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Minerals Yearbook 1967

Volume III

AREA REPORTS: DOMESTIC

Prepared by staff of the
BUREAU OF MINES

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

BUREAU OF MINES • John F. O'Leary, 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, covering calendar year 1967, marks the 86th year in which the Federal Government has issued, on an annual basis, a report on the U.S. mineral industry. In response to the desires of our readership, this 1967 edition has returned essentially to the Yearbook format in use prior to 1966, with some minor modifications. The general content of this edition follows:

Volume I–II, Metals, Minerals, and Fuels, contains all the chapters on the metal, nonmetal, and mineral fuel commodities that previously appeared in the separate *Volume I, Metals and Minerals,* and *Volume II, Mineral Fuels.* In addition, it includes a chapter reviewing these mineral industries, a statistical summary, and chapters on employment and injuries, and technologic trends. As in Yearbooks prior to 1966, text accompanies the statistical presentation. Some of the longer chapters have been redesigned so that the tabular presentation follows the text, rather than being interspersed throughout the text as in the past.

Volume III, Area Reports: Domestic, contains chapters covering 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. Volume III 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, which was not published in 1966, has been reinstated. This volume contains 85 chapters presenting 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 in the world economy.

The continuous effort of the Bureau of Mines to enhance the value of the Yearbook for its readership can be aided by comments and suggestions from its users; such comments are invited.

JOHN F. O'LEARY, *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 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 Minerals of the Alaska Department of Natural Resources.
Arizona: Arizona Bureau of Mines and Oil and Gas Conservation Commission.
Arkansas: Arkansas Geological Commission; Arkansas Oil and Gas Commission; Department of Revenue.

California: Department of Natural Resources, Division of Mines and Geology.
Colorado: The Oil and Gas Conservation Commission; Coal Mines Inspections Department; and the Colorado Bureau of Mines.
Connecticut: Geological and Natural History Survey.

Delaware: Delaware Geological Survey.

Florida: Geological Survey of Florida, Board of Conservation.

Georgia: Geological Survey of Georgia.

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: Geological Survey of Iowa.

Kansas: Conservation Division, State Corporation Commission; and State Geological Survey of Kansas.
Kentucky: Geological Survey of Kentucky.

Louisiana: Louisiana Geological Survey; Louisiana Department of Conservation; Department of Labor, Division of Employment Security; and Department of Commerce and Industry.

Maine: Geological Survey of Maine, Department of Economic Development.
Maryland: Maryland Geological Survey.
Michigan: Geological Survey Division of the Michigan Department of Conservation.
Minnesota: Minnesota Geological Survey.
Mississippi: Mississippi Geological Survey, Mississippi State Oil Gas Board; Oil and Gas Severance Tax Division, Mississippi State Tax Commission; and Mississippi Employment Security Commission.
Missouri: Division of Geological Survey and Water Resources, Department of Business Administration.
Montana: Montana Bureau of Mines and Geology, The Oil and Gas Conservation Commission.

Nebraska: Nebraska Geological Survey; and 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 Conservation Commission.
New York: Geological Survey—New York State Museum and Science Service.
North Carolina: Geological Survey of North Carolina.
North Dakota: State Geological Survey of North Dakota.

Oklahoma: Oklahoma Geological Survey; Oil and Gas Conservation Department, Oklahoma Corporation Commission; and Gross Production Division, Oklahoma Tax 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.

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; Oil and Gas Division, State Comptroller of Public Accounts.

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, Department of Conservation and Development.
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 employment and injuries chapters, this volume was prepared by the staffs of the following Bureau of Mines Mineral Resource Offices under the direction of: Mark L. Wright, Albany, Oreg.; Floyd D. Everrett, Bartlesville, Okla.; Murphy E. Hawkins, Dallas, Tex.; Ottey M. Bishop, Denver, Colo.; Robert L. Thorne, Juneau, Alaska; Robert D. Thomson, Knoxville, Tenn.; Wesley Grosh, Twin Cities, Minn.; Joel Van Sant, Pittsburgh, Pa.; Donald R. Irving, San Francisco, Calif.; Richard Appling, Spokane, Wash.

The manuscripts upon which this volume was based were reviewed by the Minerals Yearbook staff under the direction of Kathleen J. D'Amico to insure statistical consistency among the tables, figures, and text between this volume and Volume I–II, and between this volume and those for former years.

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

ALBERT E. SCHRECK,
Editor-In-Chief

Contents

Statistical Summary

By Kathleen J. D'Amico [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 imported into and exported from 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 officer, 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
1963	$13,317	$4,316	$2,002	$19,635
1964	13,623	4,623	r 2,366	r 20,612
1965	14,047	4,933	r 2,544	r 21,524
1966 r	15,112	5,176	2,703	22,991
1967	16,198	5,205	2,333	23,736

r Revised.

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

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Mineral fuels:								
Asphalt and related bitumens (native):								
Bituminous limestone and sandstone and gilsonite short tons	1,935,344	$10,038	1,911,664	$9,461	2,041,271	$8,438	1,866,666	$8,136
Carbon dioxide, natural (estimate) thousand cubic feet	1,232,816	166	1,173,676	152	1,140,907	153	1,142,374	165
Coal:								
Bituminous and lignite [2] thousand short tons	486,998	2,165,582	512,088	2,276,022	533,881	2,421,293	552,626	2,555,377
Pennsylvania anthracite do	17,184	148,648	14,866	122,021	12,941	100,663	12,256	96,160
Helium:								
Crude thousand cubic feet	3,197,016	35,322	3,566,734	39,848	3,654,700	41,556	3,697,300	42,800
Grade A do	830,481	25,923	819,100	28,880	951,400	32,541	1,015,000	29,657
Natural gas million cubic feet	15,462,138	2,387,689	16,039,753	2,494,542	r17,232,134	r2,721,875	18,171,325	2,898,741
Natural gas liquids:								
Natural gasoline and cycle products thousand gallons	7,000,181	463,600	7,288,070	494,354	r7,591,658	r524,167	r7,919,831	r549,429
LP gases do	10,743,591	362,792	11,257,267	417,249	12,134,294	527,223	13,717,861	632,994
Peat short tons	639,690	6,198	603,746	6,080	605,858	6,501	619,687	6,768
Petroleum (crude) thousand 42-gallon barrels	2,786,822	8,017,078	r2,848,514	r8,158,299	r3,028,084	r8,727,387	r3,216,715	r9,377,516
Total mineral fuels	XX	13,623,000	XX	14,047,000	XX	r15,112,000	XX	16,198,000
Nonmetals (except fuels):								
Abrasive stones [4] short tons	3,186	$292	3,603	$432	3,806	$515	2,701	$574
Asbestos do	101,092	8,143	118,275	10,162	125,928	11,056	123,189	11,102
Barite thousand short tons	830	9,796	852	10,192	947	11,259	962	11,604
Boron minerals do	776	60,871	807	64,180	866	68,209	955	74,130
Bromine thousand pounds	283,530	66,064	328,115	77,259	326,498	78,883	349,757	85,391
Calcite (optical grade) pounds	4	2	(5)	(5)	(5)	(5)		
Calcium-magnesium chloride short tons	W	W	W	W	W	W	608,965	11,983
Cement:								
Portland thousand 376-pound barrels	358,378	1,145,108	366,802	1,154,448	373,091	1,162,984	365,570	1,148,208
Masonry thousand 280-pound barrels	22,397	63,305	23,260	65,979	22,367	63,407	21,700	62,168
Natural and slag thousand 376-pound barrels	283	1,057	279	1,027	r109	r415	94	360
Clays thousand short tons	52,947	192,631	55,126	204,932	r56,713	r221,714	54,664	223,987
Emery short tons	9,214	172	10,720	204	11,102	210	(5)	(5)
Feldspar long tons	587,194	5,389	624,598	6,263	r655,452	r7,020	615,397	7,086
Fluorspar short tons	217,137	9,723	240,932	10,889	253,068	10,841	295,643	13,164
Garnet (abrasive) do	16,123	1,622	19,330	1,717	21,952	2,092	20,494	1,849
Gem stones (estimate)	NA	1,474	NA	2,218	NA	2,437	NA	2,430
Gypsum thousand short tons	10,684	38,874	10,033	37,375	9,647	35,681	9,393	34,383
Lime do	16,089	223,149	16,794	232,939	18,057	239,588	17,974	241,137
Magnesium compounds from sea water and brine (except for metals) short tons, MgO equivalent	599,698	42,177	637,857	47,197	r651,187	r46,690	544,428	41,414
Mica:								
Scrap short tons	114,729	3,353	120,255	3,468	113,133	3,733	118,503	2,876
Sheet pounds	242,662	58	716,086	185	4,500	1	20,500	(5)

Perlite—short tons	349,867	3,073	392,384	3,352	404,160	3,907	413,001	3,973
Phosphate rock—thousand short tons	25,715	161,067	29,482	193,323	r 39,044	r 261,092	39,770	265,947
Potassium salts—thousand short tons, K_2O equivalent	2,897	114,095	3,140	129,767	3,320	122,210	3,299	105,313
Pumice—thousand short tons	2,776	6,443	3,371	6,550	3,218	6,765	3,446	5,131
Pyrites—thousand long tons	847	5,471	875	5,333	873	5,088	861	7,943
Salt—thousand short tons	31,623	200,706	34,687	215,699	36,463	229,985	38,946	251,210
Sand and gravel—do	868,208	893,375	908,049	957,416	934,481	984,982	905,162	980,356
Sodium carbonate (natural)—short tons	1,274,745	30,451	1,494,105	34,717	1,737,511	40,674	1,727,977	40,539
Sodium sulfate (natural)—do	575,033	10,989	619,752	11,024	640,329	11,271	636,843	10,710
Stone [6]—thousand short tons	725,583	1,134,564	780,242	1,203,831	813,374	1,260,715	785,592	1,240,244
Sulfur:								
Frasch process mines—thousand long tons	6,035	120,776	7,251	164,654	7,721	201,292	7,682	251,670
Other mines—long tons	794	8	2,852	11	557	5	568	3
Talc, soapstone, and pyrophyllite—short tons	889,949	6,218	862,875	6,343	895,045	6,479	902,512	6,871
Tripoli—do	64,613	268	71,138	381	66,163	328	70,984	377
Vermiculite—thousand short tons	226	3,613	249	4,460	262	4,954	255	4,974
Value of items that cannot be disclosed: Aplite, brucite, diatomite, graphite, iodine, kyanite, lithium minerals, magnesite, greensand marl, olivine, staurolite, wollastonite, and values indicated by footnote [5]	XX	58,771	XX	65,028	XX	69,911	XX	55,734
Total nonmetals	XX	4,623,000	XX	4,933,000	XX	r 5,176,000	XX	5,205,000
Metals:								
Antimony ore and concentrate short tons, antimony content	632	(7)	845	(7)	927	(7)	892	(7)
Bauxite—thousand long tons, dried equivalent	1,601	$17,875	1,654	$18,632	1,796	$20,095	1,654	$19,079
Copper (recoverable content of ores, etc.)—short tons	1,246,780	812,901	1,351,734	957,028	1,429,152	1,033,850	954,064	729,401
Gold (recoverable content of ores, etc.)—troy ounces	1,456,308	50,971	1,705,190	59,682	1,803,420	63,119	1,584,187	55,447
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight	84,300	802,331	84,079	801,388	90,040	854,134	82,415	817,511
Lead (recoverable content of ores, etc.)—short tons	286,010	74,935	301,147	93,959	327,368	98,964	316,931	88,741
Manganese ore (35 percent or more Mn) short tons, gross weight	26,058	(7)	29,258	(7)	14,406	(7)	12,585	(7)
Manganiferous ore (5 to 35 percent Mn)—do	238,776	(7)	332,763	(7)	324,926	(7)	289,160	(7)
Mercury—76-pound flasks	14,142	4,452	19,582	11,176	22,008	9,722	23,784	11,639
Molybdenum (content of concentrate)—thousand pounds	65,097	97,121	77,310	120,801	91,670	144,327	81,596	133,604
Nickel (content of ore and concentrate)—short tons	15,420	(7)	16,188	(7)	15,036	(7)	15,287	(7)
Silver (recoverable content of ores, etc.) thousand troy ounces	36,334	46,980	39,806	51,469	43,669	56,463	32,119	49,784
Tin (content of concentrate)—long tons	65	185	47	126	97	265	(7)	(7)
Titanium concentrate:								
Ilmenite—short tons, gross weight	1,003,997	19,178	948,832	18,058	868,436	17,608	882,414	18,519
Rutile—do	10,547	1,016	(7)	(7)	(7)	(7)	(7)	(7)
Tungsten ore and concentrate short tons, 60 percent WO_3 basis	9,244	11,251	7,949	13,028	8,912	17,620	9,088	20,895
Uranium [8] (recoverable content U_3O_8)—thousand pounds	27,171	217,375	19,727	157,828	19,037	152,281	20,655	165,239
Vanadium (recoverable in ore and concentrate) short tons	4,362	13,061	5,226	18,284	5,166	22,210	4,963	21,331
Zinc (recoverable content of ores, etc.)—do	574,858	156,308	611,153	178,284	572,558	166,044	549,413	151,562

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Value of items that cannot be disclosed: Beryllium concentrate, cobalt, columbium-tantalum concentrate (1967), magnesium chloride for magnesium metal, manganiferous residuum, platinum-group metals (crude), rare-earth metal concentrates, zirconium concentrate, and values indicated by footnote [7]	XX	$40,183	XX	$44,804	XX	r $46,605	XX	$50,190
Total metals	XX	r 2,366,000	XX	r 2,544,000	XX	r 2,703,000	XX	2,333,000
Grand total mineral production	XX	r 20,612,000	XX	r 21,524,000	XX	r 22,991,000	XX	23,736,000

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] Final figure; supersedes figure given in commodity section.
[4] Grindstones, pulpstones, millstones (weight not recorded), grinding pebbles, sharpening stones, and tube-mill liners.
[5] Figure withheld to avoid disclosing individual company confidential data; value included with "Nonmetal items that cannot be disclosed."
[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] Beginning with 1964, the basis for reporting uranium ore has been replaced by uranium (recoverable content U_3O_8).

Table 3.—Minerals produced in the United States and principal producing States in 1967

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

See footnotes at end of table.

Table 3.—Minerals produced in the United States and principal producing States in 1967 —Continued

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

Table 4.—Value of mineral production in the United States, and principal minerals produced in 1967

(Thousands)

State	Value	Rank	Percent of U.S. total	Principal minerals in order of value
Alabama	$251,391	21	1.06	Coal, cement, petroleum, stone.
Alaska	134,066	29	.56	Petroleum, sand and gravel, coal, natural gas.
Arizona	463,863	15	1.95	Copper, sand and gravel, molybdenum, cement.
Arkansas	179,453	27	.76	Petroleum, stone, bauxite, cement.
California	1,696,233	3	7.15	Petroleum, natural gas, sand and gravel, cement.
Colorado	346,235	17	1.46	Petroleum, molybdenum, coal, sand and gravel.
Connecticut	20,619	45	.09	Stone, sand and gravel, feldspar, lime.
Delaware	2,383	50	.01	Sand and gravel, stone, clays, gem stones.
Dist. of Columbia	---	---	---	
Florida	309,797	18	1.31	Phosphate rock, stone, cement, clays.
Georgia	153,458	28	.65	Clays, stone, cement, sand and gravel.
Hawaii	16,936	46	.07	Cement, stone, sand and gravel, pumice.
Idaho	109,408	31	.46	Silver, phosphate rock, lead, zinc.
Illinois	636,801	8	2.68	Coal, petroleum, stone, sand and gravel.
Indiana	244,921	22	1.03	Coal, cement, stone, petroleum.
Iowa	113,222	30	.48	Cement, stone, sand and gravel, gypsum.
Kansas	574,068	10	2.42	Petroleum, natural gas, natural gas liquids, helium.
Kentucky	535,705	11	2.26	Coal, petroleum stone, natural gas.
Louisiana	3,961,750	2	16.69	Petroleum, natural gas, natural gas liquids, sulfur.
Maine	14,882	47	.06	Cement, sand and gravel, stone, peat.
Maryland	72,819	37	.31	Stone, cement, sand and gravel, coal.
Massachusetts	40,612	43	.17	Sand and gravel, stone, lime, clays.
Michigan	610,204	9	2.57	Iron ore, cement, sand and gravel, bromine.
Minnesota	523,326	13	2.20	Iron ore, sand and gravel, stone, cement.
Mississippi	217,010	24	.91	Petroleum, natural gas, sand and gravel, clays.
Missouri	236,659	23	1.00	Stone, cement, lead, iron ore.
Montana	186,524	26	.79	Petroleum, copper, sand and gravel, phosphate rock.
Nebraska	70,868	39	.30	Petroleum, cement, sand and gravel, stone.
Nevada	90,883	33	.38	Copper, gold, sand and gravel, diatomite.
New Hampshire	8,117	48	.03	Sand and gravel, stone, clays, felsdpar.
New Jersey	72,747	38	.31	Sand and gravel, stone, zinc, magnesium compounds.
New Mexico	874,106	7	3.68	Petroleum, natural gas, potassium salts, uranium.
New York	299,318	19	1.26	Cement, stone, sand and gravel, salt.
North Carolina	77,094	36	.32	Stone, sand and gravel, cement, phosphate rock.
North Dakota	97,538	32	.41	Petroleum, sand and gravel, coal, natural gas.
Ohio	498,888	14	2.10	Coal, stone, sand and gravel, cement.
Oklahoma	1,032,126	4	4.35	Petroleum, natural gas, natural gas liquids, cement.
Oregon	66,560	40	.28	Sand and gravel, stone, cement, nickel.
Pennsylvania	898,398	6	3.78	Coal, cement, stone, sand and gravel.
Rhode Island	4,035	49	.02	Sand and gravel, stone.
South Carolina	48,274	42	.20	Cement, stone, clays, sand and gravel.
South Dakota	52,618	41	.22	Gold, sand and gravel, stone, cement.
Tennessee	189,572	25	.80	Stone, zinc, cement, coal.
Texas	5,406,371	1	22.78	Petroleum, natural gas, natural gas liquids, cement.
Utah	354,477	16	1.49	Copper, petroleum, coal, molybdenum.
Vermont	27,268	44	.11	Stone, asbestos, sand and gravel, talc.
Virginia	283,685	20	1.20	Coal, stone, cement, sand and gravel.
Washington	82,067	34	.35	Sand and gravel, cement, stone, zinc.
West Virginia	937,858	5	3.95	Coal, natural gas, natural gas liquids, stone.
Wisconsin	79,612	35	.34	Sand and gravel, stone, cement, zinc.
Wyoming	530,696	12	2.24	Petroleum, uranium, natural gas, sodium salts.
Total	23,736,000	----	100.0	Petroleum, natural gas, coal, stone.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA								
Cement:[2]								
Portland—thousand 376-pound barrels	12,870	$40,108	13,765	$42,604	16,394	$49,537	15,364	$46,510
Masonry—thousand 280-pound barrels	2,574	7,794	2,598	7,853	2,570	7,613	2,377	6,938
Clays—thousand short tons	[3] 1,991	[3] 4,060	[3] 2,220	[3] 4,888	2,448	5,142	2,724	7,422
Coal (bituminous)—do	14,435	102,267	14,832	106,249	14,219	100,112	15,486	110,696
Iron ore (usable)—thousand long tons, gross weight	2,106	11,812	1,495	8,241	1,508	8,702	1,472	8,286
Lime—thousand short tons	599	7,118	653	7,905	699	8,442	624	7,719
Natural gas—million cubic feet	165	18	203	26	252	32	248	31
Petroleum (crude)—thousand 42-gallon barrels	8,498	22,095	8,064	21,047	8,030	20,878	7,348	19,500
Sand and gravel—thousand short tons	5,840	6,191	6,422	7,195	7,082	7,953	7,229	7,969
Stone—do	[4] 15,852	[4] 24,976	[4] 17,987	[4] 30,810	[4] 20,744	[4] 36,839	18,371	33,346
Value of items that cannot be disclosed: Native asphalt, bauxite, slag cement, clays (kaolin 1964–65, bentonite 1964–65), scrap mica, salt, stone (dimension limestone, dimension marble 1964–66, shell 1964–65, crushed sandstone 1965–66), talc, and tripoli (1965)	XX	9,251	XX	9,446	XX	4,528	XX	2,974
Total	XX	235,690	XX	246,264	XX	249,778	XX	251,391
ALASKA								
Antimony ore and concentrate—short tons, antimony content	14	$18	1	$1	8	W	10	W
Coal (bituminous)—thousand short tons	745	5,008	893	6,095	927	$6,953	925	$7,296
Copper (recoverable content of ores, etc.)—short tons	11	7	32	23	W	W	W	W
Gold (recoverable content of ores, etc.)—troy ounces	58,416	2,045	42,249	1,479	27,325	956	22,948	803
Lead (recoverable content of ores, etc.)—short tons	------	------	9	3	14	4	------	------
Mercury—76-pound flasks	303	95	W	W	W	W	W	W
Natural gas—million cubic feet	6,238	1,719	7,255	1,799	11,267	2,794	14,438	3,610
Peat—short tons	2,350	19	1,967	16	W	W	1,528	12
Petroleum (crude)—thousand 42-gallon barrels	11,059	33,627	11,128	34,073	14,358	44,007	29,126	91,164
Sand and gravel—thousand short tons	26,089	18,488	30,266	34,467	17,457	21,793	22,370	26,248
Silver (recoverable content of ores, etc.)—thousand troy ounces	7	9	8	10	7	9	6	9
Value of items that cannot be disclosed: Barite (1966–67), gem stones, platinum-group metals, stone, tin, uranium ore (1964–65) and values indicated by symbol W	XX	r 5,013	XX	r 5,512	XX	6,167	XX	4,924
Total	XX	r 66,048	XX	r 83,478	XX	82,683	XX	134,066
ARIZONA								
Asbestos—short tons	W	W	3,469	$441	W	W	W	W
Clays [3]—thousand short tons	168	$213	129	164	89	$121	67	$37
Coal (bituminous)—do	------	------	------	------	------	------	1	5
Copper (recoverable content of ores, etc.)—short tons	690,988	450,524	703,377	497,991	739,569	535,004	501,741	383,591
Diatomite—do	450	16	295	8	1,353	36	W	W
Fluorspar—do	------	------	------	------	------	------	10,000	280
Gem stones	NA	120	NA	120	NA	120	NA	150
Gold (recoverable content of ores, etc.)—troy ounces	153,676	5,379	150,431	5,265	142,528	4,988	80,844	2,830

Gypsum—thousand short tons	147	770	103	540	75	394	W	W
Helium, grade A—thousand cubic feet	46,000	1,610	58,000	2,030	63,500	2,222	73,800	2,066
Iron ore (usable)—thousand long tons, gross weight	4	32	8	51	W	W	W	W
Lead (recoverable content of ores, etc.)—short tons	6,147	1,611	5,913	1,845	5,211	1,575	4,771	1,336
Lime—thousand short tons	177	2,920	204	3,543	218	3,721	186	3,142
Mercury—76-pound flasks	77	24	158	90	363	160	W	W
Molybdenum (content of concentrate)—thousand pounds	6,296	9,532	9,399	15,880	10,161	17,812	9,261	15,385
Natural gas—million cubic feet	2,014	241	3,106	376	3,161	436	1,255	193
Petroleum (crude)—thousand 42-gallon barrels	64	W	97	W	132	370	2,924	8,188
Pumice—thousand short tons	880	1,635	1,161	1,515	1,103	1,674	1,064	904
Sand and gravel—do	18,116	20,868	14,918	16,621	18,730	20,448	16,580	17,017
Silver (recoverable content of ores, etc.)—thousand troy ounces	5,811	7,513	6,095	7,881	6,339	8,196	4,588	7,112
Stone—thousand short tons	3,759	6,283	2,474	4,171	2,271	4,091	1,910	3,491
Tungsent ore and concentrate—short tons, 60-percent WO_3 basis	16	17	3	5	2	5	W	W
Uranium (recoverable content U_3O_8)—thousand pounds	W	W	W	W	437	3,492	83	666
Vanadium (recoverable in ore and concentrate)—short tons	W	575	W	381	W	453	W	W
Zinc (recoverable content of ores, etc.)—do	24,690	6,716	21,757	6,353	15,985	4,636	14,330	3,967
Value of items that cannot be disclosed: Cement, clays (bentonite, fire clay 1964), feldspar, scrap mica, perlite pyrites, vermiculite (1967), and values indicated by symbol W	XX	r 20,222	XX	r 17,847	XX	12,125	XX	13,503
Total	XX	r 536,821	XX	r 583,118	XX	r 622,079	XX	463,863
ARKANSAS								
Barite—thousand short tons	233	$2,202	249	$2,379	233	$2,266	229	$2,266
Bauxite—thousand long tons, dried equivalent	1,562	17,431	1,593	17,974	1,718	19,439	1,571	18,269
Bromine and bromine in compounds—thousand pounds	W	W	32,254	7,171	42,307	10,467	64,450	14,885
Clays—thousand short tons	892	2,152	866	1,890	[3] 775	[3] 776	941	1,740
Coal (bituminous)—do	212	1,503	226	1,643	236	1,640	189	1,427
Gem stones	NA	33	NA	31	NA	35	NA	35
Lime—thousand short tons	189	2,814	192	2,776	207	3,004	187	2,723
Natural gas—million cubic feet	75,753	11,806	82,831	12,922	105,174	16,407	116,522	17,828
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	30,082	1,678	27,787	1,578	32,050	1,923	27,533	1,780
LP gases—do	61,616	2,460	69,752	3,139	64,664	3,233	53,730	3,009
Petroleum (crude)—thousand 42-gallon barrels	26,737	71,120	25,930	68,974	23,824	63,372	21,075	56,902
Sand and gravel—thousand short tons	11,794	14,836	12,806	15,836	16,056	21,038	14,289	15,531
Stone—do	20,241	26,172	21,241	26,778	19,109	24,588	17,454	23,236
Value of items that cannot be disclosed: Abrasive stones, cement, clays (Kaolin and fire clay 1966), gypsum, iron ore (1964–65), mercury (1966–67) phosphate rock (1964–66), soapstone, tripoli (1965–67), and values indicated by symbol W	XX	20,611	XX	16,019	XX	21,939	XX	19,822
Total	XX	174,818	XX	179,110	XX	190,127	XX	179,453
CALIFORNIA								
Antimony ore and concentrate—short tons, antimony content	-------	-------	-------	-------	1	[6]	-------	-------
Asbestos—short tons	55,041	$4,419	74,587	$6,177	81,671	$6,945	77,091	$6,726
Barite—thousand short tons	6	45	4	21	15	104	10	71
Boron minerals—do	776	60,871	807	64,180	866	68,209	955	74,180
Calcite (optical grade)—pounds	4	2	W	W	W	W	-------	-------

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
CALIFORNIA—Continued								
Cement—thousand 376-pound barrels	47,204	$149,933	45,352	$144,852	45,887	$146,302	42,034	$137,961
Clays—thousand short tons	3,685	8,433	3,207	7,226	2,984	6,708	2,609	6,037
Copper (recoverable content of ores, etc.)—short tons	1,035	675	1,165	825	1,078	780	788	602
Feldspar—long tons	102,264	W	95,975	W	100,915	W	94,769	W
Gem stones	NA	200	NA	200	NA	200	NA	200
Gold (recoverable content of ores, etc.)—troy ounces	71,028	2,486	62,885	2,201	64,764	2,267	40,570	1,420
Gypsum—thousand short tons	1,893	4,539	1,611	3,881	1,207	3,064	1,241	3,150
Lead (recoverable content of ores, etc.)—short tons	1,546	405	1,810	565	1,976	597	1,735	486
Lime—thousand short tons	577	10,294	602	11,073	552	8,764	539	8,696
Magnesium compounds from sea water and bitterns (partly estimated) short tons, MgO equivalent	94,739	7,143	r 95,652	r 7,955	87,816	7,413	76,592	6,882
Mercury—76-pound flasks	10,291	3,240	13,404	7,650	16,070	7,100	16,385	8,018
Natural gas—million cubic feet	660,444	198,551	660,384	204,059	[6] 715,113	[6] 223,175	681,080	202,290
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	720,373	54,088	655,780	49,850	[6] 677,868	[6] 52,399	643,984	49,122
LP gases—do	352,614	15,893	339,082	15,467	353,164	17,304	366,643	19,065
Peat—short tons	35,391	443	30,905	434	29,235	384	30,014	396
Petroleum (crude)—thousand 42-gallon barrels	300,009	729,022	316,428	753,099	345,295	812,834	359,219	829,133
Pumice—thousand short tons	443	1,937	676	1,744	580	1,763	866	1,357
Salt—do	1,525	W	1,638	W	1,693	W	1,732	W
Sand and gravel—do	112,995	129,333	118,310	136,227	120,692	139,157	116,125	139,212
Silver (recoverable content of ores, etc.)—thousand troy ounces	172	222	197	254	190	246	145	224
Stone—thousand short tons	45,805	63,566	42,575	59,668	43,051	61,336	37,186	55,263
Sulfur ore—long tons	520	3	360	2	557	5	568	3
Talc, soapstone, and pyrophyllite—short tons	132,601	1,631	141,074	1,725	138,340	1,847	143,466	1,945
Tin (content of concentrate)—long tons	W	W	W	W	13	21	W	W
Wollastonite—short tons	3,625	36	W	W	W	W	W	W
Zinc (recoverable content of ores, etc.)—do	143	39	225	66	335	97	441	122
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, carbon dioxide, coal (lignite), diatomite, iodine (1964–66), iron ore, lithium minerals, scrap mica, molybdenum, perlite, platinum group metals (crude) potassium salts, rare-earth metal concentrates, sodium carbonates and sulfates, tungsten concentrate, uranium (1964–66), and values indicated by symbol W	XX	r 113,080	XX	r 117,904	XX	r 141,449	XX	143,722
Total	XX	r1,560,529	XX	r1,597,305	XX	r1,710,470	XX	1,696,233
COLORADO								
Carbon dioxide, natural—thousand cubic feet	211,830	$36	155,668	$26	147,292	$25	182,701	$31
Clays—thousand short tons	558	1,275	631	1,446	r 599	r 1,315	596	1,274
Coal (bituminous)—do	4,355	23,427	4,790	24,431	5,222	26,075	5,439	25,920
Copper (recoverable content of ores, etc.)—short tons	4,653	3,034	3,828	2,710	4,237	3,065	3,993	3,053
Feldspar—long tons	W	W	521	3	891	6	300	2
Gem stones	NA	80	NA	80	NA	80	NA	118

Gold (recoverable content of ores, etc.)—troy ounces	42,122	1,474	37,228	1,303	31,915	1,117	21,181	741
Gypsum—thousand short tons	100	398	r 100	r 379	75	269	77	265
Iron ore (usable)—thousand long tons, gross weight	35	231	114	787	164	1,133	W	W
Lead (recoverable content of ores, etc.)—short tons	20,563	5,388	22,495	7,018	23,082	6,978	21,923	6,138
Lime—thousand short tons	138	2,193	118	2,074	126	2,327	118	2,028
Manganiferous ore (5 to 35 percent Mn)—short tons, gross weight	-------	-------	-------	-------	-------	-------	321	3
Molybdenum (content of concentrate)—thousand pounds	46,378	69,207	r 50,715	r 78,609	57,289	88,851	52,040	84,728
Natural gas—million cubic feet	113,691	13,489	126,381	16,303	136,667	17,767	116,857	15,542
Natural gas liquids:								
Natural gasoline—thousand gallons	52,400	2,845	54,180	3,034	59,420	3,565	51,845	3,215
LP gases—do	88,916	3,894	91,399	3,930	73,390	3,596	71,544	3,649
Peat—short tons	27,931	188	31,179	236	37,111	278	21,988	204
Petroleum (crude)—thousand 42-gallon barrels	34,755	100,094	33,511	96,512	33,492	97,462	33,905	99,003
Pumice—thousand short tons	61	114	56	134	46	104	18	105
Pyrites—thousand long tons	W	W	30	90	W	W	W	W
Sand and gravel—thousand short tons	20,746	22,227	20,810	22,041	22,245	23,485	21,810	22,904
Silver (recoverable content of ores, etc.)—thousand troy ounces	2,626	3,396	2,051	2,652	2,085	2,697	1,818	2,817
Stone—thousand short tons	3,217	6,805	4,789	8,638	7,031	11,331	2,992	5,485
Tin (content of concentrate)—long tons	29	103	32	76	44	99	31	59
Tungsten concentrate—short tons, 60 percent WO_3 basis	W	W	1,176	1,985	1,494	3,626	1,276	3,039
Uranium (recoverable content U_3O_8)—thousand pounds	W	W	W	W	2,651	21,205	2,537	20,299
Vanadium (recoverable in ore and concentrate)—short tons	3,312	9,916	4,017	14,056	3,697	15,888	3,317	14,260
Vermiculite—thousand short tons	(5)	1	-------	-------	-------	-------	-------	-------
Zinc (recoverable content of ores, etc.)—short tons	53,682	14,602	53,870	15,730	54,822	15,898	52,442	14,519
Value of items that cannot be disclosed: Beryllium concentrate, cement, fluorspar, scrap mica (1967), molybdenum (1965) perlite, rare-earth metal concentrates (1966–67), salt, and values indicated by symbol W	XX	r 44,193	XX	r 35,867	XX	14,699	XX	16,834
Total	XX	r 328,610	XX	r 340,150	XX	r 362,941	XX	346,235
CONNECTICUT								
Clays—thousand short tons	212	$262	237	$322	192	$296	191	$334
Gem stones	NA	8	NA	8	NA	8	NA	8
Lime—thousand short tons	39	689	W	W	W	W	W	W
Sand and gravel—do	10,088	9,437	9,940	9,106	9,561	8,963	8,320	8,710
Stone—do	5,864	10,764	5,871	10,444	5,618	10,482	5,097	10,141
Value of items that cannot be disclosed: Feldspar, scrap mica, peat (1964–66), and values indicated by symbol W	XX	690	XX	1,354	XX	1,597	XX	1,426
Total	XX	21,850	XX	21,234	XX	21,346	XX	20,619
DELAWARE								
Clays—thousand short ton	11	$11	11	$11	11	$11	11	11
Gem stones	NA	1	NA	1	NA	1	NA	1
Sand and gravel—thousand short tons	1,282	1,280	1,545	1,441	1,610	1,443	1,966	1,846
Stone—do	180	450	180	450	210	525	210	525
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	-------	XX	-------	XX	-------	XX	-------
Total	XX	1,742	XX	1,903	XX	1,980	XX	2,383

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
FLORIDA								
Clays—thousand short tons	627	$8,405	651	$9,752	762	$11,408	756	$11,574
Lime—do	117	1,814	101	1,558	135	1,966	155	2,425
Natural gas—million cubic feet	40	5	107	14	212	30	123	18
Peat—short tons	19,813	102	19,253	109	11,500	91	22,180	155
Petroleum (crude)—thousand 42-gallon barrels	620	W	1,464	W	1,799	W	1,568	W
Phosphate rock—thousand short tons	19,161	119,667	21,563	141,258	W	W	W	W
Sand and gravel—do	7,420	6,427	7,298	6,377	7,403	6,417	6,912	6,479
Stone—do	33,157	38,362	35,730	41,148	35,023	38,167	33,971	38,723
Value of items that cannot be disclosed: Cement, magnesium compounds, natural gas, liquids, rare-earth metal concentrates, staurolite, stone (dimension limestone 1967) titanium concentrate, zirconium concentrate, and values indicated by symbol W	XX	48,627	XX	49,104	XX	237,368	XX	250,423
Total	XX	223,409	XX	249,320	XX	295,447	XX	309,797
GEORGIA								
Barite—thousand short tons	109	$2,022	W	W	W	W	W	W
Clays—do	4,365	58,899	4,607	$63,158	5,128	$73,685	4,953	$77,314
Coal (bituminous)—do	4	15						
Iron ore (usable)—thousand long tons, gross weight	354	1,752	430	2,208	447	2,200	267	1,450
Mica								
Scrap—short tons	W	W	13,065	W	16,608	380	17,158	291
Sheet—pounds			2,793	(5)				
Sand and gravel—thousand short tons	3,588	3,594	3,675	3,588	3,915	4,185	3,787	4,206
Stone—do	22,822	46,428	23,421	48,265	24,690	48,193	23,418	49,953
Talc—short tons	40,400	135	44,800	313	41,000	255	46,150	292
Value of items that cannot be disclosed: Bauxite, cement, feldspar, kyanite, peat, rare-earth metal concentrates (1966–67), titanium concentrate (1965–67), zirconium concentrate (1965–67), and values indicated by symbol W	XX	14,292	XX	17,688	XX	19,699	XX	19,952
Total	XX	127,137	XX	135,220	XX	148,597	XX	153,458
HAWAII								
Cement—thousand 376-pound barrels	1,717	$8,877	1,564	$8,297	1,749	$9,046	1,395	$7,360
Clays—thousand short tons	3	W	W	W	W	W	W	W
Lime—do	9	321	9	305	10	320	8	265
Pumice—do	365	603	380	624	374	716	290	562
Sand and gravel—do	407	979	751	2,237	511	1,591	469	1,467
Stone—do	5,282	8,765	5,172	9,353	5,079	9,482	4,100	7,207
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	60	XX	19	XX	98	XX	75
Total	XX	19,605	XX	20,835	XX	21,253	XX	16,936

IDAHO

Antimony ore and concentrate	short tons, antimony content	585	W	818	W	834	W	823	W
Clays [3]	thousand short tons	29	$25	47	$33	23	$22	19	$16
Cobalt	thousand pounds					1	6		
Copper (recoverable content of ores, etc.)	short tons	4,666	3,042	5,140	3,639	4,961	3,589	4,210	3,219
Gem stones		NA	W	NA	150	NA	180	NA	180
Gold (recoverable content of ores, etc.)	troy ounces	5,677	199	5,078	178	5,056	177	4,838	169
Iron ore (usable)	thousand long tons, gross weight	4	33	9	84	11	97	W	W
Lead (recoverable content of ores, etc.)	short tons	71,312	18,684	66,606	20,781	72,384	21,867	61,387	17,188
Mercury	76-pound flasks	83	26	1,119	639	1,134	501	898	439
Peat	short tons	900	8	W	W	W	W	2,040	16
Pumice	thousand short tons	59	100	46	79	55	107	W	W
Sand and gravel	do	9,582	8,691	12,151	13,198	7,544	6,672	11,246	11,490
Silver (recoverable content of ores, etc.)	thousand troy ounces	16,483	21,313	18,457	23,865	19,777	25,571	17,033	26,402
Stone	thousand short tons	1,144	2,778	1,831	3,440	2,694	5,415	1,986	4,833
Tungsten concentrate	short tons, 60-percent WO_3 basis	11	8			2	1	68	175
Zinc (recoverable content of ores, etc.)	short tons	59,298	16,129	58,034	16,946	60,997	17,689	56,528	15,650
Value of items that cannot be disclosed: Barite (1964), cement, clays (fire clay, bentonite 1964–66, kaolin), abrasive garnet, lime, scrap mica (1964), perlite, phosphate rock, titanium concentrate (1964–66), vanadium, and values indicated by symbol W		XX	15,231	XX	22,053	XX	r 32,991	XX	29,631
Total		XX	86,262	XX	105,085	XX	r 114,885	XX	109,408

ILLINOIS

Cement:								
Portland	thousand 376-pound barrels	9,790	$32,191	9,358	$30,622	9,203	$28,617	9,069	$30,186
Masonry	thousand 280-pound barrels	596	2,038	615	1,907	614	1,868	591	1,851
Clays [3]	thousand short tons	2,007	4,358	2,169	4,601	1,894	3,996	1,881	3,799
Coal (bituminous)	do	55,023	208,448	58,483	218,972	63,571	244,837	65,133	252,975
Fluorspar	short tons	127,454	6,452	159,140	7,861	176,175	8,002	210,207	9,859
Lead (recoverable content of ores, etc.)	do	2,180	571	3,005	938	2,285	691	2,384	668
Natural gas	million cubic feet	7,824	905	7,396	865	7,230	860	5,144	602
Natural gas liquids:									
Natural gasoline and cycle products	thousand gallons	14,109	1,030	W	W	W	W	W	W
LP gases	do	312,173	13,758	W	W	W	W	W	W
Peat	short tons	W	W	36,774	453	44,374	565	49,716	697
Petroleum (crude)	thousand 42-gallon barrels	70,168	205,592	63,708	186,664	[6] 61,982	[6] 185,947	[6] 60,115	[6] 181,581
Sand and gravel	thousand short tons	34,880	39,966	36,228	40,480	38,237	43,201	38,801	44,175
Stone	do	42,987	56,553	47,066	61,294	46,157	60,961	48,458	66,757
Zinc (recoverable content of ores, etc.)	short tons	13,800	3,754	18,314	5,348	15,192	4,406	20,416	5,652
Value of items that cannot be disclosed: Clay (fuller's earth), gem stones, lime, tripoli, and values indicated by symbol W		XX	15,520	XX	33,020	XX	34,362	XX	37,999
Total		XX	591,136	XX	593,025	XX	618,313	XX	636,801

INDIANA

Abrasive stones	short tons	5	$16	5	$15	5	$15	5	$16
Cement [3]	thousand 376-pound barrels	15,038	48,695	14,925	48,797	15,805	49,826	15,924	53,123
Clays	thousand short tons	1,545	2,264	1,459	2,160	1,491	2,196	1,489	2,126

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
INDIANA—Continued								
Coal (bituminous)—thousand short tons	15,075	$57,246	15,565	$59,927	17,326	$67,857	18,772	$73,419
Natural gas—million cubic feet	199	47	239	56	215	51	198	46
Peat—short tons	66,568	543	53,873	511	38,111	456	42,962	441
Petroleum (crude)—thousand 42-gallon barrels	11,283	32,157	r 11,481	r 32,606	10,617	31,850	10,081	30,041
Sand and gravel—thousand short tons	24,416	21,811	24,867	22,220	24,992	23,542	26,265	25,588
Stone—do	22,318	39,978	24,574	42,124	24,323	42,474	26,977	46,725
Value of items that cannot be disclosed: Cement (masonry), gypsum, and lime (1966–67)	XX	9,026	XX	10,299	XX	11,743	XX	13,396
Total	XX	211,783	XX	r 218,715	XX	230,010	XX	244,921
IOWA								
Cement:								
Portland—thousand 376-pound barrels	13,607	$46,398	13,643	$46,273	14,058	$46,736	13,712	$45,394
Masonry—thousand 280-pound barrels	585	1,847	608	1,867	633	1,890	612	1,853
Clays—thousand short tons	1,008	1,254	1,085	1,347	1,130	1,438	1,208	1,643
Coal (bituminous)—do	973	3,447	1,043	3,694	1,025	3,783	883	3,227
Gypsum—do	1,287	5,821	1,254	5,554	1,285	5,577	1,219	5,186
Sand and gravel—do	13,890	13,546	18,205	17,152	19,644	18,213	17,734	16,564
Stone—do	23,935	33,038	25,891	35,468	27,729	40,081	26,133	37,912
Value of items that cannot be disclosed: Gem stones, lime, peat, and petroleum (1964)	XX	1,279	XX	1,428	XX	1,595	XX	1,443
Total	XX	106,630	XX	112,783	XX	119,313	XX	113,222
KANSAS								
Cement:[2]								
Portland—thousand 376-pound barrels	8,483	$25,959	8,801	$26,972	8,979	$27,246	8,833	$25,545
Masonry—thousand 280-pound barrels	384	1,173	404	1,178	395	1,151	350	1,000
Clays—thousand short tons	785	935	789	953	847	1,006	935	1,339
Coal (bituminous)—do	1,263	5,749	1,310	6,072	1,122	5,355	1,136	5,294
Helium: Crude—thousand cubic feet	2,170,512	24,941	2,551,026	29,518	2,624,200	30,951	2,719,700	32,554
Grade A—do	44,826	1,657	19,763	904	75,500	1,885	225,000	5,364
Lead (recoverable content of ores, etc.)—short tons	1,185	310	1,644	513	1,109	335	1,031	289
Natural gas—million cubic feet	764,073	96,031	793,379	105,519	847,495	114,412	871,971	116,844
Natural gas liquids:								
Natural gasoline—thousand gallons	162,725	8,713	153,485	7,791	175,053	9,399	194,173	10,703
LP gases—do	512,747	18,121	587,416	22,322	664,164	25,902	665,057	31,923
Petroleum (crude)—thousand 42-gallon barrels	106,252	310,256	104,733	305,820	103,738	306,027	99,200	297,600
Salt [9]—thousand short tons	930	11,799	1,053	12,376	969	13,388	1,069	14,686
Sand and gravel—do	12,968	9,108	12,544	8,473	11,627	8,374	12,066	8,650
Stone—do	14,138	18,912	15,270	20,538	14,027	18,789	13,551	17,806
Zinc (recoverable content of ores, etc.)—short tons	4,665	1,269	6,508	1,900	4,769	1,383	4,765	1,319

Value of items that cannot be disclosed: Natural cement, gypsum, pumice, and salt (brine)	XX	3,277	XX	2,642	XX	2,789	XX	3,152
Total	XX	538,210	XX	553,491	XX	568,392	XX	574,068
KENTUCKY								
Barite thousand short tons	6	$96						
Clays [3] do	920	1,801	1,059	$2,580	1,152	$2,277	1,195	$2,066
Coal (bituminous) do	82,747	309,896	85,766	324,523	93,156	363,440	100,294	396,883
Fluorspar short tons	38,214	1,693	31,992	1,485	28,725	1,361	32,952	1,686
Lead (recoverable content of ores, etc.) do	858	225	756	236	484	146	845	237
Natural gas million cubic feet	76,940	18,257	78,976	18,638	76,536	18,139	89,168	21,400
Petroleum (crude) thousand 42-gallon barrels	19,772	56,746	19,386	55,638	18,066	51,488	15,535	45,052
Sand and gravel thousand short tons	6,560	6,297	6,742	6,332	8,064	7,524	7,981	7,859
Silver (recoverable content of ores, etc.) thousand troy ounces	2	2	2	2	1	1	1	1
Stone thousand short tons	[4] 21,868	[4] 29,594	26,029	34,533	22,667	31,179	24,812	35,481
Zinc (recoverable content of ores, etc.) short tons	2,063	561	5,654	1,651	6,586	1,910	6,317	1,749
Value of items that cannot be disclosed: Native asphalt (1966–67), cement, ball clay, natural gas liquids, and stone (dimension sandstone 1964)	XX	19,211	XX	20,763	XX	20,899	XX	23,291
Total	XX	444,379	XX	466,381	XX	498,364	XX	535,705
LOUISIANA								
Clays thousand short tons	780	$797	909	$936	1,005	$983	995	$1,260
Lime do	725	8,312	842	9,980	835	9,274	758	9,891
Natural gas million cubic feet	4,152,731	793,328	4,466,786	812,955	5,081,435	929,902	5,716,857	1,057,619
Natural gas liquids:								
Natural gasoline and cycle products thousand gallons	1,352,980	91,931	1,431,836	102,731	1,562,075	113,802	1,754,603	130,212
LP gases do	1,247,484	45,935	1,300,038	46,101	1,469,716	72,016	1,844,689	92,234
Petroleum (crude) thousand 42-gallon barrels	549,698	1,709,622	594,853	1,841,714	674,318	2,097,129	774,527	2,419,823
Salt thousand short tons	6,401	36,056	8,126	41,812	8,736	44,189	9,585	48,483
Sand and gravel do	13,594	15,253	14,298	16,405	18,216	22,504	20,312	27,442
Stone [4] do	5,459	7,228	7,452	10,905	8,091	11,253	7,599	11,174
Sulfur (Frasch process) thousand long tons	2,733	54,996	3,577	81,372	4,018	104,472	4,233	139,739
Value of items that cannot be disclosed: Cement, gypsum, and stone (crushed miscellaneous)	XX	21,549	XX	23,350	XX	24,616	XX	23,873
Total	XX	2,785,007	XX	2,988,261	XX	3,430,140	XX	3,961,750
MAINE								
Clays thousand short tons	45	$58	49	$63	45	$58	42	$54
Gem stones	NA	35	NA	35	NA	35	NA	35
Peat short tons	6,350	171	1,275	56	1,600	60	W	W
Sand and gravel thousand short tons	13,552	6,463	17,294	7,831	15,036	7,027	11,627	5,368
Stone do	1,414	4,506	1,100	3,409	1,092	3,622	1,159	2,999
Value of items that cannot be disclosed: Cement, feldspar, and values indicated by symbol W	XX	6,341	XX	6,347	XX	5,932	XX	6,426
Total	XX	17,574	XX	17,741	XX	16,784	XX	14,882

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	value (thousands)
MARYLAND								
Clays—thousand short tons	[3] 635	[3] $798	[3] 914	[3] $1,088	[3] 856	[3] $1,084	998	$1,462
Coal (bituminous)—do	1,136	4,511	1,210	4,389	1,222	4,367	1,305	4,548
Gem stones	NA	3	NA	3	NA	3	NA	3
Lime—thousand short tons	W	W	37	481	29	386	W	W
Natural gas—million cubic feet	1,373	366	408	103	696	181	621	159
Sand and gravel—thousand short tons	15,041	18,071	16,200	21,188	15,108	20,383	12,868	17,724
Stone—do	13,348	26,715	14,553	28,432	13,868	27,229	14,479	28,581
Value of items that cannot be disclosed: Cement, ball clay (1964–66), greensand marl, peat, potassium salts, talc and soapstone, and values indicated by symbol W	XX	23,429	XX	22,311	XX	20,528	XX	20,342
Total	XX	73,893	XX	77,995	XX	74,161	XX	72,819
MASSACHUSETTS								
Clays—thousand short tons	138	$174	181	$238	202	$260	W	W
Gem stones	NA	2	NA	2	NA	2	NA	$2
Lime—thousand short tons	171	2,703	170	2,779	182	2,712	195	3,044
Sand and gravel—do	21,341	16,794	22,141	16,172	17,321	17,846	17,881	19,504
Stone—do	6,519	16,663	6,168	16,980	6,424	17,624	6,203	17,724
Value of items that cannot be disclosed: Nonmetals and value indicated by symbol W	XX	31	XX	27	XX	29	XX	338
Total	XX	36,367	XX	36,198	XX	38,473	XX	40,612
MICHIGAN								
Cement:								
Portland—thousand 376-pound barrels	26,745	$84,316	27,565	$86,996	28,171	$87,413	29,645	$94,515
Masonry—thousand 280-pound barrels	1,865	4,954	2,108	5,373	2,032	5,221	1,995	5,296
Clays—thousand short tons	2,385	2,592	2,402	2,580	2,450	2,620	2,466	2,636
Copper (recoverable content of ores, etc.)—short tons	69,040	45,014	71,749	50,798	73,449	53,133	58,458	44,692
Gypsum—thousand short tons	1,421	5,263	1,338	5,027	1,522	5,489	1,422	5,085
Iron ore (usable)—thousand long tons, gross weight	13,871	143,979	13,527	145,482	14,377	157,377	14,130	162,610
Lime—thousand short tons	1,430	19,246	1,095	13,057	1,701	20,016	1,787	21,582
Magnesium compounds from sea water and brine (except for metal) short tons, MgO equivalent	306,494	23,385	319,389	26,143	342,482	28,105	309,446	26,388
Natural gas—million cubic feet	31,388	7,984	34,558	8,674	34,120	8,598	33,589	8,296
Natural gas liquids:								
Natural gasoline—thousand gallons	W	W	9,054	607	15,703	1,099	47,817	3,491
LP gases—do	W	W	76,299	3,815	79,719	4,385	59,390	3,444
Peat—short tons	269,074	2,412	230,950	2,134	235,842	2,175	237,107	2,292
Petroleum (crude)—thousand 42-gallon barrels	15,601	43,839	14,728	41,091	14,273	40,913	13,664	39,455
Salt—thousand short tons	4,345	35,711	4,171	36,087	4,465	38,611	4,789	42,389
Sand and gravel—do	51,921	44,405	53,168	47,176	55,123	49,521	52,310	49,616
Silver (recoverable content of ores, etc.)—thousand troy ounces	349	452	458	592	483	625	302	468

Stone—thousand short tons	34,650	37,002	34,713	36,438	37,864	40,380	36,432	39,910
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, gem stones, iodine, potassium salts, and values indicated by symbol W	XX	54,278	XX	53,490	XX	56,446	XX	58,039
Total	XX	554,832	XX	565,560	XX	602,127	XX	610,204
MINNESOTA								
Clays [3]—thousand short tons	213	$319	207	$311	224	$336	228	$342
Iron ore (usable)—thousand long tons, gross weight	49,626	449,289	50,873	459,290	55,133	499,388	49,457	468,623
Manganiferous ore (5 to 35 percent Mn)—short tons, gross weight	188,481	W	280,705	W	275,581	W	236,753	W
Peat—short tons	19,188	405	7,346	123	11,366	197	13,968	257
Sand and gravel—thousand short tons	35,817	25,907	37,545	27,296	39,331	28,972	41,212	33,132
Stone—do	3,588	12,297	4,371	11,680	4,901	11,688	4,160	11,442
Value of items that cannot be disclosed: Abrasive stones, cement, fire clay, gem stones, lime, and values indicated by symbol W	XX	9,278	XX	9,060	XX	9,696	XX	9,530
Total	XX	497,495	XX	507,760	XX	550,277	XX	523,326
MISSISSIPPI								
Clays—thousand short tons	1,331	$6,130	1,502	$6,997	1,727	$7,489	1,654	$7,852
Natural gas—million cubic feet	180,428	31,385	166,825	28,861	156,652	27,257	139,497	24,133
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	27,485	1,644	26,582	1,606	23,765	1,483	17,939	1,167
LP gases—do	23,277	780	22,150	975	18,621	987	17,794	1,085
Petroleum (crude)—thousand 42-gallon barrels	56,777	151,595	56,183	148,437	55,227	146,353	57,147	155,726
Sand and gravel—thousand short tons	7,825	8,569	8,447	8,717	12,675	13,563	14,039	15,485
Stone—do	1,553	1,557	[4] 2,357	[4] 2,358	[4] 1,532	[4] 1,641	1,879	2,055
Value of items that cannot be disclosed: Cement, iron ore (1965–67), lime, magnesium compounds, and stone (dimension sandstone 1965–66)	XX	10,533	XX	12,082	XX	12,587	XX	9,507
Total	XX	212,193	XX	210,033	XX	211,360	XX	217,010
MISSOURI								
Asphalt, native—short tons	1,522	$13	W	W	W	W	W	W
Barite—thousand short tons	267	3,451	329	$4,219	337	$4,280	332	$4,444
Cement:								
Portland—thousand 376-pound barrels	12,378	42,618	13,334	46,034	13,848	46,228	15,044	52,119
Masonry—thousand 280-pound barrels	334	1,046	377	1,173	382	1,075	372	1,172
Clays—thousand short tons	1,966	4,874	2,226	5,439	2,329	5,989	2,305	6,220
Coal (bituminous)—do	3,254	13,285	3,564	14,779	3,582	14,834	3,696	15,573
Copper (recoverable content of ores, etc.)—short tons	2,059	1,343	2,331	1,650	3,913	2,831	3,215	2,458
Iron ore (usable)—thousand long tons, gross weight	1,116	14,907	1,784	24,607	1,887	26,450	1,871	26,673
Lead (recoverable content of ores, etc.)—short tons	120,148	31,479	133,521	41,659	132,255	39,981	152,649	42,742
Lime—thousand short tons	1,219	14,328	1,442	16,782	1,494	17,910	1,434	16,371
Natural gas—million cubic feet	107	26	84	21	----------	----------	121	30
Petroleum (crude)—thousand 42-gallon barrels	65	163	73	W	97	W	75	W
Sand and gravel—thousand short tons	11,483	13,380	12,068	13,735	10,702	13,540	9,716	12,556
Silver (recoverable content of ores, etc.)—thousand troy ounces	----------	----------	300	387	----------	----------	----------	----------
Stone—thousand short tons	31,487	47,984	36,247	53,574	35,240	53,393	36,585	53,953

See footnotes at end of table.

