1 Tholson, SW NE sec 2, T 49 N, R 70 W, Campbell County, pumped 349 barrels of oil daily from the Minnelusa formation at 8,754 to 8,784 feet. Closest Minnelusa production is from the Halverson field, 2 miles east, and the south Rozet field, 3 miles north.

In the southwestern portion of the State, Chandler and Associates discovered the Ruben field in January. The discovery well, No. 1 Ruben-Govt. SW NE sec 24, T 30 N, R 113 W, Sublette County, flowed 250 barrels of oil daily from the Almy sand (Tertiary) at 3,266 to 3,504 feet. In December the field yielded 57,900 barrels of oil, with a cumulative production of 608,556 barrels.

With the successful completion of the No. 1 Caster-Federal in April, Tenneco Oil Co. discovered the Banjo Flats field. The discovery well, SE SE sec 10, T 46 N, R 92 W, Washakie County, pumped 350 barrels of oil and 102 barrels of water daily from the Phosphoria formation (Permian) at 10,843 to 10,947 feet. A northwest offset was completed as a producer in July.

Although deep drilling was not as prevalent as in 1968, four deep tests, two in Uinta County and one each in Converse and Sweetwater Counties, were drilled during the year. Marathon Oil Co.'s No. 1 Albert Creek Unit, SW SE sec 36, T 18 N, R 117 W, Uinta County—the second deepest well drilled in the Rockies—was drilled to 19,817 feet. The Nugget formation (Jurassic-Triassic) was cored below 19,598 feet with no oil shows. In Sweetwater County, Forest Oil Corp. drilled the No.1—22—I Jessen Butte Unit, NW NE sec 22, T 12 N, R 110 W, to 18,489 feet with oil shows in the Dakota formation (Cretaceous).

For the second consecutive year in the Rockies, Federal leaseholds increased, with Wyoming having the largest increase. At the end of 1969, because of the high level of drilling activity, Wyoming had 21.74 million acres under lease, an increase of

1.44 million acres. This represents about one-third of the State.

To increase the oil recovery in some of the existing fields, 22 water-injection projects were begun during the year. Eight of the projects were in new fields; 14 were expansions of existing projects with eight of the 14 in Osage field.

Belle Fourche Pipeline Co. was awarded approval by the Public Service Commission of Wyoming to construct a 28-mile pipeline in Campbell County. At a cost of $400,000, the pipeline will begin in the Gas Draw-Recluse field and terminate at existing facilities in the Rozet field. The purpose of this line is to increase the capacity of existing facilities.

NONMETALS

Value of nonmetals comprised 12 percent of the State's mineral output, increasing from $69.8 million in 1968 to $78.3 million in 1969. Most of the additional value can be credited to sodium carbonate; increases, however, were also recorded for clays, gem stones, pumice, sodium sulfate, and stone. Value of cement, feldspar, gypsum, lime, phosphate rock, and sand and gravel declined.

Cement.—Monolith Portland Midwest Co., subsidiary of Monolith Portland Cement Co., was the only producer of masonry and portland cement. Decreased construction in the region caused a 20-percent decline in masonry cement production; value dropped 26 percent. Portland cement production slipped 8 percent and value 6 percent for the same reason.

During September the company placed a new, highly automated finish grinding mill in operation at Laramie. The $654,000 installation was designed to increase efficiency and offset rising costs. In addition, the company investigated alternatives for the abatement of dust emissions.

Clays.—Clay production increased 9 percent to 2 million tons; value increased 10 percent to $19 million. Bentonite continued to be produced in larger quantities than miscellaneous clays. The State continued to produce most of the Nation's bentonite supply. Eight of the 10 clay-producing companies in the State mined bentonite from mines in Big Horn, Crook, Johnson, Natrona, and Weston Counties. Other clays were mined from single operations in Big Horn and Uinta Counties.

Major markets for bentonite, in order of importance, were iron ore pelletizing, rotary drilling, and foundry usage. The order of market importance for the first two was reversed from 1968 when rotary drilling was first and iron ore pelletizing was second.