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

Mineral	1964 Quantity	1964 Value (thousands)	1965 Quantity	1965 Value (thousands)	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
MISSOURI—Continued								
Zinc (recoverable content of ores, etc.)—short tons	1,501	$408	4,312	$1,259	3,968	$1,151	7,430	$2,057
Value of items that cannot be disclosed: Tripoli (1965), and values indicated by symbol W	XX	---	XX	250	XX	288	XX	291
Total	XX	189,305	XX	225,568	XX	227,950	XX	236,659
MONTANA								
Clays [3]—thousand short tons	49	$59	76	$98	53	$56	46	$50
Coal (bituminous and lignite)—do	346	925	364	1,050	419	1,290	371	996
Copper (recoverable content of ores, etc.)—short tons	103,806	67,682	115,489	81,766	128,061	92,639	65,483	50,063
Gem stones	NA	W	NA	77	NA	109	NA	109
Gold (recoverable content of ores, etc.)—troy ounces	29,115	1,019	22,772	797	25,009	875	9,786	343
Iron ore (usable)—thousand long tons, gross weight	15	99	9	71	12	93	10	81
Lead (recoverable content of ores, etc.)—short tons	4,538	1,189	6,981	2,178	4,409	1,333	898	251
Lime—thousand short tons	136	1,385	159	1,512	225	2,116	143	1,765
Manganese ore (35 percent or more Mn)—short tons, gross weight	20,264	W	23,621	W	W	W	W	W
Manganiferous ore (5 to 35 percent Mn)—do	3,638	W	1,968	W	1,755	28	2,763	16
Natural gas—million cubic feet	25,051	1,965	28,105	2,305	30,685	2,547	25,866	2,173
Petroleum (crude)—thousand 42-gallon barrels	30,647	74,621	32,778	79,624	35,380	86,273	34,959	87,543
Pumice—thousand short tons	W	W	---	---	22	5	---	---
Sand and gravel—do	16,017	17,840	12,048	13,587	13,816	13,523	12,339	10,655
Silver (recoverable content of ores, etc.)—thousand troy ounces	5,290	6,840	5,207	6,733	5,320	6,878	2,066	3,203
Stone—thousand short tons	7,345	8,477	5,512	5,971	4,150	5,212	4,782	6,037
Zinc (recoverable content of ores, etc.)—short tons	29,059	7,904	33,786	9,866	29,120	8,445	3,341	925
Value of items that cannot be disclosed: Antimony (1966–67), barite (1964–66), cement, clays (fire clay 1964, bentonite), fluorspar, gypsum, natural gas liquids, peat, phosphate rock, talc, tungsten (1966–67), uranium ore (1964, 1966), vermiculite, and values indicated by symbol W	XX	r 21,448	XX	22,528	XX	23,846	XX	22,314
Total	XX	r 211,453	XX	228,163	XX	245,268	XX	186,524
NEBRASKA								
Clays—thousand short tons	143	$143	141	$141	153	$153	126	$142
Gem stones	NA	5	NA	5	NA	5	NA	5
Natural gas—million cubic feet	11,094	1,707	10,720	1,565	10,196	1,621	8,453	1,454
Natural gas liquids:								
Natural gasoline—thousand gallons	9,587	627	7,822	516	9,195	653	7,805	578
LP gases—do	24,556	1,092	16,946	847	19,670	1,141	20,738	1,223
Petroleum (crude)—thousand 42-gallon barrels	19,113	51,605	17,216	45,796	13,850	37,673	13,373	36,775
Sand and gravel—thousand short tons	14,641	15,748	11,993	13,697	13,539	14,179	11,739	10,878
Stone—do	3,779	6,417	4,198	6,637	5,055	7,916	4,846	7,483
Value of items that cannot be disclosed: Cement, lime, and pumice	XX	14,615	XX	14,622	XX	15,180	XX	12,330
Total	XX	91,959	XX	r 83,826	XX	78,521	XX	70,868

NEVADA								
Antimony ore and concentrate—short tons, antimony content	33	$20	26	$19	68	$63	53	$35
Barite—thousand short tons	149	1,261	91	583	139	933	154	923
Copper (recoverable content of ores, etc.)—short tons	67,272	43,861	71,332	50,503	78,720	56,946	50,771	38,815
Gem stones	NA	100	NA	100	NA	100	NA	100
Gold (recoverable content of ores, etc.)—troy ounces	90,469	3,166	229,050	8,017	366,903	12,842	434,993	15,225
Gypsum—thousand short tons	799	2,894	710	2,518	594	2,023	409	1,412
Iron ore (usable)—thousand long tons, gross weight	911	5,048	1,141	5,330	1,000	4,931	641	2,858
Lead (recoverable content of ores, etc.)—short tons	809	212	2,277	710	3,581	1,083	1,500	420
Mercury—76-pound flasks	3,262	1,027	3,333	1,902	3,355	1,482	4,703	2,301
Perlite—short tons	15,603	135	13,780	121	W	W	10,712	94
Petroleum (crude)—thousand 42-gallon barrels	255	W	209	W	307	W	279	W
Pumice—thousand short tons	W	W	68	187	55	190	105	236
Sand and gravel—do	14,142	14,427	9,455	11,796	9,085	9,134	10,166	8,644
Silver (recoverable content of ores, etc.)—thousand troy ounces	172	223	507	656	867	1,122	566	877
Stone—thousand short tons	788	1,396	1,248	2,247	2,002	2,519	1,375	2,145
Sulfur ore—long tons	274	5	336	6	------	------	------	------
Talc and soapstone—short tons	5,322	58	3,592	31	4,715	24	2,096	17
Zinc (recoverable content of ores, etc.)—do	582	158	3,858	1,127	5,827	1,690	3,035	840
Value of items that cannot be disclosed: Brucite (1965–67), cement (1965–67), clays, diatomite, fluorspar, lime, lithium minerals (1966–67), magnesite, molybdenum, peat, salt, tungsten, uranium (1964–66), and values indicated by symbol W	XX	r 11,152	XX	r 14,142	XX	r 17,555	XX	15,941
Total	XX	r 85,143	XX	r 99,995	XX	r 112,637	XX	90,883
NEW HAMPSHIRE								
Clays—thousand short tons	46	$40	53	$47	51	$51	42	$42
Mica, sheet—pounds	------	------	------	------	------	------	16,000	W
Peat—short tons	------	------	------	------	175	2	50	(5)
Sand and gravel—thousand short tons	8,768	4,996	10,584	5,559	7,626	4,807	8,449	5,137
Stone—do	202	2,138	153	1,932	206	2,091	473	2,887
Value of items that cannot be disclosed: Other nonmetals	XX	128	XX	127	XX	49	XX	51
Total	XX	7,302	XX	7,665	XX	7,000	XX	8,117
NEW JERSEY								
Clays—thousand short tons	500	$1,441	506	$1,388	488	$1,319	437	$1,189
Gem stones	NA	10	NA	10	NA	10	NA	10
Peat—short tons	W	W	40,480	431	36,312	489	43,045	542
Sand and gravel—thousand short tons	17,661	27,079	17,389	28,646	17,782	29,322	18,626	29,975
Stone—do	12,326	28,461	12,232	27,247	12,453	28,056	12,611	28,253
Zinc (recoverable content of ores, etc.)[9]—short tons	32,926	8,935	38,297	11,106	25,237	7,319	26,041	7,031
Value of items that cannot be disclosed: Iron ore, lime, magnesium compounds, manganiferous residuum, greensand marl, titanium concentrate, and values indicated by symbol W	XX	12,246	XX	11,330	XX	9,080	XX	5,747
Total	XX	78,172	XX	80,158	XX	75,595	XX	72,747

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEW MEXICO								
Barite—thousand short tons	W	W	(5)	$2				
Carbon dioxide, natural—thousand cubic feet	816,168	$61	833,819	62	795,885	$58	771,516	$57
Clays—thousand short tons	[3] 104	[3] 167	60	101	W	W	46	74
Coal (bituminous)—do	2,969	9,763	3,212	10,710	2,755	9,110	3,463	12,641
Copper (recoverable content of ores, etc.)—short tons	86,104	56,140	98,658	69,850	108,614	78,571	75,008	57,345
Fluorspar—do	137	3					W	W
Gem stones	NA	45	NA	45	NA	45	NA	60
Gold (recoverable content of ores, etc.)—troy ounces	6,110	214	9,641	337	9,295	325	5,188	182
Gypsum—thousand short tons	W	W	W	W	146	545	155	588
Helium, grade A—thousand cubic feet	82,105	2,958	80,583	[r] 2,821	95,900	3,357	71,200	2,492
Lead (recoverable content of ores, etc.)—short tons	1,626	426	3,387	1,057	1,596	482	1,827	512
Lime—thousand short tons	25	352	33	465	34	472	17	243
Manganese ore (35 percent or more Mn)—short tons, gross weight	5,794	149	5,637	156	W	W	W	W
Manganiferous ore (5 to 35 percent Mn)—do	46,657	300	50,090	328	47,590	324	49,323	348
Mica: Scrap—short tons	6,922	105	4,263	45	W	W	W	W
Natural gas—million cubic feet	873,947	101,932	937,205	110,590	998,076	124,760	1,067,510	138,776
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	356,047	21,570	358,487	20,824	338,732	19,736	338,114	20,730
LP gases—do	739,190	21,641	759,311	25,817	816,202	31,832	909,168	40,003
Perlite—short tons	286,329	2,568	331,011	2,905	343,334	3,423	346,586	3,424
Petroleum (crude)—thousand 42-gallon barrels	113,863	326,565	119,166	334,977	124,154	352,101	126,144	368,340
Potassium salts—thousand short tons, K_2O equivalent	2,675	104,861	2,848	117,771	2,953	108,653	2,883	91,098
Pumice—thousand short tons	260	760	264	915	245	787	220	639
Salt—do	62	559	64	572	66	716	82	1,036
Sand and gravel—do	8,781	10,160	11,763	12,130	15,503	13,029	14,672	14,336
Silver (recoverable content of ores, etc.)—thousand troy ounces	242	313	288	372	243	314	157	244
Stone—thousand short tons	2,760	4,244	1,911	3,020	2,652	4,056	1,391	2,403
Uranium (recoverable content U_3O_8)—thousand pounds	W	W	W	W	9,340	74,721	11,202	89,615
Vanadium (recoverable in ore and concentrate)—short tons	W	154	W	221	W	53	W	W
Zinc (recoverable content of ores, etc.)—do	29,833	8,115	36,460	10,646	29,296	8,496	21,380	5,919
Value of items that cannot be disclosed: Cement, fire clay (1964), iron ore, molybdenum, tin (1964–66), and values indicated by symbol W	XX	[r] 80,196	XX	[r] 79,936	XX	20,328	XX	23,001
Total	XX	[r] 754,321	XX	[r] 806,675	XX	[r] 856,294	XX	874,106
NEW YORK								
Clays—thousand short tons	1,499	$1,993	1,354	$1,717	1,464	$1,726	1,506	1,814
Emery—short tons	9,214	172	10,720	204	11,102	210	W	W
Gem stones	NA	10	NA	10	NA	10	NA	10
Gypsum—thousand short tons	653	3,321	662	3,511	559	2,998	570	3,118
Lead (recoverable content of ores, etc.)—short tons	732	192	601	188	1,097	332	1,653	463
Lime—thousand short tons	W	W	W	W	1,096	9,870	1,139	10,570
Natural gas—million cubic feet	3,108	963	3,340	1,029	2,699	837	3,837	1,201
Peat—short tons	32,574	261	25,098	232	27,211	250	23,053	232

Petroleum (crude)—thousand 42-gallon barrels	1,874	8,321	1,632	7,246	1,735	7,925	1,972	9,026
Salt—thousand short tons	4,816	34,216	5,002	35,771	4,980	36,203	5,320	41,568
Sand and gravel—do	39,282	38,583	39,225	40,370	41,903	43,091	43,500	44,499
Silver (recoverable content of ores, etc.)—thousand troy ounces	13	17	11	15	22	28	31	48
Stone—thousand short tons	29,141	46,669	30,801	48,675	34,130	54,543	33,389	56,615
Zinc (recoverable content of ores, etc.)—short tons	60,754	16,525	69,880	20,405	73,454	21,302	70,555	19,534
Value of items that cannot be disclosed: Cement, abrasive garnet, iron ore, talc, titanium concentrate, wollastonite, and values indicated by symbol W	XX	137,202	XX	130,684	XX	r 121,482	XX	110,620
Total	XX	288,445	XX	290,057	XX	r 300,807	XX	299,318
NORTH CAROLINA								
Barite—thousand short tons	------	------	------	------	------	------	1	6
Clays [3]—do	3,199	$2,064	3,383	$2,162	3,381	$2,241	2,977	2,012
Feldspar—long tons	r 281,449	r 2,342	278,990	3,153	301,610	3,157	265,690	3,113
Gem stones	NA	15	NA	15	NA	15	NA	25
Mica:								
Scrap—short tons	64,010	2,027	72,199	1,987	63,480	2,348	69,639	1,751
Sheet—pounds	242,662	58	713,293	185	4,500	1	4,500	W
Phosphate rock—thousand short tons	7	41	------	------	W	W	W	W
Sand and gravel—do	11,150	10,404	10,499	10,076	11,601	11,132	10,014	9,962
Stone—do	r 17,943	r 30,378	r 18,835	r 30,920	r 22,377	r 36,136	24,507	41,488
Talc and pyrophyllite—short tons	106,035	495	109,721	556	113,366	576	109,393	513
Value of items that cannot be disclosed: Asbestos, cement, clay (kaolin), lithium minerals, olivine, stone (crushed and dimension marble and dimension slate 1964–66), tungsten concentrate (1964), and values indicated by symbol W	XX	7,903	XX	11,329	XX	16,272	XX	18,224
Total	XX	55,727	XX	60,383	XX	71,878	XX	77,094
NORTH DAKOTA								
Clays—thousand short tons	85	$119	81	$114	r 76	$100	W	W
Coal (lignite)—do	2,637	5,659	2,732	5,848	3,543	6,976	4,156	$7,967
Gem stones	NA	1	NA	1	NA	1	NA	1
Natural gas—million cubic feet	34,512	7,634	35,652	5,704	46,585	7,547	40,462	6,636
Natural gas liquids:								
Natural gasoline—thousand gallons	21,368	1,338	21,059	1,263	23,200	1,415	23,284	1,443
LP gases—do	84,338	2,960	85,174	3,066	91,884	3,859	88,665	3,901
Petroleum (crude)—thousand 42-gallon barrels	25,731	63,813	26,350	65,875	27,126	69,170	25,315	65,818
Sand and gravel—thousand short tons	10,520	10,142	7,574	7,895	10,145	10,568	8,822	9,118
Stone—do	31	56	356	624	170	305	596	1,092
Value of items that cannot be disclosed: Lime (1965–67), molybdenum, peat, salt, uranium, vanadium (1965), and values indicated by symbol W	XX	r 1,336	XX	r 3,403	XX	r 2,327	XX	1,562
Total	XX	r 93,058	XX	r 93,793	XX	r 102,268	XX	97,538

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
OHIO								
Cement:								
Portland—thousand 376-pound barrels	15,553	$50,647	14,786	$47,499	15,181	$48,740	14,726	$46,860
Masonry—thousand 280-pound barrels	1,068	3,127	1,050	3,004	976	2,785	946	2,730
Clays—thousand short tons	5,005	14,426	5,070	14,816	5,089	14,522	4,670	15,185
Coal (bituminous)—do	37,310	137,776	39,390	146,028	43,341	164,444	46,014	176,921
Gem stones	NA	3	NA	3	NA	3	NA	3
Lime—thousand short tons	3,664	53,308	3,831	53,208	3,858	50,997	3,636	48,817
Natural gas—million cubic feet	37,106	8,880	35,684	8,421	43,133	10,223	41,315	9,957
Peat—short tons	6,363	83	5,352	80	5,214	84	7,301	100
Petroleum (crude)—thousand 42-gallon barrels	15,859	46,420	12,908	37,940	10,899	32,700	9,924	31,427
Salt—thousand short tons	4,537	31,092	5,026	34,816	5,138	35,735	5,407	39,549
Sand and gravel—do	37,771	45,567	40,852	49,305	43,851	52,909	43,196	52,888
Stone—do	[4] 37,715	[4] 61,814	42,263	66,969	45,002	72,900	45,458	72,534
Value of items that cannot be disclosed: Abrasive stone, gypsum, stone (calcareous marl 1964)	XX	1,794	XX	2,163	XX	1,998	XX	1,917
Total	XX	454,937	XX	464,252	XX	488,040	XX	498,888
OKLAHOMA								
Clays [2]—thousand short tons	835	$854	794	$806	745	$754	744	$869
Coal (bituminous)—do	1,028	5,474	974	5,520	843	4,935	823	4,703
Gypsum—do	694	1,899	761	2,343	785	2,212	804	2,266
Helium, grade A—thousand cubic feet	298,803	8,591	310,700	10,874	352,400	12,333	309,100	9,835
Lead (recoverable content of ores, etc.)—short tons	2,781	729	2,813	878	2,999	907	2,727	764
Natural gas—million cubic feet	1,316,201	166,747	1,320,995	182,297	1,351,225	189,172	1,412,952	202,052
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	554,053	34,011	570,129	34,561	576,124	35,715	568,905	35,846
LP gases—do	880,804	28,055	894,665	32,208	986,254	44,381	1,005,633	49,276
Petroleum (crude)—thousand 42-gallon barrels	202,524	587,320	203,441	587,944	224,839	654,281	230,749	676,095
Salt—thousand short tons	6	41	9	65	W	W	10	76
Sand and gravel—do	6,680	7,003	5,218	6,023	6,040	7,565	4,540	5,280
Stone—do	13,987	15,087	16,417	18,071	15,334	17,393	16,355	18,932
Zinc (recoverable content of ores, etc.)—short tons	12,159	3,307	12,715	3,713	11,237	3,259	10,670	2,954
Value of items that cannot be disclosed: Clay (bentonite), cement, copper (1965–67), lime, pumice, silver (1965–67), tripoli, and values indicated by symbol W	XX	22,670	XX	23,953	XX	24,484	XX	23,178
Total	XX	881,788	XX	909,256	XX	997,391	XX	1,032,126
OREGON								
Clays—thousand short tons	290	$356	291	$359	361	$362	[3] 295	[3] $295
Copper (recoverable content of ores, etc.)—short tons	15	10	W	W	W	W	108	2
Diatomite—do	W	W	W	W	W	W		

Gem stones	NA	W	NA	750	NA	750	NA	750
Gold (recoverable content of ores, etc.)—troy ounces	661	23	499	17	281	10	186	7
Lime—thousand short tons	95	1,918	98	1,853	116	2,283	99	2,059
Mercury—76-pound flasks	126	40	1,364	779	700	309	943	461
Nickel (content of ore and concentrate)—short tons	15,420	W	16,188	W	15,036	W	15,287	W
Peat—do	----	----	----	----	900	17	W	W
Perlite—do	5	(5)	----	----	W	W	8	(5)
Pumice—thousand short tons	566	909	657	1,181	714	1,256	834	1,195
Sand and gravel—do	18,253	25,158	21,800	32,849	35,327	34,986	19,630	25,250
Silver (recoverable content of ores, etc.)—thousand troy ounces	14	19	9	11	(5)	(5)	(5)	(5)
Stone—thousand short tons	16,120	19,296	21,212	27,301	33,288	48,335	13,201	20,256
Tungsten concentrate—short tons, 60-percent WO_3 basis	1	1	----	----	----	----	----	----
Value of items that cannot be disclosed: Cement, clay (fire clay 1967), iron ore (pigment material 1965–66), lead (1964–65), talc (1967), uranium (1964), vanadium (1964), zinc (1964–65), and values indicated by symbol W	XX	r 16,634	XX	r 17,866	XX	19,176	XX	16,285
Total	XX	r 64,364	XX	82,966	XX	107,484	XX	66,560
PENNSYLVANIA								
Cement:								
Portland—thousand 376-pound barrels	37,663	$113,409	40,153	$116,925	40,004	$114,357	40,197	$114,592
Masonry—thousand 280-pound barrels	2,818	7,594	3,006	7,991	2,960	7,860	2,929	7,948
Clays [8]—thousand short tons	3,187	15,814	3,394	17,697	3,293	17,033	2,994	16,703
Coal:								
Anthracite—do	17,184	148,648	14,866	122,021	12,941	100,663	12,256	96,160
Bituminous—do	76,531	388,218	80,308	407,267	81,443	425,168	79,412	419,345
Copper (recoverable content of ores, etc.)—short tons	3,614	2,356	4,354	3,083	3,178	2,299	4,401	3,365
Gem stones	NA	4	NA	4	NA	4	NA	4
Lime—thousand short tons	1,440	20,656	1,568	22,496	1,585	22,816	1,719	24,715
Natural gas—million cubic feet	81,720	22,349	84,461	22,551	90,914	25,820	89,966	25,280
Natural gas liquids:								
Natural gasoline—thousand gallons	1,138	64	1,022	55	3,211	186	1,167	77
LP gases—do	1,481	100	1,683	109	1,863	121	1,757	114
Peat—short tons	39,500	397	45,600	527	52,912	562	39,505	437
Petroleum (crude)—thousand 42-gallon barrels	5,113	22,088	4,922	21,263	4,337	19,300	4,387	19,701
Sand and gravel—thousand short tons	16,199	26,414	18,502	29,606	17,567	29,562	17,479	29,614
Stone—do	52,829	91,075	56,806	99,627	59,088	99,233	60,155	103,157
Zinc (recoverable content of ores, etc.) [9]—short tons	30,754	8,345	27,635	8,014	28,080	8,143	35,067	9,468
Value of items that cannot be disclosed: Clays (kaolin), cobalt, gold, iron ore, scrap mica, pyrites, pyrophyllite, silver, and tripoli	XX	34,519	XX	34,587	XX	30,281	XX	27,718
Total	XX	902,050	XX	913,823	XX	903,408	XX	898,398
RHODE ISLAND								
Sand and gravel—thousand short tons	1,647	$1,613	1,681	$1,811	2,276	$2,212	2,334	2,416
Stone—do	450	935	437	1,119	535	1,734	481	1,618
Value of items that cannot be disclosed: Other nonmetals	XX	1	XX	1	XX	1	XX	1
Total	XX	2,549	XX	2,931	XX	3,947	XX	4,035

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
SOUTH CAROLINA								
Clays—thousand short tons	1,743	$8,309	1,837	$8,539	2,139	$8,830	1,733	8,048
Sand and gravel—do	4,622	5,262	5,248	6,688	6,016	7,668	5,248	7,178
Stone—do	[4] 6,109	[4] 9,176	[4] 5,948	[4] 8,447	8,129	12,510	[4] 8,310	[4] 12,366
Value of items that cannot be disclosed: Barite (1964–66), cement, feldspar, kyanite, scrap mica, peat, pyrites, stone (crushed limestone 1964–65 and dimension granite 1965, 1967), and vermiculite	XX	15,966	XX	17,587	XX	16,585	XX	20,682
Total	XX	38,713	XX	41,261	XX	45,593	XX	48,274
SOUTH DAKOTA								
Beryllium concentrate—short tons, gross weight	W	W	W	W	124	$40	W	W
Cement:								
Portland—thousand 376-pound barrels	2,001	$6,873	1,575	$5,127	1,974	6,367	1,406	$4,815
Masonry—thousand 280-pound barrels	57	200	55	180	51	170	54	178
Clays—thousand short tons	245	1,076	223	1,220	231	870	199	799
Coal (lignite)—do	13	63	10	49	10	45	5	27
Feldspar—long tons	26,980	180	51,560	346	[r] 53,810	[r] 369	61,411	420
Gem stones	NA	20	NA	20	NA	20	NA	30
Gold (recoverable content of ores, etc.)—troy ounces	616,913	21,592	628,259	21,989	606,467	21,226	601,785	21,062
Gypsum—thousand short tons	19	76	7	27	17	68	12	49
Lithium minerals—short tons	W	W	150	[e] 5	W	W	W	W
Mica: Scrap—do	996	32	W	W	W	W	W	W
Petroleum (crude)—thousand 42-gallon barrels	247	495	219	438	239	479	211	502
Sand and gravel—thousand short tons	13,770	13,641	13,998	14,155	13,630	13,585	13,463	13,737
Silver (recoverable content of ores, etc.)—thousand troy ounces	133	172	129	167	110	142	121	188
Stone—thousand short tons	2,118	6,245	1,554	5,387	2,186	7,995	1,866	9,694
Value of items that cannot be disclosed: Columbium-tantalum concentrates (1967), lime, molybdenum, tin (1966), uranium, vanadium, and values indicated by symbol W	XX	[r] 3,882	XX	[r] 1,553	XX	[r] 1,796	XX	1,117
Total	XX	[r] 54,547	XX	[r] 50,663	XX	[r] 53,172	XX	52,618
TENNESSEE								
Barite—thousand short tons	39	$519	31	$442	29	$412	15	$235
Cement:								
Portland—thousand 376-pound barrels	8,343	26,791	8,724	27,535	8,177	25,718	8,062	25,548
Masonry—thousand 280-pound barrels	1,212	3,228	1,185	3,140	1,095	2,822	1,092	2,992
Clays—thousand short tons	[3] 1,310	[3] 5,576	1,495	6,103	[3] 1,359	[3] 4,909	1,574	5,152
Coal (bituminous)—do	5,990	22,674	5,865	20,930	6,309	23,763	6,832	26,974
Copper (recoverable content of ores, etc.)—short tons	13,889	9,056	14,823	10,495	15,410	11,148	14,600	11,162
Gold (recoverable content of ores, etc.)—troy ounces	133	5	122	4	141	5	181	6
Lead (recoverable content of ores, etc.)—short tons	----------	----------	----------	----------	181	55	----------	----------
Natural gas—million cubic feet	77	15	85	16	----------	----------	58	11

Petroleum (crude)—thousand 42-gallon barrels	10	W	11	W	7	W	7	W
Phosphate rock—thousand short tons	2,734	18,971	2,954	22,296	3,125	23,886	2,992	22,571
Sand and gravel—do	7,972	10,245	8,193	10,690	8,628	11,142	7,975	10,679
Silver (recoverable content of ores, etc.)—thousand troy ounces	91	117	94	122	101	130	130	202
Stone [4]—thousand short tons	26,497	38,239	28,888	38,859	31,260	41,432	31,463	41,958
Zinc (recoverable content of ores, etc.)—short tons	115,943	31,536	122,387	35,737	103,117	29,904	113,065	31,303
Value of items that cannot be disclosed: Clay (fuller's earth) (1964, 1966–67), lime, pyrites, stone (crushed sandstone, dimension sandstone 1967), and values indicated by symbol W	XX	6,993	XX	6,572	XX	7,258	XX	10,779
Total	XX	173,965	XX	182,941	XX	182,584	XX	189,572
TEXAS								
Cement:								
Portland—thousand 376-pound barrels	30,030	$94,492	30,820	$97,598	30,827	$97,188	31,944	99,329
Masonry—thousand 280-pound barrels	930	2,805	968	3,011	884	2,872	888	2,847
Clays—thousand short tons	[3] 4,156	[3] 6,695	4,469	6,865	4,516	7,187	4,497	8,081
Gem stones	NA	140	NA	150	NA	150	NA	150
Gypsum—thousand short tons	1,131	4,049	1,045	3,794	899	3,258	984	3,419
Helium: Crude—thousand cubic feet	1,026,504	10,381	1,015,708	10,330	1,030,500	10,605	977,600	10,246
Grade A—do	358,747	11,107	350,000	12,250	364,100	12,744	335,900	9,900
Lime—thousand short tons	1,350	17,201	1,338	19,663	1,473	18,696	1,564	20,713
Natural gas—million cubic feet	6,490,202	809,180	6,636,555	858,396	6,953,790	903,993	7,188,900	948,935
Natural gas liquids:								
Natural gasoline and cycle products—thousand gallons	3,512,460	232,245	3,772,471	256,959	3,890,267	269,332	4,031,589	277,105
LP gases—do	5,521,236	167,492	5,847,601	204,666	6,359,870	260,755	7,449,439	320,326
Perlite—short tons	300	3	1,000	8	W	W	W	W
Petroleum (crude)—thousand 42-gallon barrels	989,525	2,928,994	1,000,749	2,962,119	1,057,706	3,141,387	1,119,962	3,375,565
Salt—thousand short tons	6,410	28,797	6,964	30,771	7,724	33,797	8,344	36,435
Sand and gravel—do	29,155	33,394	32,649	36,075	26,222	31,313	31,398	39,170
Stone—do	40,240	52,070	39,520	53,659	43,578	56,659	49,424	61,577
Sulfur (Frasch process)—thousand long tons	3,302	65,780	3,674	83,282	3,703	96,820	3,448	111,931
Talc and soapstone—short tons	89,334	395	64,211	204	102,399	367	90,836	356
Values of items that cannot be disclosed: Native asphalt, barite (1964–66), bromine, clays (fuller's earth 1964–65, kaolin 1964), coal (lignite), graphite, iron ore, magnesium chloride (for metal), magnesium compounds (except for metal), mercury (1965–67), pumice, sodium sulfate, uranium, vermiculite (1967), and values indicated by symbol W	XX	r 85,125	XX	r 79,026	XX	r 74,918	XX	80,286
Total	XX	r 4,550,345	XX	r 4,718,826	XX	r 5,022,041	XX	5,406,371
UTAH								
Carbon dioxide, natural—thousand cubic feet	96,432	$7	86,201	$6	94,006	$7	65,664	$5
Clays [3]—thousand short tons	127	330	149	332	89	r 240	114	288
Coal (bituminous)—do	4,720	33,184	4,992	31,811	4,635	26,763	4,175	24,281
Copper (recoverable content of ores, etc.)—short tons	199,588	130,131	259,138	183,470	265,383	191,978	168,609	128,905
Gem stones	NA	75	NA	75	NA	75	NA	80
Gold (recoverable content of ores, etc.)—troy ounces	287,674	10,069	426,299	14,921	438,736	15,356	288,350	10,092
Iron ore (usable)—thousand long tons, gross weight	2,082	14,306	2,139	14,229	1,956	13,478	1,708	11,916
Lead (recoverable content of ores, etc.)—short tons	40,249	10,545	37,700	11,762	64,124	19,385	53,813	15,068

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
UTAH—Continued								
Lime—thousand short tons	163	$2,917	189	$3,470	200	$3,640	169	$3,182
Natural gas—million cubic feet	79,739	10,904	71,616	8,952	69,366	8,809	48,965	6,463
Perlite—short tons	2,003	12	W	W	W	W	W	W
Petroleum (crude)—thousand 42-gallon barrels	28,575	74,867	25,298	66,045	24,112	63,760	24,048	63,221
Salt—thousand short tons	371	3,848	384	3,591	427	3,770	403	3,525
Sand and gravel—do	10,218	10,405	10,032	10,464	12,368	12,937	9,412	8,631
Silver (recoverable content of ores, etc.)—thousand troy ounces	4,552	5,886	5,636	7,287	7,755	10,028	4,875	7,556
Stone—thousand short tons	3,105	6,930	r 2,328	r 4,765	2,246	4,269	1,831	4,108
Sulfur ore—long tons, gross weight	--------	--------	2,156	3	--------	--------	--------	--------
Uranium (recoverable content (U_3O_8))—thousand pounds	W	W	W	W	1,225	9,797	1,287	10,300
Vanadium (recoverable in ore and concentrate)—short tons	405	1,214	387	1,353	353	1,519	471	2,024
Zinc (recoverable content of ores, etc.)—do	31,428	8,548	27,747	8,102	37,323	10,824	34,251	9,483
Value of items that cannot be disclosed: Asphalt (gilsonite), cement, clays (fire clay, kaolin 1965–67), fluorspar, gypsum, magnesium compounds (1966–67), molybdenum, natural gas liquids, phosphate rock, potassium salts, pumice, pyrites (1966–67), tungsten concentrate (1967), and values indicated by symbol W	XX	r 87,271	XX	r 68,510	XX	52,243	XX	45,349
Total	XX	r 411,449	XX	r 439,148	XX	r 448,878	XX	354,477
VERMONT								
Peat—short tons	286	$4	780	$3	333	$5	280	$4
Sand and gravel—thousand short tons	1,764	1,494	2,084	1,670	2,323	1,744	3,718	2,178
Stone—do	2,070	20,652	2,591	21,564	2,650	19,926	2,761	20,520
Value of items that cannot be disclosed: Asbestos, clays, gem stones, lime, and talc	XX	3,977	XX	4,155	XX	4,235	XX	4,566
Total	XX	26,127	XX	27,392	XX	25,910	XX	27,268
VIRGINIA								
Clays—thousand short tons	1,440	$1,614	1,415	$1,657	1,486	$1,813	1,382	$1,623
Coal (bituminous)—do	31,654	123,123	34,053	139,291	35,565	153,341	36,721	171,183
Gem stones	NA	6	NA	7	NA	7	NA	7
Lead (recoverable content of ores, etc.)—short tons	3,857	1,010	3,651	1,139	3,078	930	3,430	960
Lime—thousand short tons	780	9,781	847	10,584	840	10,486	829	10,345
Natural gas—million cubic feet	1,600	479	3,152	942	4,249	1,275	3,818	1,149
Petroleum (crude)—thousand 42-gallon barrels	6	W	4	W	1	W	3	W
Sand and gravel—thousand short tons	10,588	13,722	15,322	18,019	17,191	16,635	9,863	12,494
Soapstone—short tons	3,775	9	3,549	9	3,989	10	W	W
Stone—thousand short tons	30,407	52,153	36,350	59,397	34,151	55,550	31,324	52,470
Zinc (recoverable content of ores, etc.)[9]—short tons	21,004	5,700	20,491	5,942	17,666	5,123	18,846	5,088
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	29,818	XX	30,990	XX	29,127	XX	28,366
Total	XX	237,415	XX	267,977	XX	274,297	XX	283,685

WASHINGTON								
Barite—thousand short tons	--------	--------	(5)	$1	--------	--------	(5)	$1
Carbon dioxide—thousand cubic feet	W	W	11,848	3	W	W	W	W
Cement:								
Portland—thousand 376-pound barrels	W	W	6,258	22,351	6,820	$24,340	5,614	20,581
Masonry—thousand 280-pound barrels	W	W	62	201	60	187	65	200
Clay [3]—thousand short tons	128	$119	162	211	185	249	139	203
Coal (bituminous)—do	68	575	55	497	59	514	59	517
Copper (recoverable content of ores, etc.)—short tons	35	23	30	21	34	25	21	16
Gem stones	NA	W	NA	75	NA	75	NA	75
Lead (recoverable content of ores, etc.)—short tons	5,731	1,502	6,328	1,974	5,859	1,771	2,762	773
Peat—do	35,609	170	29,729	131	25,599	136	40,608	181
Sand and gravel—thousand short tons	31,920	25,971	31,301	27,234	29,002	26,806	28,164	27,520
Stone—do	10,498	15,204	12,461	17,446	13,250	20,273	14,454	19,099
Talc and soapstone—short tons	2,680	18	2,861	17	3,880	22	4,916	26
Zinc (recoverable content of ores, etc.)—do	24,296	6,609	22,230	6,491	24,772	7,184	21,540	5,964
Value of items that cannot be disclosed: Clays (fire clay, bentonite 1965), diatomite, gold, gypsum (1966–67), lime, pumice, magnesite, mercury (1965), olivine, silver, tungsten (1965, 1967), uranium (1964–66), vanadium (1966), and values indicated by symbol W	XX	r 34,236	XX	r 11,011	XX	r 7,514	XX	6,911
Total	XX	r 84,427	XX	r 87,664	XX	r 89,096	XX	82,067
WEST VIRGINIA								
Clays [3]—thousand short tons	261	$309	289	$328	300	$334	245	$254
Coal (bituminous)—do	141,409	693,572	149,191	726,096	149,681	753,851	153,749	800,683
Lime—do	W	W	W	W	240	3,492	217	3,099
Natural gas—million cubic feet	202,765	50,968	207,416	48,743	211,610	49,940	211,460	50,962
Petroleum (crude)—thousand 42-gallon barrels	3,370	12,975	3,530	13,591	3,674	14,623	3,561	14,244
Salt—thousand short tons	1,033	3,666	1,153	5,539	1,147	5,446	1,127	5,137
Sand and gravel—do	5,472	11,555	5,253	11,480	5,448	11,569	5,827	12,167
Stone [4]—do	7,481	13,105	8,482	14,587	9,738	16,354	9,445	16,447
Value of items that cannot be disclosed: Calcium-magnesium chloride, cement, clay (fire clay), gem stones, natural gas liquids, stone (dimension sandstone) and values indicated by symbol W	XX	36,541	XX	39,240	XX	36,191	XX	34,865
Total	XX	822,691	XX	859,604	XX	891,800	XX	937,858
WISCONSIN								
Clays—thousand short tons	119	$147	119	$147	123	$148	89	$112
Iron ore (usable)—thousand long tons, gross weight	524	W	141	W	--------	--------	--------	--------
Lead (recoverable content of ores, etc.)—short tons	1,742	456	1,645	513	1,694	512	1,596	447
Lime—thousand short tons	W	W	197	3,076	204	3,186	212	3,414
Peat—short tons	3,261	136	3,090	122	2,379	164	1,823	W
Sand and gravel—thousand short tons	34,348	24,695	38,751	27,707	41,523	30,713	42,542	32,955
Stone—thousand short tons	13,901	20,232	15,344	21,924	16,150	23,735	17,122	24,863
Zinc (recoverable content of ores, etc.)—short tons	26,278	7,148	26,993	7,882	24,775	7,185	28,953	8,016
Value of items that cannot be disclosed: Abrasive stones, cement, gem stones, and values indicated by symbol W	XX	17,193	XX	11,628	XX	10,367	XX	9,805
Total	XX	70,007	XX	72,999	XX	76,010	XX	79,612

See footnotes at end of table.

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

Mineral	1964		1965		1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
WYOMING								
Clays—thousand short tons	1,271	$12,816	1,352	$13,633	1,559	$15,874	1,495	$14,313
Coal (bituminous)—do	3,101	9,774	3,260	10,150	3,670	11,840	3,588	11,876
Copper (recoverable content of ores, etc.)—short tons	5	3	6	4	---	---	---	---
Gem stones	NA	120	NA	120	NA	120	NA	125
Gold (recoverable content of ores, etc.)—troy ounces	6	(5)	3	(5)	---	---	---	---
Iron ore (usable)—thousand long tons, gross weight	2,056	24,543	2,087	25,198	1,978	19,700	1,854	19,186
Natural gas—million cubic feet	231,613	29,808	235,849	31,840	243,381	35,290	240,074	35,051
Natural gas liquids:								
Natural gasoline—thousand gallons	86,803	5,607	95,093	6,195	96,372	6,281	99,180	6,447
LP gases—do	152,982	6,433	143,331	6,020	166,080	7,308	173,821	7,648
Petroleum (crude)—thousand 42-gallon barrels	138,752	351,043	138,314	345,785	134,470	344,243	136,312	351,685
Sand and gravel—thousand short tons	5,632	5,936	7,996	8,373	7,187	7,496	8,181	8,253
Stone—do	2,154	3,671	1,594	2,791	1,393	2,560	1,246	2,375
Uranium (recoverable content U_3O_8)—thousand pounds	W	W	W	W	4,593	36,741	4,655	37,243
Vanadium (recoverable in ore and concentrate)—short tons	W	359	W	444	W	555	W	W
Value of items that cannot be disclosed; Beryllium concentrate (1964–65), cement, feldspar (1965–67), gypsum, lime, phosphate rock, pumice (1964, 1967), silver (1964–65), sodium carbonates and sulfates, vermiculite (1967), and values indicated by symbol W	XX	r 79,835	XX	r 64,901	XX	36,379	XX	36,494
Total	XX	r 529,948	XX	r 515,454	XX	r 524,387	XX	530,696

e Estimate. 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] Less than ½ unit.

[6] Final figure, supersedes figure given in commodity section volume I–II.

[7] Excludes shipments from Nye Metals, Inc., included with "Value of items that cannot be disclosed."

[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		1964		1965		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
American Samoa:									
Pumice	thousand short tons	------	------	------	------	17	$22	28	24
Sand and gravel	do	22	$20	60	$55	20	18	7	7
Stone	do	157	234	60	60	12	12	28	50
Total		XX	254	XX	115	XX	52	XX	81
Canal Zone:									
Sand and gravel	thousand short ton	84	82	83	85	72	91	56	94
Stone (crushed)	do	153	349	153	366	114	267	100	245
Total		XX	431	XX	451	XX	358	XX	339
Canton: Stone (crushed)	thousand short tons	------	------	------	------	------	------	------	------
Guam: Stone	do	469	868	483	925	900	1,396	511	820
Virgin Islands: Stone (crushed)	do	69	342	68	302	88	303	183	851
Wake: Stone (crushed)	do	2	5	1	4	11	66	31	150

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Production data for Canton and Wake furnished by U.S. Department of 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		1964		1965		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement	thousand 376-pound barrels	7,926	$23,879	7,284	$23,415	7,603	$24,277	8,447	$27,397
Clays	thousand short tons	341	271	357	288	350	271	291	244
Lime	do	18	574	27	867	30	960	35	1,106
Salt	do	5	74	8	138	11	183	12	195
Sand and gravel	do	7,816	11,492	8,147	12,405	9,879	14,554	14,101	21,633
Stone	do	5,504	8,586	5,344	9,111	5,732	10,541	7,269	12,795
Total		XX	44,876	XX	46,224	XX	50,786	XX	63,370

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

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

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals:				
Aluminum:				
Ingots, slabs, crude—short tons	188,240	$90,012	209,009	$99,961
Scrap—do	48,666	16,239	54,531	17,686
Plates, sheets, bars, etc—do	86,396	71,272	96,275	70,757
Castings and forgings—do	2,524	8,592	2,816	11,173
Antimony: Metals and alloys, crude—short tons	29	24	82	75
Bauxite, including bauxite concentrates—thousand long tons	62	4,275	2	218
Aluminum sulfate—short tons	22,059	652	16,173	531
Other aluminum compounds—do	353,364	37,374	578,627	51,075
Beryllium—pounds	61,254	1,083	76,117	530
Bismuth: Metals and alloys—do	89,382	226	152,684	395,695
Cadmium—thousand pounds	379	795	691	1,669
Chrome:				
Ore and concentrate:				
Exports—thousand short tons	19	740	8	328
Reexports—do	173	7,119	157	5,422
Chromic acid	1	482	1	392
Ferrochrome	r 8	1,870	13	3,479
Cobalt—thousand pounds	1,021	1,822	1,498	2,367
Columbium metals, alloys and other forms—thousand pounds	7	249	6	341
Copper:				
Ore, concentrate, composition metal and unrefined (copper content)—short tons	2,149	927	59,692	32,951
Refined copper and semimanufactures—short tons	319,314	338,184	200,078	213,604
Other copper manufactures—do	6,934	7,804	6,570	7,472
Copper sulfate or blue vitriol—do	3,563	1,725	979	776
Copper base alloys—do	56,311	60,069	78,213	75,809
Ferroalloys:				
Ferrosilicon—do	5,812	2,004	11,774	3,228
Ferrophosphorous—do	62,942	2,975	22,901	847
Gold:				
Ore and base bullion—troy ounces	49,117	1,719	112,578	3,940
Bullion, refined—do	13,017,549	455,614	28,607,404	1,001,259
Iron ore—thousand long tons	7,779	92,157	5,943	71,585
Iron and steel:				
Pig iron—short tons	12,122	731	7,451	319
Iron and steel products (major):				
Semimanufactures—short tons	1,375,166	281,887	1,377,676	272,160
Manufactured steel mill products—short tons	r 769,153	r 390,217	701,400	383,201
Advanced products	NA	r 203,659	NA	201,938
Iron and steel scrap: Ferrous scrap, including rerolling materials—short tons	5,880,925	177,461	7,666,630	251,236
Lead:				
Pigs, bars, anodes—do	5,435	3,966	6,536	4,767
Scrap—do	498	165	394	198
Magnesium:				
Metal and alloys and semimanufactured forms, n.e.c—short tons	15,448	10,240	13,173	9,115
Manganese:				
Ore and concentrate—do	16,487	1,491	15,375	1,502
Ferromanganese—do	545	228	1,861	760
Mercury:				
Exports—76-pound flasks	357	197	2,627	1,281
Reexports—do	476	280	475	193
Molybdenum:				
Ore and concentrates (molybdenum content)—thousand pounds	29,768	54,765	30,000	51,434
Metals and alloys, crude and scrap—thousand pounds	59	251	50	131
Wire—do	19	624	34	661
Semifabricated forms, n.e.c.—thousand pounds	72	398	292	702
Powder—do	120	502	241	434
Ferromolybdenum—do	2,200	4,085	1,533	2,436
Nickel:				
Alloys and scrap (including Monel metal), ingots, bars, sheets, etc—short tons	r 21,458	r 38,631	26,169	53,225
Catalysts—do	3,135	6,589	3,441	9,387
Nickel-chrome electric resistance wire—short tons	475	2,203	565	2,530
Semifabricated forms, n.e.c—do	1,319	4,661	1,362	5,587

See footnotes at end of table.

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

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Metals—Continued				
Platinum:				
Ore, concentrate, metal and alloys in ingots, bars, sheets, anodes, and other forms, including scrap—troy ounces	102,031	$13,414	161,585	$19,248
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys including scrap)—troy ounces	103,425	6,711	118,017	9,723
Platinum group manufactures, except jewelry	NA	3,794	NA	2,378
Rare earths:				
Cerium ore, metal, alloys and lighter flints—pounds	61,620	209	141,338	303
Silver:				
Ore and base bullion—thousand troy ounces	369	476	2,365	4,242
Bullion, refined—do	85,169	110,057	68,404	91,718
Tantalum:				
Ore, metal, and other forms—thousand pounds	198	1,798	134	1,724
Powder—do	51	1,564	157	1,839
Tin:				
Ingots, pigs, bars, etc:				
Exports—long tons	1,866	6,985	2,050	6,962
Reexports—do	981	3,849	429	1,412
Tin scrap and other tin-bearing material except tinplate scrap—long tons	7,233	1,957	2,957	1,490
Titanium:				
Ore and concentrate—short tons	1,300	213	3,027	167
Sponge (including iodide titanium and scrap—short tons	1,733	1,988	1,429	1,703
Intermediate mill shapes and mill products, n.e.c.—short tons	1,371	9,585	1,811	13,344
Dioxide and pigments—do	26,872	7,601	25,852	7,165
Tungsten: Ore and concentrates:				
Exports—do	98	223	944	2,932
Reexports—do	195	557	269	576
Vanadium ore and concentrate, pentoxide, etc. (vanadium content)—thousand pounds	1,771	4,226	1,575	4,043
Zinc:				
Slabs, pigs, or blocks—short tons	1,406	749	16,809	4,287
Sheets, plates, strips, or other forms, n.e.c.—short tons	4,921	3,198	3,565	2,709
Scrap (zinc content)—do	4,469	702	1,665	530
Semifabricated forms, n.e.c.—do	r 3,034	r 1,894	2,161	1,177
Zirconium:				
Ore and concentrate—do	2,311	326	2,729	360
Metals and alloys and other forms—pounds	421,516	4,567	637,612	6,909
Nonmetals:				
Abrasives:				
Dust and powder of precious or semiprecious stones, including diamond dust and powder—thousand carats	2,403	6,815	4,317	12,526
Crushing bort—do	58	325	18	210
Industrial diamonds—do	1,097	4,470	148	924
Diamond grinding wheels—do	436	3,331	429	2,946
Other natural and artificial, metallic abrasives and products	NA	36,812	NA	34,290
Asbestos: Unmanufactured:				
Exports—short tons	46,690	5,712	47,356	5,951
Reexports—do	306	51	362	74
Boron: Boric acid, borates, crude and refined—short tons	207,359	20,682	186,482	18,710
Cement—thousand 376-pound barrels	1,069	4,836	980	4,452
Clays:				
Kaolin or china clay—short tons	253,408	8,443	321,929	9,921
Fire clay—do	215,534	3,396	176,367	2,789
Other clays—do	605,625	19,354	651,366	19,853
Fluorspar—do	5,732	301	10,345	517
Graphite—do	3,161	428	3,569	460
Gypsum:				
Crude, crushed or calcines—thousand short tons	38	1,458	39	1,707
Manufactures, n.e.c.	NA	1,216	NA	1,211
Kyanite and allied minerals—short tons	17,339	1,131	21,428	1,408
Lime—do	59,848	1,195	52,143	1,099
Mica sheet, waste and scrap and ground—pounds	10,810,194	929	14,301,524	781
Manufactured—do	537,556	1,612	526,690	1,753

See footnotes at end of table.

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

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Nonmetals—Continued				
Mineral-earth pigments: Iron oxide, natural and manufactured—short tons	4,753	$1,307	3,123	$1,312
Nitrogen compounds (major)—thousand short tons	2,794	154,559	2,911	165,008
Phosphate rock—do	9,255	85,835	10,282	94,413
Phosphatic fertilizers (superphosphates)—thousand short tons	763	40,705	743	35,139
Pigments and compounds (lead and zinc):				
Lead pigments—short tons	2,599	1,044	1,909	772
Zinc pigments—do	6,650	1,733	4,175	1,331
Potash:				
Fertilizer—do	1,024,996	32,867	1,146,131	35,010
Chemical—do	28,489	5,292	29,060	4,886
Quartz, natural, quartzite, cryolite and chiolite—short tons	2,779	472	1,228	285
Salt:				
Crude and refined—thousand short tons	662	4,472	678	4,583
Shipments to noncontiguous Territories—thousand short tons	10	805	11	892
Sodium and sodium compounds:				
Sodium sulfate—thousand short tons	28	779	28	856
Sodium carbonate—do	346	12,249	304	9,914
Stone				
Dolomite, block—do	101	1,692	113	1,756
Limestone, crushed, ground, broken—thousand short tons	1,207	3,500	1,159	3,496
Marble and other building and monumental—thousand cubic feet	NA	1,104	NA	958
Stone, crushed, ground, broken—thousand short tons	276	3,406	306	3,743
Manufactures of stone	NA	1,432	NA	1,203
Sulfur:				
Crude—thousand long tons	2,326	78,759	2,043	81,492
Crushed, ground, flowers of—thousand long tons	47	3,404	150	9,522
Talc, crude and ground—short tons	70,377	3,917	66,195	3,450
Fuels:				
Carbon black—pounds	297,281	28,407	236,032	24,456
Coal:				
Anthracite—thousand short tons	766	9,755	595	7,622
Bituminous—do	49,302	457,899	49,510	474,853
Briquets—do	120	2,182	120	2,293
Coke—do	1,102	23,415	710	16,492
Petroleum:				
Crude—thousand barrels	1,478	4,130	26,502	85,565
Gasoline—do	2,369	14,274	3,603	19,106
Jet—do	118	548	283	1,142
Naphtha—do	1,982	22,232	2,299	21,999
Kerosine—do	249	2,214	158	1,252
Distillate oil—do	6,251	18,407	6,054	17,650
Residual oil—do	13,275	29,102	22,148	43,793
Lubricating oil—do	14,767	189,648	17,746	208,358
Asphalt—do	434	3,705	348	3,167
Liquefied petroleum gases—do	8,171	30,007	9,269	32,182
Wax—do	1,877	36,028	1,677	34,077
Coke—do	16,235	49,604	16,279	55,187
Petrochemical feedstocks—do	2,698	14,894	2,983	15,344
Miscellaneous—do	1,357	37,074	893	19,455

r Revised. NA Not available.

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

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Metals:				
Aluminum:				
Metal—short tons	r 521,021	r $217,013	449,716	$194,995
Scrap—do	33,616	10,782	30,489	10,040
Plates, sheets, bars, etc—do	r 124,023	r 76,852	58,341	40,243
Antimony:				
Ore (antimony content)—do	12,460	4,754	10,517	4,090
Needle or liquated—do	63	42	29	18
Metal—do	2,767	2,031	2,654	1,849
Oxide—do	5,383	3,998	5,098	3,762
Arsenic: White (AS_2O_3 content)—do	18,675	1,477	27,075	2,503
Bauxite: Crude—thousand long tons	11,529	147,335	11,673	151,418
Beryllium ore—short tons	2,147	581	9,511	3,167
Bismuth (general imports)—pounds	1,681,472	6,243	1,379,729	5,172
Boron carbide—do	183,321	513	214,620	469
Cadmium:				
Metal—thousand pounds	3,358	6,813	1,587	3,817
Flue dust (cadmium content)—do	1,181	989	1,166	1,093
Calcium:				
Metal—pounds	85,941	72	423,631	370
Chloride—short tons	r 2,499	r 81	4,385	158
Chromate:				
Ore and concentrates (Cr_2O_3 content) thousand short tons	841	30,379	568	21,854
Ferrochrome (chromium content)—do	66	22,076	39	13,758
Metal—do	2	3,739	1	1,842
Cobalt:				
Metal—thousand pounds	17,871	27,734	7,946	14,420
Oxide (gross weight)—do	1,279	1,411	1,044	1,670
Salts and compounds (gross weight) thousand pounds	150	81	167	200
Columbium ore—do	9,278	5,678	7,431	5,266
Copper: (copper content)				
Ore and concentrates—short tons	6,843	4,118	35,673	28,820
Regulus, black, coarse—do	117	85	2	35
Unrefined, black, blister—do	337,955	272,996	272,728	218,430
Refined in ingots, etc—do	77,783	63,654	332,065	311,164
Old and scrap—do	23,908	24,662	16,655	14,731
Old and clippings—do	5,056	5,846	2,549	2,479
Ferroalloys: Ferrosilicon (silicon content) short tons	13,133	4,610	15,337	4,456
Gold:				
Ore and base bullion—troy ounces	333,119	11,698	219,382	7,671
Bullion—do	866,926	30,306	710,487	24,876
Iron ore—thousand long tons	46,259	462,354	44,627	444,079
Iron and steel:				
Pig iron—short tons	1,186,739	45,914	605,234	27,599
Iron and steel products (major):				
Iron products—short tons	36,452	7,776	34,452	9,107
Steel products—do	r 11,006,993	1,273,730	11,411,753	1,333,221
Scrap—do	390,205	7,672	215,635	8,181
Tinplate—do	16,450	535	13,527	381
Lead:				
Ore, flue dust, matte (lead content) short tons	63,850	13,871	144,156	29,111
Base bullion (lead content)—do	1,928	575	677	1,224
Pigs and bars (lead content)—do	285,788	75,312	363,596	88,697
Reclaimed, scrap, etc. (lead content) short tons	3,956	886	9,368	1,951
Sheets, pipe, and shot—do	919	283	1,212	322
Babbitt metal and solder (lead content) short tons	731	3,203	413	1,423
Manufactures—do	r 1,373	r 563	1,363	524
Magnesium:				
Metallic and scrap—do	3,265	1,613	9,213	4,909
Alloys (magnesium content)—do	689	1,656	354	1,529
Sheets, tubing, ribbons, wire and other forms (magnesium content)—short tons	5	36	153	433
Manganese:				
Ore (35 percent or more manganese) (manganese content)—short tons	1,261,490	77,047	977,163	55,813
Ferromanganese (manganese content) short tons	194,563	r 29,455	167,548	26,108
Mercury:				
Compounds—pounds	16,340	94	14,011	14
Metal—76-pound flasks	31,364	12,322	24,348	10,735
Minor metals: Selenium and salts—pounds	286,775	1,834	300,638	1,545

See footnotes at end of table.

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

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Metals—Continued				
Nickel:				
Pigs, ingots, shot, cathodes—short tons	r 112,886	$170,806	113,860	$193,848
Scrap—do	941	709	1,104	1,240
Oxide—do	7,711	7,967	6,208	8,130
Platinum group:				
Unrefined materials:				
Grains and nuggets, including crude dust and residues—troy ounces	86,700	9,498	41,798	5,195
Scrap—do	851	86	NA	NA
Osmiridium—do	4,910	440	4,179	458
Refined metal:				
Platinum—do	r 273,333	r 31,741	322,764	38,282
Palladium—do	902,376	28,010	737,082	27,504
Iridium—do	8,161	1,130	8,784	1,505
Osmium—do	751	292	321	109
Rhodium—do	65,861	11,984	47,689	10,079
Ruthenium—do	10,164	385	56,563	2,049
Radium:				
Radioactive substitutes	NA	2,104	NA	3,000
Rare earths: Ferrocerium and other cerium alloys—pounds	13,903	65	4,293	19
Silver:				
Ore and base bullion—thousand troy ounces	35,992	43,601	25,642	33,437
Bullion—do	27,040	32,586	29,878	43,650
Tantalum: Ore—thousand pounds	2,143	4,782	1,675	5,510
Tin:				
Ore (tin content)—long tons	4,372	12,467	3,255	7,635
Blocks, pigs, grains, etc—do	41,699	152,761	50,223	166,529
Dross, skimmings, scrap, residues, and tin alloys, n.s.p.f—long tons	108	124	449	462
Tin foil, powder, flitters, etc	NA	251	NA	449
Titanium:				
Ilmenite—short tons	186,539	6,698	207,906	5,145
Rutile—do	151,482	8,494	167,100	19,566
Metal—pounds	11,959,375	10,854	14,950,359	14,415
Ferrotitanium—do	60,461	21	306,317	85
Compounds and mixtures—do	96,465,373	17,495	96,251,565	16,726
Tungsten: (tungsten content)				
Ore and concentrate—thousand pounds	4,298	6,859	1,699	3,784
Metal—do	335	666	129	524
Ferrotungsten—do	379	696	----------	----------
Other alloys—pounds	75,227	227	10,767	65
Zinc:				
Ore (zinc content)—short tons	396,375	51,696	431,319	58,075
Blocks, pigs, and slabs—do	280,307	75,624	222,002	57,531
Sheets—do	1,708	670	648	276
Old, dross, and skimmings—do	6,563	1,295	3,963	673
Dust—do	1,286	398	3,771	1,211
Manufactures	NA	545	NA	318
Zirconium: Ore, including zirconium sand—short tons	57,976	1,652	59,303	1,891
Nonmetals:				
Abrasives: Diamonds (industrial)—thousand carats	18,569	69,110	17,102	63,559
Asbestos—short tons	726,459	73,100	645,112	65,743
Barite:				
Crude and ground—do	699,045	5,766	532,314	4,659
Witherite—do	2,138	100	1,260	53
Chemicals—do	6,552	927	5,243	682
Cement—thousand 376 pound barrels	7,066	17,846	5,913	14,698
Clays:				
Raw—short tons	132,336	2,644	103,404	2,039
Manufactured—do	6,359	238	5,382	252
Cryolite—do	31,655	3,199	36,319	4,118
Feldspar: Crude—long tons	----------	----------	280	8
Fluorspar—short tons	878,546	21,968	911,870	24,485
Gem stones:				
Diamonds—thousand carats	3,484	373,776	3,961	387,472
Emeralds—do	r 218	r 5,914	242	5,518
Other	NA	46,937	NA	46,655
Graphite—short tons	56,748	2,545	56,675	2,348
Gypsum:				
Crude, ground, calcined—thousand short tons	5,481	15,852	5,212	9,809
Manufactures	NA	1,429	NA	1,544
Iodine, crude—thousand pounds	7,133	5,934	3,459	3,177
Kyanite—short tons	3,405	141	1,821	75

See footnotes at end of table.

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

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Nonmetals—Continued				
Lime:				
Hydrated short tons	203	$5	545	$12
Other do	151,703	1,772	79,983	961
Dead-burned dolomite [1] do	43,637	2,038	42,413	1,832
Magnesium:				
Magnesite do	186,200	10,941	127,955	7,612
Compounds do	11,864	542	11,293	547
Mica:				
Uncut sheet and punch thousand pounds	3,247	3,993	1,733	1,990
Scrap do	2,642	71	1,016	25
Manufactures do	7,535	6,670	5,440	3,373
Mineral-earth pigments: Iron oxide pigments:				
Natural short tons	3,662	200	3,670	271
Synthetic do	15,234	2,626	14,034	2,626
Ocher, crude and refined do	146	8	236	16
Siennas, crude and refined do	1,192	145	951	104
Umber, crude and refined do	3,762	135	4,275	162
Vandyke do	554	49	272	24
Nitrogen compounds (major), including urea thousand short tons	1,561	75,974	1,688	83,922
Phosphate, crude do	178	4,256	139	3,261
Phosphatic fertilizers do	67	3,740	105	6,167
Pigments and salts:				
Lead pigments and compounds short tons	30,497	7,353	30,645	6,569
Zinc pigments and compounds do	18,649	3,633	18,988	3,404
Potash do	r 2,544,112	r 71,821	2,925,082	73,491
Pumice:				
Crude or unmanufactured do	9,393	91	5,702	49
Wholly or partly manufactured do	273,338	723	240,273	580
Manufactures, n.s.p.f	NA	25	NA	22
Quartz crystal (Brazillian pebble) pounds	1,470,341	896	1,049,544	730
Salt thousand short tons	2,479	6,464	2,843	8,541
Sand and gravel:				
Glass sand do	18	95	44	159
Other sand and gravel do	631	811	588	753
Sodium sulfate do	237	3,981	291	4,506
Stone and whiting	NA	20,739	NA	19,823
Strontium: Mineral short tons	11,517	267	5,612	118
Sulfur and pyrites:				
Sulfur:				
Ores and other forms, n.e.s. thousand long tons	1,514	33,525	1,474	47,612
Pyrites do	16	84	10	51
Talc: Unmanufactured short tons	21,908	834	15,361	658
Fuels:				
Carbon black:				
Acetylene pounds	7,058,926	1,185	5,784,814	987
Gas black and carbon black do	385,381	61	330,910	56
Coal:				
Bituminous, slack, culm and lignite short tons	177,672	1,654	227,338	1,992
Briquets do	10,856	163	17,422	260
Coke do	95,761	1,790	92,001	1,704
Peat:				
Fertilizer grade do	289,823	11,416	277,241	12,088
Poultry and stable grade do	4,020	199	3,601	189
Petroleum thousand barrels	r 940,489	r 2,208,589	925,806	2,207,384

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

Table 10.—Comparison of world [1] and United States production of principal metals and minerals, 1966–67

Mineral	1966			1967 [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	4,325,710	2,571,552	59	4,091,593	2,483,840	61
Coal:						
Bituminous	2,096,599	530,001	25	1,993,134	546,590	27
Lignite	807,593	3,881	(2)	803,000	4,410	(2)
Pennsylvania anthracite	214,760	12,941	6	205,857	12,256	6
Coke (excluding breeze):						
Gashouse [3]	36,382	168	(2)	30,489	163	(2)
Oven and beehive	341,166	67,402	20	316,270	64,580	20
Natural gas (marketable)—millon cubic feet	26,445,895	[r] 17,206,628	65	28,384,043	18,171,337	64
Peat	210,586	[4] 611	(2)	201,374	NA	NA
Petroleum (crude)—thousand barrels	12,015,830	3,027,763	25	12,889,705	3,215,742	25
Nonmetals:						
Asbestos	3,359	126	4	3,193	123	4
Barite	4,023	1,007	25	2,447	944	(5)
Cement [6]—thousand barrels	2,722,561	[r] 401,771	15	2,686,749	385,848	14
China clay	12,426	4,385	35	7,484	3,973	(5)
Corundum	5	----------	-------	(2)	----------	-------
Diamonds—thousand carats	39,955	----------	-------	42,388	----------	-------
Diatomite	1,779	[r e] 700	[r] 39	NA	[e] 686	NA
Feldspar—thousand long tons	1,934	[r] 655	34	1,598	615	38
Fluorspar	3,129	253	8	2,365	296	(5)
Graphite	534	W	NA	350	W	NA
Gypsum	49,629	9,647	[r] 19	31,477	9,393	(5)
Lime (sold or used by producers)	82,959	18,057	22	68,912	17,974	(5)
Magnesite	11,008	W	NA	9,947	W	NA
Mica (including scrap)—thousand pounds	319,943	[r] 226,267	[r] 71	295,678	237,026	(5)
Nitrogen, agricultural [6 7]	21,300	[r] 5,711	27	23,400	6,101	26
Phosphate rock—thousand long tons	83,215	[r] 39,044	[r] 47	86,969	39,770	46
Potash (K_2O equivalent)	16,048	3,320	[r] 21	16,860	3,299	20
Pumice [8]	15,646	3,234	[r] 21	9,901	3,474	(5)
Pyrites—thousand long tons	21,134	873	4	[e p] 21,618	861	4
Salt [6]	120,119	36,474	30	111,304	38,958	35
Strontium [8]	8	----------	-------	NA	----------	-------
Sulfur, elemental—thousand long tons	16,465	[r] 8,242	50	17,247	8,283	48
Talc, pyrophylite, and soapstone	4,031	895	22	4,016	903	22
Vermiculite [8]	382	262	69	368	255	69
Metals, mine basis:						
Antimony (content of ore and concentrate)—short tons	68,513	927	1	64,402	892	1
Arsenic, white [8]	53	W	NA	25	W	NA
Bauxite—thousand long tons	38,666	1,796	5	41,326	1,654	4
Beryllium concentrate—short tons	3,578	W	NA	6,950	NA	NA
Bismuth—thousand pounds	6,660	W	NA	6,931	W	NA
Cadmium—thousand pounds	28,707	10,460	[r] 36	19,403	8,602	(5)
Chromite	4,974	----------	-------	5,111	----------	-------

Cobalt (contained)—short tons	22,094	W	NA	8,236	W	NA
Columbium-tantalum concentrates [8]—thousand pounds	22,973	----------	----------	NA	----------	----------
Copper (content of ore and concentrate)	5,789	1,429	r 25	5,436	954	18
Gold—thousand troy ounces	46,567	1,803	4	p 9 45,610	1,584	4
Iron ore—thousand long tons	627,974	90,147	r 14	618,152	84,179	14
Lead (content of ore and concentrate)	3,131	327	10	2,781	317	11
Manganese ore (35 percent or more Mn)	19,141	14	(2)	18,650	13	(2)
Mercury—thousand 76-pound flasks	265	22	8	242	24	10
Molybdenum (content of ore and concentrate)—thousand pounds	124,967	90,532	r 72	109,080	87,554	(5)
Nickel (content of ore and concentrate)	440	13	3	453	15	3
Platinum groups (Pt., Pd., etc.)—thousand troy ounces	3,039	51	2	3,154	16	(2)
Silver—thousand troy ounces	265,970	43,669	r 16	p 9 261,600	32,119	12
Tin (content of ore and concentrate)—long tons	208,577	97	(2)	211,664	W	NA
Titanium concentrates:						
Ilmenite [8]	2,884	965	33	2,169	935	(5)
Rutile [8]	279	W	NA	NA	W	NA
Tungsten concentrate (contained tungsten)—short tons	31,510	r 4,241	r 13	30,673	4,150	14
Vanadium (content of ore and concentrate) [8]—short tons	10,029	5,166	r 52	10,595	4,963	47
Zinc (content of ore and concentrate)	4,960	573	12	5,175	549	11
Metals, smelter basis:						
Aluminum	7,561	2,968	r 39	8,021	3,269	41
Copper	6,073	r 1,466	r 24	5,850	862	15
Iron, pig (including ferroalloys)	382,500	94,000	25	385,802	89,479	23
Lead	2,988	441	15	2,712	380	14
Magnesium—short tons	179,844	79,794	r 44	202,608	97,406	48
Selenium [8]—thousand pounds	2,001	620	r 31	2,069	598	29
Steel ingots and castings	524,693	r 134,101	26	538,435	127,213	24
Tellurium [8]	334	199	r 60	247	135	55
Tin—long tons	203,665	10 4,372	r 2	219,135	10 3,048	1
Uranium oxide (U_3O_8) [8]—short tons	18,993	9,587	r 51	17,458	9,125	52
Zinc	4,563	1,025	23	4,233	939	22

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] Agricultural use only.

[5] Data significantly incomplete.

[6] Including Puerto Rico.

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

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

[9] Total includes an aggregate estimate for data unavailable at the date of completion of the table.

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

Injury Experience and Worktime in the Mineral Industries, by States

By Forrest T. Moyer [1]

For the third consecutive year, the overall safety record of the mineral and mineral fuel industries in 1967 was improved slightly by the continued reduction in the injury–frequency and the injury–severity rates. General operating activity was lower than in 1966 as measured by the decline in total man-hours of work-time at all mineral operations. This lessened activity reflected in part the reduced demand for minerals and mineral products in several major segments of the economy, and in part an extended work stoppage in a major mineral industry.

These statistics 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 office workers 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 1967 are preliminary except for the anthracite, coke, petroleum 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 employment data were collected from coal producers as required by the Federal Coal Mine Safety Act as Amended (30 U.S. Code, sec. 455–482, Supp. III (1968)). Similar information was collected as required by the Federal Metal and Nonmetallic Mine Safety Act (30 U.S. Code, sec. 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 employment data.

Injury Experience.—The injury–frequency rate for all mineral industries in 1967 was 17.11 disabling work injuries per million man-hours of exposure. This overall rate comprised frequencies of 0.27 for fatal and 16.83 for nonfatal work injuries of which each was slightly more favorable than the corresponding data of 0.28 and 17.04 for 1966. The total of 508 fatalities in 1967 was 36 fewer than in the preceding year. Nonfatal injuries totaled 31,380 or 1,443 fewer than in 1966. The larger proportional declines in the numbers of injuries—7 percent for fatal and 4 percent for nonfatal disabilities —than the 3-percent decrease in man-hours worked resulted in lowered frequency and severity rates for 1967.

The 1967 injury-severity rate of 2,414 days lost per million man-hours for all mineral industries represented a 5-percent improvement over the corresponding rate of 2,539 in 1966.

Although there was an overall improvement, injury experience of the separate mineral industry groups displayed varying trends in 1967. (See summary section at end of table 1.) All general measures of injury experience (number of injuries, frequency rate, and severity rate) were improved over those of 1966 in the coal, metal, and stone industries. In the oil and

[1] Chief, Branch of Accident Analysis, Division of Accident Prevention and Health.

gas industries the injury-severity rate was lowered, but an increased number of injuries resulted in a less favorable frequency rate. The sand and gravel and the primary nonferrous smelting industries were improved in the number of injuries and the frequency rate, but the severity rate was higher than in 1966. In the nonmetal industry the severity rate and the number of injuries were slightly lower, but the frequency rate was less favorable. Although the severity rate was lowered in the native asphalt industry in 1967, the number of injuries and the frequency rate increased. All general measures of injury experience in the coke, peat, and slag industries worsened in 1967.

There were fewer fatal work injuries in 1967 in the coal, oil and gas, metal, stone, and sand and gravel industries. The primary nonferrous smelting industry had the same number as in 1966. There were no fatalities reported at operations in the peat and native asphalt industries. The number of work fatalities during 1967 was higher than in 1966 only in the nonmetal, coke, and blast-furnace-slag industries.

The numbers of nonfatal work disabilities in 1967 were reduced in the coal, metal, nonmetal, stone, sand and gravel, and primary nonferrous smelting industries. In all other mineral industry groups, nonfatal injuries increased over those of 1966.

Worktime.—The decline in operating activity in 1967, as indicated by man-hours worked, was widespread. Activity was higher only in the coal, native asphalt, and blast-furnace-slag industries. Total worktime of 1,864 million man-hours in all mineral industries during 1967 declined 3 percent from 1966 totals.

STATE DATA

State data are presented for the mineral-extractive and processing industries, however no breakdown is presented for the purely processing industries, coke, primary nonferrous smelting, and blast-furnace-slag, nor for petroleum and natural gas, although totals for these industries are included in the summarization at the end of the State table (table 1). A corresponding chapter in Volume I-II of the Minerals Yearbook contains detailed breakdowns of similar information on the specific mineral industries comprising the general groupings used in this chapter.

The mineral industries of West Virginia and Kentucky, in each of which underground coal mining was dominant, had higher injury-frequency rates than any other State. The rates of occurrence of injuries in 1967 for West Virginia operations were 54.60 and in Kentucky 43.50 per million man-hours; comparable rates for 1966 were 55.81 and 43.38, respectively. The mineral industries in Idaho, where metal mining and milling predominate, ranked third highest in injury frequency with a rate of 42.00 in 1967.

Mines and processing plants in West Virginia had the largest number of work fatalities (63) during 1967, sharply reduced from the 82 fatalities reported in 1966. States ranking next in number of mineral industry fatalities during 1967 were Kentucky (54), Pennsylvania (48), Virginia (32), and Illinois (23). States ranked by number of nonfatal injuries in mines and processing plants during 1967 were West Virginia (4,313), Pennsylvania (1,994), Kentucky (1,807), Virginia (1,259), and Illinois (1,005). Coal mining is the dominant mineral industry in each of the five States with the highest numbers of fatal and nonfatal injuries.

The injury-severity rate for the mineral industries of Kentucky (9,918) was higher than that in any other State. The next highest injury-severity rates were for the mines and mineral plants in Idaho (8,432) and Virginia (7,461).

Of the States with major mineral industry activity (more than 10 million man-hours of worktime) in 1967, mines and plants had the lowest injury-frequency rates in Minnesota (6.97), Alabama (12.93), and Florida (13.08). Similarly, the mineral industries in New York (886), Arkansas (967), and Georgia (1,173) had the most favorable injury-severity rates

The magnitude of mining and milling activity in the ranking States, as measured by worktime in thousands of man-hours, was as follows: Pennsylvania (82,439); West Virginia (80,149); Kentucky (42,784); Ohio (37,308); and California (35,112). States with the largest number of

man-hours worked within the general groupings of mining and milling industries were as follows: Coal—West Virginia, metal—Minnesota, nonmetal—California, stone—Pennsylvania, and sand and gravel —California.

ACTIVE OPERATIONS

The number of active mineral-extractive and processing establishments in the United States during 1966 are presented in table 1 for each of the general groupings except for the oil and gas industries. Similar data for 1967 are not available.

Producers and processors of minerals reported 29,256 active mines, quarries, pits, dredges, brine, well and other types of mineral-extractive operations in 1966. The largest numbers of mining establishments were in Pennsylvania (2,463), Kentucky (1,917), and West Virginia (1,806). Active mineral-cleaning and processing mills totaled 5,606.

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

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 1966	
	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	Mines	Mills
Alabama:																
Coal	5,240	5,025	1,101	1,057	8,769	8,617	5	4	122	118	14.48	14.16	4,256	3,607	170	21
Metal	1,127	1,065	312	312	2,613	2,585	---	---	27	34	10.33	13.15	295	608	25	8
Nonmetal and native asphalt	1,111	770	306	210	2,535	1,695	1	---	36	24	14.60	14.16	2,668	404	42	25
Sand and gravel	479	515	130	139	1,176	1,259	1	---	16	22	14.45	17.47	12,028	1,998	69	-----
Stone	2,583	2,550	746	723	6,194	5,950	1	3	63	55	10.33	9.75	4,764	3,639	61	55
Total or average	10,540	9,920	2,595	2,440	21,287	20,106	8	7	264	253	12.78	12.93	4,158	2,860	367	109
Alaska:																
Coal and peat	172	155	51	45	421	368	---	1	19	16	45.12	46.24	720	17,018	5	2
Metal	311	270	50	44	414	369	1	1	18	6	45.89	18.98	14,975	16,794	98	5
Nonmetal	7	15	1	1	5	11	---	---	------	1	-----	91.83	------	275	1	-----
Sand and gravel	639	765	137	156	1,098	1,406	---	---	22	15	20.03	10.67	410	267	86	-----
Stone	184	150	24	24	198	195	---	---	4	5	20.15	25.69	600	678	19	11
Total or average	1,313	1,360	263	271	2,137	2,348	1	2	63	43	29.95	19.17	3,309	5,521	209	18
Arizona:																
Coal	5	5	1	1	6	5	---	---	------	------	-----	-----	------	------	1	-----
Metal	10,720	NA	3,412	2,620	27,288	20,959	9	7	660	496	24.52	24.00	3,200	3,420	228	26
Nonmetal	240	285	54	62	437	527	---	---	17	10	38.93	18.99	2,052	378	40	13
Sand and gravel	1,257	1,160	303	262	2,421	2,121	---	---	45	44	18.59	20.74	740	2,413	189	-----
Stone	372	410	103	108	822	873	---	---	12	13	14.59	14.90	141	587	110	24
Total or average	12,594	NA	3,872	3,054	30,974	24,485	9	7	734	563	23.99	23.28	2,910	3,165	568	63
Arkansas:																
Coal	111	105	20	21	161	160	---	---	5	5	30.98	31.25	3,327	1,063	14	-----
Metal	2,083	2,050	603	563	4,830	4,500	---	---	84	51	17.39	11.33	479	251	13	5
Nonmetal	953	1,030	251	259	2,006	2,073	1	---	70	59	35.40	28.46	3,633	507	35	15
Sand and gravel	895	775	236	195	2,078	1,804	---	---	57	34	27.43	18.85	542	253	207	-----
Stone	1,580	1,195	417	329	3,629	2,857	2	---	97	77	27.28	26.95	4,102	2,875	135	80
Total or average	5,622	5,155	1,526	1,366	12,705	11,394	3	---	313	226	24.87	19.83	2,058	967	404	100
California:																
Coal	6	5	1	1	6	6	---	---	------	------	-----	-----	------	------	1	-----
Metal	2,431	2,430	600	593	4,802	4,736	5	7	126	129	27.28	28.72	8,424	9,846	313	31
Nonmetal	4,949	4,440	1,343	1,281	10,829	10,284	3	6	190	182	17.82	18.28	2,621	4,153	217	83
Sand and gravel	5,377	5,670	1,287	1,279	10,352	10,373	3	4	214	204	20.96	20.05	3,468	3,776	782	-----
Stone	4,638	4,210	1,341	1,212	10,756	9,664	---	2	163	106	15.15	11.18	648	1,719	331	146
Peat	29	30	5	6	45	49	---	---	------	------	-----	-----	------	------	4	-----
Total or average	17,430	16,785	4,577	4,372	36,790	35,112	11	19	693	621	19.14	18.23	3,036	4,133	1,648	260

Colorado:																
Coal	1,485	1,335	334	292	2,628	2,300	5	2	122	103	48.33	45.65	12,618	6,382	86	5
Metal	4,782	4,685	1,297	1,281	10,384	10,245	8	7	393	407	38.62	40.41	6,565	6,777	480	22
Nonmetal	479	480	74	76	594	610	---	---	15	4	25.24	6.55	730	383	97	20
Sand and gravel	1,298	1,370	262	250	2,109	2,014	3	2	41	42	20.87	21.85	9,232	6,319	382	---
Stone	810	500	185	121	1,520	978	2	---	50	24	34.22	24.53	8,811	3,973	193	52
Peat	21	21	3	3	23	15	---	---	------	------	-----	-----	------	------	15	-----
Total or average	8,875	8,390	2,154	2,024	17,257	16,162	18	11	621	580	37.03	36.57	7,801	6,246	1,253	99
Connecticut:																
Nonmetal and peat	177	135	50	37	413	302	---	---	8	4	19.37	13.25	395	172	8	6
Sand and gravel	555	520	130	110	1,053	896	1	---	24	14	23.73	15.62	6,438	594	98	---
Stone	394	370	97	89	851	772	---	1	26	13	30.56	18.14	484	8,197	25	19
Total or average	1,126	1,025	277	235	2,317	1,970	1	1	58	31	25.46	16.25	3,175	3,508	131	25
Delaware:																
Nonmetal	11	15	3	3	26	26	---	---	------	1	-----	38.46	------	154	1	1
Sand and gravel	69	75	13	17	105	134	---	---	------	1	-----	7.45	------	171	13	---
Stone	10	10	2	2	20	20	---	---	------	------	-----	-----	------	------	1	1
Total or average	90	100	19	22	151	180	---	---	------	2	-----	11.12	------	150	15	2
Florida:																
Metal	164	145	57	51	453	411	---	---	------	------	-----	-----	------	------	3	---
Nonmetal	3,664	3,785	1,231	1,130	9,854	9,051	4	3	138	73	14.41	8.40	2,819	3,385	56	39
Sand and gravel	369	335	93	86	845	761	---	---	18	24	21.31	31.54	1,300	619	68	---
Stone	2,142	2,200	636	636	5,654	5,637	---	2	117	105	20.69	18.98	1,574	2,735	87	69
Peat	14	19	4	5	29	42	---	---	------	1	-----	23.55	------	1,130	6	-----
Total or average	6,353	6,485	2,020	1,909	16,836	15,903	4	5	273	203	16.45	13.08	2,244	2,929	220	108
Georgia:																
Metal	244	180	66	51	571	406	---	---	13	11	22.77	27.07	482	276	22	4
Nonmetal and peat	3,241	4,000	1,023	1,153	8,174	9,334	---	---	216	284	26.43	30.43	1,945	1,191	70	40
Sand and gravel	233	245	62	64	549	571	1	---	12	15	23.66	26.26	11,364	527	33	---
Stone	3,073	2,980	808	771	6,762	6,445	2	---	160	163	23.96	25.29	3,431	1,262	92	83
Total or average	6,791	7,405	1,958	2,038	16,056	16,756	3	---	401	473	25.16	28.23	2,842	1,173	217	127
Hawaii:																
Nonmetal	95	110	10	9	76	70	---	---	1	------	13.22	-----	489	------	35	4
Sand and gravel	52	20	7	3	53	26	---	---	1	1	18.82	38.44	527	884	15	---
Stone	573	525	151	126	1,211	1,035	---	---	57	33	47.08	31.88	5,985	673	45	24
Total or average	720	660	168	139	1,340	1,131	---	---	59	34	44.05	30.06	5,458	637	95	28
Idaho:																
Metal	2,523	2,520	655	598	5,236	4,782	10	7	317	242	62.45	52.07	13,733	11,638	96	17
Nonmetal and peat	574	710	136	165	1,161	1,365	1	---	38	22	33.59	16.12	5,893	352	22	10
Sand and gravel	411	190	70	33	545	264	---	---	11	5	20.18	18.94	349	788	200	---
Stone	286	325	42	39	356	327	---	---	7	7	19.69	21.42	1,392	1,441	34	34
Total or average	3,794	3,745	902	835	7,298	6,737	11	7	373	276	52.62	42.00	10,885	8,432	352	61

See footnotes at end of table.

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by States [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 1966	
							Fatal		Nonfatal		Frequency		Severity			
	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	Mines	Mills
Illinois:																
Coal	8,367	8,500	2,132	2,156	16,629	16,720	8	19	652	700	39.69	43.00	4,561	8,618	86	46
Metal	65	50	16	13	130	105	---	---	19	4	145.78	38.23	675	210	4	1
Nonmetal	1,210	1,245	331	325	2,690	2,652	1	---	87	113	32.72	42.60	3,680	707	52	27
Sand and gravel	1,659	1,515	377	353	3,248	3,047	---	4	41	51	12.62	18.05	999	11,954	398	-----
Stone	3,513	3,695	948	995	7,819	8,235	3	---	122	135	15.99	16.39	2,900	639	251	174
Peat	19	23	2	5	19	46	---	---	1	2	52.65	43.50	53	174	6	-----
Total or average	14,833	15,030	3,807	3,846	30,534	30,805	12	23	922	1,005	30.59	33.37	3,660	6,093	797	248
Indiana:																
Coal	2,047	2,150	534	534	4,113	4,232	2	7	136	138	33.55	34.26	3,886	10,870	51	12
Nonmetal	834	885	213	228	1,689	1,798	---	---	28	24	16.58	13.35	2,432	280	35	21
Sand and gravel	1,145	1,110	277	257	2,402	2,227	3	1	38	44	17.07	20.20	7,873	4,994	272	-----
Stone	3,106	3,160	907	883	7,478	7,277	2	---	158	127	21.40	17.45	3,704	646	144	104
Peat	30	25	8	6	70	46	---	---	4	2	57.31	43.94	1,118	857	6	-----
Total or average	7,162	7,335	1,938	1,908	15,752	15,580	7	8	364	335	23.55	22.02	4,239	4,003	508	137
Iowa:																
Coal and peat	250	260	54	54	442	448	1	---	7	7	18.11	15.63	13,874	281	24	1
Nonmetal	1,108	1,045	301	281	2,422	2,263	---	---	53	52	21.89	22.98	1,571	573	28	27
Sand and gravel	1,319	1,075	290	229	2,596	2,080	3	1	46	40	18.87	19.71	7,486	3,572	386	-----
Stone	2,431	2,490	677	661	5,847	5,704	1	3	97	85	16.76	15.43	1,588	3,712	258	113
Total or average	5,108	4,865	1,321	1,225	11,307	10,495	5	4	203	184	18.40	17.91	3,418	2,861	696	141
Kansas:																
Coal	219	210	50	51	406	403	---	---	13	13	32.03	32.26	658	677	7	3
Metal	103	85	30	21	243	173	---	---	10	12	41.11	69.49	1,040	1,813	10	1
Nonmetal	1,090	1,225	295	291	2,356	2,318	2	1	64	50	28.01	22.00	5,817	2,932	36	21
Sand and gravel	807	785	181	198	1,564	1,700	---	1	41	23	26.22	14.12	785	3,820	227	-----
Stone	1,785	1,625	425	417	3,519	3,442	3	---	35	41	10.80	11.91	5,507	452	143	94
Total or average	4,004	3,930	982	978	8,088	8,036	5	2	163	139	20.77	17.55	4,306	1,920	423	119
Kentucky:																
Coal	24,225	24,000	4,519	4,698	36,001	36,800	42	51	1,588	1,620	45.28	45.41	9,576	10,868	1,729	49
Metal	41	40	13	11	101	90	---	---	12	15	118.68	166.25	7,922	2,383	1	1
Nonmetal	435	365	99	86	788	688	1	---	36	37	46.97	53.77	9,001	1,543	37	12
Sand and gravel	384	420	105	103	993	1,001	---	---	24	23	24.17	22.99	351	817	39	-----
Stone	2,001	2,050	469	507	3,841	4,205	4	3	103	112	27.86	27.35	7,208	5,296	111	105
Total or average	27,086	26,875	5,205	5,406	41,724	42,784	47	54	1,763	1,807	43.38	43.50	9,124	9,918	1,917	167
Louisiana:																
Metal	1,063	820	388	299	3,255	2,394	---	---	25	9	7.68	3.76	328	198	-----	3

Nonmetal	1,853	1,925	555	581	4,827	4,719	---	4	96	90	19.89	19.92	588	5,771	31	22
Sand and gravel	1,019	1,230	271	291	2,469	2,600	1	---	39	46	16.20	17.70	4,977	388	80	-----
Stone	625	690	207	232	1,795	1,946	---	---	31	38	17.27	19.53	485	5,118	14	19
Total or average	4,560	4,665	1,421	1,404	12,345	11,659	1	4	191	183	15.55	16.04	1,382	3,317	125	44
Maine:																
Metal and peat	32	70	6	16	45	131	---	---	------	1	-----	7.63	------	229	5	-----
Nonmetal	111	105	20	23	163	184	1	---	7	5	49.01	27.12	38,328	602	17	3
Sand and gravel	1,446	1,490	335	243	2,700	2,087	---	---	51	39	18.89	18.69	416	373	172	-----
Stone	341	465	85	101	695	819	---	1	23	15	33.09	19.54	793	8,342	15	16
Total or average	1,930	2,130	446	383	3,604	3,221	1	1	81	60	22.76	18.94	2,201	2,405	209	19
Maryland and District of Columbia:																
Coal and peat	372	420	79	88	638	726	---	1	11	9	17.25	13.78	365	8,615	76	-----
Nonmetal	364	430	93	103	766	847	---	---	25	36	32.64	42.52	8,461	604	22	12
Sand and gravel	822	825	219	217	1,917	1,878	---	2	43	45	22.43	25.03	2,968	7,267	92	-----
Stone	1,204	1,095	316	296	2,677	2,510	---	---	63	57	23.54	22.71	2,088	453	41	37
Total or average	2,762	2,770	707	704	5,997	5,960	---	3	142	147	23.68	25.17	3,000	3,615	231	49
Massachusetts:																
Nonmetal and peat	77	65	23	18	181	147	---	---	3	10	16.57	68.26	978	1,406	6	2
Sand and gravel	991	1,005	217	230	1,821	1,882	1	---	39	38	21.97	20.19	3,854	587	159	-----
Stone	1,080	955	260	255	2,103	2,059	---	1	44	51	20.92	25.26	714	3,625	45	45
Total or average	2,148	2,030	500	504	4,104	4,087	1	1	86	99	21.20	24.47	2,118	2,146	210	47
Michigan:																
Metal	5,938	5,660	1,756	1,565	14,039	12,503	8	11	481	481	34.83	39.35	5,083	6,806	28	13
Nonmetal	1,697	1,670	466	472	3,727	3,777	---	2	34	54	9.12	14.83	864	3,524	62	19
Sand and gravel	2,470	2,475	572	526	4,872	4,619	2	---	85	93	17.86	20.14	3,542	705	617	-----
Stone	3,427	3,390	1,010	1,000	8,115	8,025	1	---	87	62	10.84	7.73	1,454	373	65	47
Peat	162	157	31	29	281	261	---	---	2	2	7.11	7.67	747	31	29	-----
Total or average	13,694	13,350	3,836	3,591	31,033	29,184	11	13	689	692	22.56	24.16	3,346	3,586	801	79
Minnesota:																
Metal	10,003	9,340	2,937	2,752	23,521	22,026	4	6	97	71	4.29	3.50	1,283	2,102	61	36
Nonmetal	219	210	59	54	478	436	1	---	29	21	62.74	48.16	14,940	2,032	7	5
Sand and gravel	2,265	2,190	409	377	3,553	3,382	2	1	62	53	18.01	15.97	3,844	2,279	680	-----
Stone	1,452	1,315	376	346	3,116	2,828	---	---	47	47	15.08	16.62	391	489	93	55
Peat	25	30	3	3	19	25	---	---	------	1	-----	39.70	------	397	7	-----
Total or average	13,964	13,080	3,784	3,532	30,688	28,698	7	7	235	193	7.89	6.97	1,701	1,961	848	96
Mississippi:																
Metal	9	5	3	1	29	7	---	---	1	------	34.99	-----	630	------	1	-----
Nonmetal	960	915	234	237	1,873	1,905	---	1	57	48	30.44	25.72	5,019	3,954	40	24
Sand and gravel	537	445	149	116	1,423	1,140	---	---	27	24	18.97	21.05	580	412	79	-----
Stone	214	255	59	63	483	511	---	---	3	7	6.21	13.69	265	2,093	12	9
Total or average	1,720	1,615	444	417	3,808	3,563	---	1	88	79	23.11	22.45	2,723	2,547	132	33

See footnotes at end of table.

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by States [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 1966	
							Fatal		Nonfatal		Frequency		Severity			
	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	Mines	Mills
Missouri:																
Coal	398	380	102	105	783	778	1	---	31	32	40.86	41.13	8,684	1,069	21	5
Metal	2,615	2,290	713	622	5,703	4,974	3	2	275	188	48.75	38.20	5,049	3,323	36	7
Nonmetal and native asphalt	1,126	985	268	226	2,160	1,822	---	---	63	56	29.17	30.73	756	2,370	158	22
Sand and gravel	626	555	148	134	1,233	1,139	1	---	14	16	12.17	14.05	5,274	1,104	167	-----
Stone	3,848	4,215	1,060	1,106	8,682	9,254	8	3	171	176	20.62	19.34	6,067	2,734	229	172
Total or average	8,613	8,425	2,292	2,192	18,560	17,967	13	5	554	468	30.55	26.33	5,194	2,685	611	206
Montana:																
Coal and peat	104	90	19	17	153	134	1	---	7	6	52.24	44.71	40,352	1,162	17	1
Metal	4,139	NA	1,256	793	10,050	6,343	7	7	195	125	20.10	20.81	5,611	9,357	150	9
Nonmetal	911	775	248	196	1,988	1,566	---	1	33	54	16.60	35.12	552	6,146	28	10
Sand and gravel	915	1,085	177	151	1,425	1,273	---	---	33	25	23.16	19.64	581	399	209	-----
Stone	332	375	83	85	663	678	---	---	10	17	15.08	25.07	300	350	84	33
Total or average	6,401	NA	1,784	1,241	14,279	9,995	8	8	278	227	20.03	23.51	4,531	6,992	488	53
Nebraska:																
Nonmetal	66	45	15	10	136	82	---	---	7	2	51.47	24.49	956	147	5	3
Sand and gravel	1,063	880	222	178	2,050	1,703	1	1	20	10	10.24	6.46	3,340	3,835	323	-----
Stone	516	525	150	140	1,229	1,167	---	---	10	20	8.13	17.14	275	444	49	32
Total or average	1,645	1,450	387	328	3,415	2,951	1	1	37	32	11.13	11.18	2,141	2,392	377	35
Nevada:																
Metal	2,123	NA	635	467	5,124	3,735	2	2	146	99	28.88	27.04	3,564	4,035	157	17
Nonmetal and peat	758	720	192	183	1,547	1,468	---	1	35	44	22.62	30.66	1,323	4,601	66	19
Sand and gravel	648	685	132	150	1,056	1,187	---	---	20	20	18.94	16.84	696	442	105	-----
Stone	220	320	55	79	436	634	---	---	5	10	11.47	15.78	459	393	33	17
Total or average	3,749	NA	1,013	880	8,164	7,024	2	3	206	173	25.48	25.06	2,603	3,218	361	53
New Hampshire:																
Nonmetal and peat	11	50	2	13	19	101	---	---	1	3	52.80	29.73	264	208	6	-----
Sand and gravel	422	385	78	82	652	708	---	---	13	16	19.95	22.59	572	418	84	-----
Stone	170	160	42	40	334	322	---	---	10	7	29.92	21.76	171	603	23	11
Total or average	603	595	122	135	1,005	1,131	---	---	24	26	23.89	22.99	433	452	113	11
New Jersey:																
Metal	361	185	43	52	347	417	---	---	11	22	31.73	52.71	998	1,706	3	3
Nonmetal	347	295	93	71	742	565	---	---	14	17	18.88	30.07	570	639	22	12
Sand and gravel	1,028	1,115	269	273	2,222	2,274	---	1	51	45	22.96	20.23	628	3,219	119	-----
Stone	882	785	215	204	1,800	1,701	1	1	40	53	22.78	31.75	3,898	4,232	32	31
Peat	19	21	4	4	31	34	---	---	------	------	-----	-----	------	------	4	-----

Total or average	2,637	2,400	624	604	5,141	4,992	1	2	116	137	22.76	27.85	1,786	3,123	180	46
New Mexico:																
Coal	385	345	64	56	517	453	1	---	27	23	54.14	50.77	12,328	711	12	3
Metal	3,299	3,465	927	850	7,418	6,804	4	3	359	276	48.93	41.00	6,253	4,315	129	14
Nonmetal	2,894	2,745	1,006	906	8,049	7,246	2	6	226	209	28.33	29.67	3,151	5,685	38	23
Sand and gravel	1,199	1,180	217	197	1,746	1,617	---	1	42	32	24.05	20.41	699	7,824	268	---
Stone	239	255	52	51	411	409	---	---	12	8	29.22	19.56	506	259	98	29
Total or average	8,016	7,990	2,266	2,059	18,142	16,529	7	10	666	548	37.10	33.76	4,385	5,060	545	69
New York:																
Metal	1,668	1,565	465	417	3,732	3,334	4	---	48	39	13.93	11.70	9,508	384	6	6
Nonmetal	2,396	2,040	617	514	4,992	4,224	2	---	124	117	25.24	27.70	3,141	766	40	32
Sand and gravel	2,378	2,175	501	444	4,144	3,716	2	1	88	76	21.72	20.72	3,418	2,088	686	---
Stone	3,683	3,585	985	901	8,106	7,420	2	---	126	96	15.79	12.94	2,411	579	107	98
Peat	11	11	2	2	17	17	---	---	------	------	-----	-----	------	------	5	---
Total or average	10,136	9,375	2,570	2,278	20,991	18,711	10	1	386	328	18.86	17.58	4,043	886	844	136
North Carolina:																
Metal	2	(2)	(3)	(3)	(3)	(3)	---	---	------	------	-----	-----	------	------	1	---
Nonmetal	1,751	1,740	457	426	3,696	3,417	---	---	84	109	22.73	31.90	679	1,139	64	47
Sand and gravel	1,040	835	227	193	1,924	1,733	---	---	33	52	17.15	30.01	416	631	156	---
Stone	1,983	1,900	481	483	3,995	4,020	---	2	65	55	16.27	14.18	4,358	3,480	97	71
Total or average	4,776	4,475	1,166	1,102	9,615	9,170	---	2	182	216	18.93	23.77	2,155	2,069	318	118
North Dakota:																
Coal and peat	287	255	63	55	494	431	---	---	17	14	34.44	32.48	10,234	1,462	31	1
Metal	52	5	14	(3)	111	1	---	---	1	------	9.02	-----	9	------	8	2
Nonmetal	29	35	7	9	57	69	---	---	1	4	17.39	57.71	626	519	6	1
Sand and gravel	714	620	126	98	1,059	933	---	1	20	15	18.89	17.15	409	6,677	248	---
Stone	16	120	1	23	9	187	---	---	------	------	-----	-----	------	------	11	11
Total or average	1,098	1,035	211	186	1,729	1,622	---	1	39	33	22.55	20.97	3,192	4.251	304	15
Ohio:																
Coal	7,659	8,100	1,779	1,914	14,304	15,200	12	4	373	375	26.92	24.93	6,515	2,985	423	20
Nonmetal	2,694	2,570	695	682	5,561	5,439	---	---	119	132	21.40	24.27	1,103	577	178	48
Sand and gravel	2,248	2,360	541	546	4,534	4,560	3	4	69	62	15.88	14.48	4,714	5,796	448	---
Stone	5,402	5,505	1,524	1,493	12,478	12,095	2	1	210	168	16.99	13.97	2,060	1,268	179	161
Peat	17	18	2	2	15	15	---	---	------	------	-----	-----	------	------	11	---
Total or average	18,020	18,555	4,541	4,637	36,891	37,308	17	9	771	737	21.36	20.00	3,968	2,420	1,239	229
Oklahoma:																
Coal	217	210	43	44	337	335	---	1	7	7	20.75	23.88	842	18,767	18	1
Metal	323	400	79	108	631	867	---	1	11	34	17.44	40.38	456	14,524	74	3
Nonmetal	558	525	135	127	1,082	1,009	---	1	23	30	21.26	30.71	1,741	8,216	29	12
Sand and gravel	396	265	105	73	889	617	---	---	22	17	24.74	27.55	809	319	89	---
Stone	1,136	1,165	305	306	2,527	2,556	1	---	62	70	24.93	27.38	4,916	623	92	79
Total or average	2,630	2,565	666	658	5,467	5,385	1	3	125	158	23.05	29.90	2,853	5,378	302	95

See footnotes at end of table.

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by States [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 1966	
							Fatal		Nonfatal		Frequency		Severity			
	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	Mines	Mills
Oregon:																
Coal and peat	4	10	(3)	1	2	6	---	---	------	------	-----	-----	------	------	2	-----
Metal	143	150	31	30	251	245	1	---	6	11	27.86	44.91	24,661	1,821	38	4
Nonmetal	181	145	32	24	256	194	---	---	13	2	50.86	10.29	865	1,425	64	12
Sand and gravel	4,463	2,145	973	441	7,815	3,384	---	---	166	74	21.24	21.87	641	441	660	-----
Stone	1,840	1,115	428	265	3,428	2,102	---	1	86	59	25.09	28.54	475	3,426	307	146
Total or average	6,631	3,570	1,465	761	11,751	5,931	1	1	271	146	23.15	24.78	1,111	1,588	1,071	162
Pennsylvania:																
Bituminous coal	23,433	22,800	5,415	5,329	43,469	42,820	28	27	1,001	925	23.67	22.23	5,296	5,123	1,215	84
Anthracite	9,292	7,750	1,883	1,701	13,672	12,359	6	9	829	609	61.07	50.00	4,477	5,511	702	145
Metal	1,579	1,600	454	448	3,629	3,586	---	2	30	31	8.27	9.20	815	3,663	3	3
Nonmetal	1,731	1,430	436	357	3,545	2,920	---	---	140	89	39.50	30.48	769	740	126	43
Sand and gravel	1,205	1,195	280	287	2,384	2,409	1	1	50	55	21.39	23.25	3,766	3,731	116	-----
Stone	8,286	8,335	2,226	2,225	18,285	18,261	7	9	315	281	17.61	15.88	3,356	3,447	288	246
Peat	60	46	14	10	109	84	---	---	------	4	-----	47.87	------	3,770	13	-----
Total or average	45,586	43,155	10,706	10,357	85,092	82,439	42	48	2,365	1,994	28.29	24.77	4,318	4,549	2,463	521
Rhode Island:																
Sand and gravel	167	205	32	39	252	312	---	---	2	3	7.92	9.60	812	189	18	-----
Stone	61	45	15	11	127	98	---	---	4	4	31.61	41.02	1,636	728	5	4
Total or average	228	250	46	50	379	410	---	---	6	7	15.83	17.08	1,087	317	23	4
South Carolina:																
Nonmetal and peat	952	1,005	253	251	2,073	2,008	---	---	48	35	23.16	17.43	501	2,655	45	24
Sand and gravel	391	385	98	94	793	769	---	---	17	14	21.44	18.22	518	403	35	-----
Stone	817	840	209	225	1,712	1,870	---	1	28	42	16.35	23.00	7,759	3,582	17	15
Total or average	2,160	2,230	559	570	4,578	4,647	---	1	93	91	20.31	19.80	3,219	2,656	97	39
South Dakota:																
Coal	4	5	(3)	(3)	4	3	---	---	------	------	-----	-----	------	------	1	-----
Metal	1,740	1,695	533	528	4,246	4,222	1	---	81	114	19.31	27.00	2,262	2,729	26	3
Nonmetal	259	295	60	63	489	519	---	---	9	11	18.41	21.21	168	137	42	6
Sand and gravel	995	975	169	150	1,421	1,358	1	---	23	25	16.89	18.41	4,922	445	360	-----
Stone	389	465	95	105	790	894	---	---	16	15	20.25	16.78	1,228	302	38	15
Total or average	3,387	3,435	858	846	6,950	6,995	2	---	129	165	18.85	23.59	2,540	1,782	467	24
Tennessee:																
Coal	2,166	2,075	385	370	3,087	3,033	6	4	115	112	39.20	38.25	12,919	9,168	212	2
Metal	1,687	1,670	410	439	3,301	3,523	2	3	98	107	30.30	31.23	6,623	7,062	15	6
Nonmetal	956	730	255	178	2,124	1,464	---	---	37	36	17.42	24.60	1,661	535	47	22
Sand and gravel	708	600	185	151	1,574	1,324	---	1	33	18	20.97	14.35	460	4,961	105	-----

Stone	2,647	2,830	736	734	6,002	6,023	2	---	150	102	25.33	16.93	3,014	2,749	127	113
Total or average	8,164	7,910	1,971	1,873	16,087	15,367	10	8	433	375	27.54	24.92	5,227	4,985	506	143
Texas:																
Coal	98	95	27	27	215	214	---	---	3	3	13.93	14.02	325	322	2	-----
Metal	1,252	1,570	366	481	2,927	3,852	---	1	45	54	15.37	14.28	1,272	2,343	15	7
Nonmetal and native asphalt	3,484	3,405	1,007	993	8,171	8,042	2	3	169	170	20.93	21.51	3,026	2,726	146	72
Sand and gravel	1,976	2,115	540	559	4,854	5,126	2	1	155	155	32.35	30.43	3,115	2,111	354	-----
Stone	4,555	4,605	1,399	1,436	11,677	12,052	5	3	179	211	15.76	17.76	3,384	1,959	235	203
Total or average	11,365	11,795	3,340	3,497	27,844	29,285	9	8	551	593	20.11	20.52	2,987	2,235	752	282
Utah:																
Coal	1,375	1,240	291	255	2,302	2,015	5	---	94	80	43.01	39.70	14,738	1,667	31	6
Metal	4,941	NA	1,530	1,140	12,238	9,123	10	4	222	196	18.96	21.92	6,006	3,517	197	12
Nonmetal	932	1,010	261	268	2,094	2,147	6	---	116	113	58.25	52.62	18,284	1,750	48	19
Sand and gravel	645	600	132	122	1,061	1,008	---	1	22	24	20.73	24.80	493	6,796	230	-----
Stone	469	400	130	105	1,035	836	---	1	14	11	13.52	14.35	3,628	7,326	75	44
Native asphalt	189	222	51	55	410	440	---	---	17	23	41.42	52.25	387	5,306	12	4
Total or average	8,551	NA	2,395	1,945	19,141	15,570	21	6	485	447	26.44	29.09	7,845	3,502	593	85
Vermont:																
Nonmetal and peat	286	295	83	85	663	682	---	---	15	15	22.61	22.01	1,061	726	7	5
Sand and gravel	235	345	44	66	367	557	---	---	10	10	27.23	17.96	645	343	81	-----
Stone	1,812	1,770	464	445	3,775	3,606	---	---	125	125	33.12	34.67	1,353	738	72	51
Total or average	2,333	2,410	591	595	4,805	4,844	---	---	150	150	31.21	30.97	1,259	691	160	56
Virginia:																
Coal	12,579	14,090	2,400	2,691	19,138	21,901	30	28	923	986	49.80	46.30	11,752	9,877	1,265	29
Metal	333	335	89	90	714	718	---	---	30	32	42.01	44.58	1,978	599	3	3
Nonmetal	651	700	171	184	1,362	1,474	---	---	45	39	33.04	26.46	924	491	31	14
Sand and gravel	711	605	183	145	1,637	1,358	---	---	29	34	17.71	25.03	351	373	75	-----
Stone	4,000	3,715	1,091	989	9,030	8,222	---	4	175	168	19.38	20.92	721	4,044	161	138
Total or average	18,274	19,445	3,934	4,098	31,881	33,673	30	32	1,202	1,259	38.64	38.34	7,361	7,461	1,535	184
Washington																
Coal	80	70	18	16	146	128	---	---	4	3	27.37	23.44	609	516	6	2
Metal	409	370	116	78	932	624	1	---	56	34	61.14	54.46	13,679	1,451	27	5
Nonmetal	173	130	24	14	200	111	---	---	4	4	19.96	36.12	514	740	33	8
Sand and gravel	1,497	1,565	296	315	2,393	2,546	---	---	53	63	22.14	24.74	653	1,205	313	-----
Stone	1,120	1,270	217	250	1,748	2,007	---	---	29	29	16.59	14.45	600	524	224	155
Peat	28	30	4	6	31	47	---	---	------	1	-----	21.30	------	2,130	15	-----
Total or average	3,307	3,435	676	679	5,450	5,463	1	---	146	134	26.97	24.53	2,854	965	618	170
West Virginia:																
Coal	44,369	44,400	9,378	9,547	74,395	75,460	80	62	4,320	4,240	59.14	57.01	8,734	7,121	1,704	164
Nonmetal	1,005	785	309	195	2,472	1,559	---	---	17	18	6.88	11.55	485	429	14	9
Sand and gravel	264	220	65	61	557	530	2	---	13	13	26.91	24.52	21,898	792	16	-----

See footnotes at end of table.

Table 1.—Employment and injury experience in the mineral industries (mines and mills) in the United States, by States [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 1966	
							Fatal		Nonfatal		Frequency		Severity			
	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	Mines	Mills
West Virginia—Continued																
Stone	1,324	1,155	357	323	2,880	2,600	---	1	50	42	17.36	16.54	1,068	2,716	72	63
Total or average	46,962	46,555	10,108	10,126	80,305	80,149	82	63	4,400	4,313	55.81	54.60	8,297	6,806	1,806	236
Wisconsin:																
Metal	255	215	72	59	573	475	1	---	35	36	62.87	75.79	19,947	1,501	25	6
Nonmetal	95	105	13	12	103	97	---	---	4	1	38.94	10.31	1,421	24,742	6	3
Sand and gravel	2,014	2,010	441	407	3,784	3,589	1	3	78	69	20.88	20.06	2,059	5,358	463	-----
Stone	2,002	1,930	442	415	3,656	3,476	2	2	112	99	31.18	29.06	5,413	4,569	278	179
Peat	15	12	1	2	9	15	---	---	------	1	-----	67.97	------	476	3	-----
Total or average	4,381	4,270	968	895	8,124	7,652	4	5	229	206	28.68	27.57	4,818	4,997	775	188
Wyoming:																
Coal	324	290	75	66	576	504	---	---	23	20	39.92	39.68	11,257	1,786	14	1
Metal	1,556	1,685	371	415	3,049	3,413	1	1	78	89	25.91	26.37	3,542	4,389	59	7
Nonmetal	1,225	1,315	318	321	2,589	2,606	---	1	38	51	14.68	19.95	569	2,904	30	17
Sand and gravel	898	980	150	183	1,201	1,444	---	---	25	25	20.82	17.31	462	385	169	-----
Stone	253	270	64	58	515	462	---	---	10	13	19.42	28.12	672	6,927	60	11
Total or average	4,256	4,540	978	1,042	7,930	8,429	1	2	174	198	22.07	23.73	2,479	3,228	332	36
United States totals: [4]																
Coal	145,244	144,350	30,811	31,185	243,759	246,509	233	220	10,446	10,164	43.81	42.12	7,708	7,204	7,918	603
Peat	523	506	96	95	804	785	---	---	10	15	12.44	19.11	373	733	146	-----
Native asphalt	368	393	99	100	806	821	1	---	28	33	35.98	40.21	7,872	2,985	16	8
Metal	70,095	NA	20,301	17,807	162,907	142,670	82	72	4,010	3,455	25.12	24.73	4,428	4,401	2,357	290
Nonmetal	50,728	49,500	14,079	13,342	113,814	107,500	27	30	2,622	2,555	23.27	24.04	2,591	2,562	2,261	930
Sand and gravel	55,344	52,300	12,459	11,273	104,971	96,445	35	32	2,098	1,910	20.32	20.11	2,901	2,931	11,240	-----
Stone	85,826	84,300	23,113	22,434	190,787	185,260	51	45	3,583	3,260	19.05	17.83	2,852	2,286	5,318	3,544
Total or average	408,128	NA	100,958	96,236	817,848	779,995	429	399	22,797	21,390	28.40	27.93	4,586	4,344	29,256	5,375
Oil and natural gas [5]	451,747	445,562	NA	NA	954,527	938,946	103	88	8,724	8,776	9.25	9.44	1,050	981	NA	NA
Coke	14,216	13,701	5,094	4,873	40,730	38,956	3	9	191	226	4.76	6.03	666	1,602	NA	76
Blast-furnace-slag	1,472	1,721	407	439	3,332	3,539	---	3	44	53	13.20	15.82	709	5,762	------	61
Primary nonferrous smelting and refining	40,401	42,100	13,722	12,839	109,257	102,620	9	9	1,067	935	9.85	9.22	985	1,058	------	94
Grand total or average	915,964	NA	NA	NA	1,925,695	1,864,060	544	508	32,823	31,380	17.33	17.11	2,539	2,414	NA	NA

NA Not available.
[1] All data for 1966 are final. Data for 1967 are preliminary, except for anthracite, peat, native asphalt, oil and natural gas, coke, and slag.
[2] Less than 3.
[3] Less than 500.
[4] Data may not add to totals shown because of rounding.
[5] Includes data on officeworkers.

The data for 1967 have been collected and compiled by the Division of Statistics with some modification of procedures from those used in past years.

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

Year	Average men working daily	Man-hours worked (thousands)	Number of injuries		Injury rate per million man-hours	
			Fatal	Nonfatal	Fatal	Nonfatal
1963	926,700	1,898,476	568	32,659	0.30	17.20
1964	892,422	1,849,921	542	32,413	.29	17.52
1965	907,476	1,899,895	538	32,800	.28	17.26
1966	915,964	1,925,695	544	32,823	.28	17.04
1967 p	NA	1,864,060	508	31,380	.27	16.83

p Preliminary. NA Not available.

WORK STOPPAGES

A total of 291 work stoppages in certain mineral industry groups during 1967 resulted in a time loss of slightly more than 4.6 million man-days of work according to the U.S. Department of Labor, Bureau of Labor Statistics. (See table 3.) Comparable data for 1966 were 216 work stoppages with an aggregate time loss of slightly less than 1 million man-days.

Most of the large time loss in 1967 resulted from an extended major stoppage in the copper mining and primary nonferrous smelting industries. This strike period started about mid-July of 1967 and continued on into 1968. The affected mining districts were those in the Rocky Mountain States and in Michigan, but copper smelters were affected in most sections of the country. Some lead-zinc mines and smelters also were affected by the same stoppage.

SAFETY COMPETITIONS

The Bureau of Mines annually conducts safety competitions among the Nation's mineral industries. These contests have been recognized as effective tools to promote accident-prevention work among employees in mines, pits, and quarries. A total of 1,308 operations participated in the contests during 1967.

During 1967 a total of 921 operations competed in the 43d National Safety Competition cosponsored by the Bureau and the American Mining Congress. A total of 422, or 46 percent, of the participants operated without a disabling work injury during an aggregate worktime of 25.1 million man-hours, 16 percent of the total man-hours of exposure at all enrolled plants.

The National Safety Competition is divided into six groups to assure equality of competition among operations with relatively similar working conditions. The winning operation in each group is awarded the "Sentinels of Safety" trophy and plant flag. In addition, each employee at the winning plant receives the Bureau's Certificate of Accomplishment in Safety in recognition of his part in winning the record.

The following operations won the 1967 "Sentinels of Safety" trophies by working the greatest number of injury-free man-hours in each of the six competing groups:

Stone Quarries.—Millard quarry, Bethlehem Mines Corp., Annville, Pa.

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

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

Open-Pit mines (Metal and Nonmetal)—Sherman mine, Minnesota Ore Operations of the United States Steel Corp., Chisholm, Minn.

Underground Coal Mines.—Robena No. 3 mine, United States Steel Corp., Frick District, Carmichaels, Pa.

Surface Coal Mines.—Crescent Valley No. 7 mine, Hanna Coal Company Division, Consolidation Coal Co., Holloway, Ohio.

A total of 303 operations participated in the National Sand and Gravel Safety Competition sponsored by the Bureau. Fifty-six percent of these operations were injury-free during 1967 and worked over 4.9 million man-hours, or 37 percent of the total man-hours of exposure of all participants.

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:			Metal mining—Continued		
Anthracite:			Ferroalloy metal ores:		
1963	4	3.0	1963	1	[2] 9.6
1964	5	[1]	1964	----	----
1965	3	1.7	1965	----	----
1966	4	8.3	1966	1	[1]
1967	3	1.4	1967	1	[1]
Bituminous and lignite:			Miscellaneous metal ores:		
1963	131	[2] 234.0	1963	----	----
1964	111	340.0	1964	----	----
1965	145	258.0	1965	----	----
1966	160	629.0	1966	----	----
1967	207	[2] 158.0	1967	1	1.0
Crude petroleum and natural gas:			Primary smelting and refining of nonferrous metals:		
1963	----	----	1963	7	3.0
1964	----	----	1964	11	170.0
1965	----	----	1965	8	51.6
1966	1	50.7	1966	15	182.0
1967	2	[1]	1967	12	1,420.0
Oil and gas field services:			Mining and quarrying of nonmetallic minerals (except fuels):		
1963	1	2.5	Dimension stone:		
1964	----	----	1963	1	[1]
1965	3	[1]	1964	1	2.2
1966	1	2.6	1965	3	[2] 2.1
1967	3	[1]	1966	1	[1]
Petroleum refining:			1967	----	----
1963	1	[2] 314.0	Crushed and broken stone:		
1964	14	162.0	1963	5	3.8
1965	7	[2] 31.4	1964	8	24.7
1966	5	5.6	1965	9	38.0
1967	15	103.0	1966	7	9.2
Metal mining:			1967	1	9.0
Iron:			Sand and gravel:		
1963	1	[2] 2.4	1963	2	[1]
1964	3	5.5	1964	2	[1]
1965	3	21.9	1965	10	3.5
1966	----	----	1966	7	1.9
1967	----	----	1967	[2] 15	26.8
Copper:			Chemical and fertilizer mineral mining:		
1963	5	27.6	1963	1	[2] 88.6
1964	11	385.0	1964	4	12.5
1965	3	60.5	1965	1	[1]
1966	6	25.2	1966	2	[1]
1967	7	2,660.0	1967	10	38.9
Lead-zinc:			Cement, hydraulic:		
1963	----	[2] 91.7	1963	1	[1]
1964	9	14.9	1964	1	7.4
1965	6	43.3	1965	14	32.3
1966	4	[2] 66.0	1966	2	1.7
1967	3	[2] 93.4	1967	9	67.4
Gold-silver:					
1963	1	16.0			
1964	----	[2] 21.6			
1965	----	----			
1966	----	----			
1967	2	26.9			

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

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

The following operations won the 1967 awards in the bank or pit and dredge groups:

Bank or Pit.—Lockport plant, Material Service Division, General Dynamics Corp., Lockport, Ill.

Dredge.—Dover plant, T. L. Herbert and Sons, Linden, Tenn.

Three other competitions cosponsored by the National Lime Association, the National Limestone Institute, and the National Slag Association, were conducted during 1967. A total of 240 plants was entered in these contests.

The Mineral Industry of Alabama

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

By Ronald P. Hollenbeck [1] and W. Everett Smith [2]

The value of mineral production in Alabama in 1967 increased slightly, reaching a new high of $251 million. The gain in value over that of 1966 resulted mainly from an increase in coal production, which offset declines in production of cement, petroleum, and stone. These four commodities accounted for 86 percent of the total value of the State's mineral production.

Alabama ranked second among the States in the production of bauxite; third in masonry cement, native asphalt, and scrap mica; seventh in portland cement; ninth in iron ore, and 10th in lime.

Business activity in Alabama continued to increase but at a slower rate of growth than in 1966. Total personal income reached a record high, although the increase was below the national average of 6.9 percent. Per capita income also

[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.
[2] Chief, Economic Geology Division, Geological Survey of Alabama, Tuscaloosa, Ala.

Table 1.—Mineral production in Alabama [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Cement: [2]				
Masonry thousand 280-pound barrels	2,570	$7,613	2,377	$6,938
Portland thousand 376-pound barrels	16,394	49,537	15,364	46,510
Clays thousand short tons	2,448	5,142	2,724	7,422
Coal (bituminous) do.	14,219	100,112	15,486	110,696
Iron ore (usable) thousand long tons, gross weight	1,508	8,702	1,472	8,286
Lime thousand short tons	699	8,442	624	7,719
Natural gas million cubic feet	252	32	248	31
Petroleum (crude) thousand 42-gallon barrels	8,030	20,878	7,348	19,500
Sand and gravel thousand short tons	7,082	7,953	7,229	7,969
Stone do.	[3] 20,744	[3] 36,839	18,371	33,346
Value of items that cannot be disclosed: Native asphalt, bauxite, slag cement, scrap mica, salt, stone (dimension limestone, dimension marble, crushed sandstone), talc	XX	4,528	XX	2,974
Total	XX	249,778	XX	251,391
Total 1957–59 constant dollars	XX	[r] 252,973	XX	[p] 250,364

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

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

County	1966	1967	Minerals produced in 1967 in order of value
Autauga	W	$299,000	Sand and gravel.
Baldwin	W	187,689	Petroleum, miscellaneous clay.
Barbour	W	W	Iron ore, bauxite, sand and gravel.
Bibb	W	W	Coal, limestone, sand and gravel, miscellaneous clay.
Blount	W	W	Coal, iron ore, cement, fire clay.
Butler	$747,700	W	Iron ore.
Calhoun	W	W	Fire clay, limestone, miscellaneous clay.
Cherokee	W	W	Sand and gravel.
Chilton	W	W	Do.
Choctaw	705,507	1,091,050	Petroleum.
Clarke	W	W	Petroleum, sand and gravel.
Cleburne	20,000	----------	
Coffee	37,000	50,000	Sand and gravel.
Colbert	W	W	Limestone, native asphalt.
Covington	W	W	Limestone.
Crenshaw	W	W	Iron ore, sand and gravel.
Cullman	77,207	W	Limestone, coal.
Dallas	W	W	Lime, sand and gravel.
De Kalb	W	W	Limestone.
Elmore	W	W	Sand and gravel, miscellaneous clay.
Escambia	1,686,422	1,522,779	Petroleum, sand and gravel, miscellaneous clay.
Etowah	955,518	1,005,240	Limestone, coal, sand and gravel, fire clay.
Fayette	109,000	W	Sand and gravel.
Franklin	3,286,842	3,127,346	Iron ore, limestone, sand and gravel, fire clay.
Geneva	W	W	Sand and gravel.
Greene	W	W	Do.
Hale	2,000	2,000	Do.
Henry	W	W	Kaolin, bauxite, limestone.
Houston	W	W	Sand and gravel.
Jackson	2,126,418	W	Coal, limestone.
Jefferson	92,196,194	106,206,204	Coal, cement, limestone, iron ore, miscellaneous clay, sandstone.
Lee	W	W	Limestone.
Limestone	67,921	69,961	Do.
Lowndes	W	W	Bentonite.
Macon	W	796,000	Sand and gravel.
Madison	W	W	Limestone, miscellaneous clay.
Marengo	W	W	Cement, limestone.
Marion	W	W	Coal, kaolin, sand and gravel.
Marshall	W	W	Limestone, sand and gravel.
Mobile	W	W	Petroleum, cement, oystershell, sand and gravel, miscellaneous clay.
Monroe	46,000	34,000	Sand and gravel.
Montgomery	1,702,000	W	Sand and gravel, miscellaneous clay.
Morgan	W	W	Limestone, sand and gravel.
Pike	922,700	649,000	Iron ore.
Randolph	W	W	Mica.
Russell	W	W	Miscellaneous clay, sand and gravel.
St. Clair	W	W	Cement, limestone, fire clay, miscellaneous clay.
Shelby	28,183,862	26,065,767	Lime, cement, limestone, coal, iron ore, miscellaneous clay.
Sumter	W	W	Sand and gravel.
Talladega	W	W	Marble, sand and gravel, limestone, talc.
Tuscaloosa	W	3,741,726	Coal, sand and gravel.
Walker	W	W	Coal, fire clay, miscellaneous clay.
Washington	W	W	Salt, limestone.
Winston	W	W	Coal.
Undistributed [2]	116,905,709	106,543,238	
Total	249,778,000	251,391,000	

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

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

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

reached a new high. Construction activity, measured by housing units authorized, and value, remained at a high level with the number of housing units increasing by 2,800, and value increasing by $34.8 million. Total receipts from farm marketing decreased 6.9 percent compared with the national decrease of 1.7 percent. Value of export and import trading handled through the Mobile Custom District, which consists of nine ports located in Alabama, Florida, and Mississippi exceeded $714 million, an increase of 23.4 percent over that of 1966. Consumption of electric energy in Alabama continued to rise with an increase of 6.4 percent above the 1966 level.

Table 3.—Selected indicators of Alabama business activity

	1966	1967	Change (percent)
Personal income:			
Total millions	$7,254	$7,668	+5.7
Per capita	$2,066	$2,166	+4.8
Housing construction activity:			
Units authorized thousands	10.1	12.9	+27.7
Value of construction millions	$116.8	$151.6	+29.8
Cash receipts from farm marketings do	$647.2	$602.4	−6.9
Mineral production do	$249.8	$251.4	+0.6
Foreign trade, Mobile Customs District:			
Value of exports do	$378.1	$493.7	+30.6
Value of imports do	$200.8	$220.9	+10.0
Total sales of electric energy million kilowatt-hours	26,467.1	28,161.9	+6.4
Consumption for industrial purposes million kilowatt-hours	15,556.0	16,552.0	+6.4
Monthly average employment:			
Total nonagricultural thousands	929.3	939.9	+1.1
Manufacturing do	292.5	291.5	−0.3
Nonmanufacturing do	636.8	648.4	+1.8

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

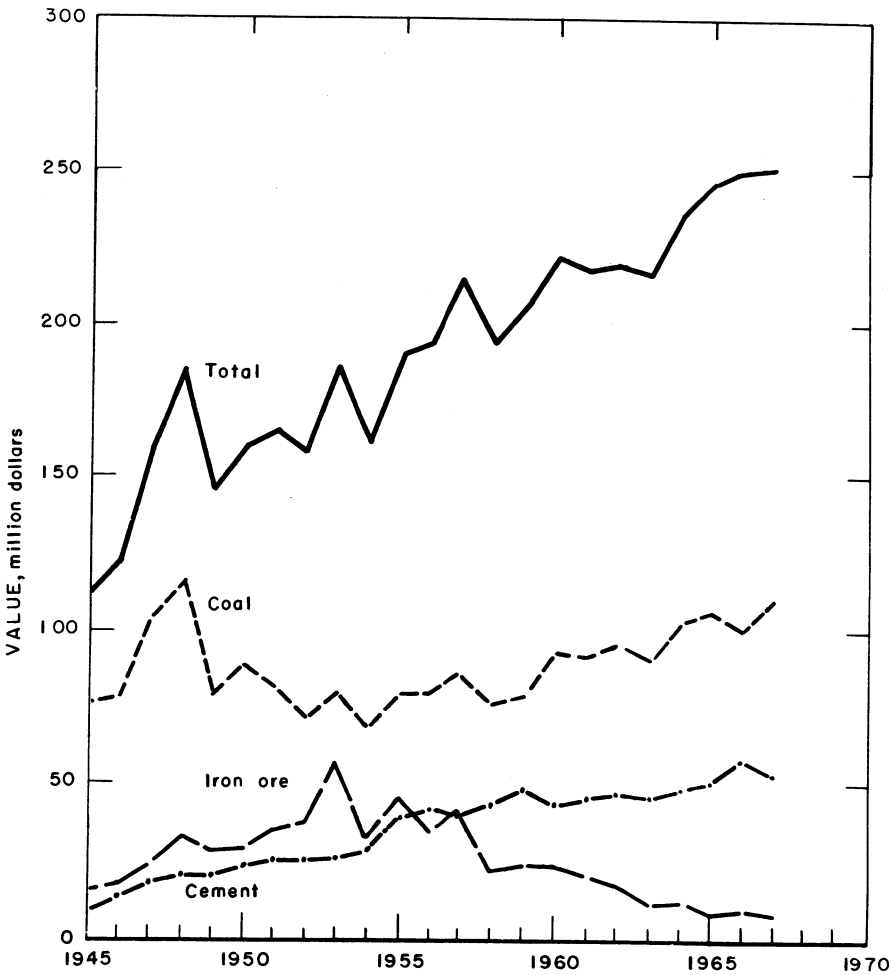

Figure1.—Value of coal, cement, and iron ore, and total value of mineral production in Alabama.

Trends and Developments.—Alabama By-Products Corp. completed the first phase of its expansion and modernization program at the Tarrant coke plant by firing 21 of the proposed 78 new coke ovens announced in 1966. When the remaining 57 ovens are completed by late 1969, coke output will have increased by more than one-third.

American Colloid Co. expanded its bentonite facilities at the Sandy Ridge plant in Lowndes County.

A. P. Green Refractories Co. announced plans to build a plant near Eufaula to manufacture refractory materials from bauxitic clay.

Commercial Metals constructed a secondary aluminum smelter in Anniston. The smelter has a melting capacity of 1.5 tons of aluminum breakage per hour. Estimated output is 200 tons of finished aluminum metal per month.

Marion Coke Co. at Brilliant was constructing 45 partially automated beehive coke ovens as additions to its present battery of 135 ovens. The company markets its coke to chemical companies along the Tennessee River in Alabama and Tennessee.

McWane Cast Iron Pipe Co. began construction of a new pig iron operation at Mobile. The plant will utilize a direct reduction process developed by the McDowell-Wellman Engineering Co. to process Brazilian hematite fines supplied by the Brasamerican Ore Corp.

Mobile Refining Co. announced plans to construct an oil refinery in Mobile.

Peabody Coal Co. reported production from its new Warrior strip mine in the Gwin coal seam near Oak Grove, Jefferson County; production will be about 1 million tons per year. Output will go to steam-generating powerplants of the Alabama Power Co.

Republic Steel Corp. completed its new plate mill at the Gadsden plant; construction began about 2 years ago. The new mill will allow the Gadsden plant to play a larger role in supplying steel for Republic's southern market.

Revere Copper and Brass Inc. announced plans to construct a 112,000-ton-per-year aluminum reduction plant at Scottsboro. The new facility will consist of two potlines, the first of which is expected to be in operation by 1971, and the second by 1972. The company's new aluminum rolling mill was in the final stage of construction and is expected to be in operation by the second quarter of 1968.

Tennessee Valley Authority awarded a $4.5 million contract to modernize its phosphate ore processing plant at Muscle Shoals, and began construction of the Browns Ferry nuclear powerplant following receipt of a construction permit from the Atomic Energy Commission.

United States Gypsum Co. announced an increase in the capacity of its lime plant at Montevallo, Shelby County, by the installation of a 400-ton-per-day rotary kiln. The new kiln is expected to be in operation by the spring of 1968.

Vulcan Materials Co. announced plans to double the capacity of its lightweight aggregate plant at Parkwood, Jefferson County, and to modernize and expand its slag. stone, and ready-mix concrete plants in Birmingham.

Exploration by major companies for bauxite, copper, and sulfide minerals continued throughout the year. There was increased interest in the recovery of scrap mica.

Legislation and Government Programs.—The Geological Survey of Alabama completed a bauxite drilling program in the Barbour–Henry County area, and coal drilling programs in the Blount Mountain area of the Plateau Coal Field and the Warrior and Plateau Coal Fields of Marion and Winston Counties. Plans were made for a lignite drilling program in southern Alabama. The Survey also completed field work for mineral resource maps of Baldwin, Choctaw, Clarke, De Kalb, Etowah, Marengo, Marion, Mobile, Monroe, Washington, Wilcox, and Winston Counties, and began geologic mapping in Coosa and Lee Counties. The Survey released 21 publications during the year, including mineral resource maps of Bullock, Butler, Coffee, Conecuh, Covington, Crenshaw, Dale, Escambia, Geneva, Henry, and Houston Counties.

The Geological Survey of Alabama in cooperation with the U.S. Geological Survey began geologic mapping in Blount, Choctaw, Mobile, and Monroe Counties. Work was completed on geologic maps of Baldwin, De Kalb, and Washington Counties.

Traffic operated on 51 percent of the State's allotment of Interstate and Defense Highway mileage.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	5,240	210	1,101	8,769	5	122	14.48	4,256
Metal	1,127	277	312	2,613	---	27	10.33	295
Nonmetal and native asphalt	1,111	275	306	2,535	1	36	14.60	2,668
Sand and gravel	479	272	130	1,176	1	16	14.45	12,028
Stone	2,583	289	746	6,194	1	63	10.33	4,764
Total [1]	10,540	246	2,595	21,287	8	264	12.78	4,158
1967: [p]								
Coal	5,025	210	1,057	8,617	4	118	14.16	3,607
Metal	1,065	293	312	2,585	---	34	13.15	608
Nonmetal and native asphalt	770	272	210	1,695	---	24	14.16	404
Sand and gravel	515	270	139	1,259	---	22	17.47	1,998
Stone	2,550	283	723	5,950	3	55	9.75	3,639
Total [1]	9,920	246	2,440	20,106	7	253	12.93	2,860

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

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Mineral fuels accounted for 52 percent of the total value of the State's mineral production, compared with 49 percent in 1966.

Asphalt (Native).—Alabama ranked third among the States in the production of native asphalt. Alabama Asphaltic Limestone Co. mined bituminous limestone at its Margerum quarry, Colbert County, for roadstone.