During the year, Wyo-Ben Products, Inc., purchased about 15 acres west of Lovell for the construction of a new bentonite plant. Construction, begun in 1969, is scheduled for completion in the fall of 1970. The plant was designed with a capacity of 300,000 tons per year. Output will be mainly for the taconite pelletizing industry.

American Colloid Co. was expanding its bentonite plant east of Lovell by installing a rotary dryer and another mill to double the size of the facility. Completion is scheduled for March 1970.

In a project underway since 1967, Benton Clay Co., Inc., Division, Georgia Kaolin Co., installed dust-collection equipment at the Mills plant; about $80,000 was spent on the facilities. A new packing and conveying system was also installed in 1969 at a cost of approximately $35,000.

Feldspar.—Both companies that formerly produced feldspar from Albany and Natrona Counties were inactive in 1969. Another firm, Northwestern Feldspar Corp., constructed a $400,000 mill at Bonneville in Fremont County. The mill will process ores from company mines on Copper Mountain north of Bonneville. Ores were stockpiled during most of the year while the mill was being constructed; late in 1969 the mill made trial runs and produced test shipments.

Gypsum.—Although small gains were registered in gypsum output, prices dropped substantially. Production increased 4 percent, whereas value decreased 18 percent.

A new producer, Wyo-Ben Products Co., began operations near Greybull in Big Horn County, producing gypsum for agricultural use and for cement production in Montana. The small increase in State output was due primarily to output from this new plant.

Other producers were Monolith Portland Midwest Co. in Albany County; Georgia-Pacific Corp., Gypsum Division, in Big Horn County; and Big Horn Gypsum Co. in Park County.

Lime.—Production of lime decreased 4 percent; revenue decreased slightly. Output of high calcium quicklime was 26,635 tons.

Quicklime was produced and used at beet-sugar refineries at Lovell, Torrington, and Worland. The Great Western Sugar Co., a subsidiary of Great Western United Corp., owns the Lovell plant; the other two are owned by Holly Sugar Corp. During the year, plans for continued modernization and year-round utilization of plant facilities were investigated.

Phosphate Rock.—Production and value of phosphate again declined at the State's single source, the Leefe mine in Lincoln County, owned by Stauffer Chemical Co. The mine, along with the processing plant at Sage, was formerly operated as San Francisco Chemical Co. A 23-percent decline in output and value was recorded for the third year of downtrend. The company's plant treated ores from Utah as well as Wyoming. Much of the production, mainly phosphoric acid, was exported.

Pumice.—Pumicite was mined by LaRue Axtell Pumice Co. in Sweetwater County about 30 miles west of Rawlins. The ore was shipped to the company plant at Callaway, Nebr., for use in abrasives.

Sand and Gravel.—In spite of a 19-percent decline in output to 7.6 million tons valued at $7.3 million, sand and gravel remained third in value among nonmetals. Average price remained near the 1968 level of 96 cents per ton, thus checking the downward price trend that began in 1966 when the average was $1.04 per ton.

Production was reported from 178 operations in all 24 counties. Although only 161 operations were active in 1968, they produced more tonnage than those in 1969. Reports were obtained from 92 commercial operations and 86 Government-and-contractor operations. After processing (washing, crushing, or screening), 7,076,000 tons of sand and gravel was utilized. The remainder of the State total (492,000 tons) was used as pit run.

Counties that yielded the largest production, in decreasing order, were Sweetwater, Carbon, Natrona, Fremont, and Johnson.

The Interstate System in Wyoming, according to the Federal Highway Administration report for the year ending December 31, 1969, had 655.27 miles completed out of a total of 913.64 miles. At yearend, 99.90 miles were under construction; 61.49 miles were designated as engineering or right-of-way; and 70.39 miles were in preliminary status or not yet in progress.[6]

[6] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program. Dec. 31, 1969. Press Release FHWA-422, Feb. 9, 1970.