Coal (Bituminous).—Bituminous coal production increased 9 percent and was at its highest level in 19 years. The five leading producers supplied 49 percent of the State's total production. The average output per mine increased from 78,000 tons in 1966 to 99,000 tons. Captive tonnage constituted 46 percent of the total production, and was the same as in 1966. Of the total production, 60 percent was from underground mines, 39 percent from strip mines, and 1 percent from auger mines. Rail and water transportation was used to ship 84 percent of the coal, and the remainder was shipped by truck. Ninety-seven percent of the coal mined underground was mechanically loaded.

Of the coal produced 73 percent was cleaned at 26 cleaning plants. The average coal recovery was 60 percent.

Table 5.—Coal (bituminous) production,[1] 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
1966:								
Bibb	2	8	-----	35	105	-----	140	$735
Blount	1	4	1	1	176	5	182	1,084
Cullman	1	-----	-----	2	-----	-----	2	16
Jackson	2	1	-----	10	534	-----	545	1,970
Jefferson	48	17	1	6,105	888	20	7,014	56,501
Marion	30	2	-----	334	165	-----	499	2,373
Shelby	9	-----	-----	522	-----	-----	522	4,809
Tuscaloosa	1	10	1	18	1,344	20	1,382	6,047
Walker	22	16	3	1,872	1,856	70	3,798	25,858
Undistributed [3]	---	3	-----	-------	135	-----	135	719
Total [2]	116	61	6	8,900	5,203	115	14,219	100,112
Earliest record to date	NA	NA	NA	NA	NA	NA	1,041,285	NA
1967:								
Bibb	2	5	-----	66	232	-----	298	1,643
Blount	---	4	-----	---	233	-----	233	1,679
Jackson	3	1	-----	4	618	-----	622	2,652
Jefferson	42	19	-----	6,381	1,882	-----	8,263	64,768
Marion	24	3	-----	282	190	-----	472	1,992
Shelby	6	1	-----	561	8	-----	570	5,299
Tuscaloosa	1	9	1	27	774	2	803	3,432
Walker	13	17	3	2,039	1,910	79	4,028	28,207
Undistributed [4]	---	3	-----	-------	197	-----	197	1,024
Total [2]	91	62	4	9,362	6,043	81	15,486	110,696
Earliest record to date	NA	NA	NA	NA	NA	NA	1,056,771	NA

NA Not available.
[1] Excludes mines producing less than 1,000 short tons.
[2] Data may not add to total shown because of independent rounding.
[3] Includes Etowah and Winston Counties.
[4] Includes Cullman, Etowah, and Winston Counties.

Coke.—Six companies produced by-product metallurgical coke at seven plants in Jefferson, Etowah, and Tuscaloosa Counties.

Natural Gas.—Marketed production of natural gas remained about the same as in 1966. The White House gasfield in Marion County was the only producing field.

Petroleum.—Production of crude petroleum decreased 8 percent. Nine fields (including three new discoveries), with 532 producing wells in five counties, contributed to the total production. Initial production from the Smackover Formation, Choctaw County (Toxey field), came from a depth of 10,460 to 10,480 feet; three producing wells were developed in the field during the year. The new Choctaw Ridge field in Choctaw County was developed in the Smackover formation at a depth of 11,940 to 11,952 feet. New oil production came from the Eutaw formation near Gilbertown (unnamed field); the confirmation well for the field was underway at yearend.

The Citronelle field, Mobile County, had 411 producing wells and was the leading producing field in the State. Other fields were the Pollard field, Escambia County, with 29 wells; the Gilbertown field, Choctaw County, with 62 wells; the South Carlton field, Clarke and Baldwin Counties, with 19 wells; the Choctaw Ridge field, Choctaw County, with three wells; the Toxey field, Choctaw County, with two wells; the Tensaw field, Baldwin County, with four wells; and the East Langsdale field with one well, and the unnamed field with one well, both in Choctaw County.

Table 6.—Crude petroleum production, by counties

(42-gallon barrels)

County	1966	1967
Baldwin	70,177	68,562
Choctaw	282,203	411,717
Clarke	121,123	119,089
Escambia	453,389	369,728
Mobile	7,103,108	6,378,904
Total	8,030,000	7,348,000
Earliest record to date	81,970,000	89,318,000

Source: State Oil and Gas Board.

Table 7.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1967

County	Drilling [1]								Geophysical, crew-weeks [2] (Reflection seismograph method)
	Development wells			Exploratory wells			Total		
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage	
Baldwin	--	----	----	----	----	1	1	9,011	-------
Bullock	--	----	----	----	----	1	1	990	-------
Choctaw	6	----	2	3	----	6	17	172,915	44.3
Clarke	--	----	----	----	----	6	6	48,973	44.0
Escambia	--	----	1	----	----	----	1	5,990	-------
Franklin	--	----	----	----	----	2	2	2,554	-------
Geneva	--	----	----	----	----	1	1	8,792	-------
Lamar	--	----	----	----	----	2	2	6,017	-------
Mobile	--	----	----	----	----	2	2	20,028	14.0
Tuscaloosa	--	----	----	----	----	1	1	900	-------
Washington	--	----	----	----	----	1	1	21,153	8.0
Wilcox	--	----	----	----	----	2	2	17,802	-------
Winston	--	----	----	----	----	1	1	1,725	-------
Total	6	----	3	3	----	26	38	316,850	110.3

[1] American Association of Petroleum Geologists.
[2] International Oil Scouts Association, Austin, Tex.

NONMETALS

Nonmetals accounted for 44 percent of the State's total value of mineral production, compared with 48 percent in 1966.

Cement.—Alabama ranked third among the States in the production of masonry cement. Eight companies produced masonry cement at 10 plants in six counties; leading producers were Southern Cement Co. and Ideal Cement Co. Shipments of masonry cement declined 8 percent; 25 percent of shipments was consumed in Alabama. Other shipments were made to Georgia, 33 percent; Florida, 17 percent; Louisiana, 6 percent; Mississippi, 6 percent; South Carolina, 4 percent; Tennessee, 4 percent; North Carolina, 3 percent; and other States, 2 percent.

Alabama ranked seventh among the States in the production of portland cement. Seven companies produced portland cement at eight plants in five counties; leading producers were Lone Star Cement Corp. and Ideal Cement Co. Shipments declined 6 percent; 34 percent of the total was shipped to Alabama destinations. Other shipments were made to Florida, 22 percent; Georgia, 22 percent; Mississippi, 9 percent; South Carolina, 4 percent; Louisiana, 3 percent; and other States, 6 percent.

Raw materials used in the manufacture of portland cement included 48 percent

cement rock, 31 percent limestone and oystershell, 11 percent clay and shale, and 10 percent other materials.

Fifty-six percent of the portland cement was used for ready-mixed concrete, 19 percent by highway contractors, 15 percent by manufacturers of concrete products, 6 percent by building material dealers, and 4 percent for other uses.

Southern Cement Co. and Cheney Lime & Cement Co. produced slag cement at plants in Jefferson and Blount Counties; total shipments declined 14 percent.

Clays.—Eleven companies mined fire clay for refractories at 12 mines in six counties; total production increased 37 percent.

Twenty companies mined 1.9 million tons of miscellaneous clay at 26 mines in 13 counties for heavy clay products, portland cement, and lightweight aggregate; total production increased 3 percent.

Kaolin was mined in Henry and Marion Counties; total production increased 57 percent.

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

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Firebrick and block	193,509	$755,173	$3.90	235,390	$924,891	$3.93
Kiln furniture	161,497	W	W	W	W	W
Building brick	-------	----------	-------	70,800	W	W
Vitrified sewer pipe	-------	----------	-------	50,603	W	W
Other uses [1]	100,107	1,418,947	14.17	265,691	2,931,037	11.03
Total	455,113	2,174,120	4.78	622,484	3,855,928	6.19

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes mortar, foundries and steelworks, and uses indicated by symbol W.

Lime.—Alabama ranked 10th among the States in the production of lime. Five companies produced quicklime and hydrated lime at six plants in Shelby County for construction, agricultural, chemical, and industrial uses; one company manufactured lime for use in the production of magnesium in Dallas County. Total production declined 11 percent. Leading producers were Southern Cement Co. and Longview Lime Corp. Intrastate shipments accounted for 57 percent of the total; other shipments were made to Georgia (13 percent), Florida (10 percent), Kentucky (6 percent), South Carolina (4 percent), Mississippi (4 percent), and other States (6 percent).

Six companies, operating seven papermills in six counties, recovered quicklime as a byproduct.

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

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Construction	136,081	$1,841,123	$13.53	104,601	$1,550,330	$14.82
Steel electric furnaces	29,341	337,270	11.49	25,011	308,075	12.32
Paper	204,367	2,454,613	12.01	204,825	2,536,845	12.39
Sewage	W	W	W	22,379	269,539	12.04
Sugar refining	4,721	59,687	12.64	3,535	44,143	12.49
Water purification	54,602	708,699	12.98	51,983	658,200	12.66
Other uses [1]	270,169	3,040,292	11.25	211,928	2,352,022	11.10
Total	699,281	8,441,684	12.07	624,262	7,719,154	12.37

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes lime used for agriculture, alkalies; brick, sand-lime, slag, and silica (1966); calcium carbide, coke food, insecticides, oil-well drilling (1966), ore concentration (1966), metallurgical uses, paint, petroleum (1967) tanning (1966), other uses, and use indicated by symbol W.

Mica.—Alabama ranked third among the States in the production of scrap mica. United States Gypsum Co. mined and processed scrap mica in Randolph County.

Salt.—Olin Mathieson Chemical Corp. produced salt in brine in Washington County; production was slightly below 1966.

Sand and Gravel.—Forty-eight commercial and two Government-and-contractor operations mined sand and gravel in 29 counties. Production increased 2 percent, and commercial operations accounted for most of the total production. Leading counties were Montgomery, Macon, and Escambia. Forty stationary and six portable plants and 23 dredges were in operation during the year. Most of the production was processed by washing. Of the total commercial production, 61 percent was shipped by truck, 30 percent by rail, 6 percent by water, and 3 percent by other methods. Of the commercial operations 21 had annual outputs of over 100,000 tons, and accounted for 88 percent of the total production; 27

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

(Thousand short tons and thousand dollars)

County	1966			1967		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Autauga	1	W	W	1	343	$299
Barbour	1	15	$15	1	W	W
Cherokee	1	2	W	1	2	W
Cleburne	1	22	20	------	------	------
Coffee	1	50	37	1	50	50
Crenshaw	1	W	W	1	9	W
Elmore	1	W	W	1	436	W
Escambia	4	518	533	4	573	522
Fayette	1	68	109	1	W	W
Franklin	2	317	W	2	W	W
Geneva	1	30	W	1	W	W
Hale	1	2	2	1	2	2
Jefferson	1	36	32	------	------	------
Macon	3	642	W	3	636	796
Marion	1	32	W	1	21	51
Monroe	1	42	46	1	38	34
Montgomery	5	1,643	1,581	5	2,079	1,987
Morgan	1	198	W	1	W	W
Talladega	2	W	W	1	170	249
Tuscaloosa	4	176	229	5	265	310
Other counties [1]	21	3,289	5,349	18	2,605	3,669
Total	55	7,082	7,953	50	7,229	7,969

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Baldwin (1966), Bibb, Chilton, Clarke, Dallas, Etowah, Green, Houston, Marshall, Mobile, Russell, Sumter, Washington (1966) Counties, and counties indicated by symbol W.

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

(Thousand short tons and thousand dollars)

Use	1966			1967		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,353	$2,270	$0.96	2,274	$2,233	$0.98
Paving	548	508	.93	644	625	.97
Fill	28	10	.36	53	22	.42
Other sands [1]	403	589	1.46	327	467	1.43
Total	3,332	3,377	1.01	3,298	3,347	1.01
Gravel:						
Structural	2,262	2,826	1.25	2,286	2,929	1.28
Paving	642	782	1.22	748	864	1.16
Miscellaneous gravel	W	W	W	207	256	1.24
Other gravel [2]	846	968	1.14	690	573	.83
Total	3,750	4,576	1.22	3,931	4,622	1.18
Total sand and gravel	7,082	7,953	1.12	7,229	7,969	1.10

W Withheld to avoid disclosing individual company confidential data.
[1] Includes engine, filtration (1966), molding and other sands.
[2] Includes fill and other gravel, and use indicated by symbol W.

operations had outputs of less than 100,000 tons.

Stone.—Limestone was mined and crushed at 47 commercial and two Government–and–contractor operations in 21 counties. Total production decreased 12 percent with commercial operations furnishing most of the production. Major uses of the stone were for concrete and roads, manufacture of cement and lime, and metallurgical flux.

Dimension limestone was quarried in Franklin County for construction and building stone.

Three firms crushed and ground marble in Talladega County for paint, putty, rubber, plastics, roofing granules, whiting, and other uses; total production increased 6 percent.

Moretti–Harrah Marble Co. quarried dimension marble in Talladega County for rough and dressed building stone and dressed monumental stone.

Two firms crushed oystershell dredged from Mobile Bay for cement, concrete, roads, and poultry grit; total production decreased 8 percent.

United States Steel Corp. and Enos Vann crushed sandstone in Jefferson County for cement, foundry, and other uses; total production decreased 11 percent.

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

County	1966			1967		
	Number of quarries	Short tons	Value	Number of quarries	Short tons	Value
Calhoun	1	293,613	$470,000	1	W	W
Colbert	4	1,251,170	1,593,971	4	1,039,563	$1,310,578
Cullman	1	39,860	61,169	1	66,338	103,620
Henry	1	3,327	5,420	1	W	W
Jackson	1	130,000	156,000	1	129,567	W
Jefferson	9	4,606,217	5,897,334	9	4,144,353	5,186,640
Lee	1	W	W	1	328,496	W
Limestone	1	45,281	67,921	1	46,641	69,961
Madison	4	2,329,479	2,155,255	4	1,299,807	1,272,390
Marengo	1	321,930	222,100	1	W	W
Marshall	1	225,000	337,000	1	W	W
Shelby	8	4,861,146	6,677,815	9	4,339,404	6,032,710
Washington	1	746,870	515,300	1	W	W
Other counties [1]	14	3,995,154	4,808,558	14	5,117,146	6,591,040
Total	48	18,849,047	22,967,843	49	16,511,315	20,566,939

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Bibb, Covington, De Kalb, Etowah, Franklin, Morgan, St. Clair, and Talladega Counties, and counties indicated by symbol W.

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

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	10,370,282	$12,753,356	$1.23	8,786,749	$10,886,970	$1.24
Cement manufacture	4,356,243	3,249,417	.75	3,832,549	2,969,314	.77
Lime manufacture	981,059	1,647,459	1.68	1,044,617	1,709,182	1.64
Fluxing stone	1,244,050	2,055,800	1.65	994,629	1,674,388	1.68
Agstone	666,144	1,152,891	1.73	839,869	1,381,908	1.65
Other uses [1]	1,231,269	2,108,920	1.71	1,012,902	1,945,177	1.92
Total	18,849,047	22,967,843	1.22	16,511,315	20,566,939	1.25

[1] Includes riprap, refractory stone, railroad ballast, alkali, paper, asphalt and fertilizer fillers, rock dust for coal mines, mineral food, and other uses.

Talc.—Talc was mined and ground at Winterboro, Talladega County, for toilet preparations, paint, and other uses.

Vermiculite.—Zonolite Co., Division of W. R. Grace & Co., exfoliated vermiculite at its plant near Birmingham, using crude material shipped from other States.

METALS

Bauxite.—Alabama ranked second among the States in production of bauxite. Three companies mined crude bauxite in Barbour and Henry Counties for refractories and chemicals; total production increased 28 percent.

Iron Ore.—Alabama ranked ninth among the States in production of iron ore. Shipments of iron ore declined 2 percent; of the total, 14 percent was direct-shipping ore compared with 10 percent in 1966. The number of operating mines decreased from 19 to 15; average usable production per mine increased from 79,000 to 98,000 tons.

Woodward Iron Co., the only red iron ore producer in the State, operated its Pyne mine in Jefferson County; production increased 24 percent.

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

	1966		1967	
	Number of mines	Long tons	Number of mines	Long tons
Mine production:				
By varieties:				
Hematite	2	942,722	1	1,036,112
Limonite	17	3,225,200	14	2,638,263
By mining methods:				
Open pit	18	3,390,200	14	2,638,263
Underground	1	777,722	1	1,036,112
Shipments from mines:				
Direct to consumers	1	149,755	1	201,195
To beneficiation plants	18	3,976,146	14	3,401,524

Table 15.—Usable iron ore shipments, by counties

County	1966			1967		
	Number of mines	Long tons	Value	Number of mines	Long tons	Value
Butler	5	140,667	$747,700	3	W	W
Crenshaw	1	16,973	120,000	1	W	W
Jefferson	1	621,527	W	1	799,256	W
Pike	4	170,356	922,700	3	123,557	$649,000
Tuscaloosa	1	19,193	W			
Other counties [1]	7	539,443	6,912,014	7	548,996	7,637,397
Total	19	1,508,159	8,702,414	15	1,471,809	8,286,397

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Barbour, Blount, Franklin, and Shelby Counties, and counties indicated by symbol W.

Table 16.—Usable iron ore production and shipments

	1966		1967	
	Long tons	Iron content, natural (percent)	Long tons	Iron content, natural (percent)
Production:				
Hematite	704,688	34	877,059	34
Limonite	876,740	44	750,880	46
Shipments:				
Direct-shipping ore	149,755	34	201,195	34
Concentrates and sinter	1,358,404	41	1,270,614	40

Fourteen producers mined brown iron ore (limonite) in seven counties; total production decreased 14 percent. Principal producing counties were Franklin, Pike, and Barbour. Imports of iron ore, chiefly from Venezuela, decreased 6 percent from 1966 levels.

Consumption of iron ore in agglomerating plants, blast furnaces, and steel furnaces was 40 percent domestic ore and 60 percent foreign ore. Consumption of foreign ore exceeded consumption of domestic ore for the fourth consecutive year.

Magnesium.—Alabama Metallurgical Corp. produced magnesium metal at its plant near Selma, Dallas County, from dolomite mined near Montevallo, Shelby County.

Pig Iron and Steel.—Total production of pig iron was 4.3 million tons; value of shipments was $235 million.

Table 17.—Principal producers

Commodity and company	Name of operation	County	Address
Alumina:			
Aluminum Co. of America	Mobile plant	Mobile	1501 Alcoa Bldg. Pittsburgh, Pa. 15219
Aluminum, smelters:			
Reynolds Metal Co	Listerhill plant	Colbert	Reynolds Metals Bldg. Richmond, Va. 23218
Asphalt (native):			
Southern Stone Co., Inc	Margerum quarry	do	2111 8th Ave., South Birmingham, Ala. 35233
Bauxite:			
Harbison-Walker Refractories Co.[1]	Eufaula mine	Henry	1800 Farmers Bank Bldg. Pittsburgh, Pa. 15222
National Properties & Mining Co., Inc.	do	Barbour	Box 556 Eufaula, Ala. 36027
Wilson-Snead Mining Co	Dixon mine	do	Box 84 Eufaula, Ala. 36027
Do	Lucas mine	Henry	Do.
Cement:			
Alpha Portland Cement Co.[2]	Phoenixville mill	Jefferson	15 South 3d St. Easton, Pa. 18042
Ideal Cement Co.[2]	Mobile mill	Mobile	420 Denver National Bldg. Denver, Colo. 80202
Lehigh Portland Cement Co.[2]	Birmingham mill	Jefferson	718 Hamilton St. Allentown, Pa. 18105
Lone Star Cement Corp.[2]	do	do	Box 6237, West End Branch Richmond, Va. 23230
Do.[3]	Demopolis mill	Marengo	Do.
Southern Cement Co.[4]	North Birmingham mill	Jefferson	Bank for Savings Bldg. Birmingham, Ala. 35203
Do.[2]	Calera mill	Shelby	Do.
Clay:			
Bentonite:			
American Colloid Co	Sandy Ridge mine	Lowndes	5100 Suffield Court Skokie, Ill. 60076
Fire:			
Dixie Clay Co	Jacksonville mine	Calhoun	Box 361 Anniston, Ala. 36202
Donoho Clay Company	Donoho mine	do	Box 843 Anniston, Ala. 36202
Marigold Coal, Inc	Jasper mine	Walker	Jasper, Ala. 35501
Riverside Clay Co	McAffee mine	St. Clair	Box 551 Pell City, Ala. 35125
Russell Coal & Clay Co	Cordova Strip mine	Walker	403 High Street Cordova, Ala. 35550
Kaolin:			
Harbison-Walker Refractories Co.[5]	Eufaula mine	Henry	1800 Farmers Bank Bldg. Pittsburgh, Pa. 15222
Thomas Alabama Kaolin Co.	Hackelburg mine	Marion	2412 Ken Oak Road Baltimore, Md. 21209
Miscellaneous:			
Bickerstaff Clay Products Co., Inc.	Bessemer mine	Jefferson	Box 1178 Columbus, Ga. 31902
Do	Bickerstaff mine	Russell	Do.
Do	Ceramic mine	do	Do.
Do	Dixie mine	do	Do.
Jenkins Brick Co	Coosada mine	Elmore	Box 91 Montgomery, Ala. 36101
Do	Montgomery mine	Montgomery	Do.
Southern Cement Co.[6]	Calera mine	Shelby	Bank for Savings Bldg. Birmingham, Ala. 35203

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Name of operation	County	Address
Clay—Continued			
Miscellaneous—Continued			
United States Steel Corp.[7]	Leeds Shale mine	Jefferson	100 Park Ave. New York, N.Y. 10017
Vulcan Materials Co.[8]	Parkwood mine	do	Box 7324–A Birmingham, Ala. 35223
Coal:			
Alabama By-Products Corp	Chetopa mine	do	Box 354 Birmingham, Ala. 35202
Do	Maxine mine	do	Do.
Peabody Coal Co	Warrior strip mine	do	301 North Memorial Drive St. Louis, Mo. 63102
Do	Seminole strip mine	Tuscaloosa	Do.
Do	Tiger Strip mine	Walker	Do.
Southern Electric Generating Co.	Segco No. 2 mine	Shelby	600 North 18th St. Birmingham, Ala. 35203
Do	Segco No. 1 mine	Walker	Do.
Woodward Iron Co	Mulga mine	Jefferson	Woodward, Ala. 35189
United States Steel Corp	Concord mine	do	Box 599 Fairfield, Ala. 35064
Coke:			
Alabama By-Products Corp	Tarrant plant	do	Box 6527 Tarrant, Ala. 35217
Republic Steel Corp	Gadsden plant	Etowah	25 Prospect Ave., N.W. Cleveland, Ohio 44115
Do	Thomas plant	Jefferson	Do.
U.S. Pipe & Foundry Co	North Birmingham plant	do	Box 2651 Birmingham, Ala. 35212
United States Steel Corp	Fairfield plant	do	Box 599 Fairfield, Ala. 35064
Woodward Iron Co	Woodward plant	do	Woodward, Ala. 35189
Iron ore:			
Glenwood Mining Co	Springhill mine	Pike	Box 296 Troy, Ala. 36081
Luverne Mining Co	Luverne mine	Butler	Box 409 Luverne, Ala. 36049
Shook & Fletcher Supply Co	Champion mine	Blount	Box 2631 Birmingham, Ala. 35202
Do	Blackburn mine	Franklin	Do.
Do	Shelby mine	Shelby	Do.
U.S. Pipe & Foundry Co	Russellville No. 15 mine	Franklin	3300 First Ave., North Birmingham, Ala. 35222
Woodward Iron Co	Pyne mine	Jefferson	Woodward, Ala. 35189
Lime:			
Primary:			
Alabama Metallurgical Corp.	Selma limekiln	Dallas	Box 340 Selma, Ala. 36702
Cheney Lime and Cement Co.	Landmark limekiln	Shelby	Allgood, Ala. 35013
Longview Lime Corp	Longview limekiln	do	Woodward, Ala. 35189
Southern Cement Co	Keystone limekiln	Shelby	Bank for Savings Bldg. Birmingham, Ala. 35203
Do	Roberta limekiln	do	Do.
United States Gypsum Co	Calera limekiln	do	101 South Wacker Drive Chicago, Ill. 60606
Regenerated:			
American Can Co	Naheola limekiln	Choctaw	Box 315 Butler, Ala. 36904
Gulf States Paper Corp	Demopolis limekiln	Marengo	Tuscaloosa, Ala. 35401
Do	Tuscaloosa limekiln	Tuscaloosa	Do.
International Paper Co	Mobile limekiln	Mobile	Box 1649 New York, N.Y. 10017
Kimberly-Clark Corp	Coosa River limekiln	Talledega	Coosa Pines, Ala. 35044
Scott Paper Co	Mobile limekiln	Mobile	Mobile, Ala. 36601
Magnesium, smelters:			
Alabama Metallurgical Corp	Selma plant	Dallas	Box 340 Selma, Ala. 36702
Mica, scrap:			
United States Gypsum Co	Dixie mine	Randolph	101 South Wacker Drive Chicago, Ill. 60606
Do	Newell mine	do	Do.
Do	Heflin plant	do	Do.
Petroleum:			
Crude:			
Chesley Pruet Drilling Co	Choctaw Ridge field	Choctaw	Box 31 El Dorado, Ark. 71730

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Name of operation	County	Address
Petroleum—Continued			
Crude—Continued			
Clarkwin Oil Corporation	South Carlton field	Baldwin	Chatom, Ala. 36518
Do	do	Clarke	Do.
E. L. Erickson	Toxey field	Choctaw	1235 Petroleum Bldg. Jackson, Miss. 39201
Humble Oil and Refining Co.	Gilbertown and Pollard fields	do	Box 61812 New Orleans, La. 70160
Mobil Oil Corporation	Citronelle field	Escambia	Box 900 Dallas, Tex. 75221
		Mobile	
Refinery:			
Chevron Asphalt Co	Mobile plant	do	Mobile, Ala. 36600
Hunt Oil Co	Tuscaloosa plant	Tuscaloosa	Tuscaloosa, Ala. 35401
Vulcan Asphalt Refining Co.	Cordova plant	Walker	Cordova, Ala. 35550
Warrior Asphalt Co	Holt plant	Tuscaloosa	Tuscaloosa, Ala. 35401
Pig Iron:			
Republic Steel Corp	Gadsden plant	Etowah	1629 Republic Bldg. Cleveland, Ohio 44115
Do	Birmingham plant	Jefferson	Do.
U.S. Pipe & Foundry Co	do	do	Birmingham, Ala. 35201
Do	No. 5 plant	do	Do.
United States Steel Corp	Alabama operations	do	Box 599 Fairfield, Ala. 35064
Woodward Iron Co	Woodward plant	do	Woodward, Ala. 35189
Salt:			
Olin Mathieson Chemical Corp.[9]	Nichols works	Washington	Box 28 McIntosh, Ala. 36553
Sand and gravel:			
Alabama Gravel Co	Elmore mine	Elmore	2325 City Federal Bldg. Birmingham ,Ala. 35203
Do	Montgomery mine	Montgomery	Do.
Radcliff Materials Inc	Alabama River dredge	Mobile	Mobile, Ala. 36601
C. T. Thackston Sand & Gravel Co.	Montgomery mine	Montgomery	Box 3211 Montgomery, Ala. 36101
Vulcan Materials Co	Shorter mine	Macon	Box 7324–A Birmingham, Ala. 35223
Do	Conley mine	Montgomery	Do.
Wade & Vance Sand & Gravel Co., Inc.	Jamieson mine	Chilton	Box 628 Bessemer, Ala. 35020
Stone:			
Limestone, crushed:			
Dolcito Quarry Co	Dolcito quarry	Jefferson	Box 6566 Birmingham, Ala. 35217
Lone Star Cement Corp	Birmingham quarry	Jefferson	Box 6237, West End Branch Richmond, Va. 23230
Do	Demopolis quarry	Marengo	Do.
Do	St. Stephens quarry	Washington	Do.
Southern Cement Co	Roberta mine	Shelby	Bank for Savings Bldg. Birmingham, Ala. 35203
Do	Roberta quarry	do	Do.
United States Steel Corp	Dolonah quarry	Jefferson	Box 599 Fairfield, Ala. 35064
Do	Leeds quarry	do	Do.
Vulcan Materials Co	Cherokee No. 20 quarry	Colbert	Box 7324–A Birmingham, Ala. 35223
Do	Tuscumbia quarry	do	Do.
Do	Glencoe quarry	Etowah	Do.
Do	Russellville quarry	Franklin	Do.
Do	Huntsville quarry	Madison	Do.
Vulcan Materials Co	Calera quarry	Shelby	Box 7324–A Birmingham, Ala. 35223
Do	Estaboga quarry	Talladega	Do.
Limestone, dimension:			
Georgia Marble Co	Rockwood & Aday quarries	Franklin	Russellville, Ala. 35653
Marble, crushed:			
Georgia Marble Co	Gantts quarry	Talladega	Gantts Quarry, Ala. 35069
Moretti-Harrah Marble Co.	Moretti-Harrah quarry	do	Box 330 Sylacauga, Ala. 35150
Thompson-Weinman & Co.	Hill quarry	do	Cartersville, Ga. 30120
Marble, dimension:			
Moretti-Harrah Marble Co.	Moretti-Harrah quarry	do	Box 330 Sylacauga, Ala. 35150

See footnotes at end of table.

Table 17.—Principal producers—Continued

Commodity and company	Name of operation	County	Address
Stone—Continued			
Oystershell:			
Radcliff Materials, Inc	Mobile Bay dredge	Mobile	Mobile, Ala. 36601
Southern Oyster Shell Milling Corp.	Mobile plant	Mobile	Box 12357 Mobile, Ala. 36601
Sandstone, crushed:			
Enos Vann	Industrial Sand Co. quarry	Jefferson	Box 246 Trussville, Ala. 35173
United States Steel Corp	Sandstone quarry	----do	100 Park Ave. New York, N.Y. 10017
Talc:			
American Talc Co	Winterboro mine	Talladega	Alpine, Ala. 35014
Vermiculite, exfoliated:			
W. R. Grace & Co	Birmingham plant	Jefferson	62 Whittemore Ave. Cambridge, Md. 01109

[1] Also kaolin. [2] Masonry and portland cement. [3] Portland cement. [4] Masonry and slag. [5] Also bauxite. [6] Also crushed limestone. [7] Also crushed limestone and sandstone. [8] Also lightweight aggregate (expanded shale). [9] Brine.

The Mineral Industry of Alaska

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

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

Crude oil production from offshore Cook Inlet fields, increasing steadily throughout the year as development wells were brought in, dominated the news of the mineral industry in 1967. Physical volume of production was more than double that of 1966; by yearend the output reached 128,363 barrels per day compared with an average daily rate of 39,300 barrels in 1966. Output from the established Swanson River field increased slightly despite cutbacks due to an oil field worker's strike. The small increase was attributable to continued successful operations in repressuring the producing reservoir in the Swanson River field.

[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 Minerals, State Department of Natural Resources, College, Alaska.

Table 1.—Mineral production in Alaska [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate, short tons, antimony content	8	W	10	W
Coal (bituminous), thousand short tons	927	$6,953	925	$7,296
Gold (recoverable content of ores, etc.), troy ounces	27,325	956	22,948	803
Lead (recoverable content of ores, etc.), short tons	14	4	------	------
Natural gas, million cubic feet	11,267	2,794	14,438	3,610
Peat, short tons	W	W	1,528	12
Petroleum (crude), thousand 42-gallon barrels	14,358	44,007	29,126	91,164
Sand and gravel, thousand short tons	17,457	21,793	22,370	26,248
Silver (recoverable content of ores, etc.), thousand troy ounces	7	9	6	9
Value of items that cannot be disclosed: Barite, copper (1966–67), gem stones, mercury, platinum-group metals, stone, and tin and values indicated by symbol W	XX	6,167	XX	4,924
Total	XX	82,683	XX	134,066
Total 1957–59 constant dollars	XX	r 81,192	XX	p 129,905

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).

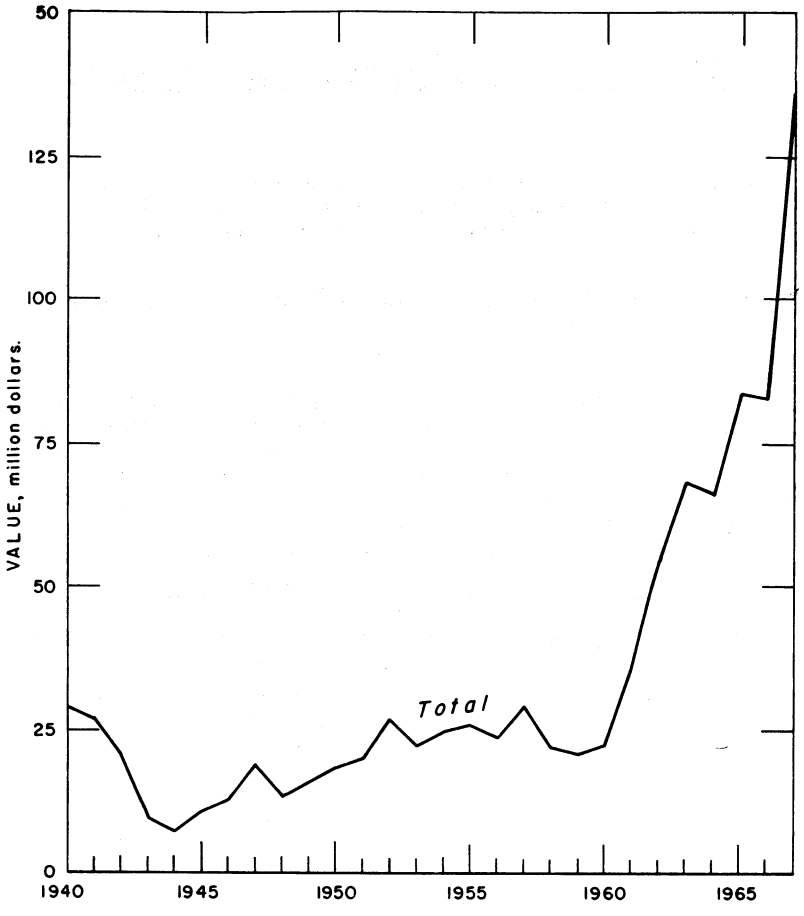

Figure 1.—Total value of mineral production in Alaska.

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

(Thousands)

Region	1966	1967	Minerals produced in 1967 in order of value
Aleutian Islands	------	$33	Sand and gravel.
Bristol Bay	$198	1	Sand and gravel.
Cook Inlet-Susitna	19,745	66,233	Petroleum, sand and gravel, coal, stone, gold, gem stones, silver.
Copper River	2,513	4,255	Sand and gravel, stone, copper, silver.
Kenai Peninsula	39,385	47,266	Petroleum, natural gas, sand and gravel, stone.
Kodiak	14	20	Sand and gravel.
Kuskokwim River	1,032	1,019	Platinum-group metals, mercury, gold, gem stones, silver.
Northern Alaska	219	59	Natural gas, sand and gravel.
Northwestern Alaska	69	7	Sand and gravel, gem stones.
Seward Peninsula	1,488	61	Tin, gold, gem stones, silver.
Southeastern Alaska	3,777	4,710	Sand and gravel, stone, barite, gold, silver.
Yukon River	14,243	10,402	Sand and gravel, coal, coal, gold, stone, gem stones, peat, antimony, silver.
Total	82,683	134,066	

[1] No production reported in Alaska Peninsula and Bering Sea regions.

Table 3.—Indicators of Alaska business activity

		1966	1967 p	Change, percent
Population	thousands	272.0	279.0	+2.6
Civilian	do	241.0	247.0	+2.5
Military	do	31.0	32.0	+3.2
Personal income:				
Total	millions	$907.0	$897.0	−1.1
Per capita		$3,421.0	$3,629.0	+6.1
Construction:				
Payroll	millions	$88.8	$95.8	+7.9
Highway work completed	do	$38.8	$44.2	+13.9
Resource production:				
Agriculture	do	$5.5	$5.5	----------
Fisheries	do	$197.3	$132.5	−32.8
Forest products	do	$73.0	$77.7	+6.4
Mineral	do	$82.7	$134.1	+62.2
Gross business receipts	do	$1,375.0	$1,506.4	+9.6
Construction	do	$310.5	$325.9	+5.0
Retail sales	do	$462.0	$489.1	+5.9
Manufacturing	do	$83.0	$93.0	+12.1
Foreign trade:				
Exports	do	$43.3	$47.4	+9.5
Imports	do	$10.1	$11.6	+14.9
Factory payrolls	do	$56.2	$55.9	−.5
Annual average labor force and employment:				
Total labor force	thousands	91.6	94.0	+2.6
Unemployment	do	8.3	8.3	----------
Employment:				
Construction	do	5.9	5.8	−1.7
Aerospace [1]	do	2.0	2.1	+5.0
Lumber and wood products	do	2.3	2.4	+4.3
Food processing	do	3.4	2.8	−17.7
All manufacturing	do	6.6	6.1	−7.6
All industries	do	83.3	85.7	+2.9

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.

Total value of mineral production in 1967 was $134.1 million, an increase of 62 percent over the figure for 1966. Crude oil and natural gas production, $91.2 million and $3.6 million respectively, made up 71 percent of the total. Value and physical volume of sand and gravel both rose appreciably, although the unit value was relatively unchanged. Tonnage of coal decreased by a fraction of 1 percent; value, reflecting the continuing unit price increases of the past few years, rose 5 percent to $7.3 million. Gold continued its downward trend; value of output, slightly more than $800,000, was only 23 percent of the 1963 figure. The last 5 years have seen a steep and unbroken decline in gold production, and an appreciable decrease is anticipated in 1968.

Legislation and Government Programs.—A new agency, the Alaska Power Administration (APA), took over the duties and functions formerly exercised by the Bureau of Reclamation in Alaska. In announcing the change, Secretary of the Interior Udall stated that APA was charged with developing soundly based methods of providing the power needed to stimulate development of Alaska's rich potential. The new administrator immediately proposed revival of negotiations for the Yukon-Taiya hydro-project first proposed in the 1950's.

The proposal, a joint project between the United States and Canada, would involve damming the upper waters of the Yukon River and conveying them through a chain of lakes that constitute the headwaters of the Yukon to the Taiya Valley north of Skagway. An 11-mile tunnel would deliver water under an 1,800-foot head to a generating site near Skagway. The Taiya project could also tie-in with the proposed North American Water and Power Alliance (NAWAPA) project. Under this proposal, surplus waters of Alaska, the Yukon Territory, and British Columbia would be diverted to the Canadian Plains, the Great Lakes, Western United States, and Mexico.

Recommending against construction of the controversial Rampart hydroelectric project on the Yukon River, Secretary of the Interior Udall proposed substitute programs for Alaska development. Included were recommendations for Department of Transportation surveys and planning studies to determine the feasibility of extending the Alaska Railroad into remote northern areas, and for a 5-year $50 million program for Federal mineral survey and research work.

The Congress extended the operations of the Federal Field Committee for Development Planning in Alaska by authorizing appropriations of $300,000 annually through 1970. The Field Committee was economic planning for the State. The Comeconomic planning for he State. The Committee planned expansion of its staff and studies of mineral and mining laws and practices, public land laws affecting Alaska, transportation and economic development, and of the Alaska Power Survey.

In fostering State programs, the committee assisted in arranging for a grant to the University of Alaska's Institute of Social, Economic, and Government Research by the Department of Commerce for a study to develop an Alaska mineral policy and legal analysis. The study was aimed at coordinating and improving Federal, State, and private industry attempts to bolster the State's mineral industry. The need for increased exploration and mapping of Alaska mineral resources was cited as well as the need for legislative changes to encourage exploration and development. The study was expected to aid the Field Committee in instituting new programs related to mineral development in the State.

Construction on the Snettisham hydroelectric project got underway when the U.S. Army Corps of Engineers awarded a $7.1 million contract for the first phase of the work. Snettisham, 28 miles southeast of Juneau, was expected to provide power to the distributor, Alaska Electric Light & Power Co., at 8.5 to 9 mills per kilowatt hour or at roughly a 50-percent reduction of previous rates. The first phase work included preparation of roads, powerhouse and camp areas, airfield embankment, and construction of the camp and accessory buildings. Also included were the driving of a diversion tunnel 10 feet in diameter and 600-feet long and the construction of boat and float plane landing facilities. First power from Snettisham was scheduled for 1972.

Congress authorized the sale to private industry of the nonmilitary sections of the Alaska Communications System (ACS), which had been operated by the U.S. Air Force since 1962 and had served government and private users since 1900. High rates, particularly on out-of-State calls, and the urgent need for upgrading facilities were the primary reasons for the move to dispose of the $20 million (estimated) system. Private communications utilities have indicated interest in acquiring the ACS network, which includes most of Alaska's long-distance telephone and telegraph lines.

Communications Satellite Corporation (Comsat) was urged to consider taking over ACS. In addition to the advantages to Alaska of modern communications technology, State and Congressional officials pointed out that Alaska offered an opportunity to develop communication satellite services in an area with the characteristics of an emerging nation but without the problems of operating in a foreign country. At yearend Comsat was preparing to send a study team to Alaska to investigate the proposal.

The Atomic Energy Commission (AEC) proceeded with camp installation and test drilling at Amchitka in the Rat Islands far out on the Aleutian chain. The drilling program was designed to determine if the island was a suitable location for a new underground testing site for nuclear weapons. Amchitka had been the site in 1965 of Project Long Shot an 80-kiloton nuclear explosion to provide scientists with basic data for distinguishing between natural earth disturbances and underground nuclear blasts.

The 1967 drilling apparently confirmed that rock conditions were satisfactory for nuclear testing. AEC was drilling a 6,000 foot, 90-inch-diameter hole. The Commission announced a definite decision to go ahead with at least one underground nuclear blast at Amchitka. Scheduled for the spring of 1968, the blast would be one of the most powerful underground nuclear explosions in history.

The Bureau of Land Management announced a proposal to classify 2.4 million acres of land in a corridor from Livengood

through Bettles and Anaktuvuk Pass to Umiat and the Sagavanirktok River. The classification would withhold the land from all forms of settlement leading to title transfer or patent until the State Department of Highways chose a right-of-way for a proposed road to the Arctic. The purpose of the classification was to prevent speculation while the Department was choosing a route.

At the State level, the Division of Mines and Minerals headquarters was moved from Juneau to the campus of the University of Alaska at College. State officials envisioned establishment of a Federal-State-University minerals research center in the interior region. The petroleum staff and backup services were kept in Anchorage. Information services were maintained at Juneau. The Nome and Ketchikan offices were closed several years ago.

As a means of raising revenue to provide disaster relief for the victims of the August flood in Fairbanks, a special session of the Alaska Legislature temporarily increased the severance tax on oil and gas production to a total of 2 percent. The tax would revert to 1 percent once the special relief fund reached $7.5 million but would automatically be reimposed when the fund fell below $5 million.

Wages and Hours.—Total insured wages in the mineral industries in the calendar year 1967, as reported by the Alaska Department of Labor, were $28.4 million ($14.4 million in 1966). The average monthly employment was 1,967 (1,171) with 130 units reporting. In the mineral industries covered by the Employment Security Act (operators with hired labor), monthly earnings averaged $1,206 compared with $1,062 in 1966. Monthly earnings in metal mining were $804, in nonmetal mining, $892; in coal mining, $1,163; and in oil and gas including production and exploration, $1,259. The figures for 1966 were $848, $963, $1,084, and $1,105 respectively.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal and peat	172	299	51	421	-------	19	45.12	720
Metal	311	160	50	414	1	18	45.89	14,975
Nonmetal	7	87	1	5	-------	-------	-------	-------
Sand and gravel	639	214	137	1,098	-------	22	20.03	410
Stone	184	133	24	198	-------	4	20.15	600
Total [1]	1,313	200	263	2,137	1	63	29.95	3,309
1967:[p]								
Coal and peat	155	289	45	368	1	16	46.24	17,018
Metal	270	162	44	369	1	6	18.98	16,794
Nonmetal	15	81	1	11	-------	1	91.83	275
Sand and gravel	765	204	156	1,406	-------	15	10.67	267
Stone	150	160	24	195	-------	5	25.69	678
Total [1]	1,360	199	271	2,348	2	43	19.17	5,521

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

Jurisdiction over the Alaska Railroad (ARR) was transferred to the newly created Department of Transportation from the Department of the Interior. However, discussions on the advisability of putting the ARR under full regulatory control of the Interstate Commerce Commission continued.

Transportation.—After a 2-year study of Alaska transportation problems, the Federal Maritime Commission came out with recommendations to improve all modes of transportation to and from the State. The Commission dealt with traffic flow patterns, transportation services, ocean freight rates, regulatory problems, terminal rates, charges, and facilities, and the relationship between transportation and the development of natural resources.

Table 5.—Coastwise receipts and foreign mineral trade

(Short tons)

Commodity	1965			1966		
	Coastwise receipts	Imports	Exports	Coastwise receipts	Imports	Exports
Bituminous coal and lignite	181	------	----	123	------	------
Gasoline	333,432	------	221	361,567	4,839	------
Kerosene, distillate, and residual fuel oil	853,750	------	697	991,432	------	------
Asphalt, tar, and pitches	40,342	------	----	35,651	------	------
Lubricating oils and greases	6,550	------	27	3,798	------	------
Petroleum and coal products, not elsewhere classified	22,510	------	----	9,467	85,850	------
Building cement	102,664	15,519	----	24,724	29,614	------
Building stone, unworked; and crushed and broken stone	69	45	----	200	------	------
Clay, ceramic and refractory materials	1,000	------	----	4,586	------	------
Structural clay products including refractories	2,164	------	----	1,438	10	------
Sulfur	------	11,608	----	------	8,830	------
Sand and Gravel	2,617	------	----	1,680	825	------
Iron ore and concentrates	51	------	----	------	------	------
Iron and steel scrap	837	------	----	------	------	81
Iron and steel products	16,795	3,445	72	7,705	9,614	------
Aluminum and aluminum alloys, unworked	232	------	----	22	------	------
Lead and zinc including alloys, unworked	26,006	------	----	------	------	------
Nonferrous metal ores and concentrates, not elsewhere classified	101	------	----	20	------	22,143
Nonferrous metals primary smelter products, basic shapes, wire, castings and forgings, except copper, lead, zinc and aluminum	60	------	----	74	106	------
Fertilizer materials	2,243	------	----	166	------	------

Source: U.S. Army Corps of Engineers. Waterborne Commerce of the United States. Part 4, Pacific Coast, Alaska, and Pacific Islands, 1965–66.

Among the Commission's recommendations were the following: An Interstate Commerce Commission (ICC) study to determine if the Alaska Railroad should be placed under full regulatory control of the ICC; improvement of port facilities at Ketchikan, Sitka, and Petersburg; cooperation between shippers, carriers, and State and local officials to achieve low rates for southbound cargo in order to encourage export of natural resources; the possibility of setting up central distribution depots at Kodiak and Dutch Harbor; and a joint airline-water carrier rate schedule for sea-air van services to Anchorage and points north and west.

With a report released in the fall entitled "Alaska Trade Study—A Regulatory Staff Analysis," the Commission chairman noted that both the Commission and the Alaska trade had already benefiited from the information developed by the staff. Information on misdescription, misweighing, and mismeasurement was cited as having a direct bearing on the Commission's inspection program. Analyzing joint sea-air van service, the Commission envisioned shipments moving under joint rates from Seattle to Anchorage by water carrier and then on to Bristol Bay, the Norton Sound area and Kotzebue, Kodiak, and Fairbanks by air carrier.

Joint studies by the Planning and Research Section of the Department of Highways and the Federal Bureau of Public Roads indicated the need for an annual expenditure of $81.7 million over a 20-year period. Factors considered included

the rapid development of oil and gas resources, potential mineral resources, timber sales, tourism, and population growth. The studies noted the great increase in motor vehicle registrations and travel in the preceding 8 years and the projected growth in these areas. Prepared at the request of the American Association of State Highway Officials, the report was to be presented to Congress along with those on other States as an aid and guide for the preparation of a nationwide highway legislative and financing program to replace the Interstate Program at its expiration in 1973.

Alaska, with help of Federal funds, was planning to spend $327 million on its highway program by the end of 1972. Of the total, $154 million was earmarked for the primary road program, $86 million for the secondary road program, and $26 million for the emergency program—highway damage from floods, landslides, earthquakes, etc. The remaining $61 million was to go toward maintenance, access roads, upgrading, and development work.

Late in the year, the Federal Highway Administrator announced that the Department of Transportation had released funds for preliminary engineering work for reconstruction of portions of the Cordova-Chitina Highway in the Copper River country. The monies were to come from the disaster relief fund and would also cover the costs of reconstruction of segments of the highway damaged by the 1964 earthquake. The Department of Transportation earlier had decided against rebuilding but had been prevailed upon to reconsider its decision.

At the request of Alaska's Governor, the State Legislature created the Northern Operations of Rail Transportation and Highways Commission (NORTH). Made up of five members from Alaska and five from the Nation as a whole, including the Undersecretary of Transportation and the General Manager of the Alaska Railroad, the Commission was to act as an advisory body to the Governor and the Legislature in order to promote and implement the policies of the State regarding economic development of northern Alaska.

Initial proposals included extension of the Alaska Railroad westward from Fairbanks to Nome by way of Bornite on the Kobuk River and construction of a winter snow road north of Fairbanks from Livengood through Bettles and Anaktuvuk Pass to Umiat and the Sagavanirktok River. At a meeting in Washington, D.C. NORTH authorized $225,000 in State funds for preliminary studies of the railroad extension from Dunbar to Bornite. Estimated cost of the 400-mile project was put at $150 to $160 million. The Undersecretary of Transportation and the general manager of the Alaska Railroad joined in support of the $225,000 spending authorization.

Legislation to modify provisions of the Jones Act thus permitting use of the British Columbia ferry system in freight shipments from the contiguous United States to southeastern Alaska ports was pending in the Congress at yearend. Under the shipping act enacted in 1920, shipment of cargo in interstate commerce was limited to the use of United States built and operated water carriers. Passage of the pending legislation was seen as providing more frequent service to Alaska's Panhandle as well as easier long-line carriage of freight to northern Alaska communities.

In a related development, Sea-Land Service, Inc., a major carrier in the Seattle-Anchorage trade, announced a new cargo service for southeastern Alaska to start in the spring of 1968. The new service was contingent upon no changes being made in the Jones Act. Sea-Land planned a $5 million investment in southeastern Alaska facilities including terminals at Ketchikan and Juneau. From these points, plans called for Alaska ferries to distribute cargo vans during 8 months of the year with tugs and barges used during the tourist season.

Ferry service to southeastern Alaska from Kelsey Bay on Vancouver Island via the British Columbia ferry system was interrupted with the grounding of the ferry Queen of Prince Rupert. When the Canadian authorities indicated that service was not scheduled to resume until the spring of 1968, Alaska moved to use vessels of its own system to provide service. In less than a month the State established a Seattle-Ketchikan run after obtaining Coast Guard designation of the Inland Passage as lakes, bays, and sounds; the Alaska ferries were not rated as ocean-going vessels.

Puget Sound-Alaska Van Lines contracted for two additional hydrotrain vessels, each of 48 railcar capacity. Puget

Sound-Alaska was operating direct Alaska service from the 48 States with no unloading or reloading required at Seattle. The new vessels were expected to increase hydrotrain capacity as much as 40 percent.

Plans announced by the fledgling chemical industry on the Kenai Peninsula appeared to more firmly establish year-round shipping service to Anchorage, pioneered by Sea-Land Service in 1965. Collier Carbon & Chemical Co. had plans for one or, perhaps, two huge oceangoing barges to move ammonia and urea to West Coast ports. Japan Gas-Chemical Co., an equal partner with Collier in the urea project ordered a special ship for shipment to the Far East. Both companies planned 12-month ship movements.

The trend toward consolidation of airlines in Alaska continued. The merger of Pacific Northern Airlines and Western Airlines, initiated in 1966, was completed. The merger of both Cordova Airlines and Alaska Coastal Airlines into Alaska Airlines, plans for which were announced in April, was proceding at yearend, approval of the merger was expected. Alaska Coastal served the panhandle from Skagway to Prince Rupert, British Columbia, with connections to most of the settlements on the Islands of the Alexander Archipelago. Cordova served the Anchorage-Copper River area, Dawson in the Yukon Territory, most of the Kenai Peninsula, and the Anchorage-Cordova-Yakutat-Juneau run. Alaska Airlines was a main carrier between Seattle and Anchorage and Fairbanks with runs to McGrath, Nome, and Kotzebue. Thus, the new combination covered most of the populated regions of the State.

In a second action, Wien Air Alaska and Northern Consolidated Airlines were in the process of merging; the new organization was to be known as Wien Alaska Airlines, Inc. Findings by a Civil Aeronautics Board examiner were that the merged lines would make possible one-carrier service between 4,200 pairs of points in Alaska. One-plane service between all or even a majority of such pairs of points was not deemed practical, but improved service was expected as a result of the merger. The new line would tie together an area one-sixth the size of the 48 contiguous States.

Developments in airfreighting continued to move forward. Alaska Airlines, which pioneered the use of the Hercules C–130 propjet in moving oil-well drilling equipment to the North slope in 1965, airlifted a drill rig capable of going to 20,000 feet from Kenai to Painter Creek in the Bristol Bay area. The rig was broken down into palletized, 46,000 pound units. On the return trip, heavy equipment used to build the airfield was freighted. At mid-year thrice weekly Hercules all-cargo flights from Seattle to Sitka, Anchorage, and Fairbanks began. Twice weekly service from Anchorage to Nome and Kotzebue was started also.

Table 6.—Freight rates, Seattle to selected Alaskan cities in 1967 Hydrotrain service [1]

(Cents per hundred pounds)

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

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

Source: Puget Sound-Alaska Van Lines.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Value of coal produced increased by 5 percent compared with 1966 figures; tonnage was virtually unchanged. For the third successive year, value per ton, $7.89, showed an increase over the previous figure ($7.50). Following the Korean conflict, Alaska coal operators had been able to effect a truly significant reduction in prices. Spurred by the competition of natural gas from the Kenai Peninsula and aided by the acquisition of modern pit equipment, the industry by 1964 had been able to reduce unit value to $6.72 per ton, a value below that of any year since 1946. The record showed 1964 to be the sixth successive year of price reduction and the 11th year in a downtrend that began in 1954.

Operators in the Nenana (Healy River) field, insulated from the threat of Kenai gas and bolstered by long term contracts to supply fuel for the new mine-mouth generating plant at Healy, were able to maintain the downtrend in unit prices. The northern operators accomplished a 9 percent reduction between 1964 and 1967. But Matanuska Valley operators, plagued with the specter of competition from natural gas and handicapped by increasing stripping costs, were unable to hold the line on prices. At yearend the major operation in the Matanuska field, in continuous production since 1922, was faced with shutdown owing to the loss of contracts to supply military bases. Matanuska coal, useful for steam generating, gave little promise of competing in Japanese import markets where coking coal was needed.

The U.S. Armed Forces were again the major consumers of Alaska coals. Military contracts for the fiscal year 1968 totaled 732,000 tons compared with 668,000 tons for the fiscal year 1967. Usibelli Coal Mine, Inc., operating in the Nenana fields, was the leading contractor with 272,000 tons. Vitro Minerals Corp., a joint venture of Vitro Corporation of America and Rochester & Pittsburgh Coal Co., supplied 250,000 tons. In the Matanuska fields, Evan Jones Coal Co. furnished 210,000 tons. For the first time in almost 10 years, coal from the Nenana fields was shipped south to fuel the military bases in the Anchorage area.

Except for minor quantities from small fields, all Alaska coal was strip-mined at four mines, two each in the Matanuska and Nenana fields. Of total tonnage mined, 37 percent was cleaned compared with 42 per-

cent in 1966. Heavy media separation was the treatment process used; only minor quantities were cleaned by jigging.

After a 5-year controversy, it appeared that natural gas producers had won the struggle to fuel the Elmendorf Air Force Base and the Fort Richardson Army Base near Anchorage. In October the two military bases announced conversion of their respective power plants to natural gas. The Congress had authorized $1.98 million for the conversion costs. Anticipated annual savings were put at $2.43 million by the Department of Defense. Congressional authorities, acknowledging the adverse impact of the decision on the economy of the coal-oriented Matanuska Valley, noted that coal costs had risen steadily over the years while Congress had been delaying a decision.

Late in the year, a group of Cordova businessmen, organized under the name of Cortella Coal Corp., disclosed plans to activate the Bering River coal fields north of Controller Bay. Mineral leases were acquired from Jewell Ridge Coal Co. of Tazewell, Virginia. Cortella hoped to open the deposits for annual shipment of 1 million tons or more of coking coal to Japan. Jewell Ridge had examined the Bering River coals in the late 1950's and thereafter had made laboratory tests and other studies in connection with possible shipments to the Orient. Coking characteristics of the coals were thought to be suitable for the Japanese markets, but the highly faulted and tilted structure of the deposit and the transportation of the coal to ocean loading facilities were seen as formidable obstacles to economic exploitation. Under consideration in the Cortella investigation was use of a pipeline to move the coal from the mine to the port of Cordova.

Golden Valley Electric Association, Inc., completed construction on its mine-mouth steam-generating plant at Healy in the northern fields. The 138,000-volt transmission line to Fairbanks also was completed. The 22,000-kilowatt system, at a capital cost of $18 million, was expected to produce power at the busbar for approximately 8 mills per kilowatt hour. Studies made while construction was underway showed increased power demand, in excess of capacity being built, was probable in the near future. As a result of these studies, tentative plans were drawn to install an additional unit at Healy which would triple present capacity.

The Bureau of Mines made no coal field investigations in the State in 1967.

Petroleum and Natural Gas.—Development wells in offshore Cook Inlet were responsible for outstanding gains in both physical volume of production and value of output. Volume and value of oil from the established Kenai Peninsula field increased by 10 percent as repressurizing activities continued in the Swanson River and Soldotna Creek units. The spectacular increase in total value of oil $91.2 million compared with $44.0 million resulted in large part from new production from the offshore Cook Inlet fields.

At yearend, 11 permanent offshore drilling and production platforms were operating in Cook Inlet. Nine of the eleven were producing oil. Total combined production from four offshore fields—Middle Ground Shoal, Granite Point, McArthur River, and Trading Bay—was greater than that of the Swanson River field. During December average daily production of offshore oil reached 92,900 barrels versus 35,500 barrels from Swanson River–Soldotna Creek.

Natural gas production totaled (65.8 billion cubic feet) of which 42.7 billion was dry gas and 23.1 billion associated gas. Of the total 51.4 billion cubic feet including 11.4 billion injected for reservior repressurization at Swanson River, was used, lost, blown, or flared. Marketed production of gas was 14.4 billion cubic feet and was valued at $3.61 million. Gas sold for injection, all of it from the Kenai unit for injection into Swanson River, was 30.6 million Mc.f. valued at $2.6 million. The 1966 gas production was 11.3 billion Mc.f. valued at $2.79 million.

Total footage drilled in 1967 was 904,368 an increase of 66 percent over the 1966 figure which in turn more than doubled the 1965 footage. Exploratory drilling was 289,941 feet (369,872 feet in 1966), development drilling showed 614,427 feet (178,127 feet in 1966).

Exploratory drilling was centered in the Cook Inlet Basin with the trend being to offshore waters and adjacent onshore lands on the west side of the Inlet. The only new field discovered in Alaska in 1967 was on the upper Kenai Peninsula where Marathon Oil Co. completed Beaver Creek No. 1–A for a new gas discovery. A prior hole,

Beaver Creek No. 1 blew out, bridged itself while blowing out of control, and was abandoned. Only seven exploratory holes were drilled on the Kenai Peninsula. Pennzoil Co. drilled two wells offshore at Cape Starichkof in lower Cook Inlet. The wells were abandoned after tests of noncommercial oil shows.

On the west side of the Inlet, five dry holes resulted from exploratory drilling on upland locations and two wildcat wells drilled in offshore waters were plugged and abandoned. On the North Slope, Atlantic Richfield Co. plugged and abandoned the Susie Unit No. 1 drilled to 13,517 feet. Union Oil Co. of California also was unsuccessful with the Kookpuk State No. 1 drilled to 10,193 feet which was located south of the Colville River Delta. Both of these wells were spudded during 1966. Also on the North Slope, Atlantic Richfield spudded Prudhoe Bay No. 1 on the flats south of the Beaufort Sea in far northern Alaska. The well was drilling at yearend. On the Alaska Peninsula, Cities Service Oil Co. drilled Painter Creek No. 1 south of Ugashik Lakes to 7,912 feet; it was plugged and abandoned.

The increase in total drilling (66 percent) over the previous year was attributable entirely to development drilling. Total development footage, reflecting the intense activity which took place from permanent offshore platforms, was 3.4 times that of 1966 and was more than the total footage for all drilling in 1966. Texaco Inc., drilled one successful gas development well at Nicolai Creek on the west side of Cook Inlet. The Nicolai Creek No. 3 was bottomed at 8,841 feet.

In the Middle Ground Shoal Unit, Shell Oil Co. completed the placing of a second platform and began drilling from the new setup late in the year. Pan American Petroleum Corp. got into production on their platform in the unit. At the close of the year four platforms, including pipeline facilities to shore, were in operation on the Middle Ground complex.

Both Mobil Oil Corp. and Pan American Petroleum Corp. began production from their respective platforms at Granite Point; by the end of the year, production from the three offshore facilities had reached 42,325 barrels of oil a day. Thus, the Granite Point field became the top producing unit in the State. Pan American moved its oil south via an underwater pipeline in Cook Inlet to loading facilities at East Foreland. Mobil's production moved via the Drift River pipeline 42 miles to tanker loading facilities at the Drift River terminal.

During the first part of the year a part of the Trading Bay producing structure, including the previously known McArthur River field, was unitized with Union Oil Co. of California designated as unit operator. Three separate platforms, two of which were erected during 1967, operated within the Trading Bay unit. Union was operating the Grayling Platform in the McArthur River field, Marathon Oil Co. produced from the Dolly Varden platform in the Dolly Varden field, and Atlantic Richfield Corp. ran the King Salmon platform on what had been a part of the Trading Bay field. The part of the Trading Bay structure not included in the unitized agreement was known as the Trading Bay field. Here production from Union's monopod began to reach shore early in the year. In the unitized section, Union got its Grayling platform pumping oil in October. Marathon and Atlantic Richfield had drilling underway on the Dolly Varden and King Salmon platforms; there was no production from these units. Total Trading Bay output from both the unitized and monopod operations of Union was 727,085 barrels from an average of nine wells.