Table 9.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1968		1969	
	Quantity	Value	Quantity	Value
Albany	1,054	$802	573	$422
Big Horn	54	67	44	46
Campbell	W	W	212	195
Carbon	631	648	834	838
Converse	12	7	122	118
Crook	81	113	113	102
Fremont	615	732	728	629
Goshen	W	W	339	333
Hot Springs	24	27	50	54
Johnson	779	814	609	597
Laramie	364	289	454	416
Lincoln	162	125	357	359
Natrona	442	528	662	752
Niobrara	196	193	78	64
Park	773	855	400	412
Platte	181	181	263	249
Sheridan	580	652	183	194
Sublette	219	272	106	67
Sweetwater	609	590	879	873
Teton	120	137	74	84
Uinta	435	429	10	10
Washakie	1,407	796	138	138
Weston	78	78	197	185
Yellowstone National Park	28	37	144	151
Undistributed	506	601	-----	-----
Total [1]	9,350	8,973	7,568	7,288

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Data may not add to totals shown because of independent rounding.

Table 10.—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	1968		1969	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	189	$259	162	$251
Paving	113	173	130	165
Fill	16	20	74	80
Other	4	5	-----	-----
Total [1]	322	457	366	497
Gravel:				
Construction:				
Building	198	280	220	354
Paving	2,240	2,530	2,521	2,210
Railroad ballast	446	162	295	110
Fill	1,289	660	51	38
Other	5	6	-----	-----
Miscellaneous	81	94	38	34
Total [1]	4,259	3,732	3,126	2,746
Total sand and gravel	4,581	4,189	3,492	3,243
Government-and-contractor operations:				
Sand:				
Building	1	3	(2)	(2)
Paving	1,952	1,948	1,696	1,688
Fill	-----	-----	1	1
Total [1]	1,953	1,951	1,697	1,690
Gravel:				
Building	3	5	(2)	(2)
Paving	2,783	2,800	2,373	2,351
Fill	30	28	6	4
Total	2,816	2,833	2,379	2,355
Total sand and gravel	4,769	4,784	4,076	4,045
All operations:				
Sand	2,275	2,408	2,063	2,187
Gravel	7,075	6,565	5,505	5,101
Total	9,350	8,973	7,568	7,288

[1] Data may not add to totals shown because of independent rounding.
[2] Less than ½ unit.

Sodium Carbonate.—Wyoming's most valuable nonmetal, sodium carbonate processed from trona, continued to increase in production and revenue—tonnage increased 27 percent and revenue 26 percent. Three companies, Allied Chemical Corp., FMC Corp., and Stauffer Chemical Company of Wyoming, a subsidiary of Stauffer Chemical Co., now produce the State's total yield from the area around Green River in Sweetwater County. Major market for soda ash was in the manufacture of glass; other uses were in detergents, pulp and paper, chemicals, and water treatment.

Activity in development and expansion was high throughout the year. During January, Allied Chemical Corp.'s new $25 million mining and processing complex, completed in late 1968, reached full capacity. This output, added to other production, made the company the largest soda ash producer in the country.

Church & Dwight Co., Inc., dedicated its bicarbonate of soda producing plant in September. The new facility utilizes part of production from Allied Chemical Corp.

FMC Corp., the State's largest and oldest producer, disclosed plans to sink a fourth shaft. The $5 million project will be the first step in another expansion program.

Stauffer Chemical began its fifth expansion since starting operations in 1962. Annual capacity of 800,000 tons was scheduled to be increased to 950,000 tons by June 1970.

Texas Gulf Sulphur Co. completed sinking a 16-foot-diameter shaft to 1,500 feet on its trona deposits near Green River. A

development program will continue into 1970.

Sodium Sulfate.—Pratt Sodium Co. shipped 8 percent less sodium sulfate; value, however, increased 7 percent. Output was from saline-lake deposits in Natrona County.

Stone.—For the second year increases occurred in quantity and value of stone shipments. Shipments were up 10 percent to 1.6 million tons, and value was up 9 percent to $3.0 million; 39 quarries were operated in 20 counties. Only Converse, Hot Springs, Niobrara Counties, and Yellowstone National Park did not register stone production. Crushed and broken stone was produced by 38 operators. Leading uses, in desending order, were railroad ballast, road material, and limestone for cement. One quarry mined dimension stone; in Albany County approximately 400 tons of sandstone blocks was quarried and used by the University of Wyoming.

Laramie County led in quantity and value of output with 670,000 tons valued at $1.3 million. All operations were open pit.

Sulfur.—Seven companies recovered byproduct sulfur from the liquid purification of sour, hydrogen sulfide-bearing natural gas. Shipments of 45,695 long tons of sulfur were 5 percent less than in 1968; value of shipments, at $933,000, was also 3 percent less than that of the previous year. Production of elemental sulfur has declined since 1967; the decline, however, was not industry-wide.

Atlantic Richfield Co. did not produce from the Riverton Dome plant during 1969. Purvin & Gertz, Inc., now Chem-Gas Products Co., closed the Garland plant in Park County and opened the Rattlesnake plant north of Worland in Washakie County near the former Texas Gulf Sulphur Co. operation.

Recovery plants were operated during the year by Atlantic Richfield Co., formerly Sinclair Oil Corp., in Carbon County; Pan American Petroleum Corp. and Western Nuclear, Inc., in Fremont County; Husky Oil Co., Pan American Petroleum Corp., and Purvin & Gertz, Inc., in Park County; and Chem-Gas Products Co. in Washakie County.

The six plants operating at yearend used the Modified Claus recovery process.

Table 11.—Stone sold or used by producers, by county

County	1968		1969	
	Short tons	Value	Short tons	Value
Albany	W	W	W	W
Big Horn	---	---	67,500	$128,250
Campbell	---	---	589	1,119
Carbon	39,159	$103,472	195	371
Crook	3,100	6,200	75,999	115,945
Fremont	27,904	41,854	233	443
Goshen	405	608	829	1,575
Hot Springs	262	393	---	---
Johnson	1,072	1,608	726	1,379
Laramie	W	W	669,727	1,309,744
Lincoln	---	---	300	570
Natrona	188	282	393	747
Niobrara	304	456	---	---
Park	21,895	22,892	W	W
Platte	W	W	W	W
Sheridan	W	W	W	W
Sublette	---	---	354	673
Sweetwater	2,832	1,798	2,500	2,000
Teton	59,000	144,100	W	W
Uinta	---	---	3	6
Washakie	---	---	30	57
Weston	---	---	624	1,186
Yellowstone National Park	62,900	55,200	---	---
Undistributed	1,215,158	2,375,270	764,291	1,447,827
Total	1,434,179	2,754,133	1,584,293	3,011,892

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

METALS

Metals declined in value because of the lower price of uranium; individually, however, all other metals (copper, gold, iron ore, and silver) increased. Uranium and iron ore were the only two metals that contributed substantial revenue to the metal category. Copper, gold, and silver yielded only a negligible dollar volume.

Iron Ore.—Production of iron ore increased 4 percent, and value increased 7 percent. Shipments came from four operations: CF&I Steel Corp (CF&I) at the Sunrise mine in Platte County; Plicoflex, Inc., at the Chugwater mine in Albany County; Union Pacific Railroad Co., Natural Resources Division, at the Jean mine in Albany County; and United States Steel Corp. (USS) at the Atlantic City mine in Fremont County. Operations ceased at the Jean mine; shipments were made from stockpiles in 1969.

All mines are open pit and produce magnetite, except CF&I's Sunrise mine where hematite was mined primarily by block-caving methods. The Sunrise mine, the only underground iron mine west of the Missouri River, is also the oldest operating iron mine in the State.

USS's Atlantic City mine, the largest mine in the State, has shipped over 10 million tons of agglomerates during 7 years of operation.