Cook Inlet Pipeline Co., a combine of Union, Mobil, Marathon, Atlantic Richfield, and Cities Service, completed the 42-mile Drift River pipeline and put it into operation. At the north end the new line gathered oil from Mobil's Granite Point platform. A tie-in just north of West Foreland provided transport service to Union's monopod and Grayling platforms as well as to the King Salmon and Dolly Varden installations of Atlantic Richfield and Marathon. Line and storage fill-up began in January. The first tanker loaded at the Drift River terminal during November.

Shipment of liquefied natural gas to Japan from the huge reserves on the Kenai Peninsula and in Cook Inlet appeared assured with the completion of contractual and governmental agreements. Upon completion of the agreements, Marathon Oil Co. and Phillips Petroleum Corp. moved to contract for two 450,000-barrel tankers to be built in Swedish shipyards. Marathon,

which was to handle the transport phase of the gigantic liquefied-gas exportation project, expected delivery of one tanker in late 1969 with the second to follow in 4 or 5 months. The first shipment to Tokyo was scheduled before the end of 1969 with both vessels in regular service by 1970. Cost of the vessels was put at $43 million.

Table 7.—Production of crude petroleum and natural gas

Year	Crude petroleum		Natural gas [1]	
	Thousand 42-gallon barrels	Value (thousands)	Million cubic feet	Value (thousands)
1963	10,740	$32,650	4,498	$1,111
1964	11,059	33,627	6,238	1,719
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

[1] Comprises gas either sold or consumed by producers, including losses in transmission, quantities added to storage and increases of gas in pipelines.

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

Year	Thousand acres
1963	14,053
1964	11,600
1965	10,184
1966	9,275
1967	7,135

Source: 1963–67 Geological Survey, U.S. Department of the Interior.

The contract with Tokyo Electric Power Co. and Tokyo Gas Co. called for annual deliveries of 50 billion cubic feet to start in 1969 and continue for 15 years. The tankers, 800-feet long with 112-foot beams and drawing 31 feet of water, were expected to make the Kenai-Tokyo round trip in 3 weeks cruising at 17 knots. The liquefied gas was to be hauled at atmospheric pressure and minus 259° F.

Table 9.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in Alaska, 1967

Region	Drilling									Geophysical, crew-weeks	
	Proved field wells			Exploratory wells			Other wells [1]	Total		Gravity meter method	Reflection seismograph method
	Oil	Gas	Dry	Oil	Gas	Dry		Wells	Footage		
Alaska Peninsula	--	--	--	--	--	1	--	1	7,912	NA	NA
Cook Inlet-Susitna	42	1	3	1	--	21	27	95	805,962	NA	NA
Kenai Peninsula	--	1	--	--	2	3	1	7	72,519	NA	NA
Northern Alaska	--	--	--	--	--	2	1	3	17,975	NA	NA
Total	42	2	3	1	2	27	29	106	904,368	16	264

NA Not available.
[1] Cook Inlet-Susitna: 1 fishing, 1 perforating, 4 testing, 11 drilling, and 10 suspended. Kenai Peninsula: 1 suspended. Northern Alaska: 1 drilling.
Source: Division of Mines and Minerals, Department of Natural Resources, Alaska. Alaska Office of Mineral Resources. International Oil Scouts Association, Austin, Texas.

Phillips got underway with construction of the $50 million liquefaction plant late in the summer. Time required for completion was put at 28 months. Marathon was to supply 30 percent of the gas from its share of the Kenai unit with Phillips and associates furnishing the balance from the North Cook Inlet field. Phillips planned to erect a platform on the North Cook Inlet structure and to pipe the gas to the plant just north of Kenai near Nikiski.

Union Oil Co. of California continued construction on a giant petrochemical complex started in 1966 near Nikiski on the Kenai Peninsula. Collier Carbon and Chemical Corp., a Union subsidiary, was handling the construction of a 1,500-ton-per-day anhydrous ammonia plant and a

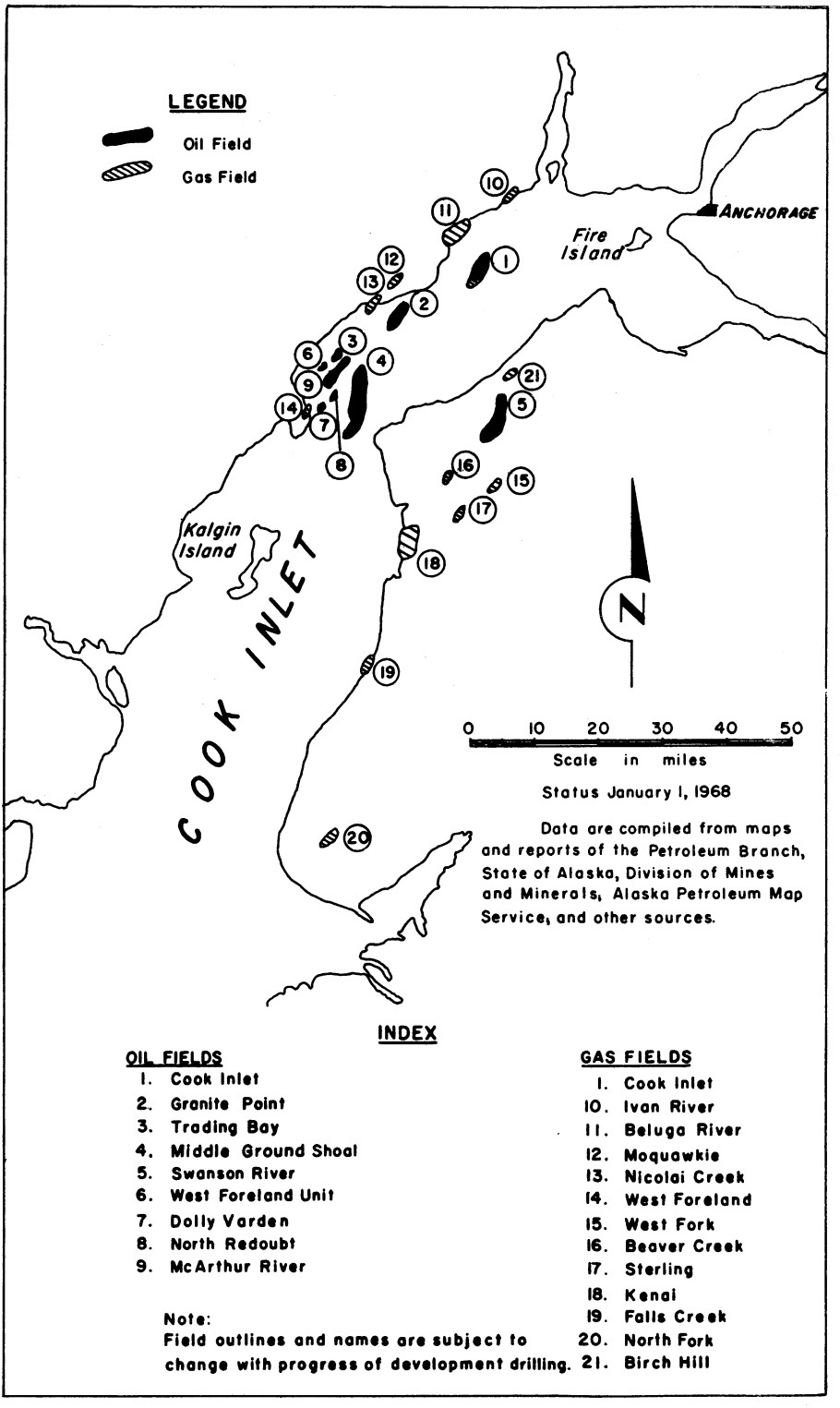

Figure 2.—Cook Inlet oil and gas fields.

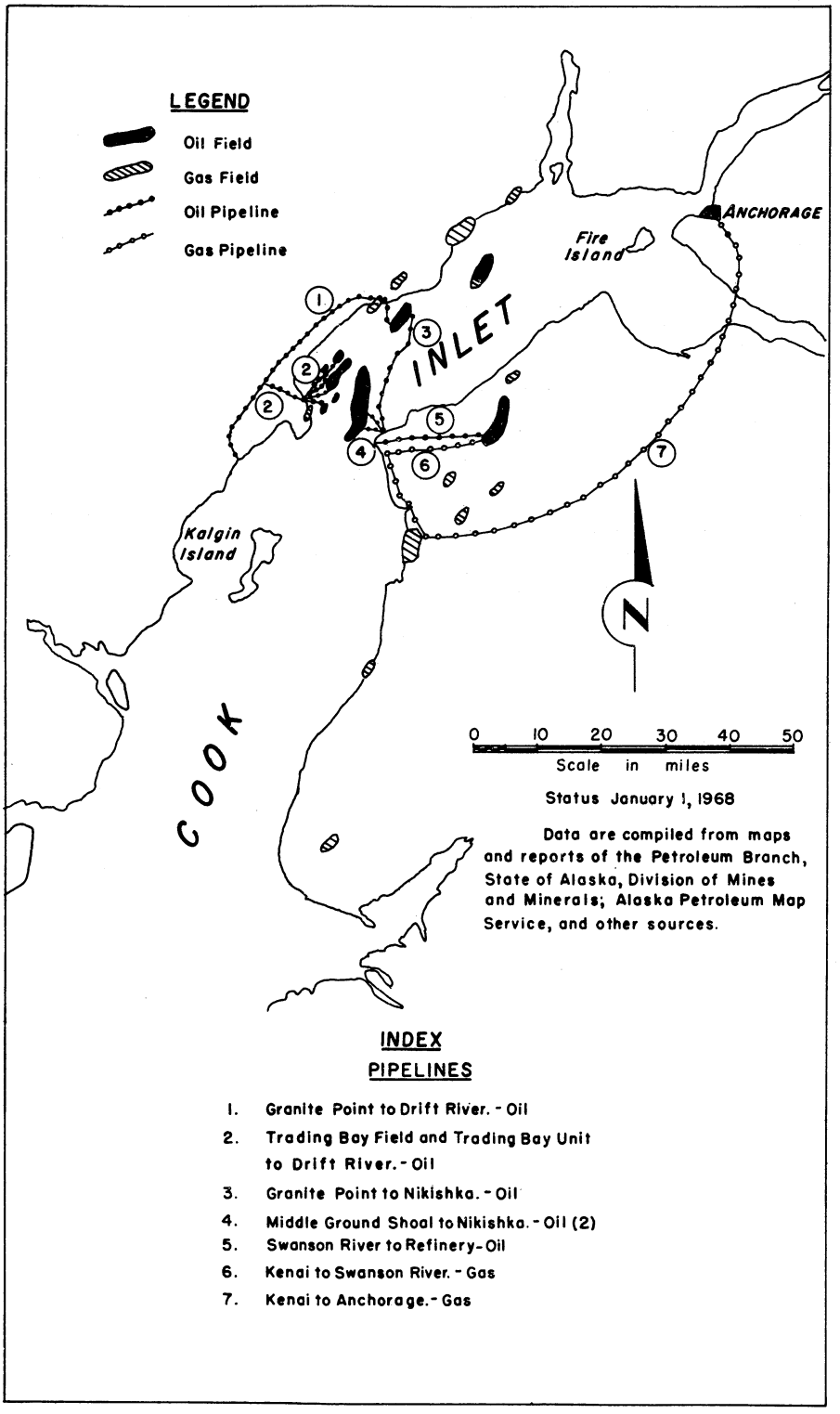

Figure 3.—Cook Inlet oil and gas pipelines.

1,000-ton-per-day prilled urea plant. Natural gas from the Kenai unit was to be the feed stock for the two plants. Target date for completion of the complex was November 1968 with full production expected in the first 3 months of 1969. Company, State, and Federal officials were striving to solve the disposal problems involved in discharging a treated plant effluent into Cook Inlet waters.

Collier received a temporary permit to discharge certain wastes into the waters of Cook Inlet in connection with the design and testing of equipment to meet the State's antipollution requirements for the main plants. The permit, effective until the summer of 1968, allowed discharge of 820,000 gallons per day of treated waste waters. Cook Inlet fishermen, however, protested the granting of the permit as harmful to marine life in the Inlet. After a series of meetings between the fishing industry and petrochemical industry interests, the State announced a new, more restrictive, permit would be issued to Collier in order to minimize the threat of pollution in Cook Inlet.

Pollution of the inlet waters was of major concern in other areas. In addition to the opposition of commercial fishermen to Collier's plan several incidents occurred which focused attention on other aspects of pollution. Tankers moving into the Inlet to load oil at terminal facilities were reported to be pumping oily ballast prior to loading. When several thousand ducks covered with a thick heavy oil coating were found dead on the beaches and waters of Cook Inlet, State officials moved rapidly to eliminate this hazard to wildlife. Severe penalties were set for any discharges into Alaska waters harmful to fish or wildlife. In another incident, a loaded tanker at the Drift River terminal was punctured when thrown by an erratic tide against a loading dock fender. An appreciable amount of oil was spilled before the oil in the ruptured compartment was transferred to shore storage. Both State and industry officials were studying means of controlling such loading accidents to reduce the hazards to Inlet waters.

Three competitive oil and gas lease sales were held during the year by the State. Proceeds from the sales totaled $20.2 million, including the record high $18.7 million received from the 20th competitive sale. Offshore tracts in Cook Inlet accounted for most of the money received. Among the successful bidders in the 20th competitive sale was a newcomer to Alaska, Alaskco U.S.A. Ltd., a Japanese firm organized in 1966 to explore and develop Alaska oil and gas potential. Alaskco bid jointly with Gulf Oil Corp. Another newcomer to Alaska was Mesa Petroleum of Amarillo, Tex., and Calgary, Alberta, Canada.

In the competitive lease sale, the State auctioned an offshore parcel of land below Kalgin Island in Lower Cook Inlet. The Federal Government immediately brought suit contesting Alaska's title to the land auctioned. The State based its ownership claims on the historic bay principle while Federal authorities claimed ownership by virtue of the land lying more than 3 miles offshore. A Federal court hearing ruled in favor of the State. An appeal by the Federal Government was expected.

A bill to return to the Department of the Interior Naval Petroleum Reserve No. 4 on the North Slope in far northern Alaska was introduced in Congress. The legislation was aimed at transferring 23 million acres so that the Department of the Interior could lease the land competitively to oil and gas interests. Continued use of gas from the South Barrow fields for government use and for use by residents of Barrow was provided for. The Defense Department would continue to administer this phase. The area was thought to hold excellent chances for discovery of important new reserves.

The Secretary of the Interior announced plans to open Federal tracts in the Gulf of Alaska to oil and gas leasing. Invitations for nomination of areas for competitive bidding on the outer Continental Shelf were expected by early 1968 with the first sale held in 1969. Some 60 million acres under Federal jurisdiction were involved. In a unique suggestion, the Secretary proposed that the long-standing native land claims be settled by giving the natives a share in Federal royalties from oil and gas wells drilled in offshore Gulf waters. The natives had laid claim to about 75 percent of Alaska's 586,400 square miles and were seeking large tracts of land as settlement.

Reacting to the Department of the Interior announcement on the Gulf of Alaska leasing, 18 oil companies operating in or having an interest in Alaska oil formed a consortium to fund and admin-

ister a survey of oceanographic conditions in the Gulf. Standard Oil Co. of California, named as operator for the group, announced that an $800,000 contract had been awarded to Marine Advisers of La Jolla, Calif., and that the survey was underway in December. Scheduled to last 2 years, the survey was to cover an area from the Trinity Islands south of Kodiak to Cape Spencer west of Juneau and from the coast to the edge of the Continental Shelf. Data collected was expected to aid in the design of offshore platforms and to predict seasonal operating conditions for logistic purposes. The companies hoped to be ready to operate in the Gulf by 1970. The need for speedy collection, analysis, and dissemination of oceanographic data to expedite offshore Gulf operations was given as the reason for the survey being undertaken by a private group rather than by the Federal Government.

METALS

Antimony.—No shipments of antimony ore or concentrate were made in 1967. Earl R. Pilgrim, operating the Stampede mine north of Mt. McKinley in the Kantishna district, Yukon River region, reported production of 17.4 tons of concentrate running 57 percent antimony. Assessment work was done at the Klem mine of Tillicum Mining Co. in the Petersburg district and at the K&D lode in the Ketchikan district both in the Southeastern Alaska region. There were no reports from operators in the Chulitna district, Cook Inlet-Susitna region or in the Fairbanks district, Yukon River region.

Beryllium.—Interest in beryllium prospecting and exploration continued to wane. Only one operator responded to the Bureau of Mines canvass. The operator stated only, "These claims have been abandoned."

Copper.—Major mining organizations continued to show interest in the copper potential of Alaska. Atlas Mining Co. of Vancouver, British Columbia, Canada, had an exploration crew on a large group of claims on Prince of Wales Island, Southeastern Alaska region. Falconbridge Nickel Mines Ltd., was back in the Kasna Creek area examining the large low-grade copper mineralization near the south shore of Lake Kontrashibuna in the Lake Clark area, Bristol Bay region. Tennessee Corp., associated with Dome Mines, Ltd., Moneta Porcupine Mines, and Sunshine Mining Co., continued exploration of the Pass Creek deposit east of Denali in the Cook Inlet-Susitna region.

Bear Creek Mining Co., the exploration subsidiary of Kennecott Copper Corp., had a large reconnaissance crew in the Kobuk area, northwestern Alaska region. Bear Creek operated independently of the New Mines Division of Kennecott which was developing the deposit at Bornite. Homestake Mining Co. was reported to be active in various sections of the interior. United States Smelting, Refining and Mining Co. and Newmont Mining Corp. carried on joint reconnaissance programs in several areas. The Hanna Mining Co. was active in north central Alaska. Prospects in the Knight Island area, Copper River region, drew some attention. Some of the major oil companies also indicated interest in the State's copper potential.

In the Copper River region, Consolidated Wrangell Mining Co. again produced from the Kennecott Green Placer property in the Nizina district. Consolidated Wrangell mined and upgraded surface talus from the old Kennecott Copper Corp. deposits; the company did not give permission to release figures on operations. Also in the Nizina district, Copper Basin Mining Co. continued work at the Nikolai mine in the area of the Bonanza and other rich copper-silver deposits worked by Kennecott from 1911 to 1938.

At Bornite, Kennecott found itself with a major water control problem in the 1,100-foot vertical shaft sunk to open up the Ruby Creek deposit north of the Arctic Circle near Kobuk, northwestern Alaska region. Late in 1966 the company had reached target depth in the shaft and was proceeding with lateral exploration and development openings when a trimming round to complete the sump released a flow of water beyond the pumping capacity of the shaft.

With new pumping equipment of 5,000 g.p.m. capacity, Kennecott pumped more than 400 million gallons of water in a series of draw-down tests to determine the rate of inflow. Through the use of remote control closed circuit television, the area of inflow was shown to be isolated at the shaft bottom. Using 4,000 sacks of cement without aggregate, to plug the bottom 23

feet of the shaft, the company was able to seal off the incoming water.

By yearend, Kennecott had invested more than $10 million in the Ruby Creek deposit; property acquisition, logistics, or exploration had been underway since 1956.

Gold.—In spite of the attention focussed on gold due to the monetary and fiscal problems of the Nation, the amount and value of Alaska's gold output again declined. The value of production, $803,000, was 16 percent less than that of 1966. For the first time since annual production records were kept, the State had no lode gold output of record. Tabulations lump the years 1882 to 1905; from 1905 on, annual figures are available.

Placer production continued its almost unbroken decline since the industry's recovery from World War II limitations and restraints. In 1941, Alaska placer output had been 542,000 troy ounces. By 1945 the figure had slipped to 57,700. Peaking at 276,000 ounces in 1950, output had shown a steep declining trend from 1950 to 1967 with the exception of 1962 when high values encountered in the winding-up process of a major operation caused a temporary reversal. The 1967 output was less than 10 percent of the 1950 recovery high and only 4 percent of the 1940 figure.

Nor was the future outlook favorable. United States Smelting, Refining and Mining Co., the only major gold dredge operator left in the State, stated in its 1967 annual report to stockholders that "normal operating conditions and costs were experienced at both Hogatza and Chicken

Table 10.—Mine production of gold, silver, and other metals,[1] in terms of recoverable metals [2]

Year	Mines producing		Material sold or treated [3] (Short tons)	Gold (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)
1963	4	72	914	99,573	$3,485
1964	4	87	2,493	58,416	2,045
1965	6	69	3,305	42,249	1,479
1966	4	55	7,346	27,325	956
1967	W	50	W	22,948	803

Year	Silver (lode and placer)		Other		Total value (thousands)
	Troy ounces	Value (thousands)	Short tons	Value (thousands)	
1963	14,010	$18	5	$1	$3,504
1964	7,336	9	11	7	2,061
1965	7,673	10	41	26	1,515
1966	7,193	9	W	W	965
1967	5,787	9	W	W	812

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

Table 11.—Placer production of gold

Year	Mines producing [1]	Material treated (thousand cubic yards)	Gold recovered		
			Troy ounces	Value	Average value per cubic yard
1963	72	6,265	98,362	$3,442,670	$0.549
1964	87	3,313	56,284	1,969,940	.595
1965	69	1,785	38,686	1,354,010	.758
1966	55	r 7,805	26,532	928,620	r .119
1967	50	1,888	22,948	803,180	.425

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

Creek; however, production underruns occurring at Chicken Creek made further dredging at that location economically unfeasible. Accordingly dredging operations at Chicken have been discontinued and the dredge was put in dry-dock. Operating plans for 1968 include continuation of the dredging program at Hogatza." The Chicken shutdown left Alaska dredging with only one major operation. Both the Hogatza and Chicken boats were considered medium-sized dredges.

In addition to the two USSR & M operations, other small dredges worked on the Seward Peninsula (Council), at Otter and Flat Creeks (Iditarod), and on Gaines Creek (Innoko). Flat Creek Placers on Willow and Flat Creeks, Prince Creek Mining Co. (Iditarod), Collinsville area (Yentna), Marvel Creek Mining Co. (Aniak), and Minalaska, Inc. (Innoko), all had nonfloat operations.

Activity and interest in offshore placer deposits continued strong throughout 1967. At yearend well over 1,000 prospecting permits, covering more than 2.5 million acres were in force. Interest centered in Norton Sound, particularly in the Nome offshore deposits. Here Shell Oil Co. continued testing in areas covered by its own permits and also in areas covered by permits granted to Nome Gold Coast, Inc. Other areas that drew interest included Bluff-Daniels Creek, the west end of the Seward Peninsula, the Kotzebue section, Juneau and Ketchikan in southeastern Alaska, Goodnews Bay, Valdez Bay, and waters off Unga Island near the tip of the Alaska Peninsula. Unga was the scene of a little-known gold lode operation with appreciable production around the turn of the century.

The Bureau of Mines operated its research vessel *Virginia City* off the coast of Nome during the summer months in conjunction with the heavy metals program of the Department of the Interior. The U.S. Geological Survey also participated in the Nome research. One of the major aims of the Bureau's work was the testing and developing of equipment and techniques for coring and sampling offshore deposits. The Bureau reported that some gold had been found in each of 49 holes drilled in Nome tests. No claim of economic concentrations in the area sampled was made. Further work in the Nome area was scheduled for the *Virginia City* in the 1968 field season.

Notwithstanding the lack of lode gold production in the year, there was limited activity in gold lodes. In the Chandalar district, 200 miles north of the Arctic Circle, Chandalar Gold Mining and Milling Co. (CGM & M) went ahead with plans for building a mill to treat the high-grade deposits of the district. It was expected that the mill would be operational in late 1969 and in full operation in 1970. CGM & M held the property under a sub-lease from Little Squaw Mining Co., a subsidiary of Grandview Mines and Metaline Mining and Leasing Co. Little Squaw and principals of CGM & M had been active in the Chandalar district for a number of years.

The office of Minerals Exploration (OME), of the Geological Survey, contracted to participate in exploration of the Hard Luck Claims in the Palmer district near Anchorage. The claims were said to have placer showings of gold and platinum. Exploration by trenching, test-pitting, ground sluicing, or churn drilling was authorized. Terms and conditions of OME participation were as setup in standard OME contracts. A second OME contract was approved on a gold-platinum placer prospect in the Bethel district. Geophysical anomalies occurring at the Chagvan prospect north of Cape Newenham were to be churn drilled. Work was to be done near the mouth of the Salmon River below ground then being worked by Goodnews Bay Mining Co.

Iron Ore.—No developments of any significance occurred in the State's iron resources in 1967. United States Steel Corp. reported holding or assessment work only on its large low-grade magnetite deposits at Klukwan in the Haines area at the head of Lynn Canal. Assessment work only was likewise reported for the magnetite at Union Bay on the Cleveland Peninsula. Both deposits were in southeastern Alaska.

Utah Construction & Mining Co. reported the Mt. Andrew and the Poorman properties as inactive. Both were on the Kasaan Peninsula, Prince of Wales Island in southeartern Alaska.

Pan American Petroleum Corp., a subsidiary of Standard Oil Co. of Indiana, reported as inactive its large low-grade iron deposits near Chenik Mountain in the Iliamna area at the head of the Alaska Peninsula. Bonanza Gold, Inc. was reported

to have relinquished its agreement covering the Jumbo Mine on Hetta Inlet, Prince of Wales Island.

Mercury.—In spite of strong prices for mercury throughout the year, production of the liquid metal was less than that of 1966. Alaska's output of mercury had been small since Alaska Mines & Minerals, Inc., shut down company operations at the Red Devil mine in 1963.

What small production was recorded came from the old Kolmakof mine on the north bank of the Kuskokwin River just below Napamute, from the Alice and Bessie (formerly called the Parks property) also on the north branch of the Kuskokwim below Sleetmute, and from the White Mountain deposit between the Big and Tatlawiksuk Rivers some 70 miles south-southeast of McGrath. The Alice and Bessie and the Kolmakof were in the Aniak district; the White Mountain deposit was in the McGrath district.

Prospectors and mining scouts were active throughout the Kuskokwim region where the possibility of uncovering mercury deposits were thought to be highly favorable. At the Schaefer deposits on Beaver and Cinnabar Creeks, Aniak district, Georgetown subdistrict, Diamond Shamrock Chemical Co., a division of Diamond Shamrock Corp. was evaluating the high-grade cinnabar showings on the Lucky Day and Broken Shovel groups of claims. The deposits were 300 miles west of Anchorage in a particularly inaccessible part of the Kuskokwim region. The company said preliminary results of the work were encouraging, giving some promise of a deposit large enough to support commercial production. Ydrametals Corp., an Italian company with New York offices, was participating with Diamond Shamrock as a joint venture.

At Egnaty Creek, the Bureau of Mines continued its examination of widespread but low-grade occurrences of cinnabar in sandstone.

Nickel.—Except for assessment work necessary to hold unpatented mining claims, there was no record of significant activity in nickel.

Platinum-Group Metals.—As in past years, Goodnews Bay Mining Co. was the only producer of record of platinum and the only primary producer of the metal in the Nation. The company continued dredging operations on the Salmon River in the extreme southwestern part of the Kuskokwim River region. Physical volume and value of output were of the same order as the figures for 1966. The company did not release the figures for publication. Goodnews used an 8-foot 100-bucket Yuba electrically-powered dredge to mine the Salmon River deposits. Overburden was stripped and tailings stacked with a 6-yard Bucyrus-Erie Monighan diesel-electric.

As noted under gold, two gold-platinum placer properties (Palmer and Bethel areas) were under exploration with Office of Minerals Exploration participation.

Scrap.—Shipments of ferrous scrap increased over those of the preceding year while nonferrous shipments decreased markedly. Total value of scrap shipped decreased 73 percent from that of 1966. Shipments, mostly from Anchorage and Ketchikan, were consigned to Seattle. There was no record of scrap exports. Alaska scrap figures carried no significance in National totals.

Silver.—Alaska silver production, despite price increases for this metal, was again well under 10,000 ounces and was 14 percent below that of 1966. Silver in Alaska had been almost entirely a byproduct from gold operations. Some lode silver was shipped in concentrates from the Nizina district. The Nizina (Copper River region) shipments were copper concentrates with silver as a byproduct.

Tin.—Small quantities of tin concentrates were produced from two placer operations, one near Tin City and one at Lost River. Both operations were on the western tip of the Seward Peninsula. At Tin City, Lee Brothers Dredging Co. used a small dredge to recover cassiterite from deposits on Cape Creek. No concentrates were shipped in 1967. At Lost River, L. Grothe and C. Pearson produced tungsten-bearing tin concentrates from the Therassa Placer. Gravel was bulldozed to sluices without any stripping. Concentrates were shipped to the Wah Chang smelter at Texas City. The smelter made no payment for the contained tungsten.

Uranium.—No reports of activity at uranium deposits were received for 1967. The Ross-Adams deposit at Bokan Mountain on Prince of Wales Island was inactive

throughout the year. Last worked in 1964, the deposit was shut down owing to loss of market. Appreciable reserves were thought to exist at Bokan Mountain under the changed conditions for uranium that emerged in 1966–67.

NONMETALS

Barite.—Alaska Barite Co. continued to produce from the Red Cliff holdings on Castle Island, 25 miles west of Petersburg. The Red Cliff was purchased from A. J. Industries, successor to the old Alaska Juneau Gold Mining Co. Shipments were made to Gulf Coast ports for chemical uses and for manufacture of oil-well drilling muds.

Some interest was reported in the possibility of establishing offshore barite reserves off Castle Island. No data was available to judge the economic feasibility of offshore mining of barite.

Gem Stones.—Raw jade was produced from areas on Dahl Creek and on the Kobuk River in the Shungnak district, northwestern Alaska region.

At Grubstake Creek in the Willow Creek district, Cook Inlet-Susitna region, Lloyd Hill reported production of 10 tons of soapstone valued at $5,000. The material was sold for carving purposes. Hill reported opening of a new deposit in 1967.

Sand and Gravel.—Physical volume and value of sand and gravel both increased markedly over the 1966 figures. Physical volume was up by 28 percent, value increased by 20 percent. Unit value was $1.17 compared with $1.25 in 1966. Both commercial and government-and-contractor producers shared in the increases in output and value.

Twenty-one commercial producers accounted for 8 percent of output and 7 percent of value. Average value of commercial production was $0.96 per ton compared with $1.17 in 1966. Commercial operators washed 342,000 tons (19 percent) of output valued at $1,043,000 or $3.05 per ton. Unwashed product was 1,480,000 tons valued at $0.48 per ton. Commercial producers included the Alaska Railroad, an agency of the U.S. Department of Transportation. The railroad was classed as a commercial producer to permit comparison with data published for other States.

Twenty-six Federal, State, and municipal agencies (or their contractors) produced sand and gravel. For government agencies, output was 20,548,000 tons, valued at $24.5 million or $1.19 per ton. Washed or otherwise prepared product was 1,868,000 tons with a unit value of $2.78. Untreated product was 18,680,000 tons at $1.03 per ton. The Alaska Department of Highways,

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	1966		1967	
	Quantity	Value	Quantity	Value
Construction:				
Building:				
Sand	57	$201	49	$223
Gravel	84	268	54	234
Paving:				
Sand	404	1,408	506	1,700
Gravel	1,634	4,192	1,399	4,154
Fill:				
Sand	3,532	3,775	4,852	5,206
Gravel	11,444	11,560	15,499	14,700
Railroad ballast: Gravel	16	27	6	14
Other:				
Sand	44	85	3	11
Gravel	242	277	2	6
Total	17,457	21,793	22,370	26,248
Commercial:				
Sand	301	403	96	278
Gravel	774	860	1,726	1,471
Government-and-contractor: [1]				
Sand	3,736	5,066	5,314	6,862
Gravel	12,646	15,464	15,234	17,637

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

the State Division of Lands and the U.S. Army Corps of Engineers were the major producers. The Alaska Department of Highways furnished 61 percent of the tonnage and 71 percent of the value credited to Government agencies.

Of total production, 91 percent was used as fill, 8 percent for paving, and 1 percent for building construction. There was no recorded production of industrial sand.

Stone.—Both physical volume and value of stone dropped sharply from the 1966 results. Physical volume decreased by 43 percent from the 1966 output. Value was down 33 percent. Unit value was $2.33 per ton compared with $1.98 in 1966. The decrease resulted almost entirely from greatly reduced use of stone by the two major consumers in 1966, the Bureau of Public Roads and the Alaska Department of Highways.

Commercial producers accounted for 1 percent of volume and 1 percent of value compared with 6 and 4 percent respectively in 1966. The Alaska Railroad was classed as a commercial producer. Railroad figures were included in commercial production to make stone figures for Alaska comparable with those of the other States.

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

Table 13.—Principal producers of metals, minerals, and fuels, Alaska, 1967

Commodity and company	Mine, quarry or field	Region	Address
Coal:			
Evan Jones Coal Co	East Mine	Cook Inlet-Susitna	Jonesville, Alaska.
Usibelli Coal Mine, Inc	Usibelli Strip	Yukon River	Usibelli, Alaska.
Vitro Minerals Corp	Cripple Creek	do	Fairbanks, Alaska.
Gold:			
Flat Creek Placers	Flat and Willow Creeks	Yukon River	New York, N.Y.
U.S. Smelting Refining and Mining Co.	Chicken Creek	do	Do.
U.S. Smelting Refining and Mining Co.	Hogatza River	do	Do.
Natural Gas:			
Standard Oil Co. of California	Beluga River Field	Cook Inlet-Susitna	Anchorage, Alaska.
Union Oil Co. of California	Kenai Field, Sterling Field	Kenai Peninsula	Do.
Petroleum-crude:			
Mobil Oil Corp	Granite Point Field	Cook Inlet-Susitna	Anchorage, Alaska.
Pan American Petroleum Corp.	Granite Point Field, Middle Ground Shoal Field.	do	Do.
Shell Oil Co	Middle Ground Shoal Field	Cook Inlet-Susitna	Anchorage, Alaska.
Standard Oil Co. of California	Swanson River Field	Kenai Peninsula	Do.
Union Oil Co. of California	Trading Bay Field, McArthur River Field.	Cook Inlet-Susitna	Do.
Platinum-group Metals: Goodnews Bay Mining Co.	Salmon River Mine	Kuskokwim River	Fairbanks, Alaska.
Sand and gravel:			
Alaska Department of Highways.		Various	Juneau, Alaska.
State Division of Lands		do	Do.
U.S. Army Corps of Engineers.		do	Do.
Stone:			
Bureau of Public Roads		do	Juneau, Alaska.
Alaska Department of Highways.		do	Do.
U.S. Forest Service		do	Do.
Petroleum Refining: Standard Oil Co. of California.		Kenai Peninsula	Nikiski, Alaska.

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

The 25-percent decline in value of mineral production in Arizona, to $463.9 million, was directly attributable to the copper strike, which began July 15 and continued to yearend. High rates of production during the first half of the year and continued operations during the strike at five of the State's major copper mines limited the decline.

Mineral production centered on the metals group, which represented 90 percent of the total value of mineral output. Accounting for 83 percent of the total value of mineral output and 92 percent of the value of metals, copper was the

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

Table 1.—Mineral production in Arizona [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays [2] thousand short tons	89	$121	67	$37
Coal (bituminous) do	-------	-------	1	5
Copper (recoverable content of ores, etc.) short tons	739,569	535,004	501,741	383,591
Diatomite do	1,353	36	W	W
Fluorspar do	-------	-------	10,000	280
Gem stones	NA	120	NA	150
Gold (recoverable content of ores, etc.) troy ounces	142,528	4,988	80,844	2,830
Gypsum thousand short tons	75	394	W	W
Helium [3] thousand cubic feet	63,500	2,222	73,800	2,066
Lead (recoverable content of ores, etc.) short tons	5,211	1,575	4,771	1,336
Lime thousand short tons	218	3,721	186	3,142
Mercury 76-pound flasks	363	160	W	W
Molybdenum (content of concentrate) thousand pounds	10,161	17,812	9,261	15,385
Natural gas (marketed) million cubic feet	3,161	436	1,255	193
Petroleum (crude) thousand 42-gallon barrels	132	370	2,924	8,188
Pumice thousand short tons	1,193	1,674	1,064	904
Sand and gravel do	18,730	20,448	16,580	17,017
Silver (recoverable content of ores, etc.) thousand troy ounces	6,339	8,196	4,588	7,112
Stone thousand short tons	2,271	4,091	1,910	3,491
Tungsten concentrate (60-percent WO_3 basis) short tons	2	5	W	W
Uranium [4] (recoverable content U_3O_8) thousand pounds	437	3,492	83	666
Vanadium short tons	W	453	W	W
Zinc (recoverable content of ores, etc.) do	15,985	4,636	14,330	3,967
Value of items that cannot be disclosed: Asbestos, cement, clay (bentonite), feldspar, iron ore, mica (scrap), perlite, pyrites, vermiculite (1967), and values indicated by symbol W	XX	r 12,125	XX	13,503
Total	XX	r 622,079	XX	463,863
Total 1957–59 constant dollars	XX	r 509,867	XX	370,189

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 bentonite; included with "Value of items that cannot be disclosed."
[3] Bureau of Mines estimate from noncompany sources.
[4] Method of reporting changed from short tons of ore and f.o.b. mine value (AEC Circular 5, Revised price schedule) to recoverable pounds of uranium oxide and f.o.b. mill value.

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

County	1966	1967	Minerals produced in 1967 in order of value
Apache	r $5,783,021	$11,894,526	Petroleum, helium, uranium, sand and gravel, clays, natural gas, vanadium, pumice, stone.
Cochise	51,094,213	30,668,887	Copper, lime, sand and gravel, stone, silver, gold, fluorspar, zinc, lead.
Coconino	r 4,968,407	3,540,840	Sand and gravel, pumice, stone, copper, uranium, coal.
Gila	72,186,623	43,679,807	Copper, sand and gravel, asbestos, lime, molybdenum, stone, silver, gold, clays, mercury.
Graham	148,568	310,985	Sand and gravel, copper, stone, pumice.
Greenlee	105,583,016	64,893,359	Copper, lime, silver, stone, gold, sand and gravel, molybdenum.
Maricopa	7,739,805	5,698,147	Sand and gravel, lime, mercury, mica, stone, clays, copper, silver, vermiculite, gold.
Mohave	24,412,574	26,681,969	Copper, molybdenum, silver, sand and gravel, zinc, stone, feldspar, gold, clays, lead.
Navajo	r 1,356,168	801,870	Sand and gravel, iron ore, stone.
Pima	162,020,777	150,770,174	Copper, cement, molybdenum, silver, sand and gravel, zinc, gold, stone, lead, clays, tungsten concentrate.
Pinal	151,631,186	91,298,718	Copper, molybdenum, sand and gravel, silver, gold, perlite, gypsum, stone, lime, pyrites, diatomite, iron ore, lead.
Santa Cruz	808,662	577,669	Sand and gravel, zinc, lead, stone, silver, copper, gold.
Yavapai	r 31,860,644	30,487,994	Copper, cement, zinc, sand and gravel, lead, silver, molybdenum, stone, lime, gold, gypsum, clays, pumice, iron ore.
Yuma	2,364,802	2,409,053	Copper, sand and gravel, stone, lead, silver, gold, zinc.
Undistributed	120,000	150,000	Gem stones.
Total	r 622,079,000	463,863,000	

r Revised.

Table 3.—Indicators of Arizona business activity

		1966	1967	Change, percent
Mining:				
Sales of product (all mining)	millions	$554.1	$391.7	−29.3
Mineral production	do	$622.0	$464.0	−25.4
Industry payrolls (copper mining only)	do	$116.6	$85.0	−27.1
Agriculture:				
Value of agricultural output	do	$505.4	$506.7	+.3
Contract construction:				
Value of contract awards, total	do	$464.9	$446.1	−4.0
Value of contract awards, residential building	do	$150.6	$182.8	+21.4
Value of contract awards, nonresidential building	do	$141.2	$136.8	−3.1
Value of contract awards, nonbuilding	do	$173.1	$126.5	−26.9
Industry sales	do	$392.0	$429.8	+9.6
Industry payrolls	do	$195.5	$210.2	+7.6
Manufacturing:				
Industry payrolls	do	$466.6	$478.6	+2.6
Retail trade:				
Sales (daily average)	do	$6.0	$6.2	+3.3
Industry payrolls (excluding eating and drinking places)	do	$248.0	$263.6	+6.3
Transportation:				
Air travel, major metropolitan areas (persons)	thousands	2,416.2	2,932.8	+21.4
Highway traffic, northern Arizona (vehicles)	do	135.0	NA	--------
Highway traffic, southern Arizona	do	397.0	NA	--------
Interstate automobile traffic, northern Arizona (autos)	do	2,097.9	2,050.9	−2.2
Interstate automobile traffic, southern Arizona	do	2,454.6	2,490.7	+1.5
Interstate truck traffic, northern Arizona (trucks)	do	31.0	29.0	−6.5
Interstate truck traffic, southern Arizona	do	125.8	116.4	−7.5
Tourism:				
Visitors to national parks, northern Arizona (persons)	do	3,690.9	3,712.7	+.6
Visitors to national parks, southern Arizona	do	819.7	878.0	+7.1
Border crossings at Nogales	do	9,092.6	8,758.7	−3.7
Travel to interior Mexico through Nogales	do	99.9	102.6	+2.7
Travel to interior Mexico through Texas cities	do	[1] 223.4	NA	--------
International trade:				
Value of U.S. exports through Arizona	millions	$41.3	NA	--------
Value of U.S. imports through Arizona	do	$111.3	$110.0	−1.1

NA Not available.
[1] Eight months only June, July, August, and December 1966 data missing.
Compiled by the Division of Economic and Business Research, College of Business and Public Administration, The University of Arizona, Tucson.

Sources of original data: Arizona State Tax Commission, Employment Security Commission of Arizona, Arizona State Highway Department, F. W. Dodge Corp., City of Phoenix, Tucson Airport Authority, Arizona State Commission of Agriculture & Horticulture, U.S. National Park Service, U.S. Deaprtment of Commerce, U.S. Immigration & Naturalization Service, American Automobile Association, and the Nogales, Arizona, Chamber of Commerce.

primary metal produced along with its associated metals—gold, silver, and molybdenum. The value of uranium output was substantially lower, because the U.S. Atomic Energy Commission (AEC) uranium allotment to the Orphan mine, at the Grand Canyon, was fulfilled in 1966, and the property shut down. The mine was reopened in September 1967 on a limited basis. Metals production occurred primarily in Pima, Pinal, Greenlee, and Gila Counties.

The strike closure of the copper mines also resulted in declines in output of a number of nonmetallic minerals used in the processing of ores. Foremost of these minerals was limestone, a basic chemical used at large copper concentrators, for flux in copper smelting, and in manufacturing line.

Sand and gravel ranked second in value of mineral commodities produced, and although accounting for 45 percent of the nonmetal output value provided only 4 percent of the overall mineral output value. Because the total value of construction contracts awarded in Arizona last year declined due to lower activity in nonbuilding construction and slightly lessened activity in commercial and industrial building, output of sand and gravel, which is used extensively by the construction industry, declined 11 percent. Nonresidential building contracts were 3 percent lower in 1967, whereas nonbuilding contracts dropped 26 percent. Residential building contracts rose 21 percent above 1966 levels.

The mineral fuels output represented 2 percent of the total value of mineral production in the State. Petroleum output accounted for most of the value, followed by helium, natural gas, and coal. With the completion of the discovery well of the Dineh bi Keyah field in February 1967, petroleum production increased substantially. By the end of September, the new field had 12 producing wells with a total daily output of 12,000 barrels.

Employment and Injuries.—Employment[3] in the mining and quarrying sector in the Arizona economy reached 17,400 in June, averaging 16,900 per month for the first 6 months. Employment dropped to 7,700 in October because of the labor strike, and averaged 9,500 for each of the last 6 months of the year while the strike continued. Individual payrolls were substantially lower; weekly and hourly earnings in the copper mining industry declined respectively from $154.47 and $3.38 in December 1966 to $131.45 and $3.27 in December 1967. The average number of hours worked remained nearly constant at 42.5 per week.

[3] Unemployment Compensation Division, Employment Security Commission of Arizona, Arizona's Current Employment Developments. January-December 1967.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	5	140	1	6	-------	-------	-------	-------
Metal	10,720	318	3,412	27,288	9	660	24.52	3,200
Nonmetal	240	226	54	437	-------	17	38.93	2,052
Sand and gravel	1,257	241	303	2,421	-------	45	18.59	740
Stone	372	276	103	822	-------	12	14.59	141
Total[1]	12,594	307	3,872	30,974	9	734	23.99	2,910
1967: p								
Coal	5	200	1	5	-------	-------	-------	-------
Metal	NA	NA	2,620	20,959	7	496	24.00	3,420
Nonmetal	285	221	62	527	-------	10	18.99	378
Sand and gravel	1,160	226	262	2,121	-------	44	20.74	2,413
Stone	410	263	108	873	-------	13	14.90	587
Total[1]	NA	NA	3,054	24,485	7	563	23.28	3,165

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

Legislation and Government Programs.—The General Services Administration (GSA) and Duval Sierrita Corp., a subsidiary of Duval Corp., Houston, Tex., entered into a domestic copper production expansion contract on November 28. The agreement was for the development of a low-grade copper-molybdenum ore body adjacent to the Esperanza mine in Pima County. The contract was entered into under the authority of the Defense Production Act of 1960 as amended, on the basis of a program authorized by the President on March 29, 1966, to encourage additional production of copper in the interest of national security. Since April 11, 1966, when GSA was authorized by the Office of Emergency Planning (OEP) to undertake the program, the Interagency Working Group composed of representatives of the U.S. Departments of Commerce and Interior, OEP, and GSA had evaluated over 140 submissions, 30 of which were located in Arizona.

Copper export regulations were relaxed to permit U.S. mining companies unaffected by the strike to export their copper products. The new regulation allowed any independent concern to ship overseas up to 80 percent of its average monthly copper ore production where the refined metal was to be sold abroad, and to ship the entire output where all finished metal was returned to the United States. Duval Corp., with operations at the Esperanza and Mineral Park mines, was the first to obtain a permit, followed by Pima Mining Co. and Bagdad Copper Corp.

The copper stockpile remained at about 259,000 tons, 516,000 tons below the objective of 775,000 tons; no releases of stockpile copper were announced in 1967.

The Office of Minerals Exploration (OME), U.S. Geological Survey, contracted to assist Robert C. Hanford in exploring for silver at the Lane Silver Mines group of claims in Yavapai County. Of the total cost of the work, estimated at $30,000, OME participation was 75 percent ($22,500).

OME also contracted to assist Western Minerals Corp. in exploring for copper and silver at the Silver Hill and Homestake-Indiana property in Pima County. Total cost of the work was estimated at $79,200, of which OME participation was 62.5 percent ($49,500).

Construction contracts financed by Federal, State, and municipal funds utilized much of the cement, sand and gravel, and stone production. State highway construction contracts awarded during the year totaled $70 million. Fifty-five percent ($38,500 million) was for construction of roads in the National System of Interstate and Defense Highways.[4] Of the 1,167.3 miles of Interstate highways in Arizona 732.3 miles were open to the public at yearend; 434 miles were under construction, engineering, or right-of-way phase; and 1 mile had not been started.[5]

Exploration and Development.—Exploration for mineral commodities in Arizona continued at a slightly reduced rate. In the Basin and Range province parts of the State, including areas in 11 of the 14 counties, over 50 separate entities—companies and individuals—were engaged in exploration. Although gold, silver, and molybdenum were sought for in the potential deposits, copper was the primary target. The most active areas of exploration were the Vekol district (Casa Grande) in contiguous parts of Maricopa, Pima, and Pinal Counties, the Patagonia region of Santa Cruz County, and the Owl Head district in Pinal County. Other areas of interest included the western part of San Manuel, Safford (Lone Star), San Xavier, Cochise (Johnson Camp), and Helvetia. An indication of the trend in exploration and development activity in the State was given by the footage of work reported to the Bureau of Mines.

Total drilling dropped 28 percent to 612,200 feet. Of the total, more than 99 percent was for metals. Copper and uranium accounted for 75 and 15 percent, respectively; silver accounted for about 3 percent; magnetite, zinc, and molybdenum each accounted for about 2 percent.

Footage from churn drilling, formerly an important method of exploration from

[4] Engineering News-Record, State Highway Departments' Construction Contracting Plans for 1968 . . . and Budgets for Maintenance: Highway Spending Goes for a New Record Despite Federal Aid Cuts. V. 180, No. 14, Apr. 4, 1968, pp. 86–87.

[5] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1967. Press Release FHWA-118, Feb. 14, 1968.

the surface, was virtually the same, 41,000 feet. The footage for diamond drilling, decreasing 40 percent, accounted for 61 percent (74 percent in 1966) of the total drilled. The footage for rotary drilling decreased 4 percent, and the footage for percussion drilling increased 110 percent.

Footage excavated by shaft sinking, raising, drifting, and crosscutting increased 25 percent, to 102,878 feet. For metals, the footage was 101,641 feet compared with 79,573 in 1966; whereas, the footage for nonmetals decreased from 2,527 to 1,237.

REVIEW BY MINERAL COMMODITIES[6]

METALS

Copper.—Output of copper was at an 8-year low because of the strike led by the United Steelworkers of America against the major copper producers throughout the United States. Begun at most mines on July 15, the strike was in effect for the remainder of the year and, based on 1966 production, resulted in a loss to Arizona of an estimated 305,600 short tons of copper valued at $234 million. Continued operations at five of the State's major copper mines—Bagdad, Esperanza, Mineral Park, Pima, and Silver Bell—together with high rates of production during the first half of the year and some increase in capacity, prevented the decline from being much worse.

Declines in sales, employment, and payrolls were reported for the industry as a whole. Total taxable sales of the State mining firms was 30 percent lower than in 1966. Mine workers lost an estimated $60 million in wages, averaging about $4,000 per worker.

The Arizona Tax Commission estimated a loss of $500,000 per month each for general and copper sales taxes. Governor Williams estimated that the walkout cost the State $171 million, including $4 million in income taxes, $5 million in mine sales taxes, $800,000 in personal sales taxes, $1.25 million in personal income taxes, and $50 million each to company suppliers and retail sales.

For the past 10 years, mines in Arizona yielded more than 50 percent of the Nation's primary copper production. Of the Nation's 25 largest copper mines, 15 are in Arizona.[7] Production from 13 major open pits (81 percent) and three underground mines (16 percent) accounted for 97 percent (486,145 tons) of the State total, with the remaining 3 percent supplied by 56 smaller producers. Mined throughout a large area of Arizona, extending from Mineral Park in the northwest (Kingman, Mohave County), to Copper Queen-Lavender Pit in the southeast (Bisbee, Cochise County), copper was a significant factor in the economy of seven of the State's 14 counties.

Since 1962, Pima County has been the State's leading copper producer, and its share of the State output will be further increased with the completion, in 1970, of The Anaconda Company's Twin Buttes property south of Tucson. The mines in Pima County were all open pit.

Output from underground mines operated by Magma Copper Co. accounted for 58 percent of the copper produced in Pinal County, which ranks second in the State's copper production. Greenlee, Gila, and Cochise Counties also had substantial production, followed by Mohave and Yavapai Counties.

Copper was produced in the State by an industry similar in structure to many segments of the Nation's economy. In 1967, the mine-production capacity and output of primary copper were dominated (56 percent of total output) by three firms: Phelps Dodge Corp. (three properties, 31 percent) and American Smelting and Refining Co. (Asarco) and Magma Copper Co. (each two properties, 12 to 13 percent).

Totaling more than 56 million tons, porphyry copper ores were mined at 10 open pits and one underground mine in Cochise, Gila, Greenlee, Mohave, Pima, Pinal, and Yavapai Counties. The recoverable copper content of the ores milled

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

[7] Copper Queen (underground) mine and Lavender pit are counted as one mine.

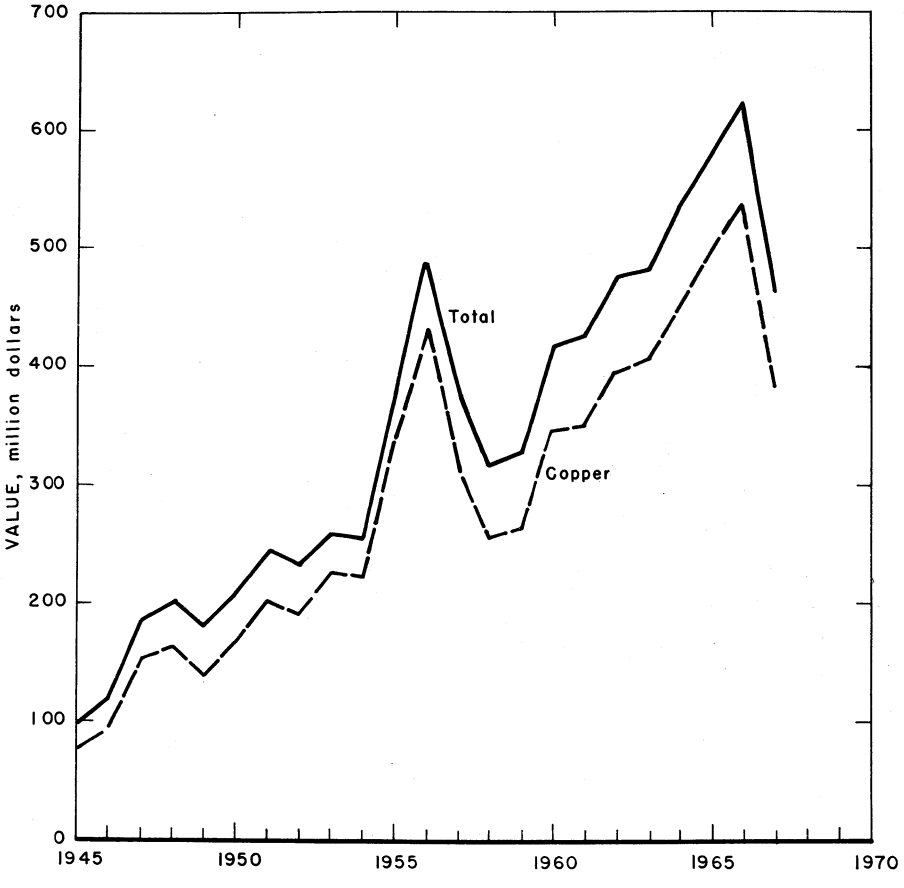

Figure 1.—Value of mine production of copper, and total value of mineral production in Arizona.

ranged from a low of 0.407 to 0.688 percent copper, averaging about 0.588 percent, slightly lower than the 1966 range of 0.417 to 0.708 percent, averaging 0.630 for more than 85 million tons of ore mined from the same pits. The copper content of the 14.5 million tons of ores associated with alkaline sedimentary rocks—the hornfels, argillites, and tactites—ranged from 0.482 to 0.782 percent, averaging 0.577. The copper ores having a low copper content generally contained molybdenum as a byproduct—the molybdenum offsetting the lower copper values.

The mining of 68.3 million tons of open-pit ore, the extension of existing pits, and the development of new ore bodies required the removal of 253.7 million tons of waste and leach material. Averaging about 2.4 to 1, stripping ratios (the ratio of waste and leach material to ore) at the 14 major properties ranged from a low of 1.28 to 1 at the Inspiration (Thornton-Live Oak pits) mine in the Globe-Miami district in the central part of the State, to a high of 4.4 to 1, at the Lavender pit at Bisbee in the southeast. The higher stripping ratios reflected development work in extending the pit limits at five of the principal properties—Pima, Mission,

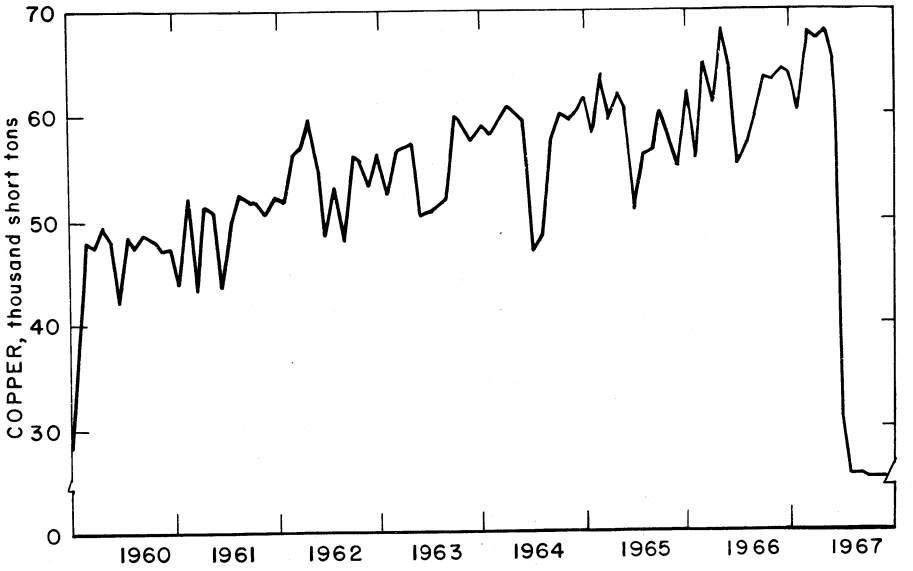

Figure 2.—Mine production of copper in Arizona, by months, in terms of recoverable metal.

Lavender, Bagdad, and Christmas mines. About 35.3 percent of the waste and leach material was removed from the Twin Buttes property. The ratio of waste to leach material at 11 of the larger open-pit mines was 1.2 to 1.

Selective mining ceased to be a major copper source in Arizona. More than 92 percent of the underground ores was mined by block caving; only 660,000 tons was mined selectively. The copper content of the 8.5 million tons of ore from three large underground mines ranged from 0.758 percent copper developed by block caving at San Manuel to 4.77 percent. The higher analysis represented the copper in ores mined selectively at Magma. The Copper Queen underground mine at Bisbee, in continuous operation since 1871, yielded both mill and high-grade direct-shipping ores.

From three open pits and one underground mine, Phelps Dodge Corp., the largest producer in the State, accounted for about 31 percent of the total output. The company mines at Morenci and Ajo were operated at capacity until July 15, when operations ceased because of the strike. The Lavender open pit and Copper Queen underground mine were operated at capacity until July 2, when the regular vacation shutdown began; operations were not resumed because of the strike. Until closed by the strike, the open-pit mines were worked 188 days, the equivalent of a 6.5-day week; the underground mines were worked 174 days, equivalent to a 6-day week.

Designed to recover part of the nonsulfide copper content of the Morenci ores, operation of the leach-precipitation-flotation plant (LPF) system was reported to have improved, although it had not reached designed annual capacity of 10,000 tons. Further improvement was expected in 1968. During the year modification was begun on the sulfuric acid plant built in 1965 to provide acid for the LPF system and for outside customers.

The Morenci open-pit mine operated by Phelps Dodge Corp. was the State's leading copper producer, mining 29.2 million tons of material, of which 11

Table 5.—Fifteen leading copper producing mines in 1967, in order of output

Rank in 1967	Rank in 1966	Mine	District	County	Operator	Source of copper in 1967
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	8	Pima	Pima	Pima	Pima Mining Co	Do.
4	3	Ray	Mineral Creek	Pinal	Kennecott Copper Corp	Copper ore, copper precipitates.
5	4	New Cornelia	Ajo	Pima	Phelps Dodge Corp	Copper ore, gold-silver ore.
6	7	Mission	Pima	do	American Smelting and Refining Company	Copper ore.
7	5	Copper Queen, Lavender Pit	Warren	Cochise	Phelps Dodge Corp	Copper ore, copper precipitates.
8	6	Inspiration	Globe-Miami	Gila	Inspiration Consolidated Copper Co	Do.
9	9	Mineral Park	Wallapai	Mohave	Duval Corp	Do.
10	11	Silver Bell	Silver Bell	Pima	American Smelting and Refining Company	Do.
11	12	Esperanza	Pima	do	Duval Corp	Do.
12	13	Bagdad	Eureka	Yavapai	Bagdad Copper Corp	Do.
13	10	Copper Cities	Globe-Miami	Gila	Miami Copper Co	Do.
14	14	Magma	Pioneer	Pinal	Magma Copper Co	Copper ore.
15	----	Christmas	Banner	Gila	Inspiration Consolidated Copper Co	Do.

Table 6.—Ore mined, waste and leach material removed, and total copper production at principal copper open-pit and underground mines

Mine	Ore mined (thousand short tons)		Waste and leach material removed (thousand short tons)		Total copper produced from all sources [1] (short tons)	
	1966	1967	1966	1967	1966	1967
Open pit:						
Morenci	19,325	11,052	28,808	18,193	141,178	82,034
Pima [2]	6,024	9,900	[3] 13,405	[3] 21,203	[4] 39,300	[4] 46,500
Ray	8,758	4,948	17,826	9,362	70,820	[5] 46,670
New Cornelia	10,487	6,078	14,920	9,601	68,297	40,118
Mission	5,969	4,604	29,179	14,331	[4] 47,941	[4] 36,746
Mineral Park	5,379	5,632	9,016	12,163	[5] 25,565	[5] 27,143
Inspiration	6,447	4,014	8,404	5,132	48,917	27,126
Esperanza	4,207	4,977	9,477	8,748	[5] 23,364	[5] 23,911
Silver Bell	3,564	3,812	8,844	9,181	[5] 24,393	[5] 22,960
Lavender	6,107	3,176	25,154	13,933	34,729	19,686
Bagdad	2,092	2,091	8,548	8,172	[5] 20,310	[5] 18,645
Copper Cities	4,354	2,430	8,468	4,659	[5] 24,897	[5] 12,924
Christmas	384	857	607	3,076	1,717	4,494
Underground:						
San Manuel	14,391	7,892	----------	----------	101,390	53,963
Copper Queen	721	386	----------	----------	26,964	14,436
Magma	432	220	----------	----------	19,631	9,550
Christmas	551	-----	----------	----------	6,479	------

[1] Includes copper recovered from leaching of material in place and in dumps.
[2] Daisy-Pima, Northeast in 1966.
[3] Thousand cubic yards.
[4] Gross metal content in concentrates shipped.
[5] Gross metal content in concentrates and precipitates shipped.

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

Table 7.—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)
1963	90	4	81,214	140,030	$4,901	5,373	$6,873
1964	85	1	86,742	153,676	5,379	5,811	7,513
1965	92	2	93,466	150,431	5,265	6,095	7,881
1966	92	1	r102,168	142,528	4,988	6,339	8,196
1967	76	1	74,742	80,844	2,830	4,588	7,112
1890–1967	NA	NA	NA	13,544,413	361,550	398,093	325,789

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	660,977	$407,162	5,815	$1,256	25,419	$5,846	$426,038
1964	690,988	450,524	6,147	1,611	24,690	6,716	471,743
1965	703,377	497,991	5,913	1,845	21,757	6,353	519,335
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
1890–1967	21,723,338	9,745,006	649,601	128,577	1,015,354	247,686	10,808,608

r Revised.
NA Not available.
[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings, or slimes retreated, and ore, old tailings, or copper precipitates shipped to smelters during the calendar year indicated.
[2] Does not include gravel washed or tonnage of precipitates shipped.

million tons were ore and 18.2 million waste and leach material.[8] Production of copper from all sources (milling and leaching of ores and waste dumps) totaled 82,034 short tons, compared with 141,178 tons in 1966. Ore and waste material were mined at a daily average rate of 162,000 tons. The ratio of waste and leach material to ore was 1.65 to 1, compared with 1.49 to 1 in 1966, and 1.55 to

[8] Phelps Dodge Corp. Annual Report, 1967, p. 11.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1967, by counties, in terms of recoverable metals

County	Mines producing [1]		Material sold or treated [2]	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	(short tons)	Troy ounces	Value	Troy ounces	Value
Cochise	8	----	3,578,370	17,767	$621,845	448,289	$694,848
Coconino	1	----	[3] 36,600				
Gila	9	----	8,605,304	2,655	92,925	142,083	220,229
Graham	2	----	[3]				
Greenlee	2	----	11,052,067	6,903	241,605	393,920	610,576
Maricopa	6	----	254	12	420	1,281	1,986
Mohave	8	1	5,673,296	126	4,410	517,540	802,187
Pima	11	----	29,483,860	22,165	775,775	1,931,707	2,994,146
Pinal	12	----	13,061,737	17,719	620,165	568,734	881,538
Santa Cruz	2	----	961	2	70	8,630	13,376
Yavapai	12	----	2,963,146	13,480	471,800	575,113	891,425
Yuma	3	----	286,522	15	525	784	1,215
Total:							
1967	76	1	74,742,117	80,844	2,829,540	4,588,081	7,111,526
1966	92	1	102,068,390	142,528	4,988,480	6,338,696	8,195,934

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Cochise	34,380	$26,283,968	1	$154	126	$34,871	$27,635,686
Coconino	[3] 413	[3] 315,327	----	----	----	----	[3] 315,327
Gila	53,502	40,903,120	----	----	----	----	41,216,274
Graham	[3]	[3]	----	----	----	----	[3]
Greenlee	82,036	62,718,507	----	----	----	----	63,570,688
Maricopa	14	10,818	----	----	----	----	13,224
Mohave	26,708	20,418,991	2	560	576	159,554	21,385,702
Pima	172,535	131,906,955	167	46,690	3,245	898,452	136,622,018
Pinal	109,285	83,550,645	3	784	----	----	85,053,132
Santa Cruz	1	382	165	46,340	170	47,191	107,359
Yavapai	20,703	15,828,048	4,393	1,230,152	10,212	2,827,101	21,248,526
Yuma	2,164	1,654,268	40	11,200	1	235	1,667,443
Total:							
1967	501,741	383,591,029	4,771	1,335,880	14,330	3,967,404	398,835,379
1966	739,569	535,004,215	5,211	1,575,285	15,985	4,635,650	554,399,564

[1] Operations at miscellaneous cleanups not counted as producing mines.
[2] Does not include gravel washed, or tonnage of precipitates shipped.
[3] Coconino and Graham Counties combined to avoid disclosing individual company confidential data.

1 in 1965. The principal acquisitions during the year included four new 2,000-horsepower locomotives, and 26 new 40-cubic-yard dump cars. In addition, to facilitate the expansion of the mine to the south, four 65-ton trucks were purchased for use in mining above the established rail-haulage system.

Significant quantities of byproduct gold, silver, and molybdenum were recovered from copper ores milled at the Morenci concentrator. Limestone mined by the company at the Morenci quarry was used as a smelting flux and in manufacturing quicklime for metallurgical purposes. Near Morenci the company quarried sandstone for use as a smelter flux.

The project to relocate the town of Morenci was continued with the construction of a new hospital and shopping center. At yearend, 50 new houses for employees were nearly completed and ground had been broken for another 50. Plans were developed for a new theater, library, and business office complex to replace similar structures in the area encroached upon by the mine.

Oldest of the three active branches, the Copper Queen Branch accounted for 22 percent (3.6 million tons) of the copper produced by the company. This property consists of the Copper Queen underground mine and Lavender open pit, which produced respectively, 386,000 and 3.2 million tons. In addition, approximately 13.9 million tons of waste and leach material was removed from the Lavender pit. The ratio of waste and leach material to ore moved in 1967 was approximately 4.38 to 1, compared with 4 to 1 in 1966. The increase in stripping ratio resulted primarily from the development work connected with the

Table 9.—Mine production of gold, silver, copper, lead, and zinc in 1967, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold	5	474	29	105	14,300	---	---
Dry gold-silver	4	49,529	73	3,426	846,300	---	---
Dry silver	10	13,551	8	37,995	44,300	5,100	---
Total	19	63,554	110	41,526	904,900	5,100	---
Copper	35	74,289,203	66,933	3,996,587	901,853,500	300	672,400
Copper-zinc	2	17,306	10	6,937	585,600	2,900	1,363,800
Lead	3	1,163	4	2,122	3,300	116,500	7,200
Lead-zinc and zinc [2]	[3] 7	344,307	12,997	526,233	1,014,700	9,350,400	26,616,600
Total	45	74,651,979	79,944	4,531,879	903,457,100	9,470,100	28,660,000
Other "lode" material:							
Gold-silver tailings	2	24,987	407	10,889	103,600	---	---
Copper cleanup	[4]	1,309	31	868	296,500	---	---
Copper precipitates	22	66,892	---	---	98,718,600	---	---
Lead cleanup	[4]	288	350	2,919	1,300	66,800	---
Total	24	93,476	788	14,676	99,120,000	66,800	---
Total "lode" material	76	74,809,009	80,842	4,588,081	1,003,482,000	9,542,000	28,660,000
Placer	1	---	2	---	---	---	---
Total all sources	77	74,809,009	80,844	4,588,081	1,003,482,000	9,542,000	28,660,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] 6 lead-zinc mines and 1 zinc mine.
[4] From properties not classed as mines.

Table 10.—Mine production of gold, silver, copper, lead, and zinc in 1967, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation: Ore	2	1	---	---	---
Concentration and smelting of concentrates: Ore	75,548	4,418,383	[1] 874,273,900	9,264,000	28,496,600
Direct-smelting:					
Ore	4,504	155,021	14,350,600	211,200	163,400
Cleanup	381	3,787	297,800	66,800	---
Precipitates	---	---	98,718,600	---	---
Old tailings	407	10,889	103,600	---	---
Total	5,292	169,697	113,470,600	278,000	163,400
Other: Leaching of copper ore	---	---	15,737,500	---	---
Placer	2	---	---	---	---
Grand total	80,844	4,588,081	1,003,482,000	9,542,000	28,660,000

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

extension of the mine begun in 1966. Relocation of U.S. Highway 80, the main Douglas-Tucson highway, along the north side of the pit, progressed on schedule.

Approximately 3.4 million tons of ore were treated at the copper concentrator at an average rate of 19,000 tons per operating day. The recovered copper content of the open-pit ores mined during the year was 0.55 percent. Part of the ore from the underground mine was shipped to the company smelter at Douglas; part was

treated at the Lavender open pit concentrator, and all of the concentrate produced was smelted at Douglas.

Although underground exploration was continued during the year, no important discoveries were made. The tonnage of new ore developed was somewhat less than the tonnage mined. The company expected a sharp decline in the output of Copper Queen underground and Lavender pit ores during the early 1970's. To replace these operations, Phelps Dodge planned to start developing another ore body with the completion of the Tyrone project in New Mexico in late 1969 or in 1970.

The Douglas smelter, 40 miles east of the Copper Queen Branch operations at Bisbee, treated ores from the underground mines at Bisbee, concentrates from the Lavender-pit concentrator, and copper precipitates from Lavender pit leach material. Also treated at the smelter were copper scrap and other copper-bearing materials on a custom or toll basis.

Production of copper from the New Cornelia Branch, Ajo mine, was 40,118 tons, representing 26 percent of company output. The ratio of waste to ore mined in the Ajo open pit was 1.58 to 1, the lowest stripping ratio of the three properties operated by the company. Installation of a short-head cone crusher and of automatic ball mill controls were among the major developments at this property during the year.

Phelps Dodge Corp. and Tidewater Oil Co., in a joint venture, were the successful bidders on one of two tracts of land on the San Xavier Indian Reservation. The bonus offer was $501,938 for 24,935 acres in the central and western part of the reservation. Under terms of the mineral prospecting permit, with option to lease, Phelps Dodge and Tidewater were to have 2 years to evaluate the property and determine its potential. Prospecting may be conducted for all minerals, other than gas or oil or other hydrocarbons, sand and gravel, and building stone. The successful bid was to be approved by the landowners before the permits were to be issued.

Ray Mines Division, Kennecott Copper Corp., replaced the old jaw crusher located at the Ray pit with a new 54-inch primary gyratory crushing plant. The old jaw crusher and other usable equipment was to be installed in the silicate-ore leaching plant under construction.

Ore treatment capacity at the concentrator operated by Inspiration Consolidated Copper Co., at Inspiration, was limited by loss of the new leaching-plant excavator, which failed during tests in 1966. Available highest grade ores were mined; production was at the maximum with the old equipment. Ore treatment at Inspiration involved segregation and treatment of three kinds of ore—oxide, oxide-sulfide, and sulfide ores. Oxide ore with negligible sulfide content was discarded after leaching. After leaching, mixed oxide-sulfide ores were sent to the concentrator for milling to recover the sulfide content. Selectively mined ores, high in sulfide and low in oxide, were sent directly to the concentrator.

The Live Oak and Thornton open-pit mines were operated continuously until closed by the strike. Before the shutdown, preproduction stripping of the Thornton West extension was completed and ore production begun. Preliminary development of the Red Hill pit was completed. The division mined and milled 4.0 million tons of ore at an average rate of 20,270 tons per day. The ratio of waste to ore was slightly lower, 1:28 in 1967 compared with 1:30 in 1966. In 1967, 1,739 tons, 6 percent of the total output by Inspiration Division, was produced by waste dump and in-place leaching. Vat leaching, a similar process, was also used as the first step in the processing of ore-grade material. Leach solutions from vat leaching were stripped of their copper content by electrowinning, which produced a refined copper cathode, and by precipitation of copper in the off-solution in the form of cement copper. Leached ores were retreated by grinding and flotation concentration to liberate and recover the sulfide copper. The tank leach-concentrator process recovered 50.8 million pounds of copper, 94 percent of the Inspiration output.

Operated by Christmas Division, Inspiration Consolidated Copper Co., the Christmas underground mine, 10 miles north of Hayden, was closed from October 10, 1966, to July 15, 1967, and was successfully replaced by an open-pit operation. In the early stages of development, some difficulties were encountered because the pit was small, cramped, and lacked the preproduction stripping needed for full production. Accelerated waste stripping, extensive drilling, and assembling and train-

ing a new work force caused abnormally high costs. To offset these costs, copper produced from ores mined at Christmas was priced at 47 cents per pound rather than the 38-cent price that prevailed among most primary producers.

During 1967, the Christmas concentrator was operated 195 days and treated 856,926 tons of ore at an average of 4,394 tons per day, recovering 4,494 tons of copper. The daily quantity of ore treated was approximately 400 tons over the rated capacity. Ore reserves at this property were believed to be sufficient for approximately 8 years, during the early part of which period the stripping ratio was expected to remain high. Prospects for developing additional ore were reported as good.

Concentrates produced from the open-pit ores at Christmas were trucked 36 miles north to Miami and discharged into railroad cars for a short haul up the hill to the company smelter. At the nearby electrolytic refinery, blister copper obtained from the smelting of the concentrates was refined to cathode copper.

Bagdad Copper Corp., a major independent copper producer in Arizona, reported the production of 18,373 tons of copper. Recovery of copper from sulfide ores was 25.7 million pounds, 6 percent lower than that reported in 1966. Accounting for the drop in production, the average grade of ore mined during 1967 was 0.77 percent, compared with 0.94 percent in 1966. The quantity of waste material stripped from the ore body during 1967 was 4 percent below that removed in 1966; stripping, however, was in excess of that required for ore production. The company began stripping operations to uncover an additional 17 million tons of ore. Estimated life of the sulfide ore reserves was 23 years; leach ore should last for an equal period. The company operated normally during the strike period, except that sales, somewhat irregular, were largely for export; 13.3 million pounds of copper were sold in the overseas market.

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

Production at the Magma and San Manuel underground properties, of Magma Copper Co., was adversely affected by the strike. San Manuel Division mined 7.9 million tons of ore containing 0.758 percent sulfide ore, compared with 14.4 million tons assaying 0.772 percent sulfide ore in 1966. Ore mined per operating day increased for the second consecutive year, from 37,791 tons in 1965, and 40,312 tons in 1966, to 41,463 tons in 1967. Copper recovery declined from 14.09 pounds per ton of ore mined in 1966 to 13.68 pounds in 1967. San Manuel quarried 36,100 tons of limestone and 6,500 tons of quartzite for metallurgical use.

The San Manuel concentrator treated 7.8 million tons of ore at an average rate of 41,227 tons per operating day. Approximately 89 percent of the total copper and 93 percent of the sulfide copper were recovered, indicating a slight rise in plant efficiency. The San Manuel smelter processed 183,460 tons of concentrate assaying 29.88 percent copper; 339,652 tons assaying 29.95 percent copper was smelted in 1966. Metal production was 53,963 tons of copper, 2,000 tons of molybdenum sulfide, 10,500 troy ounces of gold, and 166,900 troy ounces of silver.

The Magma mine at Superior, about 65 miles east of Phoenix in the Pioneer (Superior) mining district, was operated by Superior Division, Magma Copper Co. Output was 219,510 tons of ore containing 4.77 percent copper, 0.026 troy ounce of gold, and 1.01 troy ounces of silver per ton, compared with 431,900 tons mined in 1966 containing 4.70 percent copper, 0.032 troy ounce of gold, and 1.13 troy ounces of silver per ton. Copper production at Magma was 9,550 tons, compared with 19,631 tons in 1966.

Development in the upper limestone beds added 3.5 million tons of ore to the 3.5 million ton reserve reported in that area in 1966. Including the ore in the lower beds, total reserves were estimated at nearly 9 million tons of plus 5-percent-copper ore. A study was underway to determine the economic value of the ore re-

serves. Consideration was given to the development of new mining methods, new entries to the mine, and additional production and treatment capacities. If carried out, the program would increase daily production capacity of ore from 1,500 tons to a minimum of 2,200 tons at an estimated cost of $20 million.

Twenty-two miles southwest of Tucson at the Mission mine, operated by Asarco, the $9 million expansion program was completed during the first quarter, increasing daily capacity about 50 percent to 25,000 tons. The company mined 4.6 million tons of ore and 14.3 million tons of waste material from the pit during the year. Concentrates containing 36,746 tons of copper were produced. Also recovered at the concentrator was 194 tons of molybdenum concentrate and a small tonnage of zinc concentrate. The mine was shut down on July 17 because of the strike at the smelter to which it ships its output. At the Silver Bell mine, 40 miles northwest of Tucson, Asarco mined 3.8 million tons of ore and 9.2 million tons of waste material. The mine was operated at full capacity throughout the year, producing concentrates containing 22,960 tons of copper.

About 1.5 miles north of the Mission mine on the San Xavier Indian Reservation, 4.6 million tons of waste material was stripped from a mineralized area. The mine will provide siliceous oxidized copper ores for use as a converter flux at the company Hayden smelter.

Plant construction and premining stripping of overburden was begun at the Duval Sierrita Corp. copper-molybdenum ore body adjacent to the Esperanza property. Funds required to finance the project, estimated at $151 million including working capital, were to be obtained from the following sources: $83 million from GSA, $48.75 million from commercial bank loans, and the remainder from Duval as equity or loans. Duval agreed to provide management and technical guidance to Duval Sierrita Corp. at cost.

The contract provided that the repayment of the Government advances was to be made by deliveries of refined copper to the Government by June 30, 1975; advances to be credited at the rate of 38 cents per pound of copper delivered. The contract also provided that from the beginning of production to the final repayment date certain minimum deliveries were to be made at stated intervals.

Development of the mine for production was to require removal of 105 million tons of overburden. The plant was designed for a minimum daily capacity of 60,000 tons of ore. Production from known reserves was expected to total 1.3 million tons of copper and 119,500 tons of molybdenum, together with 9 million ounces of silver.

Reaching an agreement with its unions on September 1, Pima Mining Co. operated throughout the copper strike. The new 3-year contract was expected to increase labor costs about 6 percent over the term of the contract. Authorized in September 1966, the third major expansion in 3 years was completed in July, a $16.6 million project which increased capacity of the mine and mill from 18,000 tons to 30,000 tons per day. The molybdenum recovery plant, completed late in the year as a part of the expansion program, was expected to recover approximately 450 tons annually.

Sales of copper in concentrates totaled 36,500 tons in 1967, compared with 34,500 tons in 1966. Copper concentrate produced from ores mined and milled at Pima were normally smelted and refined by Asarco and Phelps Dodge Corp. Because of the strike these smelters were closed; thus, the company negotiated sales to smelters in Japan and Canada, shipping concentrates to these countries between August and October.

Under terms of an agreement dated November 23, 1959, Pima mined and milled ores from the Banner Mining Co. property, a part of the Pima pit. Banner reimbursed Pima for mining, milling, smelting, and refining costs.

Cement copper recovered from the leaching of ore and waste dumps, in tanks and in place, at 23 operations contained 69,473 short tons of recoverable copper. The copper content of the precipitates ranged from a low of 46.3 percent copper to a high of 80.8 percent, averaging 73.8 percent. Copper produced by precipitation from mine-water and leach solutions with iron represented 10.5 percent of the mine production.

Eight primary smelters were operated in the State, primarily on ores produced by the operating company. Four of the smelters—Phelps Dodge Corp. smelter at

Douglas, Inspiration Consolidated Copper Co. smelter at Inspiration, Magma smelter at Superior, and Asarco smelter at Hayden —also treated ores on a custom or toll basis. Phelps Dodge Corp., with smelters at Ajo, Douglas, and Morenci, controlled 57 percent of the total smelting capacity within the State; Magma Copper Co., with smelters at San Manuel and Magma, accounted for 13 percent. The smelters operated by Kennecott Copper Corp. and Asarco at Hayden, and by Inspiration Consolidated Copper Co. at Inspiration, each accounted for 10 percent.

Approximately 2.2 million tons of ore, concentrates, and precipitates was shipped to smelters in or outside the State. These shipments consisted of 1.9 million tons (87 percent) of concentrates obtained from milling copper ores; 203,900 tons of direct shipping ores (9 percent); and 76,500 tons (4 percent) of precipitates from leaching ores in dumps, in place, in tanks, and in heaps.

Leaching.—As companies incorporated the leaching process from a sideline to that of an integral part of the copper-producing operation, leaching of low-grade copper ores in mine dumps was expanded. More than 42.3 million tons of leach material was placed in new or existing dumps. Ultimately leading to large-scale chemical mining, studies were underway or planned on the use of nuclear and conventional explosive charges to fracture low grade copper ore bodies which would be leached in place by the controlled percolation of solutions containing catalysts, solvents, and bacteria.

As a forerunner of the new mining systems, Ranchers Exploration and Development Corp. installed a solvent-extraction-electrowinning facility at its Bluebird mine near Miami, Gila County. The facility was to upgrade copper-bearing solutions from the heaps by filtration and mixing with a solvent to separate the copper from acid and water. In the process, the copper is stripped from solvent with a high-acid solution; the copper and solution are then sent to the electrowinning units, consisting of cells containing starting sheets surrounded by circulating copper-and-solution. Electric current passed through the solution attracts the copper ions to the starting plates. The copper cathode grows to almost 1 inch thick and weighs about 300 pounds. Shipped directly to the fabricator, the cathodes contained 99.9 percent copper. The plant designed and constructed by Bechtel Corp. has a daily capacity of 15 tons of copper.

Kennecott Copper Corp. submitted a proposal, based on a study,[9] to the Atomic Energy Commission for a joint experiment to evaluate the use of nuclear explosives in fracturing a low-grade copper ore body for subsequent extraction of copper by in-situ leaching methods. The Safford deposit of Kennecott Copper Corp., located about 9 miles northeast of Safford, was suggested as the experiment site. The experiment was to involve detonating a 20-kiloton nuclear explosive underground in the oxide part of the deposit to fragment a test zone of copper ore. (One kiloton is equivalent to 1,000 tons of TNT high explosive.) A pilot leaching plant, having commercial size equipment, was to be built to leach and extract copper from broken ore. Collection of sufficient data to evaluate the experiment was expected to take about 1 year.

In May, Kennecott Copper Corp. began constructing a copper silicate ore plant and auxiliary facilities at Ray. The $35 million project was to include a 10,000-ton-per-day leaching plant and a sulfuric acid plant to produce 750 tons of acid daily from sulfur dioxide gas generated at the smelter. The silicate ores were to be crushed in a conventional crushing plant to minus ½ inch, and the sands treated by 10-day vat leaching. Classifier slimes were to be leached by agitation for 24 hours and then washed; the copper sulfate solution was combined with the solution from vat leaching, and the copper recovered by electrolysis. The new plant was designed to increase the annual copper output at Ray by 24,000 tons. The acid plant, expected to begin operations in the last quarter of 1968, was to minimize sulfur dioxide emitted to the atmosphere. Under construction, to replace the existing facility, was a new cone-type precipitation plant. The old facility, located near the pit, was removed to extend the pit perimeter.

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[9] Kennecott Copper Corp., U.S. Atomic Energy Commission, U.S. Bureau of Mines, Lawrence Radiation Laboratory, and with technical assistance of the Oak Ridge National Laboratory. Sloop. June 1, 1967, 44 pp.

During the first 6 months of the year, Inspiration Consolidated Copper Co. conducted full-scale test of plans for mining and leaching the Ox-Hide ore body, small areas were mined, and dumps prepared and acid-leached. With earlier projections confirmed, the property was prepared for production—initial grading for leach-dump areas and the design of plant facilities was begun. Initially, the ore was to be mined at a rate of about 6,000 tons per day; later the rate was to be increased to 12,000 tons. Estimates indicated that about 3.8 pounds of copper was to be recovered per ton of ore treated. Tractor-rippers were to be used for ground breaking, since little drilling and blasting were required; self-loading scrapers were to transport broken ore to leach dumps.

Gold.—The 43-percent decline in gold production reflected the lower output of copper; gold production totaled 80,800 troy ounces. Eighty-three percent, 66,900 ounces of gold, was recovered as a byproduct in the refining of copper; 16 percent, 13,000 ounces, as a byproduct of lead-zinc ores; and 1 percent from other ores. Eight mining operations—Copper Queen, New Cornelia, and Morenci Branches, Phelps Dodge Corp.; Iron King, Shattuck Denn Mining Corp.; San Manuel, San Manuel Division, Magma, Superior Division, Magma Copper Co.; Christmas, Inspiration Consolidated Copper Co.; and Ray, Ray Mines Division, Kennecott Copper Corp.—furnished 98 percent of the gold output. Phelps Dodge Corp., the largest producer, accounted for 59 percent of the output.

This firm's combined byproduct gold output, recovered from the refining of copper totaled 48,000 ounces, compared with 87,000 ounces in 1966 and 96,000 ounces in 1965. Magma Copper Co., the second largest producer in the State, also recovered gold as a byproduct of copper refining. Stipulated in the annual report, the company produced 15,504 troy ounces of gold—10,534 ounces at the San Manuel Division and 4,970 ounces at the Superior Division in Pinal County.[10] Combined output from the two properties was 56 percent below that of the previous year primarily because of lower tonnage of ore milled and a lower gold content of the ore.

Shattuck Denn Mining Corp. recovered approximately 13,500 troy ounces of gold from lead-zinc ores obtained from the Iron King mine in Yavapai County.

Iron Ore.—Production of iron ore in Arizona increased significantly during the year because of the threefold increase in the tonnage of ore mined and shipped from the Apache mine for testing by CF&I Steel Corp. The Apache deposit, east of Young on the Fort Apache Indian Reservation, is held by the company under lease from the Apache Indian tribe. Chas. Pfizer & Co., Inc., produced hematite ore for use as a paint pigment from the Cowden mine, near Seligman, Yavapai County. Of special interest to the mining community was the recent announcement[11] by Sovereign Industries, Inc., that it had acquired rights to the Black Mountain magnetite ore deposits in Pinal County, together with the mining equipment and metallurgical facilities at Coolidge. The company announced plans to operate the Black Mountain deposit and the hydrogen plant at Coolidge. This operation was in conjunction with a new reduction furnace for the output of 20,000 tons of sponge iron pellets per year for sale to the mining companies, for the precipitation of cement copper. Scheduled to begin production in August 1968, the plant also had a designed capacity to produce 10,000 tons per year of metallurgical-grade iron powder. Sovereign also planned to operate the electric steelmaking facilities at Coolidge and to transfer to this site a small rolling mill from Philadelphia, Pa. Reportedly, the company was also considering plans to produce 2 to 5 million tons of iron pellets per year, for shipment by unit train to western and gulf steel mills, as well as for the Japanese market.

Lead.—Output of lead recovered from ores mined in the State totaled 4,771 short tons, 8 percent below that of 1966. Most of the output was from lead-zinc ores produced at the Iron King mine, 20 miles west of Prescott, by Shattuck Denn Mining Corp., and concentrated in the company mill. Concentrates from the mill were shipped to the Asarco smelters at Amarillo and El Paso, Tex. Continental Materials Corp., the second largest producer, mined zinc ores from the CWT mine in Pima

[10] Magma Copper Co. Annual Report, 1967, pp. 7–8.

[11] Skillings' Mining Review. Sovereign Iron Ore and Steel Projects in Arizona. V. 56, No. 48, Dec. 2, 1967, p. 16.

County. Arivaca Mining Corp. operated the Glove mine near Tucson, and Donald C. Gilbert operated the Royal mine near Patagonia. Yavapai County, with three operators, led the State with output of 4,393 tons, representing 92 percent of the production. The remaining 8 percent came from 11 operations in Cochise, Mohave, Pima, Pinal, Santa Cruz, and Yuma Counties.

Mercury.—A small quantity of mercury was produced from five mines in the Mazatzal Mountains in Gila and Maricopa Counties. Reflecting a lower demand for the commodity in world and domestic markets, production and value of mine shipments declined. The availability of supplies from the GSA stockpile tended to set a market ceiling at a level of $500 to $510 per 76-pound flask, limiting output from high-cost properties.

Mercury content of the ore mined ranged from 0.05 to 0.17 percent, with 96 percent of the ore furnaced and the balance retorted. The Pine Mountain mine, Maricopa County, operated by United Nuclear Corp. was the largest producer, followed in descending order by the National mine, Maricopa County, owned by Big Sam Mines, Inc.; Sunflower mine, Maricopa County, operated by Posey Mining Co.; and the Cypress mine, Gila County, owned by Gordon K. Grimes and operated by Cane Springs Milling & Mining Co. Gale Smith recovered a small quantity of mercury from dump material at the Ord mine in Gila County. Buyers of mercury, in order of quantity purchased, were Philipp Bros. and Chemical Manufacturing Co.

Molybdenum.—The molybdenum shortage that occurred in 1964–66 ended early in 1967. Supply and demand were in reasonable balance in the first half of the year, as consumers built inventories in anticipation of strikes. Augmented by U.S. stockpile releases, these large inventories carried most consumers through the year-end, unaffected by strikes in the copper industry and at molybdenum conversion plants.

Output of molybdenite concentrate (MoS_2) at byproduct recovery plants in the State declined 7 percent because of the strike. Six of the State's 11 conversion plants were closed. With the strike in effect, mines in Arizona accounted for 11 percent of the total U.S. molybdenum shipments.

More than 56.3 million tons of crude ore from 10 properties, containing from 0.002 to 0.053 percent M_oS_2, were processed to recover 1.2 million tons of copper concentrates. Recovered from these concentrates were 8,645 short tons of molybdenite concentrate, whose molybdenum content ranged from 46.1 percent to 55.8 percent, averaging 53.8 percent for the 4,650 tons produced. Shipments were 8,633 tons of concentrate with content of 4,630 tons molybdenum valued at $15.4 million.

Exports of concentrates containing 791 tons of molybdenum, represented 17 percent of the total shipments. Stocks on hand December 31, 1967, were 173 tons, compared with 161 tons at the end of 1966. The average price received for molybdenum in concentrate form was $1.66 per pound, compared with $1.75 per pound in 1966.

Begun by Pima Mining Co. in mid-1966, a molybdenum-production program was completed during the year with the installation of additional equipment to process approximately 450 tons of low-grade concentrate annually into a marketable product.

Silver.—The increased industrial demand, and the sharp rise in the price resulting from the curtailment of sales by the Government, prompted considerable interest in silver-bearing properties. Exploration and development activities were reported in several areas of the State, notably in the Tombstone area where in less than 4 months 400 new locations were filed. Escapule Mining Association continued work at the Santa Anna mine. Piedras del Sol Mining Co. reported that it had completed a crosscut to a silver-bearing vein at the Side Wheel mine on Military Hills 2 miles from Tombstone; at the last report the company was drifting on the vein. W. W. Grace and Associates exercised an option to purchase the Old Chance mine, adjoining Escapule's Santa Anna mine. In Mohave County, the old McCracken mine, a silver-lead-zinc property near Yucca, was reopened by the Canadian firm of Magnum Consolidated Mining Co., Ltd. Underground exploration was continued at the Silver Crown mine, a silver-lead development of Arizona-Michigan Mining Co. in Yavapai County.

Completed to the satisfaction of the Government were the OME contracts negotiated with Big Treasure Mining and Development Co. and Donald C. Gilbert, to explore for silver at the Little Treasure-Adjust group of claims in Pinal County and the Royal Deer-Horn claims in Santa Cruz County, respectively.

Production of silver dropped 28 percent (1.8 million ounces) below that of 1966, largely because of the copper strike. Of the total quantity of silver produced, 87 percent, 4.0 million ounces, was recovered as a byproduct of copper ore, 11 percent from lead-zinc ores, 1 percent from dry silver ores, and 1 percent from miscellaneous ores and materials. Phelps Dodge Corp., with three mines—Copper Queen-Lavender, New Cornelia, and Morenci—was the leading producer, accounting for 1.2 million ounces, 25 percent of the production. The five leading silver-producing companies—Phelps Dodge Corp., Asarco, Duval Corp., Pima Mining Co., and Shattuck Denn Mining Corp.—accounted for 81.3 percent of the State total. In 1967, the ratio of recoverable silver to copper, in the copper ores mined, was 8.9 ounces of silver for each ton of copper produced, compared with 8.2 ounces in 1966.

Tungsten.—A small quantity of tungsten concentrate (60 percent WO_3) was produced from ore mined at the Carboloy mine in Pima County and shipped to Kennametal Inc., Fallon, Nev., by Fernstrom Mining Co.

Uranium.—Valued at $666,000, production (recoverable content U_3O_8) declined 81 percent, both in output and in value. These declines were caused primarily by the closing in July 1966 of the Orphan mine of Westec Corp. on the south rim of the Grand Canyon, and by a lower output of ore by Foote Mineral Co. and Vanadium Corporation of America (VCA) from mines in Apache County. On August 30, stockholders of these two companies approved the merger of VCA into Foote Mineral Co. The Monument No. 2 mine, VCA's largest uranium-vanadium operation, was closed. The Orphan mine, purchased by Cotter Corp. in August, began mining at the end of September at the rate of 100 tons of ore per day.

Shipments of crude ore from 14 operations, 13 in Apache and one in Coconino County, to processing plants at Grand Junction and Canon City, Colo., and Shiprock and Grants, N. Mex., totaled 15,723 short tons. The f.o.b. mine value of the ore shipped ranged from $2.56 per ton for crude ore containing 0.08 percent uranium oxide (U_3O_8) to $203.50 per ton for crude ore containing 2.09 percent U_3O_8. The average grade of the ore shipped was 0.28 percent U_3O_8, 0.08 below that reported for the previous year. The average value of mine shipments for the 15,700 tons produced was $22.29, $8.53 per ton below that reported in 1966.

Vanadium.—Vanadium was recovered from uranium-vanadium ores mined in Apache County. The ores were processed at the Climax Uranium Co., Amax Nuclear Division, American Metal Climax, Inc., mill at Grand Junction, Colo., and the Foote Mineral Co. mill at Shiprock, N. Mex.

Zinc.—Ores from three lode mines in Mohave, Pima, and Yavapai Counties yielded 13,700 tons, 95 percent, of the recoverable zinc produced in the State. Total State output declined 10 percent in quantity and 14 percent in value below that of 1966. This decline was caused primarily by a decrease in the tonnage and grade of the ore produced at the Iron King mine operated by Shattuck Denn Mining Corp., and by the closing of the Old Dick mine in mid-1966 when ore reserves were exhausted. Except for an exploration and development program to search for new ore and to develop a previously discovered ore zone, the Old Dick underground mine and 330-ton-per-day selective flotation mill owned by Cyprus Mines Corp. were inactive the entire year. The Bruce shaft was deepened to 70 feet below the 1,700-foot level; crosscuts and drifts were driven on four levels to develop and delineate the deep ore body. By the fourth quarter of 1968, the shaft was to be at its planned depth of 2,200 feet and the mine developed on eight levels. With the completion of development work late in 1968, sufficient ore reserves would be available to operate the mill at its maximum monthly capacity of 10,000 tons for at least 18 months.

NONMETALS

Asbestos.—Asbestos was shipped from three underground mines located in the Salt River Valley of South Central Arizona near Globe. Nearly all of the output was short-fiber material used in manufacturing asbestos products; a small quantity was classified as filter fiber. The leading producer, Jacquays Mining Corp., selectively mined and hand sorted chrysotile ore at the Chrysotile mine for shipment to the company mill at Globe. Production also was reported by Asbestos Manufacturing Co. from the Phillips mine and Metate Asbestos Corp. from the Lucky Seven. Through research, in recent years Arizona producers have developed several useful applications for the iron-free fiber, both in food and as a medium in water filtration.

Cement.—Portland and masonry cements were produced by Arizona Portland Cement Co., a division of California Portland Cement Co., at its Rillito plant, Pima County, and by Phoenix Cement Co., a division of American Cement Corp., at Clarkdale, Yavapai County. Portland cement clinker produced in the Rillito and Clarkdale plants was used in making masonry cement. Most of the portland cement produced consisted of types I and II. Shipments of finished portland and prepared masonry cements were mainly within the State. Only a small percentage of the entire output was bagged; most of the cement was shipped in bulk by truck or rail.

Clays.—The total quantity and value of clay sold or used in the State increased. Output of miscellaneous clay used in manufacturing building brick and portland cement declined 25 percent. Kaolin mined by Franconia Mining Corp. from the Klaner and Doolin pits near Franconia, Mohave County, was sold for refractory use. The quantity of bentonite clay used in filtering and decoloring mineral and vegetable oils, as reservoir lining, as a binder for taconite pellets, for enameling, and other purposes, increased 44 percent.

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

Feldspar.—Industrial Minerals Division, International Minerals & Chemical Corp., was the State's only producer of crude and ground feldspar. Used in manufacturing pottery and enamel, all of the potash feldspar produced at the Taylor mine in Mohave County was ground in the company mill near Kingman.

Fluorspar.—C. L. Whitelock reported the production and shipment of 10,000 tons of fluorspar from the Lone Star mine in Cochise County. The material containing 80 percent CaF_2, was used as a fluxing agent.

Gypsum.—Gypsum production came from three mines in Pinal County and one in Yavapai County. Harquahala Gypsum Co. near Salome, Yuma County, was idle. One-third of the total output was calcined and used in the manufacture of building products. Uncalcined gypsum was sold for agricultural purposes and as a cement retarder.

Lime.—The closing of the copper mines by the strike resulted in a 15-percent decline (32,190 tons) in the quantity of quick and hydrated lime sold or used lowering the total to 186,234 tons. Of the seven plants reporting production, three were at copper concentrators—Morenci, Ray, and San Manuel. Most of the output was used in concentrating copper; the remainder was used in manufacturing electric furnace steel, magnesium, pulp and paper, sugar refining, and water purification. With the installation of a new 220-ton-per-day rotary kiln, Paul Lime Plant, Inc., Paul Spur, doubled production capacity in April. Installation was prompted by the need to provide additional capacity to supply an expanding copper industry. Spreckels Sugar Co. reported new production of lime at its recently completed sugar refinery near Chandler.

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

Perlite.—Output of crude perlite from three Pinal County mines increased 25

percent. Most of the crude was shipped to processing plants outside the State. Arizona Perlite Roofs, Inc., operated the Adams and Iberri mines near Superior in Pinal County and shipped crude perlite to the Supreme Perlite, Inc., expanding plant in Maricopa County and to an expanding plant outside the State. Expanded perlite produced by Supreme Perlite, Inc., was used as concrete aggregate, in plaster, as loose-fill insulation, and as a soil conditioner. Harborlite Corp. shipped crude perlite from its mine in Pinal County to company-owned and other expanding plants outside the State.

Pumice.—Accounting for 31 percent of the Nation's requirements, Arizona led all other States in the production of pumice and pumicite materials. Output of pumice —consisting of volcanic cinders, scoria, and pumice—decreased 39,000 tons. Production came from 11 mines, eight in Coconino County and one each in Apache, Graham, and Yavapai Counties. The main use was in road construction; other uses were as railroad ballast and as a concrete aggregate.

Pyrites.—Pyrite from the Magma mine, Magma Copper Co., was sold to Kennecott Copper Corp. as a supplemental feed for its sulfuric acid and sponge iron plant at Ray. Primary feed for the acid plant was copper sulfide ores from the Ray pit. The sulfuric acid was used in leaching waste dumps and with sponge iron in the LPF process. Output of byproduct pyrite declined 50 percent in quantity and 49 percent in value.

Sand and Gravel.—Ranking second in value of mineral output in the State, sand and gravel production declined 11 percent (2.2 million tons) in quantity and 17 percent ($3.4 million) in value. Output was reported from 86 commercial and 105 Government-crew and -contractor operations. Of the 8.2 million tons shipped by commercial carrier, 99 percent were by truck and 1 percent by rail. Ninety percent of the total output was processed at 63 stationary and 52 portable plants.

Commercial production consisted of 4.5 million tons of gravel and 3.8 million tons of sand. Approximately 306,000 tons of the commercial sand and gravel produced was pit-run material. The average price for pit-run material was $0.69 per ton; that for processed material was $1.14. Overall average for the 8.2 million tons produced was $1.13 per ton.

Table 11.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Apache	344	$444
Cochise	1,028	925
Coconino	1,977	1,923
Gila	372	631
Graham	295	259
Greenlee	189	179
Maricopa	5,098	5,325
Mohave	483	484
Navajo	598	660
Pima	1,988	2,034
Pinal	1,240	1,271
Santa Cruz	521	456
Yavapai	2,000	1,801
Yuma	447	625
Total	16,580	17,017

Government-crew and -contractor output consisted of 6.6 million tons of gravel and 1.7 million tons of sand. Approximately 1.3 million tons was pit-run material. The average value for pit-run material was $0.50; that for processed material was $1.01.

Road construction absorbed 63 percent (10.4 million tons) of the total output of 16.5 million tons of construction sand and gravel; that for building, 4.4 million tons, 27 percent of the total. A small quantity was used for railroad ballast, fill, and unspecified uses.

Industrial sand production, 25 percent below that reported for 1966, was mostly unground sand used in oil-formation fracturing; a small quantity was sold for engine and blast sand.

Stone.—Production of stone in the State declined to 1.9 million tons valued at $3.5 million—16 percent, 361,000 tons, in quantity and 15 percent, $600,000, in value. Crushed limestone, used principally in making cement and lime, and as a flux in copper smelting, accounted for 76 percent of the total stone produced. Production of miscellaneous stone by Federal agency crews and contractors for riprap and concrete and road material declined 77 percent. Crushed sandstone for use as flux in the milling of copper ores declined 43 percent. Output of crushed basalt and marble increased. A small amount of crushed granite was produced for use in constructing roads.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	2,849	$3,382	2,663	$2,997
Paving	439	573	560	665
Railroad ballast	------	--------	[1] 102	[1] 287
Fill	234	200	455	175
Other	[2] 24	[2] 208	(1)	(1)
Industrial:				
Blast	(2)	(2)	(1)	(1)
Engine	1	8	1	9
Oil (hydrafrac)	(2)	(2)	(1)	(1)
Total	3,547	4,371	3,781	4,135
Gravel:				
Construction:				
Building	2,213	2,945	1,775	2,569
Paving	1,468	1,784	1,892	2,075
Railroad ballast	------	--------	[3] 17	[3] 34
Fill	722	554	737	421
Other	------	--------	(3)	(3)
Miscellaneous	74	83	30	49
Total	4,477	5,366	4,451	5,148
Total sand and gravel	8,024	9,737	8,232	9,281
Government-and-contractor operations:				
Sand:				
Paving	1,380	1,373	1,371	1,320
Fill	211	182	355	283
Total	1,591	1,555	1,726	1,603
Gravel:				
Building	75	62	--------	--------
Paving	8,845	8,912	6,539	6,071
Fill	195	182	83	62
Total	9,115	9,156	6,622	6,133
Total sand and gravel	10,706	10,711	8,348	7,736
All operations:				
Sand	5,138	5,926	5,507	5,736
Gravel	13,592	14,522	11,073	11,281
Total	18,730	20,448	16,580	17,017

[1] Railroad ballast, "Other (construction)," blast, and oil (hydrafrac) sand combined to avoid disclosing individual company confidential data.
[2] "Other (construction)," blast, and oil (hydrafrac) sand combined to avoid disclosing individual company confidential data.
[3] Railroad ballast and "Other" gravel combined to avoid disclosing individual company confidential data.

Table 13.—Stone production in 1967, by counties

County	Short tons	Value
Apache	3,089	$6,888
Cochise	W	W
Coconino	129,789	370,175
Gila	136,002	301,588
Graham	1,253	5,018
Greenlee	W	W
Maricopa	14,920	36,673
Mohave	42,836	154,188
Navajo	2,414	13,950
Pima	W	W
Pinal	61,045	169,020
Santa Cruz	7,234	14,310
Yavapai	529,114	621,170
Yuma	6,673	116,610
Undistributed	975,821	1,681,550
Total	1,910,190	3,491,140

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

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

Year	Basalt and related rocks (traprock)		Granite		Limestone		Marble	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1963	80,816	$208,716	20,705	$32,738	1,771,114	$2,307,107	22,713	$287,042
1964	40,814	36,370	W	W	1,800,623	2,483,623	[1] 22,476	[1] 275,787
1965	W	W	236,735	362,186	1,601,867	2,146,626	W	W
1966	10,347	31,226	-------	----------	1,590,470	2,261,527	21,164	278,708
1967	146,075	367,937	34,877	117,313	1,449,230	1,934,303	23,124	289,902

Year	Sandstone		Other stone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1963	714,897	$1,574,782	646,370	$658,765	3,256,615	$5,069,150
1964	788,171	1,675,194	[2] 1,107,096	[2] 1,811,973	3,759,180	6,282,947
1965	460,152	1,233,788	175,287	428,575	2,474,041	4,171,175
1966	318,444	883,907	330,111	635,813	2,270,536	4,091,181
1967	211,253	704,523	45,631	77,162	1,910,190	3,491,140

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

Table 15.—Stone sold or used by producers, by uses

Use	1966		1967	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction, short tons	1,357	$12,985	132	$1,160
Rubble, do	283	3,260	200	4,000
Rough architectural, cubic feet	16,159	14,524	21,466	26,268
Dressed architectural, do	7,999	20,570	12,878	32,805
Flagging, do	55,892	54,590	29,225	42,924
Total (approximate, in short tons)	7,700	105,929	5,200	107,157
Crushed and broken stone:				
Riprap, short tons	130,026	195,048	15,725	27,767
Metallurgical, do	502,006	1,086,688	305,289	682,937
Concrete and roadstone, do	235,673	548,251	248,603	610,618
Lime, do	450,016	896,545	347,504	702,095
Other, do	[1] 945,086	[1] 1,258,720	[2] 987,917	[2] 1,360,566
Total, do	2,262,807	3,985,252	1,905,038	3,383,983
Total stone (approximate, in short tons)	2,270,500	4,091,181	1,910,200	3,491,140

[1] Includes stone used in abrasives, agriculture, animal feed, cement, landscaping, mineral food, paper, polyester filler, precasting, roofing granules, signs, stucco, terrazzo, walls, and for unspecified use.
[2] Includes stone used in abrasives, animal feed, cement, ceramics, cleansers, decorative uses, enamel, neutralizer, plastering, roofing granules, terrazzo, veneer, and for unspecified use.

MINERAL FUELS

Helium.[12]—Grade-A helium was produced throughout the year at the Kerr-McGee Corp. Navajo helium plant. At the plant, helium was extracted from naturally occurring, nonhydrocarbon gas produced from the Pinta Dome and Navajo Springs fields in Apache County.

The Bureau of Mines estimated[13] that the Navajo plant produced for sale about 73.8 million cubic feet of grade-A helium in 1967 valued at $2.07 million, a 16-percent increase over the estimated 1966 production of 63.5 million cubic feet.

The Navajo plant was equipped to liquefy large quantities of the produced helium. However, no data were available on the relative volumes of gaseous and liquid helium produced and sold at the plant.

Early in the year, Kerr-McGee Corp. notified the State Land Department that because it was unable to find helium purchasers interested in the price of $35 per 1,000 cubic feet of helium, the gas was offered at $28. The change reduced the wellhead value of the helium-bearing gas from $1.76 to $1.06 per 1,000 cubic feet; this change, in turn, reduced the royalties received by the State.

Financial difficulties continued to delay construction of the proposed $1 million helium plant of Arizona Helium Corp.; originally scheduled for completion in January, the plant was planned for a site near the town of Navajo, south of the Pinta Dome helium field.

Natural Gas.—The State Oil and Gas Conservation Commission reported[14] a 16-percent decline in natural gas production, resulting from depletion of the reservoirs in the producing fields. At yearend, seven wells were producing natural gas.

As part of its plan to supply additional gas to the southern California market, El Paso Natural Gas Co. built 130 miles of 30-inch gas pipeline in Navajo, Coconino, Yavapai, and Mohave Counties. El Paso also replaced a 20-year-old gas pipeline which served the Morenci mine of Phelps Dodge Corp. The new 10-inch line was to supply gas to three existing mining and smelting customers: Phelps Dodge was to receive 10.31 million cubic feet per day; Compañia Minera de Cananea, S.A., 4.44 million; and Kennecott Copper Corp., 3.36 million. The remaining 1.02 million cubic feet of daily capacity was to serve four utility customers.

Petroleum.—In petroleum production, Arizona had a record year—drilling reached an alltime high, and the first major field was discovered. Output of crude oil was 22 times that of the previous year—all because of the new field.

The discovery of the new field, Dineh bi Keyah (in Navajo "The People's Field"), resulted from the workover of an old well: The Kerr-McGee Corp. No. 1 Navajo, sec. 32, T 36 N, R, 30, E, Apache County, drilled in 1965 to total depth of 3,864 feet in granite and abandoned. In January 1967 the well was reentered and casing was perforated with four shots per foot in the 2,860- to 2,885-foot interval; after acidizing and fracturing, the well was completed for a daily gage of 634 barrels of 43.3° API oil. An additional zone, 2,885 to 2,942 feet, was opened in July; production was gaged at 1,851 barrels of oil per day. The productive zone was unique in that it was an intrusive Tertiary syenite sill in sediments of Pennsylvanian age.

The field rapidly developed on a 160-acre pattern; at yearend, 13 wells were yielding 298,850 barrels of oil per month. During the summer, Kerr-McGee built a 33-mile, 8-inch crude-oil pipeline from the field to the Four Corners Pipeline Co. pipeline 12 miles southeast of Shiprock, N. Mex.; the line had an initial daily capacity of 20,000 barrels but, with the addition of pump stations, could be increased to 40,000 barrels. Helium-bearing gas showing helium-content of 5.18 to 6.23 percent was found in several of the wells in the Devonian formations.

Of the older fields, Dry Mesa field was the leading source, with output of 45,854 barrels; East Boundary Butte was next with 39,355 barrels.

Drilling activity was at an alltime high; the 47 wells exceeded the previous record year, 1962, by one well. Exploratory drilling increased 10 wells over the level of 1966; the one discovery well—at Dineh bi

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[12] Prepared by Office of Assistant Director—Helium, Washington, D.C.

[13] The Bureau of Mines estimate is based on Arizona Oil and Gas Commission reports, and does not involve information or data furnished by the company.

[14] State of Arizona. Monthly Oil, Gas, and Helium Production, December 1967 and December 1966.

Keyah—caused the huge increase in development drilling and was the incentive for much of the exploratory effort.

The interest aroused by the Dineh bi Keyah field was reflected in bidding at Navajo Tribal Council sales of oil and gas leases. Two sales brought total bonuses of $1.59 million for leases on 175,670 acres, an average of $9.03 per acre. A sale on March 16, covering 45,242 acres, brought bonuses of $400,167; high bid was $52.77 per acre. On May 26, the tribe offered leases on 215,822 acres situated on the flanks of, and away from, the expected production trend of the Dineh bi Keyah field. However, $1.19 million was paid for leases covering 130,428 acres of the offering; high bid was $100 per acre and the average was $9.09.

Table 16.—Oil and gas well drilling in 1967, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Apache	1	---	22	23	75,125
Coconino	--	---	1	1	6,500
Navajo	--	---	1	1	1,400
Total	1	---	24	25	83,025
Development completions:					
Apache	11	3	8	22	75,762
Total all drilling	12	3	32	47	158,787

Source: Petroleum Information Corp., 1967 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

Table 17.—Principal producers and processing plants in 1967

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Asbestos:					
Asbestos Manufacturing Co.	Box 812 Globe, Ariz. 85501	Underground mine	Gila		Crushing, screening, and air-separation plant.
Jacquays Mining Corp.	1219 S. 19th Ave. Phoenix, Ariz. 85009	do.	do.		Crushing, screening, and air-separation plant at Globe.
Cement:					
American Cement Corp., Phoenix Division.	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Plant	Yavapai	Clay, stone	Dry process; three-rotary-kiln cement plant at Clarkdale.
Arizona Portland Cement Co., a division of California Portland Cement Co.	Mobil Bldg. 612 S. Flower St. Los Angeles, Calif. 90017	do.	Pima	Stone	Dry process; three-rotary-kiln cement plant at Rillito.
Clays:					
Filtrol Corp.	3250 E. Washington Blvd. Los Angeles, Calif. 90023	Open pit mine	Apache		
Grabe Brick Co., Inc.	Box 5631 Tucson, Ariz. 85703	do.	Pima		
Phoenix Brick Yard	1814 S. 7th Ave. Phoenix, Ariz. 85007	Two open pit mines	Maricopa, Pima		
Tucson Pressed Brick Corp.	Box 2592 Tucson, Ariz. 85702	Open pit mine	Pima		
Copper:					
American Smelting and Refining Company.	120 Broadway New York, N.Y. 10005	Three open pit mines, leach dumps, two mills, precipitation plant.	do.	Silver, zinc, molybdenum.	Two open-pit mines, leach dumps, flotation mill and precipitation plant at Silver Bell; open pit mine and flotation mill near Sahuarita.
Do.	do.	Hayden custom smelter	Gila	Gold, silver	
Arizona Ranch & Metals Co.	218 W. Main Scottsdale, Ariz. 85251	Open pit mine, precipitation plant.	Yuma		Vat leaching-iron precipitation.
Bagdad Copper Corp.	Box 245 Bagdad, Ariz. 86321	Open pit mine, leach dumps, mill, precipitation plant, refinery.	Yavapai	Gold, silver, molybdenum.	Flotation mill, powdered copper refinery.
Duval Corp.	Box 1271 Kingman, Ariz. 86401	Open pit mine, leach dumps, mill, precipitation plant.	Mohave	Gold, silver, molybdenum.	Open pit mine, leach dumps, flotation mill, and precipitation plant near Kingman.
Do.	Box 38 Sahuarita, Ariz. 85629	Two open pit mines, leach dumps, mill, precipitation plant.	Pima	do.	Two open pit mines, leach dumps, flotation mill, and precipitation plant near Sahuarita.
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	Three open pit mines, leach dumps and in-place leaching, two mills, precipitation plant, electrolytic refinery.	Gila	do.	Open pit mine and flotation mill at Christmas; two open pit mines, leach dumps and in-place leaching, "Dual-process" mill, precipitation plant, and electrolytic refinery at Inspiration.
Do.	do.	Custom smelter	do.	Gold, silver	

Table 17.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Copper—Continued					
Kennecott Copper Corp., Ray Mines Division.	Hayden, Ariz. 85235	Open pit mine, leach dumps and in-place leaching, precipitation plant, mill, smelter.	Pinal	Gold, silver, pyrites.	Leach-precipitation-flotation mill and copper smelter at Hayden, Gila County.
Magma Copper Co.; San Manuel Division.	Box M San Manuel, Ariz. 85631	Underground mine, mill, smelter.	Pinal	Gold, silver, molybdenum.	Flotation mill, copper smelter.
Do Superior Division:	Box 37 Superior, Ariz. 85273	Underground mine, mill	do	Gold, silver, pyrites.	Do.
Do	do	Custom smelter	do	Gold, silver	
McAlester Fuel Co	Box 907 McAlester, Okla. 74501	Open pit mine, precipitation plant.	Yavapai		Heap leaching.
Miami Copper Co., a division of Tennessee Corp.	Box 100 Miami, Ariz. 85539	Open pit mine, mill, leach dumps and in-place leaching, three precipitation plants.	Gila	Gold, silver, molybdenum.	Castle Dome leach dumps and precipitation plant; Copper Cities open-pit mine, flotation mill, and precipitation plant; Miami in-place leaching and precipitation plant.
Phelps Dodge Corp	Douglas, Ariz. 85607	Underground mine, three open pit mines, three mills, two smelters	Cochise, Greenlee, Pima.	Gold, silver, molybdenum.	New Cornelia open-pit mine, flotation mill, and copper smelter at Ajo; Copper Queen underground mine, Lavender open-pit mine, flotation mill, leach dumps, and precipitation plant at Bisbee; Morenci open-pit mine, leach-precipitation-flotation mill, leach dumps, precipitation plant and copper smelter at Morenci.
Do	do	Douglas custom smelter	Cochise	Gold, silver	
Pima Mining Co	Box 7187 Tucson, Ariz. 85713	Open pit mine and mill	Pima	Silver, zinc, molybdenum.	Flotation mill.
Ranchers Exploration and Development Corp.	4204 Coal Ave., S.E. Albuquerque, N. Mex. 87108	Open pit mine, precipitation plant.	Gila		Heap leaching.
Diatomite:					
Arizona Gypsum Corp	Box 6675 Phoenix, Ariz. 85005	Open pit mine and plant	Pinal		Stationary crushing, drying, grinding, and air-classifying plant at Mammoth.
Feldspar:					
International Minerals & Chemicals Corp., Industrial Minerals Division.	Administration Center Old Orchard Road Skokie, Ill. 60079	Open pit mine and mill	Mohave	Stone (quartz)	Stationary crushing and screening plant; dry-grinding mill at Kingman.
Fluorspar:					
C. L. Whitelock	Box 698 Benson, Ariz. 85602	Underground mine	Cochise		

Gold:					
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	*See* Copper	Gila	Silver, copper, molybdenum.	
Kennecott Copper Corp., Ray Mines Division.	Hayden, Ariz. 85235	do	Pinal	Silver, copper, molybdenum, pyrites.	
Magma Copper Co., San Manuel Division:	Box M San Manuel, Ariz. 85631	do	do	Silver, copper, molybdenum.	
Do Superior Division:	Box 37 Superior, Ariz. 85273	do	do	Silver, copper, pyrites.	
Phelps Dodge Corp.	Douglas Ariz., 85607	do	Cochise, Greenlee, Pima.	Silver, copper, molybdenum.	
Shattuck Denn Mining Corp.	P. O. Drawer C Humboldt, Ariz. 86329	*See* Zinc	Yavapai	Silver, copper, lead, zinc.	
Gypsum:					
Arizona Gypsum Corp., Verde Division.	Box 6675 Phoenix, Ariz. 85005	Open pit mine and plant	do		Portable crushing, dry-screening, fine-grinding plant at Camp Verde.
Winkelman Division	do	do	Pinal		Portable primary crushing plant; stationary crushing, dry-screening, fine-grinding plant at Winkelman.
National Gypsum Co	325 Delaware Ave. Buffalo, N. Y. 14202	do	do		Open pit mine and crushing, grinding, and screening plant near Winkelman; calcining equipment, wallboard plant at Phoenix.
Helium:					
Kerr-McGee Corp., Gas Processing Department.	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Six wells and plant	Apache (Pinta Dome field)		Extraction plant at Navajo.
Eastern Petroleum Co	Box 291 Carmi, Ill. 62821	Five wells	Apache (Pinta Dome, Navajo Springs fields)		
Iron Ore:					
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Open pit mine	Navajo		
Lead:					
Shattuck Denn Mining Corp.	P. O. Drawer C Humboldt, Ariz. 86329	*See* Zinc	Yavapai	Gold, silver, copper, zinc.	
Lime:					
The Flintkote Co., U.S. Lime Products Division.	2244 Beverly Blvd. Los Angeles, Calif. 90057	Plant	do	Stone	Rotary-kiln and continuous hydrator lime plant at Nelson.
Paul Lime Plant, Inc.	Drawer T Douglas, Ariz. 85607	do	Cochise	do	Five-rotary-kiln plant at Douglas.
Phelps Dodge Corp.	do	do	Greenlee	do	Rotary-kiln, fluidized bed kiln, continuous, hydrator lime plant at Morenci.
Mercury:					
United Nuclear Corp	Box 1537 Santa Fe, N. Mex. 87501	Underground mine, crusher, furnace.	Maricopa		Gould furnace.
Mica:					
Buckeye Mica Co	Box 416 Buckeye, Ariz. 85326	Open pit mine and plants	do		Stationary crushing and screening plant; dry grinding mill.

Table 17.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Molybdenum:					
American Smelting and Refining Company.	120 Broadway New York, N. Y. 10005	*See* Copper	Pima	Silver, copper, zinc.	Molybdenum recovery circuits at Mission and Silver Bell mills.
Bagdad Copper Corp	Box 245 Bagdad, Ariz. 86321	do	Yavapai	Gold, silver, copper.	Molybdenum recovery circuit at Bagdad mill.
Duval Corp	Box 1271 Kingman, Ariz. 86401	do	Mohave	do	Molybdenum recovery circuit at Mineral Park mill; molybdic oxide plant.
Do	Box 38 Sahuarita, Ariz. 85629	do	Pima	do	Molybdenum recovery circuit at Esperanza mill; molybdic oxide plant.
Magma Copper Co., San Manuel Division.	Box M San Manuel, Ariz. 85631	do	Pinal	do	Molybdenum recovery circuit at San Manuel mill.
Pima Mining Co	Box 7187 Tucson, Ariz. 85713	do	Pima	Silver, copper	Molybdenum recovery circuit at Pima mill.
Natural gas and petroleum:					
Consolidated Oil & Gas, Inc	4150 E. Mexico Ave. Denver, Colo. 80222	Crude oil and natural gas wells.			East Boundary Butte, North Toh Atin fields.
El Paso Natural Gas Co	Box 1492 El Paso, Tex. 79948	Crude oil and natural gas well.			Bita Peak field.
Humble Oil & Refinery Co	2000 Classen Center North Bldg. Oklahoma City, Okla.	Crude oil and natural gas well.			East Boundary Butte, Dineh bi Keyah fields.
Kerr-McGee Corp	Kerr-McGee Bldg. Oklahoma City, Okla. 73106	do			Dineh bi Keyah field.
Monsanto Co., Hydrocarbons Polymers Division.	800 N. Lindbergh Blvd. St. Louis, Mo. 63116	Crude oil wells			Dry Mesa field.
Pan American Petroleum Corp	Box 591 Tulsa, Okla. 74101	Crude oil and natural gas well.			Undesignated.
Texaco Inc	1570 Grant St. Denver, Colo. 80203	Crude oil well			Walker Creek field.
Perlite:					
Arizona Perlite Roofs, Inc	1012 S. 20th Place Phoenix, Ariz. 85034	Open pit mine	Pinal		
Harborlite Corp	Box 458 Escondido, Calif. 92026	do	do		
Pumice:					
Apache County Highway Dept	St. Johns, Ariz. 85936	do	Apache		
Atchison, Topeka & Santa Fe Railway Co.	Winslow, Ariz. 86047	Open pit mine and plant	Coconino		Crushing, grinding, and screening plant.
U.S. Bureau of Public Roads	Box 36096 San Francisco, Calif. 94102	Open pit mine	do		
Pyrites:					
Kennecott Copper Corp., Ray Mines Division.	Hayden, Ariz. 85235	*See* Copper	Pinal	Gold, silver, copper.	Pyrite concentrate recovery circuit at Hayden mill.
Magma Copper Co., Superior Division.	Box 37 Superior, Ariz. 85273	do	do	do	Pyrite concentrate recovery circuit at Superior mill.

Sand and gravel (commercial):					
Arizona Sand and Rock Co	Box 959 Phoenix, Ariz. 85001	Two pits and two plants	Maricopa		Portable crushing and screening plant; stationary crushing and screening plant at Phoenix.
Sanner Contracting Co	415 E. Mineral Road Phoenix, Ariz. 85040	do	Gila, Maricopa		Portable crushing and screening plant; stationary crushing and screening plant at Peoria.
Tucson Sand & Soil, Inc	2430 W. Curtis St. Tucson, Ariz. 85705	Pit and plant	Pima		Stationary crushing and screening plant at Tucson.
Union Rock & Materials Corp., Bentson Contracting Co. Division.	2800 S. Central Ave. Phoenix, Ariz. 85040	Three pits and plants	Maricopa		Three stationary crushing and screening plants at Phoenix.
San Xavier Rock & Materials Co. Division.	do	Two pits and plants	Pima		Two stationary crushing and screening plants at Tucson.
United Metro Materials & Concrete Co., Inc.	Box 13309 Phoenix, Ariz. 85002	Eight pits and plants	Maricopa, Pinal, Yuma.		One stationary crushing and screening plant each at Buckeye, Casa Grande, Glendale, Mesa, Phoenix, and Tempe, Maricopa County; one at Coolidge, Pinal County; and one at Yuma, Yuma County.
Silver:					
American Smelting and Refining Company.	120 Broadway New York, N. Y 10005	*See* Copper	Pima	Copper, lead, molybdenum.	
Bagdad Copper Corp	Box 245 Bagdad, Ariz. 86321	do	Yavapai	Gold, copper, molybdenum.	
B. O. W. Mining Co	1272 E. Cambirdge Phoenix, Ariz. 85006	Open-pit mine	Pinal		
Continental Materials Corp	Box 11216, Emery Park Station Tucson, Ariz. 85706	*See Zinc*	Pima	Copper, lead, zinc.	
Duval Corp	Box 1271 Kingman, Ariz. 86401	*See* Copper	Mohave	Gold, copper, molybdenum.	
Do	Box 38 Sahuarita, Ariz. 85629	do	Pima	do	
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	do	Gila	do	
Kennecott Copper Corp., Ray Mines Division.	Hayden, Ariz. 85235	do	Pinal	Gold, copper, pyrites, molybdenum.	
Magma Copper Co., San Manuel Division.	Box M San Manuel, Ariz. 85631	do	do	Gold, copper, molybdenum.	
Do Superior Division	Box 37 Superior, Ariz. 85273	do	do	Gold, copper, pyrites.	
Miami Copper Co., a division of Tennessee Corp.	Box 100 Miami, Ariz. 85539	do	Gila	Gold, copper, molybdenum.	
Phelps Dodge Corp	Douglas, Ariz. 85607	do	Cochise, Greenlee, Pima.	Gold copper, molybdenum.	
Pima Mining Co	Box 7187 Tucson, Ariz. 85713	do	Pima	Copper, molybdenum.	
Shattuck Denn Mining Corp	P. O. Drawer C Humboldt, Ariz. 86329	*See* Zinc	Yavapai	Gold, copper, lead, zinc.	