Uranium.—Value of the energy mineral uranium was fourth among all minerals produced throughout the State, for a total of $40 million, a 9 percent ($4.0 million) decline from the 1968 value. The decline was due to a reduction in price as shipments increased by 13 percent (788,000 lbs.) to 6.7 million pounds. Uranium comprised 6.2 percent of the total mineral value produced in the State.

On a national basis, Wyoming was again ranked second in uranium production and value with 28 percent of the total United States output of 23.7 million pounds valued at $142.2 million.

The number of active mining operations was reduced from 40 to 37 in 1969. Of the total, 29 were in Fremont County; Carbon and Natrona Counties each had four operations.

According to AEC information, Wyoming, with 46 percent of the total footage drilled, again led all 14 western States active in uranium drilling. The 13.8 million feet drilled statewide was 15 percent above last year's record 12 million feet, resulting in new reserves of 82,300 tons, based on a price of $8 per pound.

Land leasing, exploration, and development continued at an accelerated rate. At the beginning of the year, uranium companies held nearly one-ninth of the State's total area, or 7 million acres. At yearend about one-sixth or 10.2 million acres was held.

Major oil companies continued to be active in property acquisitions. Phillips Petroleum Co. purchased 40,000 acres of Powder River basin claims from Century Nuclear, Inc. Mobil Oil Corp. made an agreement with General Nuclear, Inc., to explore 25,000 acres west of South Pass City. Getty Oil Co. purchased 12,000 acres in the Powder River basin from General Nuclear. Humble Oil & Refining Co. acquired approximately 9,000 acres from General Nuclear in the Far West Gas Hills area. Gulf Mineral Resources Co., a Gulf Oil Co. subsidiary, also purchased 176 uranium claims from General Nuclear in the Far West Gas Hills area. General Nuclear joined Cerro Corp. in exploring 5,000 acres west of Casper in the southeast part of the Wind River basin. Other companies were also active in uranium properties. W. R. Grace & Co. and Silver Bell Mines Co. signed an agreement covering exploration of approximately 18,000 acres of claims in the Red Desert-Crooks Gap area. National Resources Corp. acquired a 9,000-acre uranium lease in the South Powder River basin. Western Standard Uranium, Inc., obtained over 1,000 uranium claims in the Powder River basin.

The Gas Hills area remained the main source, with four of the State's five operating uranium mills located there. Gas Hills operators were Federal American Partners, Union Carbide Corp., Utah Construction & Mining Co., and Western Nuclear Corp. The fifth mill in the State, located in the Shirley basin was operated by Petrotomics Co. Other uranium processing developments were as follows: Kerr-McGee Corp. plans to construct a new mill in the Powder River basin; Petrotomics Co. will enlarge capacity of the Shirley Basin mill by 50 percent; and early in 1969, Utah Construction & Mining Co. started building a 1,200-ton-per-day mill at Shirley basin with an annual capacity of 2.3 millions of U_3O_8.

America's newest town, Shirley Basin, Wyo., came into being during 1969 because of uranium mining. The mobile home community was developed by Kerr-McGee Corp., Petrotomics Co., and Utah Construction & Mining Co. for their employees. The planned community should have a population of about 2,500 in 2 years.