Table 17.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Stone:					
American Cement Corp., Phoenix Divi ion	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Quarry and plant	----do	Cement	Stationary crushing and screening plant.
Arizona Portland Cement Co., a division of Calif. Portland Cement Co.	612 S. Flower St. Los Angeles, Calif. 90017	----do	Pima	----do	Do.
Paul Lime Plant, Inc	Drawer T Douglas, Ariz. 85607	----do	Cochise	Lime	Do.
Uranium:					
Cotter Corp	Box 751 Canon City, Colo. 81212	Underground mine	Coconino		
Foote Mineral Co., (formerly Vanadium Corporation of America).	200 Park Ave. New York, N. Y. 10017	Open pit mine and underground mine; heap-leaching operation.	Apache	Vanadium	
Vanadium:					
Foote Mineral Co.,	200 Park Ave. New York, N. Y. 10017	*See* Uranium	----do	Uranium	
Zinc:					
Continental Materials Corp	Box 11216, Emery Park Station Tucson, Ariz. 85706	Underground mine, mill	Pima	Silver, copper, lead.	Flotation mill.
Shattuck Denn Mining Corp	P. O. Drawer C Humboldt, Ariz. 86329	----do	Yavapai	Gold silver, copper, lead.	Company and custom ore treated at flotation mill.
Standard Copper Corp	120 Wall St. New York, N. Y. 10005	----do	Mohave	----do	Flotation mill.

The Mineral Industry of Arkansas

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

By Raymond B. Stroud [1]

Total value of Arkansas mineral production in 1967 was $179.5 million, nearly $11 million under that of 1966. The decrease ended a 5-year period of consistent annual gain in value of the State's mineral output. Of the 18 minerals or mineral substances produced, nine registered value losses, led by petroleum and sand and gravel; substantial gains were noted in value of seven minerals, mainly bromine and natural gas, and value of two commodities was unchanged. The value gain of more than $7 million was offset by overall loss of nearly $18 million. The nonmetallic segment of the mineral industry accounted for the major part of the value decrease, although petroleum sustained the largest deficit of a single mineral commodity. The general decline in construction activity was the principal reason for lower output of minerals and the consequent value drop. Significant gains were scored in value of bromine, cement, and natural gas, as all reached alltime highs in production. Phosphate rock was not produced in 1967. Mercury output was recorded for the second consecutive year.

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

Table 1.—Mineral production in Arkansas [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Barite—short tons	232,856	$2,266	229,344	$2,266
Bauxite—long tons, dried equivalent	1,718,390	19,439	1,570,694	18,269
Bromine—thousand pounds	42,307	10,467	64,450	14,885
Clays—thousand short tons	[2] 775	[2] 776	941	1,740
Coal—do	236	1,640	189	1,427
Gem stones	NA	35	NA	35
Lime—thousand short tons	207	3,004	187	2,723
Natural gas—million cubic feet	105,174	16,407	116,522	17,828
Natural gas liquids:				
Natural gasoline and cycle products—thousand gallons	32,050	1,923	27,533	1,780
LP gases—do	64,664	3,233	53,730	3,009
Petroleum (crude)—thousand 42-gallon barrels	23,824	63,372	21,075	56,902
Sand and gravel—thousand short tons	16,056	21,038	14,239	15,531
Stone (includes slate and shell)—do	19,109	24,588	17,454	23,236
Value of items that cannot be disclosed: Abrasive stone, cement, clay (1966), gypsum, mercury, phosphate rock (1966), soapstone, and tripoli	XX	21,939	XX	19,822
Total	XX	190,127	XX	179,453
Total 1957–59 constant dollars	XX	186,657	XX	174,639

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

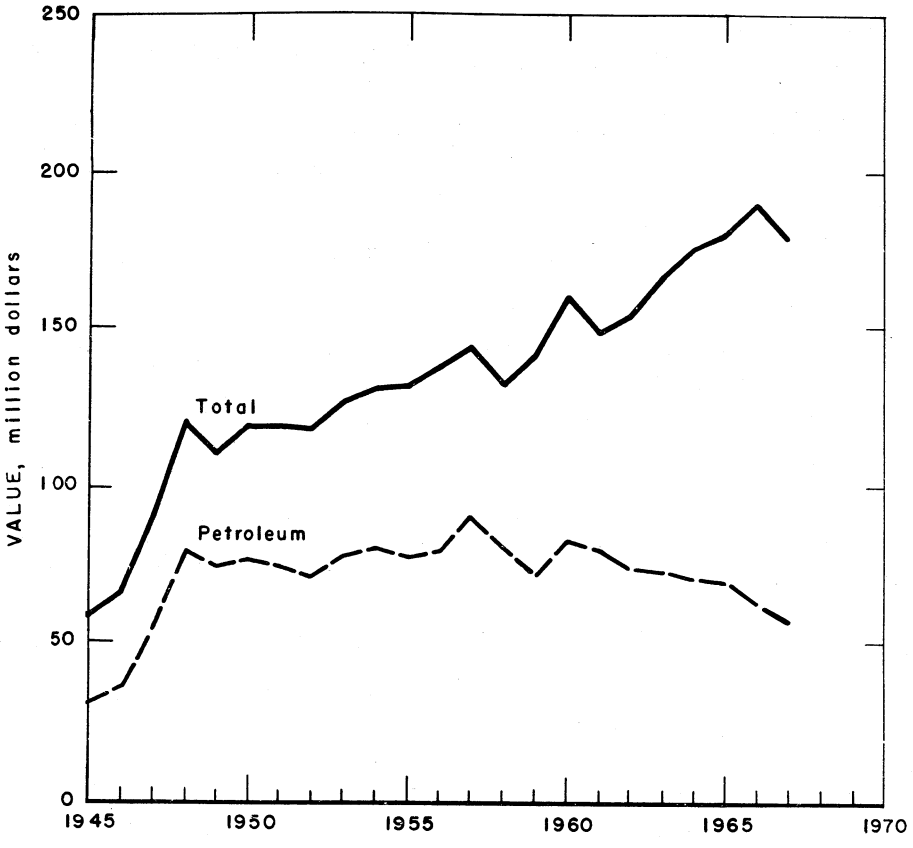

Figure 1.—Value of petroleum and total value of mineral production in Arkansas.

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

County	1966 r	1967	Minerals produced in 1967 in order of value
Arkansas	W	$51,585	Sand and gravel, shell.
Ashley	$227,551	174,935	Lime, sand and gravel.
Baxter	24,935	78,381	Sand and gravel, stone.
Benton	192,207	312,214	Stone, sand and gravel.
Boone	714,557	482,703	Do.
Bradley	741,981	713,316	Petroleum, sand and gravel.
Calhoun	996,748	1,193,912	Sand and gravel, petroleum.
Carroll	W	W	Sand and gravel, stone.
Chicot	120,000	100,000	Sand and gravel.
Clark	1,632,130	388,738	Sand and gravel, stone, clays.
Clay	114,000	124,000	Sand and gravel.
Cleburne	74,016	82,264	Stone.
Cleveland	43,000	46,000	Sand and gravel.
Columbia	30,492,024	26,922,029	Petroleum, natural gas liquids, bromine, natural gas, sand and gravel.
Conway	769,293	908,513	Stone, sand and gravel, natural gas.
Craighead	286,550	328,747	Sand and gravel, clays.
Crawford	2,825,317	3,842,093	Natural gas, stone, sand and gravel.
Crittenden	89,400	98,800	Clays, sand and gravel.
Cross	1,851,000	1,313,000	Sand and gravel.
Dallas	30,000	15,000	Do.
Desha	179,000	354,000	Do.
Drew	112,000	148,000	Do.
Faulkner	854,044	1,051,563	Stone, sand and gravel.
Franklin	5,903,625	5,861,291	Natural gas, coal, stone, sand and gravel.
Fulton	----------	40,000	Sand and gravel.
Garland	395,651	468,639	Abrasive stone, tripoli, sand and gravel, gem stones, stone.
Grant	172,000	151,000	Sand and gravel.
Greene	322,000	354,000	Do.
Hempstead	173,360	248,757	Sand and gravel, clays, petroleum.
Hot Spring	3,823,955	3,781,944	Barite, sand and gravel, clays, stone.
Howard	6,046,143	5,912,521	Cement, gypsum, stone, slate, sand and gravel, clays, tripoli.
Independence	3,114,395	2,409,700	Stone, lime, sand and gravel, shell.
Izard	1,889,994	2,031,202	Stone, sand and gravel.
Jackson	214,725	130,000	Sand and gravel.
Jefferson	781,323	534,817	Lime, sand and gravel.
Johnson	2,252,995	2,396,138	Natural gas, coal, clays, stone, sand and gravel.
Lafayette	17,034,331	15,474,207	Petroleum, natural gas, natural gas liquids, sand and gravel.
Lawrence	740,220	865,301	Stone, sand and gravel.
Lee	32,729	6,000	Sand and gravel.
Lincoln	335,000	132,000	Do.
Little River	13,584,212	W	Cement, stone, sand and gravel, clays.
Logan	1,356,911	1,355,526	Natural gas, stone.
Lonoke	387,099	386,119	Stone, clays.
Madison	505,305	7,230	Sand and gravel, stone.
Marion	83,299	129,465	Do.
Miller	6,484,439	5,777,329	Petroleum, sand and gravel, natural gas, natural gas liquids, clays.
Mississippi	48,000	71,000	Sand and gravel.
Monroe	687,852	95,000	Do.
Montgomery	765,451	W	Slate, sand and gravel, stone.
Nevada	2,298,879	2,187,494	Petroleum, sand and gravel.
Newton	173,075	96,622	Stone, sand and gravel.
Ouachita	8,173,085	8,058,392	Petroleum, sand and gravel, natural gas, clays, stone.
Perry	158,337	150,550	Stone, sand and gravel.
Phillips	W	W	Sand and gravel.
Pike	788,401	1,051,975	Sand and gravel, gypsum, mercury, stone, gem stones.
Poinsett	488,178	203,000	Sand and gravel, shell.
Polk	223,507	203,485	Stone, sand and gravel, clays.
Pope	1,523,553	1,489,642	Stone. natural gas, sand and gravel, clays.
Prairie	53,000	113,000	Sand and gravel.
Pulaski	14,991,948	9,130,854	Stone, sand and gravel, clays, bauxite.
Randolph	113,244	162,768	Sand and gravel, stone.
St. Francis	869,421	W	Sand and gravel.
Saline	20,576,559	21,120,020	Bauxite, lime, stone, sand and gravel, clays, slate, talc.
Scott	365,382	119,407	Sand and gravel, stone, natural gas.
Searcy	1,000	85,614	Stone, sand and gravel.
Sebastian	3,051,480	2,979,246	Natural gas, stone, sand and gravel, coal, clays.
Sevier	W	W	Sand and gravel, stone.
Sharp	----------	171,698	Stone, sand and gravel.
Stone	17,111	64,044	Do.
Union	23,262,462	25,547,994	Petroleum, bromine, natural gas, natural gas liquids, sand and gravel, clays.

See footnotes at end of table.

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

County	1966 r	1967	Minerals produced in 1967 in order of value
Van Buren	W	74,906	Stone.
Washington	985,598	546,497	Stone, sand and gravel, natural gas.
White	882,812	626,553	Stone, sand and gravel.
Woodruff	----------	329,912	Do.
Yell	282,391	354,402	Do.
Undistributed	1,342,810	17,235,946	
Total	190,127,000	179,453,000	

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

Table 3.—Indicators of Arkansas business activity

	1966	1967 p	Change (percent)
Personal income:			
Total—millions	$3,931.0	$4,113.0	+4.6
Per capita	$2,010.0	$2,090.0	+4.0
Construction activity:			
Building permits—millions	$105.1	$110.4	+5.0
Construction contracts—do	$502.0	$485.0	−3.4
U.S. Army Corps of Engineers contracts awarded [1]—do	$48.0	$47.0	−2.1
State Highway Department:			
Value of highway contracts awarded—do	$77.2	$57.8	−25.1
Cement shipments to and within Arkansas—thousand 376-pound barrels	4,903.0	4,436.0	−9.5
Mineral production—millions	$190.1	$179.5	−5.6
Cash receipts from farm marketings—do	$935.4	$852.1	−8.9
Manufacturing payrolls—do	$645.1	$703.9	+9.1
Nonmanufacturing payrolls—do	$896.1	$962.5	+7.4
Annual average labor force and employment:			
Total labor force—thousands	688.7	698.8	+1.5
Unemployment—do	30.3	31.4	+3.6
Employment—do	658.4	667.4	+1.4
Food and kindred products	23,261	23,470	+.9
Lumber and wood products	24,245	23,096	−4.7
Chemicals and allied products	4,894	5,792	+18.3
Petroleum refining and related industries	1,859	1,877	+1.0
Stone, clay, and glass products	4,158	4,034	−3.0
Primary metal industries	3,524	3,916	+11.1
Mining	4,954	4,785	−3.4
Contract construction	21,848	31,369	−1.3

p Preliminary.
[1] Little Rock District Office only.

Sources: Bureau of Business and Economic Research, University of Arkansas; Survey of Current Business, U.S. Department of Commerce; U.S. Army Corps of Engineers, Little Rock, Ark.; State Highway Department, Arkansas; State Employment Security Division, Department of Labor, Arkansas.

U.S. Army Corps of Engineers and Arkansas State Highway Department provided major markets for stone and sand and gravel. Construction contracts were awarded by U.S. Army Corps of Engineers, Little Rock District, in the Arkansas River Development Program, at the sites of Locks and Dams 1 through 13, which includes Dardanelle and Ozark Locks and Dams. At year-end, the lock and dam construction projects were 75 to 100 percent complete. Significant progress was made in construction of the De Gray, Gillham, and De Queen Dams. The agency provides markets for more than 1.7 million tons of stone valued at $2.5 million. Arkansas State Highway building programs required 4.8 million tons of stone and 6.2 million tons of sand and gravel valued at $6.6 million and $4.4 million, respectively. The need for construction materials declined as compared with former years, as many major highway construction projects were nearing completion.

Utility, transportation, and communication firms continued expansion of systems and services in 1967, with expenditures totaling $126 million.

Union Carbide Corp. completed construction of its vanadium oxide extraction plant in Garland County. Rated capacity of the facility was 1,600 tons of crude ore daily. At yearend, final adjustments were being made in processing phases preparatory to plant operation. Open-pit development continued and some ore was stockpiled.

The Dow Chemical Co. completed construction of a new bromine extraction plant near Magnolia, Columbia County; production began in April 1967. Plant capacity added to that of the three other plants brought total State capacity to well over 100 million pounds annually. During the year, both Great Lakes Chemical Corp. and Arkansas Chemicals Inc. doubled capacity at their respective bromine extraction plants. The bromine is recovered from oil well brines.

Arkla Chemical Corp. began production of anhydrous ammonia at its Big River plant, a chemical fertilizer complex at Helena. Other plant production facilities, when fully operable, will include phosphoric, sulfuric, and nitric acid, diammonium phosphate, urea, and nitrogen units.

The Arkansas Geological Commission contracted with Aero Service Corp. to make an aerial magnetometer survey of about 4,000 square miles in West-Central Arkansas. Initial maps of the survey were made in November 1967.

Drilling activity by the oil and gas industry decreased about 10 percent in number of wells drilled, but accounted for discovery of several new oil and gas pools. Humble Oil and Refining Co. set a new depth record in Arkansas by drilling an exploratory well in Ashley County; the well, drilled to a total depth of 16,611 feet, was abandoned as a dry hole.

Arkansas Power and Light Co. announced plans to construct a nuclear-fueled, electric-generating plant near Russellville. The plant will have an 800,000-kilowatt capacity. Construction was scheduled to start in late 1968 and was to be completed in 1972. Development of the Southwest Experimental Fast Oxide Reactor (SEFOR) plant in Washington County, nearing completion at yearend, was scheduled for operation in May 1968. The experimental plant, for development of breeder reactor systems, will produce its fuel for self-sustained operation. The major objective of the research is to develop nuclear power plants that will simultaneously produce electric power and fuel.

Employment.—Mineral industry payroll totaled $30.1 million, a 4 percent increase over 1966 figures. Weekly wages, compared with 1966 data, averaged $143.95 in metal mining, a 2.5-percent increase; $105.50 in coal mining, a 1.4-percent increase; $125.96 in production of crude oil and natural gas, a 10.8-percent increase; and $108.33 in nonmetallic mining and quarrying, a 4.2-percent increase. The mining industry average monthly employment was 4,785 workers compared with average monthly employment of 4,954 workers in 1966.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	111	183	20	161	-----	5	30.98	3,327
Metal	2,083	289	603	4,830	-----	84	17.39	479
Nonmetal	953	263	251	2,006	1	70	35.40	3,633
Sand and gravel	895	263	236	2,078	-----	57	27.43	542
Stone	1,580	264	417	3,629	2	97	27.28	4,102
Total [1]	5,622	271	1,526	12,705	3	313	24.87	2,058
1967:[p]								
Coal	105	200	21	160	-----	5	31.25	1,063
Metal	2,050	275	563	4,500	-----	51	11.33	251
Nonmetal	1,030	251	259	2,073	-----	59	28.46	507
Sand and gravel	775	251	195	1,804	-----	34	18.85	253
Stone	1,195	275	329	2,857	-----	77	26.95	2,875
Total [1]	5,155	265	1,366	11,394	-----	226	19.83	967

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

REVIEW OF MINERAL COMMODITIES

MINERAL FUELS

Output of petroleum, natural gas, natural gas liquids, and coal, listed in order of value, contributed 45.1 percent of the entire mineral production value of the State. Of the mineral fuels, only natural gas gained in value (8.7 percent); combined value of all fuels was $80.9 million, nearly $6 million less than that of 1966. The value drop marked the fourth consecutive year of decrease. As a group, however, mineral fuels regained the lead as the most important contributor to the value of the State's mineral output.

Coal (Bituminous).—Seven coal mines were credited with output of 1,000 tons or more. Two of the mines (strip operations) were in Franklin and Sebastian Counties and five (two strip and three underground operations) were in Johnson County. Coal production from Johnson County led with about 105,000 tons; about 73,000 tons was produced in Franklin County; and Sebastian County was last with about 11,000 tons of coal output. Coal seams mined included the Charleston, Spadra, and Hartshone beds; thickness of the seams ranged from 12 to 48 inches. The underground seams mined were 38 to 42 inches thick. Value per ton for Arkansas coal ranged from $7.16 to $8. Reserves of coal amenable to strip or underground mining methods are sufficient to sustain a much larger production. Completion of the navigational facilities on the Arkansas River creating low-cost transportation may result in increased output. Total coal output was 20 percent less than that recorded in 1966 because of competition from lower cost coals produced elsewhere.

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

Year	Quantity	Value
1963	221	$1,505
1964	212	1,503
1965	226	1,643
1966	236	1,640
1967	189	1,427

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

Oil and Gas Exploration and Development.—Total number of holes drilled for oil and gas was 10 percent under 1966 figures. The overall success ratio was slightly more than 50 percent, up from the 44 percent success ratio in 1966. Five percent of the exploratory wells drilled were completed as producers of oil or gas. Oil completions decreased

but gas completions were 40 percent higher than in 1966. Of the 102 wells drilled for natural gas in north Arkansas, 74 were gas productive for a 72 percent success ratio. As a result of the new gas discoveries, reserves of natural gas were 8 percent higher than in 1966.

Crude oil and natural gas liquids reserves declined 3 percent and 10 percent, respectively, as only 135 of 328 field development and exploratory wells were completed as oil producers. Thus oil well drilling, confined essentially to south Arkansas, had only a 43 percent success ratio. Most of the productive oil wells were in Union County. Oil discoveries in south Arkansas were confined to Upper and Lower Cretaceous strata and Jurassic beds. Three new fields were found—Mayton field in Miller County, and Langley and Oginaw fields in Ouachita County. Several new oil sources and field extensions were developed in south Arkansas.

The Patmos oilfield in Hempstead County, discovered in 1966, was not confirmed by the six test wells drilled in 1967, thus the production potential declined sharply. Arkansas continued to have only seven oil productive counties.

Secondary recovery projects to increase oil output, utilizing water, steam, gas or fireflood methods, were active in Columbia, Miller, Nevada, Ouachita, and Union Counties.

Table 6.—Oil and gas drilling in 1967, by counties

County	Development			Exploratory			Total	Geophysical prospecting (reflection seismograph), crew-weeks
	Oil	Gas	Dry	Oil	Gas	Dry		
Arkansas	----	------	------	------	------	2	2	--------
Ashley	----	------	------	------	------	3	3	--------
Benton	----	------	------	------	1	1	2	--------
Bradley	5	------	1	------	------	------	6	--------
Calhoun	----	------	------	------	------	2	2	16.0
Columbia	4	------	3	------	------	6	13	7.5
Conway	----	------	1	------	1	2	4	--------
Crawford	----	11	4	------	------	------	15	--------
Franklin	----	25	1	------	------	------	26	--------
Grant	----	------	------	------	------	1	1	--------
Hempstead	----	------	2	------	------	4	6	--------
Johnson	----	13	5	------	------	------	18	--------
Lafayette	9	1	18	------	------	14	42	2.5
Logan	----	3	5	------	------	------	8	--------
Miller	11	------	13	1	------	9	34	21.0
Nevada	8	------	7	------	------	5	20	--------
Ouachita	28	------	7	2	------	10	47	6.0
Pope	----	1	2	------	------	------	3	--------
Scott	----	2	3	------	------	------	5	--------
Sebastian	----	12	4	------	------	1	17	--------
Union	70	1	44	------	------	28	143	1.5
Yell	----	3	1	------	------	------	4	--------
Total:								
1967	135	72	121	3	2	88	421	54.5
1966	147	52	147	9	6	105	466	84.5

Source: Arkansas Oil and Gas Statistical Bulletin.

Table 7.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves Dec. 31, 1966	Changes in proved reserves, due to revisions, extensions, and new discoveries in 1967	Proved reserves, Dec. 31, 1967 (production was deducted)	Change from 1966 percent
Crude oil—thousand barrels	181,327	15,496	176,429	−3
Natural gas liquids [1]—do	16,174	−79	14,574	−10
Natural gas—million cubic feet	2,599,629	335,250	2,811,251	+8

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

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. Published in the Tulsa Daily World, v. 63, No. 208, Apr. 8, 1968, p. 22.

Franklin, Crawford, Johnson, and Sebastian Counties, in north Arkansas, contained most wells completed as successful producers of dry natural gas. Two new gas discoveries in Benton and Conway Counties, respectively, opened the Tucker Chapel field and the Blick field in Conway County. A number of new productive zones were found in existing gasfields. The north Arkansas gasfields were in Arkoma Basin, which is rapidly increasing in significance as a gas-productive area in Arkansas and Oklahoma.

Pipeline Construction.—Arkansas Louisiana Gas Co. (Arkla) began construction of a 100-mile pipeline from Logan County, Ark., to McDonald County, Mo. The new line was scheduled for completion in mid-1968. The company completed its new 24-inch natural gas pipeline project in central Arkansas. The new line, paralleling an existing 16-inch-diameter pipeline, increased daily natural gas transmission capacity to 375 million cubic feet.

Natural Gas.—For the 11th consecutive year, production value of natural gas reached a new high. The commodity ranked fourth in value among minerals produced in the State. Benton County joined ten other north Arkansas counties having natural gas output or having known occurrences of natural gas. The north Arkansas gasfields accounted for $11.6 million in natural gas output, or 65 percent of the State's total production. Franklin County led the State with natural gas output valued at $5.1 million, Sebastian County ranked second, Crawford County third, and Johnson County fourth. Production in north Arkansas came primarily from the Atoka Formation and Morrow Group of sediments of Pennsylvanian age; some output was from Silurian and Devonian age rocks.

Six south Arkansas counties were gas productive, with Lafayette and Columbia Counties accounting for the major share. Natural gas was produced from Upper and Lower Cretaceous and Jurassic age sediments. The south Arkansas gas was recovered from oil and condensate fields and was processed at six gas treatment plants in four counties—Columbia, Lafayette, Union, and Miller. Total daily capacity of the plants was 432.0 million cubic feet of gas. Arkla Chemical Corp.'s Hamilton plant in Columbia County, having the largest capacity, processed the largest quantity of natural gas.

Table 8.—Gross withdrawals and disposition of natural gas

(Million cubic feet)

Year	Gross withdrawals [1]			Disposition			
				Marketed production [2]			Vented and wasted [3]
	From gas wells	From oil wells	Total	Quantity	Value (thousands)	Repressuring	
1963	57,700	41,500	99,200	76,101	$11,796	19,191	3,908
1964	57,900	42,900	100,800	75,753	11,806	21,411	3,636
1965	57,500	46,500	104,000	82,831	12,922	20,155	1,014
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

[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.

Natural Gas Liquids.—Six plants accounted for the total output of natural gasoline and cycle products, and liquefied petroleum gases. The Arkla Chemical Corp. Columbia County plant led with nearly 69 percent of the total value of natural gas liquids. Sunray DX Oil Co. operated its Kelly Bayou plant in Miller County for the first full year.

Petroleum.—Output and value declined for the seventh consecutive year, but the value was sufficient to mark petroleum as the State's most significant mineral product. Nine south Arkansas counties reported petroleum production. Colum-

bia County, with 32 percent, and Union County, with 23 percent, accounted for the major part of the output. Six refineries, with total processing capacity of 90,650 barrels of crude oil per day, were operated during the year.

Oilfields in south Arkansas were productive through more than 6,000 active wells at yearend. A major part of the output was from secondary recovery projects. The Mobil Oil Corp. steamflood project of the Nacatoch (Upper Cretaceous age) in the Troy and Irma oilfields, Nevada County, and the fireflood project of the Tokio Formation in the Troy field, were regarded as the most significant secondary recovery projects.

The Magnolia field in Columbia County again was credited with most of the production, 4.1 million barrels, and with the largest reserve, 50.0 million barrels, at yearend.

Table 9.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	26,219	$1,466	66,377	$2,497	92,596	$3,963
1964	30,082	1,678	61,616	2,460	91,698	4,138
1965	27,787	1,578	69,752	3,139	97,539	4,717
1966	32,050	1,923	64,664	3,233	96,714	5,156
1967	27,533	1,780	53,730	3,009	81,263	4,789

Table 10.—Crude petroleum production by fields [1]

(Thousand 42-gallon barrels and thousand dollars)

Field	1966		1967	
	Quantity	Value	Quantity	Value
Champagnolle	538	$1,431	(2)	(2)
Dorcheat-Macedonia	368	979	(2)	(2)
El Dorado	388	1,032	346	$934
Fouke	701	1,865	(2)	(2)
Irma	492	1,309	(2)	(2)
Magnolia	5,510	14,657	4,060	10,962
McKamie-Patton	1,121	2,982	(2)	(2)
Midway	2,506	6,666	2,246	6,064
Sandy Bend	461	1,226	(2)	(2)
Schuler	1,320	3,511	1,259	3,399
Smackover	3,213	8,547	3,061	8,265
Stephens	1,275	3,392	1,241	3,351
Wesson	910	2,421	(2)	(2)
Other fields [3]	5,021	13,354	8,862	23,927
Total	23,824	63,372	21,075	56,902

[1] Based on The Oil & Gas Journal data adjusted to Bureau of Mines total.
[2] Included with "Other fields."
[3] Includes oil consumed on leases and net change in stocks held on leases for the State.

Table 11.—Crude petroleum production, indicated demand, and stocks in 1967, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Arkansas
January	1,907	1,781	1,013
February	1,717	1,673	1,057
March	1,870	1,905	1,022
April	1,775	1,645	1,152
May	1,818	1,917	1,053
June	1,723	1,678	1,098
July	1,762	1,847	1,013
August	1,759	1,832	940
September	1,695	1,500	1,135
October	1,749	1,716	1,168
November	1,656	1,790	1,034
December	1,644	1,809	929
Total:			
1967	21,075	21,093	XX
1966	23,824	r 23,422	XX

r Revised. XX Not applicable.

NONMETALS

Production value of 12 nonmetallic mineral commodities was only slightly less than that contributed by the mineral fuels group. The major contributors, listed in order of importance, were stone, cement, sand and gravel, and bromine. Output of clays, barite, and lime contributed from $1.7 to $2.7 million. Seven nonmetallic mineral commodities scored gains in production and value. The most spectacular rise was that in value of bromine, which increased nearly $4.5 million. Similarly, cement production value was the highest on record. The greatest value drop occurred in clay output as a much smaller tonnage of high-grade clays was mined.

Abrasive Stone.—Tonnage and value of Arkansas Novaculite for whetstone manufacture surged to a new high in 1967 as more than 1.25 million pounds of the stone was sold. Three producers, Norton Pike Division of Norton Co., Arkansas Oilstone Co., and Arkansas Abrasives, Inc., mined and prepared the novaculite. Arkansas Oilstone Co. processed its crude novaculite into finished stones within the State. All of Norton Co.'s production went to Eastern States for finishing.

Barite.—Arkansas again ranked second in the United States in barite output. However, the decrease in oil- and gas-well drilling operations, along with competition from other producing States, resulted in a continuation of a lower production rate for the Arkansas barite industry. Dresser-Magcobar utilized underground mining methods, whereas National Lead Co., Baroid Division, extracted barite using both underground and open-pit methods. Both companies processed the ore by flotation, separation, and grinding to finished products. All of the State's barite output was utilized in well-drilling mud manufacture. The Milwhite Co., Inc., ground crude barite from Missouri at its plant at Bryant, Saline County, Ark. The plant product was used in various industrial applications.

Bromine.—In addition to elemental bromine, ethylene dibromide, ethyl bromide, methyl bromide, and tetrabromobisphenol, were produced by Arkansas bromine companies. Existing bromine industry operations were joined by a fourth producer, The Dow Chemical Co., in establishing a record high output of bromine. This development further emphasized the impact of Arkansas bromine on U.S. markets. The State's bromine productive capacity increased sharply, and Arkansas is gaining on Texas as the leading producing State. Three of the plants are in Union County, but the new plant is in Columbia County, thus increasing the resource of oilfield brines that are suitable for bromine extraction.

Table 12.—Primary barite sold or used by producers

Year	Short tons	Value (thousands)
1963	236,077	$2,161
1964	233,455	2,202
1965	249,233	2,379
1966	232,856	2,266
1967	229,344	2,266

Cement.—An overall 7 percent gain in cement shipments, including masonry and portland types, was reported by two cement producers. Demand for Arkansas cement increased substantially and led to the increased output which established a value record. Shipments of cement to consumers in Arkansas, however, decreased to 9.5 percent. Nearly equal parts of the cement output was shipped by rail and truck to building material dealers, concrete product manufacturers, ready-mix concrete companies, and highway construction companies. About 70 percent of the output was used for highway construction and in ready-mix concrete. For the second consecutive year, 94 percent of the cement transported was shipped in bulk form.

Clays.—Total clay production dropped sharply in 1967, largely because of decreased tonnage of fire clay and kaolin mined and processed. Fifteen companies operated mines or plants in 18 counties. The U.S. Forest Service produced clay for road construction. Two companies mined clay for refractory and chemical uses from Pulaski and Saline Counties. Fire clays were produced in Hot Spring and Miller Counties. Arkansas Cement Corp. and Ideal Cement Co. used clay in cement manufacture. Three lightweight aggregate plants utilized clays in Sebastian, Lonoke, and Crittenden Counties. S. & S. Co. closed its lightweight aggregate plant at Fort Smith about midyear. Arkansas Lightweight Aggregate Corp. acquired control of the lightweight aggregate plant that was opened in 1966 at West Memphis. Plants for manufacture of brick, tile, and sewer pipe were operated in six counties. Hot Spring, Lonoke, Johnson, and Sebastian Counties accounted for 57 percent of the State's total clay production.

Gypsum.—Gypsum mined and processed by Dulin Bauxite Co., Inc., at Highland, in Pike County, was used as a retarder in cement. Dierks Forests, Inc., produced gypsum in Howard County for use in wallboard, related products, and cement. Both companies utilized strip-mining methods to recover gypsum, and practiced land reclamation to restore the mined-out land to useful purposes.

Lime.—Aluminum Company of America (Alcoa) and Reynolds Metals Co. were the principal producers of primary lime that was used in converting bauxite to alumina in Saline County. The companies processed limestone that was mined in Izard County. Rangaire Corp., Batesville White Lime Division, quarried, crushed, and calcined limestone for lime in Independence County. The lime output was used in chemical and industrial applications and for construction and soil stabilization. Three paper manufacturing companies produced and used primary lime and regenerated lime in company operations.

Phosphate Rock.—No phosphate rock was produced in the State in 1967. Although resources and grade of phosphate rock in Van Buren County are adequate to supply a phosphate rock industry on a small scale, the Peyton Creek Phosphate Rock Mining Co. terminated its operations. Presumably, competition from other sources caused the shutdown.

Sand and Gravel.—The sustained growth record in sand and gravel output, extending from 1962 to 1966, was broken in 1967 as output decreased about 11 percent compared with that of 1966. The lower production resulted from decreased construction activity of the U.S. Army Corps of Engineers and Arkansas State Highway Department. The commodity was produced in 72 of the 75 counties in the State. The number of sand and gravel operations, including commercial and government-and-contractor suppliers, increased from 279 in 1966 to 313 in 1967. About 72 percent of the total output classified as commercial production had a unit value of $1.29 per ton, about 5 cents under that of 1966. Government-and-contractor sand and gravel output had a unit value of 60 cents per ton, a decrease of 63 cents compared with 1966 figures; competition factors caused the

lower value. Nine Arkansas counties were credited with sand and gravel output of 400,000 tons or more and accounted for 49 percent of the total production. Cross County led with an output of 1.4 million tons and was followed, in order of tonnage produced, by Miller, Crawford, Calhoun, and Hot Spring Counties. The Arkansas State Highway Department provided the largest single market in the State.

Soapstone.—Arkansas' only soapstone producer, The Milwhite Co., Inc., increased output about 29 percent in 1967. The soapstone was mined and ground in Saline County and was used principally in insecticide and roofing compound manufacture. The soapstone was mined by open-pit methods and trucked to the company plant in Bryant for drying and grinding.

Table 13.—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
1963	7,699	$9,096	4,400	$4,493	12,099	$13,589
1964	8,637	10,990	3,157	3,846	11,794	14,836
1965	9,559	12,001	3,247	3,835	12,806	15,836
1966	11,677	15,656	4,379	5,382	16,056	21,038
1967	10,202	13,113	4,037	2,414	14,239	[1] 15,531

[1] Data does not add to total value 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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,443	$1,616	1,145	$1,190
Paving	3,047	3,076	2,681	3,290
Fill	372	334	W	W
Other [1]	340	1,128	640	1,056
Total sand	5,202	6,154	4,466	5,536
Gravel:				
Building	1,696	2,733	1,431	2,217
Paving	4,751	6,751	4,214	5,275
Fill	21	10	21	12
Other [2]	7	8	70	73
Total gravel	6,475	9,502	5,736	7,577
Total sand and gravel	11,677	15,656	10,202	13,113
Government-and-contractor operations:				
Sand:				
Building	10	10	W	W
Paving	1,963	1,817	W	W
Total sand	1,973	1,827	1,397	765
Gravel:				
Building	83	123	----	----
Paving	2,323	3,432	2,640	1,653
Total gravel	2,406	3,555	2,640	1,653
Total sand and gravel	4,379	5,382	4,037	[3] 2,414
Grand total	16,056	21,038	14,239	[3] 15,531

W Withheld to avoid disclosing individual company confidential data.
[1] Includes fill (1967), other construction sand, and industrial sand (ground and unground).
[2] Includes other construction gravel and railroad ballast (1966).
[3] Data does not add to total shown because of independent rounding.

Stone.—Production of stone, including limestone, sandstone, syenite, marble, novaculite, slate, and shell, decreased for the second consecutive year, but value of the output was still sufficient to rank the commodity second in the State in terms of overall importance. The Arkansas State Highway Department and U.S. Army Corps of Engineers provided markets for 37.3 percent of the total tonnage valued at $9.1 million.

Crushed sandstone output, with 7.1 million tons valued at $8.4 million, accounted for the major share of the stone production. It was produced in 34 counties and used principally for road construction, concrete aggregate, railroad ballast, and riprap. Crushed limestone production, including that for cement and lime, totaled 5.2 million tons and was valued at $6.2 million. Limestone was produced in 17 counties and was used, in addition to lime and cement manufacture, for road construction, concrete aggregate, building, and riprap. Output of syenite contributed 5.0 million tons with a value of $7.3. Other stone types provided the remaining tonnage and value. Stone was produced in 43 counties, attesting to the widespread nature and usefulness of the commodity. Slate was produced in Howard, Montgomery, and Saline Counties. Dimension marble was produced in two counties. Mussell shell, used for seeding cultured pearls, was exported to foreign markets. Dimension sandstone was prepared by five companies in Logan County and by one producer in Independence County. All syenite output was credited to Pulaski County.

Table 15.—Stone sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	18,913	$22,727
1964	20,241	26,172
1965	21,241	26,778
1966	19,109	24,588
1967	17,454	23,236

The average unit value of crushed sandstone was $1.19 per ton. Crushed limestone had an average value of $1.19 per ton. Value of commercial stone, including crushed limestone, sandstone, and syenite was $1.27, 2 cents over that of 1966. Value of stone produced for government-and-contractor use was $1.26 per ton compared with $0.91 per ton in 1966.

The five leading counties in stone output were Pulaski, Independence, Crawford, Little River, and Izard.

Sulfur (Recovered Elemental).—Sulfur recovered from treatment of sour natural gas at three plants was about 8 percent under that of 1966; however, value was nearly 19 percent higher, which reflected higher prices paid for sulfur. Olin Mathieson Chemical Corp. led with production from its McKamie plant in Lafayette County. Arkla Chemical Corp. and Monsanto Company produced byproduct sulfur in Columbia and Union Counties, respectively.

Tripoli.—Tripoli was produced in two Arkansas counties, Garland and Howard, in 1967. The mineral commodity was mined by open-pit methods and was prepared for markets at Hot Springs and near Dierks. Most of the plant product was used for abrasive purposes. Some was used as filler and in other industrial applications.

METALS

Bauxite was the principal metal-bearing ore produced in Arkansas. Mercury was produced for the second consecutive year. Vanadium ore was mined and stockpiled by Union Carbide near its plant in Garland.

Aluminum.—Two aluminum plants, Jones Mills and Gum Springs, operated by Reynolds Metals Co., continued near capacity production during 1967 in line with capacity production of primary aluminum in the United States. The company also began operation of its new aluminum cable plant in 1967 at Jones Mills near Malvern. Plant capacity is 12,500 tons of transmission cable annually.

Bauxite and Alumina.—Output and value of bauxite decreased despite the continued high demand for alumina, activated bauxite, and calcined bauxite. Arkansas however again led the States in bauxite production with 95 percent of the total. Aluminum Company of America (Alcoa) accounted for the major share of the bauxite mined in the State and processed the bauxite to alumina at its

plant in Saline County. Alcoa also was one of the Nation's two producers of tabular alumina. Reynolds Metals Co. operated underground and open pit bauxite mines in Saline County and was a close second in production of crude ore. Reynolds announced plans to increase alumina capacity at its Hurricane Creek plant also in Saline County by 2,150 to 2,300 tons per day. American Cyanamid Co. mined bauxite by open-pit methods in Saline and Pulaski Counties, then calcined the bauxite for chemical uses at its plant near Benton in Saline County. Alumina produced in Arkansas was used primarily for aluminum production; however, significant quantities were consumed in abrasives, chemicals, refractories, ceramics, cements, and a host of other industrial applications.

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
1963	1,771	1,478	$16,701	1,725	1,483	$17,543
1964	1,864	1,562	17,431	1,773	1,531	17,859
1965	1,911	1,593	17,974	2,100	1,803	20,786
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

Porocel Corp. and Stauffer Chemical Co. produced activated bauxite from stocks of crude ore at plants in Pulaski County. Plant products were used for a number of filter applications.

Mercury.—Mercury output, recorded for the second successive year, was higher than in 1966. The high price paid for mercury led to renewed interest in the Arkansas deposits.

Pike County was the center of activity, where Great Southwestern Mines, Inc., mined and processed cinnabar. The mercury ore is associated with strongly folded and fractured beds of sandstone.

Vanadium.—Union Carbide Corp. continued development of its vanadium deposit in Garland County. The vanadium ore is found in association with an intrusion of alkalic igneous rocks that penetrate sedimentary rocks comprised essentially of novaculite and shales. The company mined and stockpiled ore for processing at its new plant near the mines. Two ore bodies outlined by drilling were mined by open-pit methods and the ore hauled by truck to the plant. Construction phases of the plant were completed, and at yearend the company was completing adjustments in the mill flow circuits to improve efficiency of operations.

Table 17.—Principal producers of metals, minerals, and fuels

Commodity and company	Type of activity	County	Address
Abrasives:			
Arkansas Abrasives, Inc	Mine and plant	Garland	Hot Springs, Ark.
Arkansas Oilstone Co., Inc	do	do	Do.
Norton-Pike	Mine	do	Littleton, N.H.
Barite:			
Dresser Minerals	Mine and plant	Hot Spring	Houston, Tex.
National Lead Co	do	do	Do.
Bauxite:			
Aluminum Company of America [1]	Mine and plant	Saline	Pittsburgh, Pa.
American Cyanamid Co	do	do	Wayne, N.J.
Do	Mine	Pulaski	Do.
Porocel Corp	Plant	Pulaski	Menlo Park, N.J.
Reynolds Mining Corp.[1]	Mine and plant	Saline	Richmond, Va.
Stauffer Chemical Co.[2]	Plant	Pulaski	New York, N.Y.

See footnotes at end of table.

Table 17.—Principal producers of metals, minerals, and fuels—Continued

Commodity and company	Type of activity	County	Address
Bromine:			
Arkansas Chemicals, Inc	Brine wells and plant	Union	El Dorado, Ark.
Dow Chemical Co	do	Columbia	Midland, Mich.
Great Lakes Chemical Corp	do	Union	West Lafayette, Ind.
Michigan Chemical Corp	do	Union	Chicago, Ill.
Cement:			
Arkansas Cement Corp.[3]	Mine and plant	Little River	Foreman, Ark.
Ideal Cement Co.[3]	do	Howard	Denver, Colo.
Clay:			
Acme Brick Co	Mine and plant	Hot Spring and Sebastian	Fort Worth, Tex.
Ark. Lightweight Aggregate Corp.	do	Crittenden and Lonoke	England, Ark.
W.S. Dickey Clay Mfg. Co	do	Miller and Polk	Kansas City, Mo.
El Dorado Brick Co	do	Union	El Dorado, Ark.
Eureka Brick & Tile Co	do	Johnson	Clarksville, Ark.
Hope Brick Works	do	Clark and Hempstead	Hope, Ark.
A.P. Green Refractories Co	do	Saline and Pulaski	Mexico, Mo.
Malvern Brick & Tile Co	do	Hot Spring	Malvern, Ark.
S. & S. Co	do	Sebastian	Fort Smith, Ark.
Wheeler Brick Co., Inc	do	Craighead	Jonesboro, Ark.
Coal:			
Clarksville Coal Co., Inc	Mine	Johnson	Clarksville, Ark.
Dixie Construction Co	do	do	Fort Smith Ark.
Garland Coal & Mining Co	do	Franklin	Do.
Hilton Coal Co., Inc	do	Johnson	Clarksville, Ark.
Johnson Coal Co., Inc	do	do	Do.
F.S. Neely Coal Co	do	Sebastian	Fort Smith, Ark.
Prairie Coal Co., Inc	do	Johnson	Clarksville, Ark.
Gypsum:			
Dierks Forests, Inc	Mine and plant	Howard	Hot Springs, Ark.
Dulin Bauxite Co., Inc	do	Pike	Do.
Lime:			
Rangaire Corp., Batesville White Lime Division.[4]	Mine and plant	Independence	Batesville, Ark.
Mercury:			
Great Southwestern Mines, Inc.	do	Pike	Lincolnwood, Ill.
Sand and gravel:			
Arkhola Sand & Gravel Co.[5]	Dredge and plant	Crawford	Fort Smith, Ark.
Big Rock Stone & Material Co.[5]	do	Pulaski	Little Rock, Ark.
Braswell Sand & Gravel Co	do	Sevier	Minden, La.
Gifford-Hili & Co., Inc	Mine and plant	Lafayette and Miller	Dallas, Tex.
Humphries & Kail	do	Cross	Earle, Ark.
Malvern Gravel Co.[5]	do	Hot Spring	Malvern, Ark.
Mobley Construction Co., Inc	Dredge and plant	Faulkner	Morrilton, Ark.
Do	do	Howard	Do.
Do	do	Conway	Do.
Do	do	Pope	Do.
Do	do	Yell	Do.
Do	do	Johnson	Do.
Do	do	Jackson	Do.
Do	do	Independence	Do.
Do	do	Monroe	Do.
Pine Bluff Sand & Gravel [5]	Dredge and plant	Ouachita and Jefferson	Pine Bluff, Ark.
St. Francis Material Co	Mine and plant	Ashley and Calhoun	Forrest City, Ark.
Do	do	Craighead	Do.
Do	do	Poinsett	Do.
Do	do	St. Francis	Do.
Stone:			
Acme Material Co	Quarry	White and Woodruff	Little Rock, Ark.
Anderson-Oxandale Co	do	Conway	Morrilton, Ark.
Arkhola Sand & Gravel Co.[6]	do	Crawford	Fort Smith, Ark.
Arkansas Limestone Division, Rangaire Corp.	do	Izard	Batesville, Ark.
Batesville White Lime Division, Rangaire Corp.[1]	do	Independence	Do.
Big Rock Stone & Material Co.[6]	do	Pulaski	Little Rock, Ark.
Bird & Son, Inc	do	Montgomery	Glenwood, Ark.
Black Rock Limestone Products Co.	do	Lawrence	Little Rock, Ark.
Cabot Quarries, Inc	do	Faulkner and Logan	Do.
Do	do	Lonoke	Do.
Do	do	Pope	Do.
Do	do	Pulaski	Do.
Do	do	Woodruff	Do.
Do	do	Sharp	Do.

See footnotes at end of table.

Table 17.—Principal producers of metals, minerals, and fuels—Continued

Commodity and company	Type of activity	County	Address
Stone—Continued			
Love Hollow Limestone Division, Rangaire Corp.	Quarry	Izard	Batesville, Ark.
G.P. Freshour	do	Cleburne and Faulkner	Sweet Home, Ark.
Do	do	Franklin	Do.
Do	do	Izard	Do.
Do	do	Lonoke	Do.
Do	do	Pope	Do.
Do	do	Pulaski	Do.
Do	do	Randolph	Do.
Do	do	Sharp	Do.
Freshour Construction Co. Inc	Quarry	Cleburne and Conway	Sweet Home, Ark.
Do	do	Faulkner	Do.
Do	do	Franklin	Do.
Do	do	Johnson	Do.
Do	do	Lonoke	Do.
Do	do	Polk	Do.
Do	do	Scott	Do.
Do	do	Sebastian	Do.
Do	do	White	Do.
Freshour Corp	do	Conway and Franklin	Do.
Do	do	Independence	Do.
Do	do	Izard	Do.
Do	do	Logan	Do.
Do	do	Scott	Do.
Do	do	Sharp	Do.
Do	do	Stone	Do.
Ben Hogan Co., Inc	Quarry	Clark and Franklin	Little Rock, Ark.
Do	do	Johnson	Do.
Do	do	Logan	Do.
Do	do	Lonoke	Do.
Do	do	Pope	Do.
Do	do	White	Do.
Do	do	Izard	Do.
Do	do	Newton	Do.
Do	do	Yell	Do.
Do	do	Baxter	Do.
Do	do	Lawrence	Do.
Jeffrey Stone Co., Inc	do	Faulkner and Pulaski	North Little Rock, Ark.
McClinton Bros. Co	do	Benton and Carroll	Fayetteville, Ark.
Do	do	Madison	Do.
Do	do	Washington	Do.
McGeorge Contracting Co., Inc.	do	Pulaski	Pine Bluff Ark.,
Midwest Lime Co	do	Independence	Batesville, Ark.
Talc and soapstone:			
The Milwhite Co., Inc	Mine and plant	Saline	Houston, Tex.
Tripoli:			
Caddo Minerals Co., Inc	do	Pike	Dallas, Tex.
Malvern Minerals Co	do	Garland	Hot Springs, Ark.
Natural gas liquids:			
Arkla Chemical Corp	Plant	Columbia	Magnolia, Ark.
Austral Oil Co., Inc	do	Lafayette	Stamps, Ark.
Denton Corp	do	Union	El Dorado, Ark.
Humble Oil & Refining Co	do	Lafayette	Stamps, Ark.
Sunray DX Oil Co	do	Miller and Lafayette	Do.
Petroleum:			
American Oil Co	Refinery	Union	El Dorado, Ark.
Berry Petroleum Co	do	Columbia	Magnolia, Ark.
Cross Oil & Refining Co. of Arkansas.	do	Union	Smackover, Ark.
Lion Oil, Div. Monsanto Co	do	do	El Dorado, Ark.
Macmillan Ring-Free Oil Co., Inc.	do	do	Norphlet, Ark.

[1] Also lime.
[2] Also clay.
[3] Also limestone and clay.
[4] Also limestone.
[5] Also stone.
[6] Also sand and gravel.

The Mineral Industry of California

This chapter has been prepared under a cooperative agreement for the collection of mineral data between the Bureau of Mines, U.S. Department of the Interior, and the California Department of Conservation, Division of Mines and Geology.

By L. E. Davis [1]

California's mineral industry in 1967 was highlighted by oil production that exceeded 1 million barrels daily (in October) for the first time since February 1954. The production value for all mineral fuels, 1 percent less than in 1966, represented 65 percent of the total State mineral output value. Among the fuels, increases were reported for only petroleum and liquid petroleum gases.

Of 26 nonmetallic mineral commodities produced, value of output increased for only six. As a group, value of nonmetallic mineral production declined over $13 million, reflecting a generally depressed construction industry. Value increases over 1966 totals were reported for five of 12 metals, principally tungsten, iron ore, and mercury. Overall production value for metals rose more than $5 million.

Consumption, Trade, and Markets.—In 1967, California held the number one position among the States not only in the number of different mineral commodities produced and marketed (48) but also in the number of different minerals found (602). Many of the minerals reported have been found only in California. Despite this diversity, California was not self-sufficient in minerals, particularly mineral fuels. Refinery receipts (all sources) rose 3 percent, and natural gas receipts (pipeline) from out-of-State, were 11 percent above 1966 figures. Plants within the State processed 13 billion cubic feet less wet gas than in 1966 yet the output of natural gas liquids, including condensate, was only slightly lower. California was third highest in the Nation in petroleum production and consumption of petroleum products was higher than that of any other State. More than 1,335 billion cubic feet of natural gas was received from sources outside the State to meet consumer needs despite a production that was sixth highest in the Nation.

California was the sole domestic source for boron minerals and compounds, yielded all the sulfur ore production, was the leader by far in sand and gravel output, and the principal producer of short fiber asbestos, diatomite, mercury, rare-earth minerals and compounds, salt cake, tin, and tungsten. Plants in California also processed many nonmetallic minerals produced in other States, principally Arizona and Nevada.

Trends and Developments.—California oil production reached an alltime high of 1,019,000 barrels daily in December, topping the previous daily high of 1,006,000 barrels reported in July 1953. Credit for the increase went to well completions in the Wilmington field, most of which were on four offshore islands. Except for the Wilmington field, offshore development slowed while operators awaited Federal and State lease sales scheduled for 1968. As in 1966, principal areas of new onshore development were in Kern and Los Angeles Counties. Increased production in Kern County came primarily from steaming operations where projects were fewer in number owing to consolidations.

Refining capacity in California was increased to 1.5 million barrels daily in 1967. In Contra Costa County, Sequoia Refining Co. placed its new refining com-

[1] Physical scientist, Bureau of Mines, San Francisco, Calif.

Table 1.—Mineral production in California [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Antimony ore and concentrates short tons, antimony content	1	(2)		
Asbestos short tons	81,671	$6,945	77,091	$6,726
Barite (crude) thousand short tons	15	104	10	71
Boron minerals short tons	866,000	68,209	955,000	74,130
Cement thousand 376-pound barrels	45,387	146,302	42,034	137,961
Clays thousand short tons	2,984	6,708	2,609	6,037
Copper (recoverable content of ores, etc.) short tons	1,078	780	788	602
Feldspar long tons	100,915	W	94,769	W
Gem stones	NA	200	NA	200
Gold (recoverable content of ores, etc.) troy ounces	64,764	2,267	40,570	1,420
Gypsum thousand short tons	1,207	3,064	1,241	3,150
Lead (recoverable content of ores, etc.) short tons	1,976	597	1,735	486
Lime thousand short tons	552	8,764	539	8,696
Magnesium compounds from sea-water bitterns (partly estimated) short tons, MgO equivalent	87,816	7,413	76,592	6,882
Mercury 76-pound flasks	16,070	7,100	16,385	8,018
Natural gas million cubic feet	715,113	223,175	681,080	202,290
Natural gas liquids:				
Natural gasoline and isopentane thousand gallons	r 607,286	r 46,651	588,250	44,610
LP gases and ethane do.	353,164	17,304	366,643	19,065
Condensate do.	70,582	5,748	55,734	4,512
Peat short tons	29,235	384	30,014	396
Petroleum (crude) thousand 42-gallon barrels	[3] 345,295	812,834	[3] 359,219	829,133
Pumice, pumicite, and volcanic cinder thousand short tons	580	1,763	866	1,357
Salt (common) do.	1,693	W	1,732	W
Sand and gravel do.	120,692	139,157	116,125	139,212
Silver (recoverable content of ores, etc.) thousand troy ounces	190	246	145	224
Stone [4] thousand short tons	43,051	61,336	37,186	55,263
Sulfur ore long tons	557	5	568	3
Talc, pyrophyllite and soapstone short tons	138,340	1,847	143,466	1,945
Tin concentrates (content) long tons	13	21	W	W
Zinc (recoverable content of ores, etc.) short tons	335	97	441	122
Value of items that cannot be disclosed: Bromine, calcium chloride, calcite (optical grade) (1966), carbon dioxide, coal (lignite), diatomite, iodine, (1966), iron ore, lithium minerals, mica (scrap), molybdenum, perlite, platinum-group metals, potassium salts, rare-earth metals, sodium carbonate, sodium sulfate, tungsten concentrates, uranium (1966), wollastonite, and values indicated by symbol W	XX	r 141,449	XX	143,722
Total		r 1,710,470	XX	1,696,233
Total 1957–59 constant dollars		r 1,654,000	XX	p 1,623,000

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

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

[2] Less than ½ unit.

[3] Excludes condensate.

[4] Includes slate.

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

County	1966	1967	Minerals produced in 1967 in order of value
Alameda	$22,873,682	$23,790,832	Sand and gravel, salt, stone, magnesium compounds, lime, petroleum, bromine, clays.
Alpine	57,564	79,107	Sand and gravel, stone, silver, gold, lead, zinc, copper.
Amador	3,066,348	3,202,953	Sand and gravel, clays, coal, stone, soapstone, gold.
Butte	3,555,712	3,903,017	Natural gas, sand and gravel, stone, gold, silver.
Calaveras	19,407,836	18,215,656	Cement, asbestos, stone, clays, sand and gravel, gold, silver.
Colusa	4,847,288	4,422,745	Natural gas, sand and gravel, mercury.
Contra Costa	r 17,971,749	16,284,281	Natural gas, stone, petroleum, sand and gravel, lime, peat, natural gas liquids, clays, mercury.
Del Norte	504,941	990,329	Stone, sand and gravel, gold.

See footnotes at end of table.

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

County	1966	1967	Minerals produced in 1967 in order of value
El Dorado	$2,638,668	$2,573,291	Stone, lime, sand and gravel, tungsten, soapstone, gold, silver.
Fresno	74,315,131	72,978,845	Petroleum, sand and gravel, natural gas, natural gas liquids, asbestos, stone, mercury, gold, clays, silver.
Glenn	6,078,993	5,064,762	Natural gas, sand and gravel, lime.
Humboldt	2,835,261	2,442,097	Natural gas, sand and gravel, stone.
Imperial	2,815,964	5,931,506	Sand and gravel, gypsum, lime, calcium chloride, clays, stone, gold, mica.
Inyo	20,614,146	23,789,781	Tungsten, sodium carbonate, talc, stone, molybdenum, copper, sand and gravel, lead, silver, zinc, perlite, pumice and volcanic cinder, boron, clays, barite, gold, sulfur, wollastonite.
Kern	426,956,114	424,868,053	Petroleum, boron, natural gas, cement, natural gas liquids, sand and gravel, stone, gypsum, sodium sulfate, clays, salt, carbon dioxide, tin pumicite and volcanic cinder, iron ore, mercury silver, tungsten, gold, copper, lead, zinc.
Kings	17,039,802	13,509,382	Natural gas, natural gas liquids, petroleum, sand and gravel, mercury.
Lake	1,046,879	1,256,209	Sand and gravel, mercury, volcanic cinder, stone, clays.
Lassen	r 622,811	436,244	Sand and gravel, volcanic cinder, stone.
Los Angeles	290,227,105	319,726,615	Petroleum, sand and gravel, natural gas, natural gas liquids, stone, clays, gold, soapstone, silver.
Madera	2,158,321	2,778,904	Sand and gravel, natural gas, tungsten, stone, volcanic cinder, clays.
Marin	2,973,252	2,397,102	Stone, sand and gravel, mercury, clays.
Mariposa	123,381	125,697	Sand and gravel, stone, gold, clays, silver.
Mendocino	1,011,705	1,142,461	Sand and gravel, stone, mercury.
Merced	7,103,427	3,846,147	Sand and gravel, stone, gypsum, gold, mercury, silver.
Modoc	539,940	757,482	Volcanic cinder, peat, sand and gravel, stone.
Mono	1,167,169	422,829	Pumice and volcanic cinder, sand and gravel, clays, stone.
Monterey	35,835,560	37,004,005	Petroleum, magnesium compounds, lime, sand and gravel, stone, natural gas, feldspar, salt, mercury.
Napa	3,841,656	3,179,356	Stone, salt, clays, mercury, diatomite, sand and gravel, volcanic cinder, perlite.
Nevada	354,726	1,082,537	Sand and gravel, stone, gold, silver.
Orange	121,418,023	119,221,179	Petroleum, natural gas, sand and gravel, natural gas liquids, clays, lime, salt, peat, stone.
Placer	1,165,044	911,682	Sand and gravel, clays, stone, gold, silver.
Plumas	288,953	514,485	Do.
Riverside	r 67,046,319	72,027,318	Iron ore, cement, sand and gravel, stone, clays, petroleum, wollastonite, tungsten, copper, silver.
Sacramento	r 21,237,899	19,588,409	Natural gas, sand and gravel, gold, natural gas liquids, clays, silver.
San Benito	10,471,981	10,483,030	Cement, stone, mercury, asbestos, sand and gravel, petroleum, natural gas, clays.
San Bernardino	r 120,182,458	113,356,370	Cement, boron, stone, rare-earth minerals, sodium carbonate, sodium sulfate, potassium salts, sand and gravel, iron ore, salt, lime, lithium minerals, clays, calcium chloride, talc and pyrophyllite, bromine, tungsten, petroleum, pumice and volcanic cinder, gypsum, natural gas, barite, copper, lead, silver, gold.
San Diego	12,811,989	14,517,347	Sand and gravel, stone, magnesium compounds, salt, clays, pyrophyllite.
San Francisco	W	W	Sand and gravel.
San Joaquin	14,932,952	10,630,428	Natural gas, sand and gravel, lime, clays, gold, silver.
San Luis Obispo	5,141,754	6,383,931	Petroleum, mercury, sand and gravel, natural gas liquids, stone, natural gas, gypsum, clays.
San Mateo	14,638,201	14,315,729	Cement, magnesium compounds, salt, stone, sand and gravel, clays, petroleum, natural gas.
Santa Barbara	r 129,393,266	132,565,326	Petroleum, natural gas, diatomite, natural gas liquids, sand and gravel, lime, mercury, stone.
Santa Clara	32,816,421	32,951,928	Cement, stone, sand and gravel, mercury, clays, petroleum.
Santa Cruz	11,529,324	12,501,351	Cement, sand and gravel, stone, clays.
Shasta	8,921,723	6,786,366	Cement, sand and gravel, stone, clays, volcanic cinder, barite, gold, diatomite, silver.
Sierra	109,194	277,314	Sand and gravel, gold, stone, silver.
Siskiyou	1,164,864	1,173,773	Sand and gravel, pumice and volcanic cinder, stone, gold, silver.
Solano	r 16,444,472	13,250,416	Natural gas, stone, natural gas liquids, sand and gravel.
Sonoma	5,257,405	4,419,564	Sand and gravel, mercury, stone, clays, natural gas.
Stanislaus	1,508,876	1,187,703	Sand and gravel, lead, clays, gold, silver, stone, copper.

See footnotes at end of table.