Other major developments are expected because of recent discoveries in the southern Powder River basin.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Monolith Portland Midwest Co.	Box 65677, Glassell Station Los Angeles, Calif. 90065	Plant	Albany.
Clays:			
American Colloid Co	5100 Suffield Court Skokie, Ill. 60076	Open pit mine and plant	Big Horn.
		Open pit mine	Crook.
		Open pit mine and plant	Weston.
Ashland Chemical Co., Foundry Products Division.	Box 2458 Columbus, Ohio 43216	do	Crook.
		do	Weston.
Black Hills Bentonite Co	Box 1, Mills, Wyo. 82644	do	Johnson.
Dresser Industries, Inc., Dresser Minerals Division.	Box 6504 Houston, Tex. 77005	do	Big Horn.
International Minerals & Chemical Corp., Eastern Clay Products Dept.	Administration Center Old Orchard Road Skokie, Ill. 60079	15 open pit mines and plant.	Crook.
National Lead Co., Baroid Division.	Box 1675 Houston, Tex. 77001	Open pit mine and plant	Do.
		Open pit mine	Weston.
Wyo-Ben Products, Inc	Box 1979 Billings, Mont. 59103	Open pit mine and plant	Big Horn.
Coal:			
The Kemmerer Coal Co	Frontier, Wyo. 83121	2 strip mines, crushing and oil treatment plant.	Lincoln.
Pacific Power & Light Co	920 S.W. 6th Avenue Portland, Oreg. 97204	Strip mine	Converse.
Gypsum:			
Big Horn Gypsum Co	Box 590, Cody, Wyo. 82414	Open pit mine and wallboard plant.	Park.
Iron ore:			
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Underground mine and beneficiation mill.	Platte.
United States Steel Corp., Western Ore Operations.	Lander, Wyo. 82520	Open pit mine and agglomerator.	Fremont.
Lime:			
The Great Western Sugar Co.	Box 5308 Denver, Colo. 80217	Pot kiln at beet-sugar plant.	Big Horn.
Holly Sugar Corp	Holly Sugar Bldg. Colorado Springs, Colo. 80902	Shaft kiln at beet-sugar plant.	Goshen.
		do	Washakie.
Natural gas and petroleum: [1]			
Phosphate rock:			
Stauffer Chemical Company of Wyoming.	636 California Street San Francisco, Calif. 94119	Open pit mine and beneficiation plant.	Lincoln.
Sand and gravel (commercial):			
Boatright-Smith	Box 1129 Casper, Wyo. 82002	4 pits and plants	Natrona.
Casper Concrete Co	Box 561 Casper, Wyo. 82601	Pit, dredging operation, and 2 plants.	Natrona.
Gilpatrick Construction Co., Inc.	Box 973 Riverton, Wyo. 82501	Pit	Albany.
		2 pits and plants	Fremont.
		Pit	Niobrara.
		Pit	Platte.
		Pit	Sublette.
		Pit	Sweetwater.
		Pit	Washakie.
Teton Construction Co	Box 3243 Cheyenne, Wyo. 82001	Pit and plant	Campbell.
		Pit	Carbon.
		Pit	Johnson.
		Pit	Laramie.
		Pit	Sweetwater.
Union Pacific Railroad Co	1416 Dodge Street Omaho, Nebr. 68102	Pit	Albany.
Sodium carbonate:			
FMC Corp., Inorganic Chemicals Division.	Box 872 Green River, Wyo. 82935	Underground mine and refinery.	Sweetwater.
Stauffer Chemical Company of Wyoming.	Box 513 Green River, Wyo. 82935	do	Do.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone:			
The Great Western Sugar Co.	Box 5308 Denver, Colo. 80217	Quarry and plant	Laramie.
Guernsey Stone Co	Guernsey, Wyo. 82214	----do	Platte.
Monolith Portland Midwest Co.	Box 65677, Glassell Station Los Angeles, Calif. 90065	2 quarries and plants	Albany.
O. B. Forgey Construction Co.	Box 255 Casper, Wyo. 82601	Quarry and plant	Park.
Union Pacific Railroad Co.	1416 Dodge Street Omaho, Nebr. 68102	----do	Laramie.
Uranium:			
Federal American Partners.	Box 991 Riverton, Wyo. 82501	3 open pit mines and mill	Fremont.
Petrotomics Co	Drawer 2450 Casper, Wyo. 82601	Open pit mine and mill	Carbon.
Utah Construction & Mining Co.	Box 911 Riverton, Wyo. 82501	2 open pit mines, leaching operation.	Do.
		2 open pit mines, 2 underground mines, and mill.	Fremont.
Western Nuclear, Inc	1700 Broadway, Suite 1900 Denver, Colo. 80202	5 underground mines, 1 open pit mine, leaching operation, and mill.	Do.

[1] Most of the major oil and gas companies and many smaller companies operate in Wyoming, and several commercial directories contain complete lists of them.