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

County	1966	1967	Minerals produced in 1967 in order of value
Sutter	$14,429,138	$13,098,841	Natural gas, sand and gravel, clays, stone.
Tehama	1,489,975	918,244	Natural gas, sand and gravel, stone, volcanic cinder.
Trinity	190,450	717,492	Stone, mercury, sand and gravel, gold, clays, silver.
Tulare	2,842,214	2,396,886	Natural gas, sand and gravel, stone, petroleum, barite, clays, gold, silver.
Tuolumne	r 1,480,418	1,478,243	Stone, lime, sand and gravel, tungsten, gold, zinc, silver.
Ventura	107,501,291	87,836,354	Petroleum, natural gas, natural gas liquids, sand and gravel, clays, gypsum, stone.
Yolo	4,142,062	3,628,464	Sand and gravel, lime, natural gas.
Yuba	3,235,578	2,530,740	Gold, sand and gravel, clays, stone, platinum, silver.
Undistributed [1]	r [2] 6,092,625	361,862	
Total	r 1,710,470,000	1,696,233,000	

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

[1] Includes gem stones, tungsten and mercury that cannot be assigned to specific counties and value indicated by symbol W.

[2] Includes petroleum condensate.

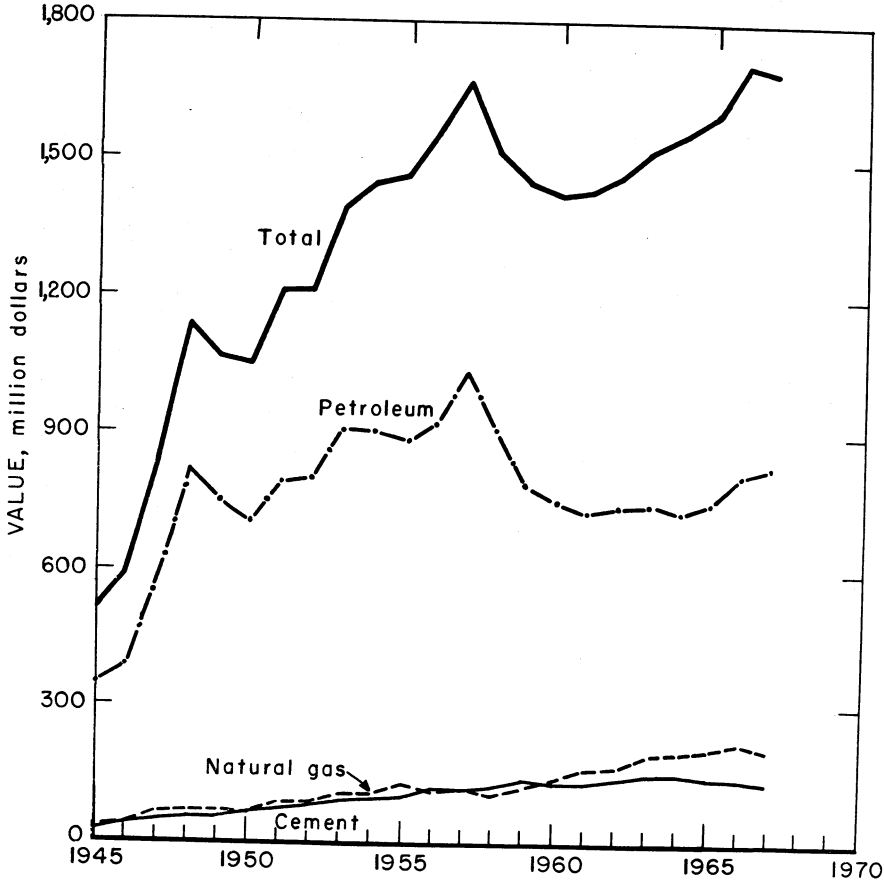

Figure 1.—Value of petroleum, natural gas, cement, and total value of mineral production in California.

Table 3.—Indicators of California business activity [1]

		1966	1967 p	Change (percent)
Personal income:				
Total	millions	$65,002	$70,097	+7.8
Per capita		$3,457	$3,660	+5.9
Annual insured payrolls:				
Agriculture, forestry, and fisheries	millions	$938.8	$928.9	−1.1
Mineral extraction	do	$272.1	$283.2	+4.1
Mineral production	do	$1,710	$1,696	−.9
Contract construction	do	$2,733.2	$2,555.6	−6.5
Manufacturing	do	$11,885.6	$12,841.9	+8.0
Transportation, communication, and utilities	do	$2,804.6	$3,064.8	+9.3
Wholesale and retail trade	do	$7,364.9	$7,769.2	+5.5
Finance, insurance, and real estate	do	$1,932.0	$2,089.7	+8.2
Services	do	$4,683.8	$5,211.3	+11.3
State and local government [2]	do	$114.3	$130.7	+14.3
Total labor force	thousands	7,595	7,833	+3.1
Unemployment	do	375	389	+3.7
Average annual employment:				
Agriculture, forestry, and fisheries	do	289.1	281.0	−2.8
Mineral extraction	do	32.3	32.1	−.7
Contract construction	do	305.6	277.2	−9.3
Manufacturing	do	1,531.4	1,591.7	+3.9
Transportation, communications, and utilities	do	410.5	432.5	+5.3
Wholesale and retail trade	do	1,329.3	1,358.2	+2.1
Finance, insurance, and real estate	do	310.6	316.8	+1.9
Services	do	1,031.5	1,084.4	+5.1
Government	do	1,195.7	1,270.5	+6.2

p Preliminary.
[1] Source: Survey of Current Business; Califonia Department of Employment; California Department of Industrial Relations.
[2] Includes nonclassifiable establishments.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	6	130	1	6	----	-----	-------	-------
Peat	29	177	5	45	----	-----	-------	-------
Metal	2,431	247	600	4,802	5	126	27.28	8,424
Nonmetal	4,949	271	1,343	10,829	3	190	17.82	2,621
Sand and gravel	5,377	239	1,287	10,352	3	214	20.96	3,468
Stone	4,638	289	1,341	10,756	----	163	15.15	648
Total	17,430	263	4,577	36,790	11	693	19.14	3,036
1967: p								
Coal	5	200	1	6	----	-----	-------	-------
Peat	30	205	6	49	----	-----	-------	-------
Metal	2,430	244	593	4,736	7	129	28.72	9,846
Nonmetal	4,440	288	1,281	10,284	6	182	18.28	4,153
Sand and gravel	5,670	226	1,279	10,373	4	204	20.05	3,776
Stone	4,210	288	1,212	9,664	2	106	11.18	1,719
Total	16,785	261	4,372	35,112	19	621	18.23	4,133

p Preliminary.

Table 5.—Principal custom mills, commercial grinding plants, and primary smelters in 1967

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.
Macco Corp	Kern	Rosamond	do	Do.
Calada Materials Co	Los Angeles	Harbor City	do	Do.
American Minerals Co	do	Los Angeles	do	Do.
Western Talc Co	do	do	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.
Yuba Minerals & Milling Co	Sutter	Sutter	do	Do.

plex on stream at Hercules, Standard Oil Co. of California developed new equipment at Richmond to reclaim hydrogen sulfide and ammonia from refinery waste water, and Shell Oil Co. developed a dry catalytic process at its Martinez refinery to reclaim 70 to 95 percent of the sulfur in crude oil products. Shell also drilled 33 coreholes in tar sands near San Luis Obispo, Calif., and planned pilot plant tests of a process for separating the tars from the sands. Should the tests prove successful, the pioneering research by the Bureau of Mines would once again be demonstrated. More than two decades ago the Bureau reported results of pilot tests it conducted on tar sands from the same area.

In 1967, American Cement Corp. established a cement distribution terminal at Stockton, San Joaquin County, and announced that a 3-million-barrel cement plant for Amador County was in the planning stage. Pacific Western Industries, Inc., began shipping portland cement from its 3-million-barrel Los Robles facility, Kern County. Johns-Manville Corp. acquired the gypsum division of Fibreboard Corp., including wallboard plants in California, Nevada, and Colorado, and gypsum quarries in Colorado and Nevada. American Potash & Chemical Corp. became a wholly owned subsidiary of Kerr-McGee Corp. Earlier in the year American Potash had purchased the Little Placer borate deposit near Boron, Kern County, and completed a new million-dollar plant to produce 30,000 tons per year of coarse potassium sulfate at Trona, San Bernardino County. Stauffer Chemical Co. acquired Mountain Copper Co. and gained control of San Francisco Chemical Co. which had been jointly owned by the two firms. All assets and liabilities of Kern County Land Co. were purchased by Tenneco, Inc. United States Borax & Chemical Corp. completed its new anhydrous boric acid plant at Boron, Kern County, and shipments were begun in May. Western Talc Co., Inc. completed a modernization program at its mines and plant, San Bernardino County, providing facilities necessary to produce 300 tons per day of a wide range of talc and clay grades.

Molybdenum Corporation of America essentially completed construction of rare-earth processing facilities at Mountain Pass, San Bernardino County, initiated in 1965, with the installation of cerium hydrate, lanthanum hydrate, and lanthanum carbonate circuits. National Steel Corp. contracted to purchase about 3,000 acres of undeveloped riverfront property at the confluence of the Sacramento and San Joaquin Rivers, Solano County. The company indicated tentative plans to construct a steel plant on the property. Union Carbide Corp. announced it had undertaken expansion of its Pine Creek tungsten mine, Inyo County. In December, Utah Construction & Mining Co. agreed in principle to acquire all assets of The Bunker Hill Co., Kellogg, Idaho.

At midyear, Union Oil Co. of California joined with Magma Power Co. and Thermal Power Co. in the production of geothermal steam. Under the agreement, Union was to operate the production facilities and began an aggressive drilling program on 14,000 acres in northern California. Western Geothermal, Inc., was installing equipment in the Imperial Valley to increase the output of calcium chloride from one of its geothermal brine wells.

Exploration for minerals and metals continued at a high level in 1967, with 99 active exploration projects reported in the State, 20 were in San Bernardino County. Companies were searching for 20 commodities but gold was the most actively sought with 32 projects, followed by 17 mercury, 13 talc, seven limestone, six silver, five tungsten, three clays, and two each of gypsum, iron ore, and lead.

Legislation and Government Programs.—The 1967 session of the State Legislature passed a bill (SB 169) to authorize the leasing of State lands for geothermal exploration. It established procedures for obtaining prospecting permits and leases, royalties and rentals, maximum acreage, and lease lengths. The program will be administered by the State Lands Commissioner. (A parallel bill to lease Federal lands for geothermal exploration was passed by the U.S. Congress late in 1966 but vetoed by President Johnson because it contained a controversial "grandfather clause.") Another bill (SB 1230) concerning mining claims was successfully carried with minor amendments. This legislation contains two important changes:

1. It provides a claimant with the alternative of drilling a hole to a specific depth to satisfy the discovery work re-

quirements, instead of the 10-foot discovery shaft.

2. Starting November 8, 1968, it requires that the affidavit of annual assessment work be specific in the description of what work was done and by whom; further, the affidavit must state that the claim monuments and all notices required by law were in place at a date within the assessment year for which the affidavit is made. Failure to file an affidavit in the form specified creates a "prima facie presumption of the act and intent of the owner to abandon such claim at the end of the assessment year . . ."

The State Legislature also passed a Resolution (SCR 49) requesting the Governor to inform the United States Mission to the United Nations of California's interest in being host and cosponsor for a United Nations Conference of Geothermal Resources.

Public land orders by the Bureau of Land Management withdrew nearly 56,000 acres of land from mineral location under U.S. mining laws, of which about 53,000 acres remained open to mining and mineral leasing under the Multiple Land Use Act. Land orders restored over 9,000 acres to mineral location and leasing in Mendocino and Lake Counties. California received U.S. Treasury checks in the amount of $3,170,575.53 in bonuses, royalties, and rentals from mineral leases and permits on Federal lands within the State borders in 1967, about $15,000 more than in 1966.

Of the three applications received from California producers since enactment of the Lead-Zinc Stabilization Program in October 1962, one had been recertified (after June 1, 1966) and two had been withdrawn, suspended, or disqualified. Payments totaling $1,532 were made on 239.9 tons of lead produced in 1966, and $1,467 on 195.6 tons of lead produced in 1967.

The Bureau of Mines' San Francisco Petroleum Research Office initiated a study to determine the chemical properties of water drained from irrigated lands and the treatment necessary to make the water suitable for waterflooding oilfields in the San Joaquin Valley. Preliminary results indicated that this waste water can be used after inexpensive treatment for injection into reservoirs to recover additional petroleum.

The Petroleum Research Office continued to study rapid, yet accurate, methods to predict the performance of waterfloods,[2] and also was studying complex decline equations to predict future oil recovery utilizing an electronic computer. The complex equations, which are too difficult for practical solution without a computer, give a better prediction of future performance of oilfields, than formerly used equations.

During 1967, the Bureau of Mines Marine Minerals Technology Center, Tiburon, Calif., completed conversion of a surplus 205-foot Navy Ocean Fleet Tug for use as a marine mining research vessel. This vessel, commissioned in May as the *Virginia City,* provided the working platform for a joint Bureau of Mines-Geological Survey heavy-metals research project off the coast of the southern Seward Peninsula, Alaska, during July, August, and September. The ship covered an area of approximately 200 square miles and completed 537 linear miles of subbottom profiling and 50 statute miles of magnetometer surveys. Also, 627 drillhole samples were recovered from 56 holes drilled from the ship. At Tiburon, a large vertical test tank was built and experiments were initiated to evaluate the performance of marine mineral sampling equipment in controlled environments.

The Bureau of Mines Thermodynamics Research Laboratory at Berkeley, Calif., was transferred to, and became a part of, the Albany Metallurgy Research Center, Albany, Oreg. effective July 1, 1967.

The Bureau's San Francisco Office of Mineral Resources, in making an overall study of the Tertiary gravels of California as a part of the Heavy Metals Program, determined they constituted a major gold resource. The deposits were conservatively estimated to contain 3 to 4 billion cubic yards of gravel with an average gold content of $0.25 per cubic yard. The study provided a basis for mining and metallurgical research. Previous exploitation of the gravels was halted by legal restrictions involving environmental problems rather than by economic considerations. Wilderness mining investigations, including an

[2] Higgins, R. V., D. W. Boley, and A. J. Leighton. Unique Properties of Permeability Curves of Concern to Reservoir Engineers. BuMines Rept. of Inv. 7006, 1967, 19 pp.

Higgins, R. V., and A. J. Leighton. Computer Techniques for Predicting Three-Phase Flow in Five-Spot Waterfloods. BuMines Rept. of Inv. 7011, 1967, 45 pp.

appraisal of mineral deposits in the Emigrant Basin and Salmon-Trinity Alps Primitive Areas, proposed as Wilderness Areas, continued as a cooperative effort with the U.S. Geological Survey. Sampling and mapping of the known tungsten deposits in Emigrant Basin were completed. Literature and claim record searches were continued on the Salmon-Trinity Alps area and a list of claims and mines compiled.

The San Francisco office also began a study to provide the necessary information and forecasts regarding the mineral industry in the California hydrologic region for an interagency Type I Comprehensive Framework Study. The project was undertaken as a part of the Bureau's continuing participation in River Basin Studies.

The Region II Field Office, Office of Minerals Exploration (OME), U.S. Geological Survey, received 17 applications from persons interested in exploring for minerals in California under the OME program. Of these, 11 applications were processed and three contracts were let. At yearend, seven contracts were active, two of which were continued from 1966.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS[3]

Carbon Black.—Overall production of carbon black dropped 20 percent from the 1966 total. Decreases were reported for all grades except SAF (super abrasion furnace) with thermal black having the largest decline. Sales also were lower. Shell Chemical Co. produced thermal black from natural gas as a byproduct of hydrogen production in an ammonia-base fertilizer plant at Pittsburg, Contra Costa County. In Kern County, Continental Carbon Co. at Bakersfield, and United Carbon Co., Inc. at Mojave, each produced several grades of carbon black from liquid hydrocarbons. Output averaged 9.52 pounds of thermal black per thousand cubic feet from natural gas and 5.08 pounds of carbon black per gallon from liquid hydrocarbons. Plant outputs were used by the rubber, metal, and chemical industries.

Carbon Dioxide.—Getty Oil Co., formerly Tidewater Oil Co., and Standard Oil Co. of California extracted carbon dioxide from natural gas in natural gasoline plants near Taft, Kern County. Plant output by Getty was unchanged from 1966 and was sold for use in carbonated beverages. Standard removed the gas to meet natural gas pipeline specifications but did not market the carbon dioxide.

Coal (Lignite).—American Lignite Products Co., Inc., California's only lignite producer, strip-mined lignite from beds in the Ione area, Amador County. Production rose appreciably but the unit value of the lignite dropped slightly, compared with that of 1966. The company processed the mine output to recover several grades of wax, which were sold for a wide variety of industrial uses.

Coke.—Kaiser Steel Corp. at Fontana, San Bernardino County, operated California's only coking facility. The coke was consumed in company blast furnaces and coke breeze was used in the company agglomerating plant. Consumption of coke declined 2 percent while that of coke breeze increased 2 percent, compared with 1966 levels. The coking coal was obtained from captive mines outside the State.

Natural Gas.—Marketed production of natural gas declined 5 percent from that in 1966 with 58 percent of the output coming from oil zones. Dry-gas production from 962 wells at 101 fields in 22 counties averaged 766 million cubic feet daily, down nearly 13 percent from that of 1966. There were 89 new gas wells, 27 more than in 1966. Fields with the largest number of new wells were Rio Vista (11), Solano County; Harvester (6), Kings County; Grimes (5), Sutter County; and Sherman Island (5), Sacramento County. Four fields—Malton (Glenn County), Merrit Island (Yolo County), Denverton Creek (Solano County), and Sherman Island—discovered in earlier years, began producing in 1967. Of the four, Malton was the most important discovery. Rio Vista continued to be the State's largest gasfield.

[3] Prepared by Calvin H. Riggs, Petroleum and Natural Gas Engineer, Bureau of Mines, San Francisco, Calif.

Drilling of 53 exploratory wells resulted in the discovery of four new gasfields—French Camp (San Joaquin County), West Sacramento (Yolo County), Ryer Island (Solano County), and Zamora (Butte County). In addition, two major and nine minor extensions were made in older fields. The new fields were not in production by yearend.

The volume of gas injected for repressuring and pressure maintenance declined to 120 billion cubic feet from 160 billion in 1966. More gas production was utilized for steaming operations than in any previous year.

Natural Gas Liquids.—The volume of wet gas processed declined over 13 billion cubic feet from that of 1966. The quantity and value of natural gas liquids, including plant condensate, continued to decrease at an annual rate of about 1 percent. The output of liquefied petroleum gas (LPG) and ethane produced was up 4 percent in quantity and 10 percent in value. Declines were reported for natural gasoline and isopentane (3 percent in quantity and 4 percent in value) and plant condensate 21 percent in quantity and 22 percent in value). The output of field condensate, from wells at fields in the four producing counties—Contra Costa, Sacramento, Santa Barbara, and Solano—dropped 32 percent below 1966 production. Of the eight contiguous counties where wet gas processing plants were operated, output increased only in Fresno and Ventura Counties and the increases were minor. In January, 64 plants were operating, one more than at the same time in 1966.

Peat.—Production and sales of peat ended a decline begun in 1964, rising nearly 3 percent above 1966 figures. Output of reed-sedge material came from two deposits, both in Contra Costa County. A Modoc County deposit yielded all the peat moss and an Orange County pit, all

Table 6.—Natural gas (marketed production) and petroleum produced in 1967, by counties

County	Petroleum [1]				Natural gas, marketed production [2]			
	Average number of producing wells		Production (thousand barrels)	Value (thousands)	Oil zones		Dry gas zones	
	Oil	Dry gas			Million cubic feet	Value (thousands)	Million cubic feet	Value (thousands)
Alameda	4		90	$244				
Butte		23					8,584	$2,130
Colusa		63					12,689	3,800
Contra Costa	34	60	554	1,810	3,344	$953	25,283	7,926
Fresno	2,908		21,402	54,295	23,192	6,874		
Glenn		97					15,112	4,520
Humboldt		20					3,451	1,035
Kern	20,061	76	121,856	270,977	149,856	42,754	9,784	2,922
Kings	191	17	949	2,741	15,842	4,751	2,675	734
Los Angeles	8,760	9	104,476	252,143	80,011	23,699	966	285
Madera		24					2,072	586
Monterey	911		18,349	25,391	3,126	922		
Orange	3,842	1	39,916	93,371	28,298	8,348	1,133	334
Riverside	3		21	46				
Sacramento		137					40,862	13,087
San Benito	24	4	89	267	54	16	214	63
San Bernardino	21		45	125	14	4		
San Joaquin		71					22,861	6,296
San Luis Obispo	164		1,497	2,658	572	167		
San Mateo	16		34	90	1	[3]		
Santa Barbara	1,705	16	27,306	62,403	56,052	17,858	43,598	12,862
Santa Clara	2		2	4				
Solano		137					38,689	12,294
Sonoma		5					28	7
Sutter		159					44,458	12,960
Tehama		8					1,576	472
Tulare	26	29	48	96			4,019	1,085
Ventura	2,936	2	22,585	62,472	41,030	12,104	61	18
Yolo		13					1,573	424
Total	41,608	971	359,219	829,133	401,392	118,450	279,688	83,840

[1] Excludes condensate. Quantity figures courtesy of Conservation Committee of California Oil Producers.
[2] Quantity figures courtesy of California Department of Conservation, Division of Oil and Gas.
[3] Less than ½ unit.

the humus material. The latter was sold unprepared, directly from the pit. All reed-sedge peat was shredded before shipment and one producer made bulk sales only while the other packaged two-thirds of his output. All the peat moss was shredded, kiln dried, and packaged. In all instances the material was sold for soil improvement uses.

Petroleum.—Production from an average of 41,608 active producing wells, 274 more than in 1966, rose 4 percent from 1966 levels and averaged 985,000 barrels daily. The major increases were in the Wilmington field (Los Angeles County), up 45,000 barrels daily, and the Kern River field (Kern County), up 16,000 barrels daily. Fields with lesser increases were Midway-Sunset, McKittrick, and Cymric (Kern County), and the new Crescent Heights field, in downtown Los Angeles.

Completion of 205 new wells in the Wilmington field, 178 of which were on the four offshore islands near Long Beach, raised the oil production from this field to 190,000 barrels daily, making Wilmington the most productive field in the United States. The newly developed Crescent Heights field, drilled from a simulated office building in the City of Los Angeles, was producing 20,000 barrels daily by yearend. New wells in all counties totaled 2,385, an increase of 21 percent. Kern River field led the State with 571 new wells, followed by Midway-Sunset with 441. Average depth of new wells was only 2,226 feet, compared with 2,906 feet in 1966, reflecting the drilling activity in shallow fields for thermal (steam) stimulation, which was greater in 1967 than in any preceding year.

Former producing wells abandoned during the year totaled 2,125.

Production using thermal recovery methods, particularly steam stimulation, increased 16 percent over the 1966 output. Steam injection projects toaled 208, 15 less than in 1966, principally as a result

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

(Thousand gallons and thousand dollars)

County	LP gases and ethane			Natural gasoline and isopentane		Condensate [1]	
	Number of plants	Quantity	Value	Quantity	Value	Quantity	Value
1966:							
Contra Costa	--	--	--	--	--	2,560	$205
Fresno	2	W	W	W	W	--	--
Kern	18	115,880	$5,976	138,906	$11,524	27,352	2,216
Kings	3	W	W	W	W	--	--
Los Angeles	18	53,908	2,491	153,307	11,906	--	--
Orange	5	16,511	737	97,881	7,460	--	--
Sacramento	--	--	--	--	--	482	38
San Luis Obispo	1	W	W	W	W	--	--
Santa Barbara	6	57,392	2,780	70,703	5,616	37,657	3,084
Solano	--	--	--	--	--	2,531	205
Ventura	10	57,051	2,362	98,017	6,147	--	--
Undistributed	--	52,422	2,958	48,472	3,998	--	--
Total	63	353,164	17,304	607,286	46,651	70,582	5,748
1967:							
Contra Costa	--	--	--	--	--	1,848	$148
Fresno	2	W	W	W	W	--	--
Kern	19	120,361	$6,510	135,492	$11,226	26,334	2,132
Kings	3	W	W	W	W	--	--
Los Angeles	18	55,946	2,760	148,200	11,314	--	--
Orange	5	17,121	816	94,649	7,091	--	--
Sacramento	--	--	--	--	--	378	30
San Luis Obispo	1	W	W	W	W	--	--
Santa Barbara	6	59,575	3,081	68,333	5,338	24,738	2,004
Solano	--	--	--	--	--	2,436	198
Ventura	10	59,209	2,620	94,773	5,841	--	--
Undistributed	--	54,431	3,278	46,803	3,800	--	--
Total	64	366,643	19,065	588,250	44,610	55,734	4,512

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Quantity figures courtesy of California Department of Conservation, Division of Oil & Gas.

Table 8—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1967

County	Drilling [1] [2]								Geophysical, crew-weeks	
	Proved field wells			Exploratory wells			Total			
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage	Gravity meter method	Reflection seismograph method
Alameda	6	-----	3	1	-----	5	15	75,987	-----	15
Butte	-----	4	1	-----	1	2	8	31,541	-----	-----
Colusa	-----	1	2	-----	-----	4	7	44,635	9	-----
Contra Costa	2	5	2	-----	-----	10	19	106,776	1	22
Fresno	144	-----	12	1	-----	8	165	413,787	-----	43
Glenn	-----	3	2	-----	-----	3	8	37,406	12	-----
Humboldt	-----	2	-----	-----	-----	-----	2	10,555	8	9
Kern	1,537	7	101	4	-----	48	1,697	3,058,595	5	142
Kings	-----	7	7	-----	-----	5	19	75,732	-----	46
Los Angeles	317	-----	18	6	-----	24	365	1,781,236	-----	-----
Madera	-----	1	-----	-----	-----	-----	1	5,700	-----	5
Marin	-----	-----	-----	-----	-----	1	1	7,800	-----	-----
Mendocino	-----	-----	-----	-----	-----	2	2	10,199	-----	1
Merced	-----	-----	-----	-----	-----	3	3	23,064	-----	46
Monterey	55	1	2	-----	-----	14	72	166,083	-----	-----
Orange	161	-----	1	-----	-----	4	166	481,109	-----	-----
Sacramento	-----	9	1	-----	-----	1	11	95,853	1	-----
San Benito	-----	-----	1	-----	-----	-----	1	2,108	-----	-----
San Joaquin	-----	15	6	-----	1	17	39	272,179	20	-----
San Luis Obispo	24	-----	2	-----	-----	5	31	87,260	13	2
San Mateo	-----	-----	-----	-----	-----	2	2	14,130	-----	-----
Santa Barbara	95	-----	2	-----	-----	22	119	490,930	-----	[3] 5
Santa Clara	1	-----	-----	-----	-----	-----	1	7,407	-----	-----
Santa Cruz	-----	-----	-----	-----	-----	1	1	7,700	-----	-----
Solano	-----	22	5	-----	2	17	46	394,907	85	7
Sonoma	-----	-----	-----	-----	-----	3	3	15,336	-----	2
Stanislaus	-----	-----	-----	-----	-----	2	2	18,150	-----	8
Sutter	-----	7	2	-----	-----	2	11	84,297	-----	-----
Tehama	-----	2	11	-----	-----	2	15	68,665	9	-----
Tulare	-----	-----	1	-----	-----	1	2	4,102	-----	23
Ventura	43	-----	5	1	-----	13	62	330,427	-----	[3] 15
Yolo	-----	3	3	-----	3	13	22	121,428	6	-----
Total	2,385	89	190	13	7	234	2,918	8,345,084	-----	-----

[1] Does not include 125 service wells (364,930 feet).
[2] Does not include 74 wells (274,469 feet) standing suspended at year end.
[3] Vibro-seismograph method.

of consolidations, with steam injection into 9,955 wells, 837 of which were drilled expressly for that purpose. Steaming operations was the prime reason for increased production in the Kern River field where many of the new wells were drilled. Twenty-two in-situ combustion projects were operated in 13 fields, compared with 20 projects in 18 fields during 1966, seven of which were included in the steam injection projects. Overall increase in production resulting from in-situ combustion was only 325 barrels daily.

Waterflood projects totaled 198, 30 more than in 1966, and six projects were abandoned during the year. Included were 1,269 water injection wells where more than 2 million barrels of water was injected daily. At yearend nearly 254 million cubic feet of gas was injected daily into 95 wells to increase oil production at 32 projects. The major projects were at large unitized pressure-maintenance operations in Kern County.

Over 1 million feet of exploratory drilling for 194 wells seeking new production resulted in the discovery of five new fields and 11 new reservoirs in older fields. The new fields were the Livermore, Alameda County; Five Points and San Emigdio Creek, Kern County; Los Posas, Ventura County; and Crescent Heights, Los Angeles County. The latter was the most important discovery. Two fields—South Elwood offshore, Santa Barbara County, and Venice Beach, Los Angeles County—discovered late in 1966, began producing in 1967.

During 1967, refining capacity in California was increased to 1.5 million barrels daily. Sequoia Refining Co. at Hercules, Contra Costa County, placed its new refining complex on stream in May with 25,000-barrel-per-day crude oil capacity.

In Los Angeles County, facilities were completed at four refineries to increase capacity and construction was underway at three refineries with completion dates scheduled for 1968. At yearend Humble Oil & Refining Co. was approaching the halfway point in the construction of its new 72,000-barrel-per-day Benecia refinery, Solano County. Completion was scheduled for the first quarter of 1969.

NONMETALS

Asbestos.—About 63 percent of domestic asbestos production came from California mines despite a decline from 1966 levels of nearly 6 percent in sales by the State's producers. Chrysotile asbestos fiber was produced by four companies—Pacific Asbestos Corp., Calaveras County; Atlas Minerals Corp. and Coalinga Asbestos Co., Fresno County; and Union Carbide Corp., San Benito County. The San Benito County output was processed by Union Carbide in a Monterey County plant. Pacific Asbestos, the State's major producer, prepared and shipped groups 4, 5, 6, and 7 fiber; the other producers milled group 7 fiber only. Most of the processed asbestos was used in the manufacture of pipe, sheet, and tile for the construction industry.

Barite.—Production and shipments of crude barite dropped 37 and 33 percent, respectively, below 1966 figures. Although production was reported from eight properties in five counties, a high percentage of the total came from the Castella (Loftus claims) deposit of Yuba Minerals & Milling Co., Shasta County, and the Embree property, Tulare County. Receipts of crude barite at grinding plants were 3 percent lower but shipments of ground barite rose 21 percent. Five grinding plants—one each in Los Angeles, Sacramento, Kern, Fresno, and Sutter Counties—were active in 1967 and operated principally on crude barite supplied by Nevada producers. Less than one-third of the ground barite output from California plants came from crude mined within the State. Nearly 96 percent of all ground barite sold was used in well drilling muds. The barium chemicals plant of FMC Corp., Stanislaus County, was operated on crude barite produced at the company's Nevada mine.

Boron Minerals and Compounds.—Borate deposits in Kern and Inyo Counties, and brines from Searles Lake, San Bernardino County, yielded all the domestic production of boron minerals and compounds. In Inyo County, colemanite was mined by Kern County Land Co. and United States Borax & Chemical Corp., and ulexite by the latter. U.S. Borax refined crude borates from the company open-pit mine, Kern County, in plants in Kern and Los Angeles Counties. American Potash & Chemical Corp., division of Kerr-McGee Corp., and Stauffer Chemical Co. extracted boron compounds from brines in plants at Searles Lake. Stauffer also produced high-purity boron chemicals, in its San Fransicso plant, from purchased Kern County borates. Quantity and value increases, over 1966, were attributed to outputs of borax and rasorite, the latter a partially refined product produced for sale and for further refining.

Bromine and Bromine Compounds.—American Potash & Chemical Corp., Division of Kerr-McGee Corp., recovered elemental bromine from Searles Lake brines in the company plant at Trona, San Bernardino County, and sold it to manufacturers of chemicals and pharmaceuticals. FMC Corp. extracted elemental bromine from saltworks bitterns and converted it to ethylene dibromide in its Newark plant, Alameda County, for sale principally as a soil fumigant. Production dropped 43 percent below that of 1966.

Calcite (Optical Grade).—The optical grade calcite property near Mount Baldwin, Mono County, was idle throughout 1967.

Calcium Chloride.—Liquid calcium chloride was recovered from Bristol Lake brine, San Bernardino County, by Leslie Salt Co. and National Chloride Company of America, and well brine was recovered by Chloride Products, Inc. and Imperial Thermal Products Co., a new producer, near Calipatria, Imperial County. Hill Bros. Chemical Co. prepared a flake product, from purchased liquid, in a plant near Bristol Lake. More liquid product was produced than in 1966 but the output of flakes was virtually unchanged. The Bristol Lake products were sold to chemical companies for use a a hygroscopic agent and a fireproofing material, and to help processors. The Imperial County liquid product

was used chiefly as an ingredient in well-drilling muds.

Cement.—Shipments of portland cement totaled 42.0 million barrels, down from 45.4 million in 1966, reflecting a generally depressed construction industry. Sales to ready-mixed concrete companies and building materials dealers dropped nearly 3 million barrels. Of the total shipments, 37 million barrels was in bulk and 5 million in bags. Producers shipped about 4.4 million barrels to out-of-State customers and California customers received 556,000 barrels from producers outside the State. Apparent consumption in California was 38 million barrels compared with 42 million in 1966.

New construction and modernization programs increased annual production capacity to 62.3 million barrels in 1967. In February, Pacific Western Industries, Inc. began shipping from its new 3-million-barrel-per-year dry-process Los Robles plant, Kern County. American Cement Corp. announced tentative plans for a 3-million-barrel plant near Volcano, Amador County, and Creole Corp., a subsidiary of Texas Industries, Inc., planned construction of a 3-million-barrel plant near Plaster City, Imperial County, where the company purchased a limestone deposit. Calaveras Cement Division of The Flinkote Co., at San Andreas, Calaveras County, planned construction of a slurry pipeline to convey crushed limestone to the plant from its new quarry 17 miles away. Pacific Cement & Aggregates Division, Lone Star Cement Corp., announced plans for a multimillion-dollar modernization program for its Santa Cruz County cement plant and limestone quarry that included a crushing and conveyor system, and increased cement producing capacity.

Clay and Shale.—Total output, sold and used, of clay and shale declined 13 percent from that in 1966, attributed chiefly to a drop in shale production for lightweight aggregate use. Fire clay and miscellaneous clay and shale, produced for use in making cement and heavy clay products, comprised 66 percent of all clays sold or used in 1967. Ball clay was mined at two properties in San Bernardino County and one in Stanislaus County. Bentonite was produced at two mines in Inyo County and one each in Imperial, San Benito, and San Bernardino Counties. Fuller's earth production came from two properties in Inyo County, and kaolin was mined from one deposit in Mono County and two in Orange County. Fire clay and stoneware clay were produced from 17 deposits in seven counties with more than half the output coming from Riverside County. Miscellaneous clays and shales, comprising 81 percent of the total output of all clays, were mined at 61 properties in 29 counties, 77 percent of which came from deposits in 10 counties—Calaveras, Kern, Los Angeles, Napa, Orange, Riverside, San Bernardino, San Mateo, Santa Cruz, and Ventura.

Table 9.—Finished portland cement

(Thousand 376-pound barrels and thousand dollars)

District [1]	Active plants	Capacity Dec. 31	Production	Shipments from mills			Stocks at mills Dec. 31	Estimated consumption
				Quantity	Value			
					Total	Average per barrel		
1966:								
Northern California	6	r 21,650	18,930	19,020	$63,088	$3.32	1,372	17,912
Southern California	7	37,600	26,391	26,367	83,214	3.16	1,776	24,414
Total	13	r 59,250	45,321	45,387	146,302	3.22	3,148	42,326
1967:								
Northern California	6	21,700	17,877	17,822	61,109	3.43	1,418	16,490
Southern California	8	40,600	24,178	24,212	76,852	3.17	1,744	21,701
Total	14	62,300	42,055	42,034	137,961	3.28	3,162	38,191

r Revised.

[1] Northern and Southern California are divided by the northern boundaries of San Luis Obispo and Kern Counties and the western boundaries of Inyo and Mono Counties.

Table 10.—Source and destination of shipments of portland cement

(Thousand 376-pound barrels)

Destination	Source				Total	
	Northern California mills		Southern California mills			
	1966	1967	1966	1967	1966	1967
Northern California	15,932	14,139	1,240	1,806	17,172	15,945
Southern California	359	361	24,039	21,329	24,398	21,690
Nevada	215	154	632	592	847	746
Oregon	W	W	W	W	(1)	(2)
Arizona	------	------	267	270	267	270
Other	[3] 2,514	[3] 3,168	[4] 189	[4] 215	2,703	3,383
Total	19,020	17,822	26,367	24,212	45,387	42,034
Building material dealers	1,171	1,188	2,893	2,063	4,064	3,251
Concrete product manufacturers	1,840	1,601	3,090	2,982	4,930	4,583
Ready-mixed concrete	11,637	11,876	17,148	14,857	28,785	26,733
Contractors and government agencies	4,251	3,032	2,962	4,096	7,213	7,128
Miscellaneous and own use	121	125	274	214	395	339
Total	19,020	17,822	26,367	24,212	45,387	42,034

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Included with "Other;" total 1,171,000 barrels shipped from northern and southern California to Oregon.
[2] Included with "Other;" total 1,203,000 barrels shipped from northern and southern California to Oregon.
[3] Includes Alaska, Idaho, New Mexico (1966), Oregon, Utah (1967), Washington, Foreign countries, and U.S. Possessions and Territories.
[4] Includes Colorado, Hawaii, Idaho, Iowa, Kansas (1966), Louisianan (1967), Michigan, Missouri, Nebraska (1966), New Mexico (1967), Oklahoma (1966), Oregon, Texas, Utah (1967), Washington, Wyoming (1967), and foreign countries.

Table 11.—Clays sold or used by producers, by counties

County	1966			1967		
	Clays used in cement and heavy clay products (short tons)	Total clays		Clays used in cement and heavy clay products (short tons)	Total clays	
		Short tons	Value		Short tons	Value
Alameda	9,392	11,392	$21,596	13,835	W	W
Amador	10,792	79,006	369,760	----------	W	$338,570
Calaveras	163,888	W	W	184,630	W	W
Contra Costa	52,500	81,500	118,700	47,457	84,957	114,864
Inyo	---------	7,717	38,810	----------	7,399	29,495
Kern	37,932	W	137,481	84,670	137,467	181,618
Lake	1,800	2,700	15,957	2,144	3,200	18,912
Los Angeles	173,106	173,806	240,596	130,500	130,712	163,780
Madera	7,650	7,650	9,563	10,500	11,000	13,750
Mariposa	---------	----------	----------	----------	360	450
Modoc	----------	4,700	5,875	----------	----------	----------
Orange	81,139	243,061	812,058	65,841	159,619	544,068
Placer	143,010	W	W	65,746	W	W
Plumas	---------	----------	----------	----------	49,390	61,738
Riverside	337,336	339,336	625,715	390,562	414,562	745,170
Sacramento	10,700	14,666	19,418	8,575	11,940	14,749
San Bernardino	132,904	172,759	320,849	131,745	168,317	694,193
San Joaquin	29,197	W	W	17,470	W	W
San Luis Obispo	9,149	9,149	11,436	6,363	6,363	7,954
San Mateo	184,615	W	W	164,166	W	W
Santa Clara	6,732	6,732	6,732	13,757	W	W
Santa Cruz	184,161	W	W	183,471	W	W
Shasta	90,800	W	W	67,453	W	W
Siskiyou	---------	70,000	87,500	----------	----------	----------
Stanislaus	1,612	3,112	23,269	1,775	W	W
Sutter	13,987	W	W	18,273	W	W
Trinity	---------	----------	----------	----------	100	125
Tulare	4,600	4,600	5,900	2,665	2,665	3,500
Yuba	11,151	W	W	16,920	W	W
Other counties	[1] 79,754	[2] 1,752,201	[2] 3,836,461	[1] 88,658	[2] 1,420,627	[2] 3,103,617
Total	1,777,907	2,984,087	6,707,676	1,717,176	2,608,678	6,036,553

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Fresno, Marin, and San Diego.
[2] Includes Fresno, Imperial, Marin, Mono, Napa, San Benito, San Diego, Sonoma, Ventura, and counties indicated by symbol W.

Diatomite.—Diatomite production was 7 percent below that of 1966, yet three producers in the Lompoc-Santa Maria area, Santa Barbara County, yielded more than 50 percent of the national output. Johns-Manville Products Corp. was the major producer, followed by GREFCO, Inc., and The Airox Co. Airox was the only producer reporting crude sales. In Napa County, Basalt Rock Co., Inc., processed diatomaceous silica for pozzolan. Cherokee-Lassenite, Inc., stockpiled diatomite to be processed for pozzolan in its Lassen County plant near Hallelujah Junction. A small quantity of diatomite from the Castella deposit, Shasta County, was used in the construction of swimming pools. The Keystone property of Pacific Clay Products Co., Tuolumne County, was idle in 1967. Crude sales declined 44 percent and prepared sales were down 6 percent from 1966 levels. Prepared sales, in order of greatest demand, were for filtration, filler, pozzolan, insulation, lightweight aggregate, and absorbents.

Feldspar.—The tonnage of marketable feldspar sold and used was 6 percent below that in 1966 but the value was 6 percent higher. Del Monte Properties Co. and Owens-Illinois Glass Co. mined and processed feldspathic dune sands of the Monterey peninsula near Pacific Grove. Both companies removed heavy minerals from the sand, Del Monte by froth flotation and Owens-Illinois by magnetic separation. Owens-Illinois shipped its plant product to company glass plants. Del Monte sold sand to the glass industry and also produced feldspar and silica concentrates by flotation, and blended and ground them to customer specifications, principally for manufacturing sanitary ware and fiberglass.

Gypsum.—Crude gypsum production rose 3 percent above the 1966 figure because of increased demand for agricultural use. In 1967, gypsum mining for use in plaster and board products was limited to the Fish Creek deposit of United States Gypsum Co., Imperial County. The output was consumed in the producer's Plaster City gypsum products plant. U.S. Gypsum's Midland mine and plant, Riverside County, was idle throughout the year and put on a standby basis. Underground workings were sealed off and some plant equipment dismantled.

Late in the year Fibreboard Corp. sold its idle Southgate plant, Los Angeles County, to Johns-Manville Products Corp. along with other mine and plant facilities in Nevada and Colorado but retained the gypsum products plant at Newark, Alameda County. Seven plants were active in 1967, one in Imperial County and two each in Alameda, Contra Costa, and Los Angeles Counties.

About 585,000 tons of calcined gypsum was produced, 15 percent less than in 1966 and the smallest quantity in more than 10 years. Consumption of agricultural gypsum was nearly 1.2 million tons, including crude gypsum mined and byproduct gypsum from magnesia and phosphoric acid plants, more than half of which came from Kern County mines. Producers of portland cement consumed 360,000 tons of crude and byproduct gypsum in 1967.

Iodine.—No crude iodine was produced in 1967. The Dow Chemical Co., which ceased production in 1966, continued to make potassium and titanium iodates in its Seal Beach plant, Orange County, until April at which time the facilities were shut down.

At Compton, Los Angeles County, Deepwater Chemical Co. purchased foreign crude iodine and produced various iodides and iodates. Some crude iodine was resublimed for resale.

Lime.—Lime and dead-burned dolomite production decreased over 2 percent. The decline was attributed to lower consumption at magnesia, water purification, and masonry plants, and at sugar refineries. Greater consumption was reported for soil stabilization, insecticide manufacture, and ore processing. Producer consumption was 330,000 tons and sales totaled 209,000 ton. California consumers received 225,000 tons of lime from out-of-State plants, 17,000 tons more than in 1966. Total consumption of primary lime was about 740,000 tons, down more than 2,000 tons from 1966.

The Flintkote Co. planned construction of a lime hydrating facility in Los Angeles County similar to one established by the company in 1966 at Richmond, Contra Costa County.

Lithium Compounds.—American Potash & Chemical Corp., division of Kerr-McGee Corp., recovered dilithium sodium phos-

phate from Searles Lake brines in a plant at Trona, San Bernardino County. The compound was converted to finished lithium carbonate before shipment. Plant output was 1 percent above that in 1966.

Magnesium Compounds.—Production, sales, and producer consumption of magnesium compounds were lower than in 1966. The decline was particularly significant in refractories use, reflecting a depressed steel indutry. FMC Corp. extracted magnesia from salt-works bitterns at plants in Alameda and San Diego Counties. The San Diego plant also produced magnesium chloride. Kaiser Aluminum & Chemical Corp. and Merck & Co., Inc., recovered magnesia from sea water at plants in Monterey and San Mateo Counties, respectively. Kaiser consumed most of its output in the manufacture of refractories, most of which were used in the integrated steel plant of Kaiser Steel Corp., San Bernardino County. Merck also produced magnesium carbonate and magnesium trisilicate in its San Mateo County plant where an extensive modernization program was completed in 1967.

Mica.—Western Industrial Minerals mined mica (sericite schist) near Ogilby, Imperial County, and dry-ground the material for sale to a paint manufacturer. The Bouquet Canyon property near Saugus, Los Angeles County, was idle throughout the year, and exploration work only was reported from the Hyalumsil claims near Quincy, Plumas County.

Kelly-Moore Paint Co., Inc., mined and stockpiled mica schist near LeGrande, Mariposa County, but none of the rock was processed or shipped.

Perlite.—The Fish Springs quarry, Inyo County, operated by American Perlite Co., was the State's only active perlite property. A small tonnage of stockpiled crude perlite at the Alvo mine, Napa County, of Perlite Materials Co. was expanded and used by the producer for lightwe'ght aggregate. American Perlite shipped to its affiliate and other expanding plants in Los Angeles County.

A total of 11 expanding plants were operated in five counties, seven in Los Angeles County and one each in Napa, Contra Costa, San Diego, and Sonoma Counties. Plants in the last three named counties purchased all their crude requirements from sources outside the State. Five of the seven Los Angeles plants also obtained some crude perlite from out-of-State.

Crude sales declined 26 percent and sales of expanded perlite dropped more than 32 percent, compared with 1966. About 37 percent of the expanded output was used for filter aids, 30 percent for plaster aggregate, 9 percent as filler, 8 percent for soil conditioner, 7 percent as concrete aggregate, and 9 percent for all other uses including loosefill insulation.

Potassium Salts.—American Potash & Chemical Corp., division of Kerr-McGee Corp., the State's only producer of potassium compounds, extracted potassium chloride from Searles Lake brines at Trona, San Bernardino County, and converted part of the output to potassium sulfate. Overall production was above that of 1966. Although more sulfate was produced, sales were lower.

Pumice.—Combined output of pumice, pumicite, and volcanic cinder rose nearly 50 percent above 1966 figures but sales of prepared material were 9 percent lower. The overall increase in production was attributed to large tonnage of volcanic cinder used in road construction and maintenance by Federal, State, and County agencies. Crude sales represented 86 percent of the total output with only 14 percent of all materials having been crushed, screened, ground, or otherwise processed before shipment.

Salt.—Salt production continued its rising trend and established a record high in 1967. Seven companies and one metropolitan water district reported crude salt production by solar evaporation. Most of the output was recovered from sea water at evaporating ponds in three San Francisco Bay Area counties—Alameda, San Mateo, and Napa. Additional production came from seawater ponds in Monterey, Orange, and San Diego Counties, and from inland dry lakes in Kern and San Bernardino Counties. Leslie Salt Co., the State's largest producer, made all grades of salt in its Alameda County plant at Newark. Morton Salt Co. refined purchased crude salt in an adjacent plant. All other companies produced the crude product only. Leslie also produced some rock salt at Bristol Lake, San Bernardino County. Nearly half the total output went to

Table 12.—Pumice [1] sold or used by producers in 1967, by counties

County	Crude		Prepared		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Inyo	-------	-------	W	W	W	W
Kern	W	$11,454	W	W	W	$11,454
Lake	W	W	W	W	93,760	211,407
Lassen	25,000	25,000	W	W	25,000	25,000
Madera	-------	-------	W	W	W	W
Modoc	320,322	320,322	-------	-------	320,322	320,322
Mono	W	W	10,313	W	10,313	W
Napa	648	1,200	-------	-------	648	1,200
San Bernardino	-------	-------	17,444	$17,951	17,444	17,951
Shasta	57,059	76,699	817	1,591	57,876	78,290
Siskiyou	284,620	286,691	17,820	45,100	302,440	331,791
Tehama	6,264	6,396	-------	-------	6,264	6,396
Undistributed	48,958	71,520	77,109	493,528	32,307	353,641
Total	742,871	799,282	123,503	558,170	866,374	1,357,452

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

consumers in California although significant quantities were exported to Japan and Canada, and shipped to Arizona, Nevada, Oregon, and Washington.

Sand and Gravel.—Production of sand and gravel was about 4.6 million tons less than in 1966. The decline occurred in southern California—over 4 million tons in Los Angeles County alone—and was attributed entirely to reduced building construction. Output in northern California rose about 430,000 tons to supply the requirements for construction of freeways, a section of the Bay Area Rapid Transit system in Alameda County, Bullards Bar Dam in Yuba County, and resorts in the Lake Tahoe area.

The total value of the overall output remained virtually unchanged from 1966. The unit value increase of $0.05 per ton was attributed to a lower volume of base and fill material and a higher cost for specification materials used in the construction of sections of Interstate Highways 5 and 8.

Sand and gravel was produced in all 58 counties, and output ranged from 40,000 tons in Solano County to over 22 million tons in Los Angeles County. Eight counties—Alameda, Fresno, Los Angeles, Orange, Riverside, Sacramento, San Bernardino, and San Diego—yielded more than 5 million tons each.

Of the 381 sand and gravel operations classified as commercial, 21 produced over 1 million tons each; 32 produced between 500,000 and 1 million tons each; 125, between 100,000 and 500,000 tons each; and 201, less than 100,000 tons each. Over 82 percent of the total output was supplied by commercial producers, other than government crews, and onsite contractors.

Production of ground and unground industrial sands increased slightly above 1966 figures, particularly for glass manufacture and industrial fillers. A lower output was reported for blast, molding, engine, and filtration uses.

Sodium Compounds.—Sales of sodium compounds were below the 1966 figures. A decline in sales of sodium carbonate more than offset an increase reported for sodium sulfate. Soda ash and sodium sesquicarbonate were recovered from the brines of Owens Lake, Inyo County, by Pittsburgh Plate Glass Co.; byproduct salt cake was produced by United States Borax & Chemical Corp. in its Wilmington refinery, Los Angeles County, from crude borates mined by the company in Kern County; and American Potash & Chemical Corp., division of Kerr-McGee Corp., and Stauffer Chemical Co. each produced soda ash and salt cake from Searles Lake brines, San Bernardino County. Stauffer also produced Glauber's Salt at its Searles Lake plant and recovered byproduct anhydrous sodium sulfate from purchased Kern County borates in its San Francisco facility.

Stone.—Stone production was down nearly 14 percent from that of 1966. The drop was attributed largely to lower requirements for miscellaneous stone used for

Table 13.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Sand		Gravel		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	47,831	$53,658	64,354	$74,520	112,185	$128,178
1964	45,297	53,309	67,698	76,024	112,995	129,333
1965	48,536	58,152	69,774	78,075	118,310	136,227
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

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Glass	W	W	W	W
Molding	67	$320	63	$287
Building	21,347	25,046	18,837	22,227
Paving	14,906	16,123	13,756	15,264
Blast	271	1,160	262	1,152
Engine	62	179	54	153
Filter	13	62	W	W
Other	6,062	8,746	7,373	10,613
Total	42,728	51,636	40,345	49,696
Gravel:				
Building	24,904	30,054	20,739	25,596
Paving	31,886	37,858	28,757	34,939
Railroad ballast	153	194	251	279
Other	3,513	3,632	5,602	6,672
Total	60,456	71,738	55,349	67,486
Total sand and gravel	103,184	123,374	95,694	117,182
Government-and-contractor operations: [1]				
Sand:				
Building	103	119	110	127
Paving	2,870	3,535	7,777	8,958
Fill	3,222	1,835	504	498
Other	7	19	3	5
Total	6,202	5,508	8,394	9,588
Gravel:				
Building	34	82	129	219
Paving	9,715	8,924	10,151	10,856
Fill	1,414	1,044	1,634	1,235
Other	143	225	123	132
Total	11,306	10,275	12,037	12,442
Total sand and gravel	17,508	15,783	20,431	22,030
All operations:				
Sand	48,930	57,144	48,739	59,284
Gravel	71,762	82,013	67,386	79,928
Total	120,692	139,157	116,125	139,212

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

Table 15.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Alameda	10,341	$12,389	Plumas	426	$449
Butte	1,565	1,770	Riverside	5,572	8,062
Colusa	658	610	Sacramento	5,023	6,416
Del Norte	378	392	San Bernardino	5,611	6,251
El Dorado	180	313	San Diego	6,609	9,932
Fresno	6,630	8,051	San Joaquin	2,931	3,798
Glenn	333	W	San Luis Obispo	459	611
Humboldt	754	969	Santa Barbara	1,593	1,552
Imperial	3,160	4,090	Santa Clara	3,019	2,869
Inyo	427	552	Santa Cruz	1,500	1,680
Kern	3,059	4,366	Shasta	2,383	1,941
Kings	325	325	Sierra	174	234
Lake	415	539	Siskiyou	637	642
Lassen	328	392	Solano	40	47
Los Angeles	22,246	24,957	Sonoma	2,318	2,206
Madera	1,285	1,468	Stanislaus	938	1,137
Mariposa	50	68	Sutter	114	114
Mendocino	726	919	Tehama	410	423
Merced	1,748	2,254	Trinity	136	159
Modoc	198	W	Tuolumne	90	90
Mono	147	149	Ventura	3,775	3,544
Monterey	978	1,902	Yolo	2,018	W
Napa	44	60	Yuba	1,004	1,232
Nevada	641	1,061	Other counties [1]	3,700	9,081
Orange	8,575	8,521			
Placer	454	625	Total	116,125	139,212

W Withheld to avoid disclosing individual company confidential data; included with "Other Counties."
[1] Includes Alpine, Amador, Calaveras, Contra Costa, Marin, San Benito, San Francisco, San Mateo, and Tulare.

riprap as major flood control and water resource projects were completed. Declines were reported for all stone categories. The demand for limestone and oystershell for use in making cement and lime was about 1 million tons below the 1966 level. The output of stone for concrete aggregate and roadstone also was down 1 million tons. Basalt quarries in the San Francisco Bay Area counties of Alameda, Napa, and Sonoma supplied aggregate for the Bay Area Rapid Transit (BART) system construction. Because of reduced residential construction, basalt quarries in Contra Costa and Marin Counties were idle throughout the year, but sandstone output in Contra Costa County was relatively high in order to meet BART and freeway needs.

A generally depressed construction industry required less marble for terrazzo and roofing granules; less sand-stone, quartz, and quartzite for cement and brick manufacture; and much less dimension stone for use in building construction. The output of slate was off 6,000 tons from that in 1966. A drop in the tonnage of decomposed granite for subsurfacing roads and base material for building construction was partly offset by the production of granite from southern California quarries for harbor development and building of offshore well-drilling islands.

Sulfur.—Eight companies recovered elemental sulfur from sour natural gas and refinery gases at nine plants in three counties—three in Contra Costa, five in Los Angeles, and one in San Luis Obispo. In all instances the Klaus process, or a modification, was used to recover the sulfur. Production and shipments rose 2 and 16 percent, respectively, compared with 1966 levels. Douglas Oil Co., Los Angeles County, began production late in 1966 and Shell Oil Co., Contra Costa County, went onstream early in 1967.

Sulfur ore was produced by only one company, Inyo Soil Sulphur Co., which produced and shipped sulfur ore from the Crater deposit, Inyo County. The tonnage shipped was slightly higher than in 1966 but the value declined 42 percent.

Talc, Soapstone, and Pyrophyllite.—Mine output and shipments to grinders of talc, soapstone, and pyrophyllite rose 4 and 6 percent, respectively, from 1966 levels while sales to consumers dropped 8 percent. Consumption, all categories, was up 13 percent with the most notable ton-

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

Use		1966		1967	
		Quantity	Value	Quantity	Value
Dimension stone:					
Rough construction and rubble	short tons	240,134	$759,823	157,064	$680,606
Rough architectural	cubic feet	W	W	78,816	883,278
Approximate equivalent	short tons	W	----------	6,475	----------
Monuments and mausoleums	cubic feet	[1] 57,887	[1] 571,594	12,208	229,214
Approximate equivalent in	short tons	[1] 4,920	----------	1,069	----------
Flagging	cubic feet	33,597	66,589	35,339	66,773
Approximate equivalent in	short tons	2,873	----------	3,017	----------
Total dimension stone approximate	do	247,927	1,398,006	167,625	1,859,871
Crushed and broken stone:					
Riprap	do	10,635,683	12,976,784	6,450,780	10,421,442
Metallurgical	do	W	W	W	W
Concrete and roadstone	do	15,450,210	20,509,414	14,273,307	17,750,088
Railroad ballast	do	W	W	W	W
Agricultural	do	W	W	W	W
Chemical	do	W	W	W	W
Miscellaneous [2]	do	[3] 16,716,862	[3] 26,451,486	[4] 16,293,848	[4] 25,231,368
Total crushed and broken stone	do	42,802,755	59,937,684	37,017,935	53,402,898
Grand total approximate	do	43,050,682	61,335,690	37,185,560	55,262,769

W Withheld to avoid disclosing individual company confidential data.
[1] Includes rough architectural.
[2] Includes whiting substitute, filler, mineral food, poultry grit, stucco, roofing granules, filter beds, terrazzo, miscellaneous, and crushed and broken stone uses indicated by symbol W.
[3] Includes 12,022,091 tons of limestone and oystershell used in cement valued at $11,772,970 and 748,698 tons of limestone used in lime valued at $2,227,037.
[4] Includes 10,964,120 tons of limestone and oystershell used in cement valued at $11,023,183 and 628,993 tons of limestone used in lime valued at $1,887,932.

Table 17.—Stone [1] production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Alameda	2,269	$1,508	Riverside	1,115	$3,401
Alpine	11	14	San Benito	W	W
Amador	1	2	San Bernardino	5,163	8,590
Butte	3	3	San Diego	1,868	4,188
Calaveras	W	W	San Luis Obispo	W	W
Contra Costa	2,975	4,322	San Mateo	1,496	2,111
Del Norte	304	598	Santa Barbara	13	54
El Dorado	425	1,452	Santa Clara	4,917	3,878
Fresno	170	217	Santa Cruz	1,120	1,618
Humboldt	309	438	Shasta	W	W
Imperial	8	7	Sierra	25	15
Inyo	214	788	Siskiyou	176	193
Kern	2,324	2,694	Solano	455	711
Lake	16	37	Sonoma	400	W
Lassen	5	W	Stanislaus	[2]	[2]
Los Angeles	2,612	4,399	Sutter	W	W
Madera	64	223	Tehama	14	17
Marin	W	W	Trinity	501	379
Mariposa	223	54	Tulare	220	302
Mendocino	80	W	Tuolumne	W	W
Merced	1,964	1,588	Ventura	104	123
Modoc	35	W	Yuba	18	14
Mono	[2]	[2]	Other counties	5,519	11,312
Monterey	W	W			
Napa	W	W	Total	37,186	55,263
Nevada	23	11			
Orange	[2]	[2]			
Placer	W	W			
Plumas	27	2			

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.

Table 18.—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]	
1963	3,814	$6,098	2,024	$2,801	16,447	$22,806
1964	3,994	5,479	2,282	3,144	16,908	23,582
1965	4,286	6,193	2,480	3,035	15,840	22,959
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
	Sandstone		Other stone [2]		Total	
1963	3,363	$5,898	12,329	$20,650	37,977	$58,253
1964	3,065	6,118	19,556	25,243	45,805	63,566
1965	4,061	7,202	15,908	20,279	42,575	59,668
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

[1] Includes limestone and oystershell used in cement and lime as follows (in thousand short tons and thousand dollars): 1963, 13,242 tons, $13,580; 1964, 13,657 tons, $14,226, 1965, 12,993 tons, $13,870; 1966, 12,771 tons, $14,000; 1967, 11,593 tons, $12,911.

[2] Includes light-colored volcanics, schist, serpentine, river boulders, and such other stone as cannot properly be classed in any main group; also marble and slate.

nage increases reported for rubber, paint, and insecticide uses. Comparatively high average unit prices led to the use of substitute materials, such as diopside from an Arizona mine, for ceramic use. Exports (all talc) totaled nearly 1,000 tons.

All pyrophyllite mined in 1967 came from San Diego County deposits although shipments were made to grinders from stockpiles in Mono and San Bernardino Counties. Mines in Inyo and San Bernardino Counties yielded all the State's talc and deposits in Amador, El Dorado, and Los Angeles Counties, all the soapstone.

Grinding plants were operated in Alameda County (talc and soapstone), El Dorado County (soapstone), Inyo County (talc and soapstone), Los Angeles County (talc and soapstone), San Bernardino County (talc, soapstone, and pyrophyllite), and San Diego County (pyrophyllite).

Other Nonmetals.—Chas. Pfizer & Co., Inc., produced natural and manufactured iron oxide pigments in an Alameda County plant, the only such facility in California. Output was 5 percent below that in 1966. Declines were reported in all categories except manufactured yellows. Basic raw material for the natural products came from out-of-State sources.

Phosphate rock from Idaho mines and pebble phosphate from Florida were shipped to chemical and fertilizer plants in Contra Costa, San Francisco, and San Joaquin Counties. Pebble phosphate shipments into the State rose 44 percent but receipts of phosphate rock from Idaho by California consumers were nearly 8 percent lower than in 1966.

Vermiculite exfoliation plants were operated in Alameda and Los Angeles Counties by California Zonolite Co., using crude ore received from the company mine in Montana. La Habra Products Co. exfoliated crude vermiculite, imported from the Republic of South Africa, in its Orange County plant. Plant products were used chiefly for lightweight aggregate in plaster and concrete, thermal and accoustical insulation, and a soil conditioner at nurseries. All sales except those for aggregate were higher than in 1966.

Wollastonite was mined from an open pit near Spanish Springs, Inyo County, by International Pipe & Ceramics Corp. and near Blythe, Riverside County, by Chas. Pfizer & Co., Inc. In both instances the mineral was used in ceramics. Float wollastonite collected in previous years for use as building and ornamental stone, was not collected in 1967. Total production dropped substantially.

Western Industrial Minerals made a test shipment of kyanite from its Bluebird No. 1 claim, Imperial County, to a prospective customer in Colorado.

In Antelope Valley, Kern County, Great Lakes Carbon Corp. operated furnaces to produce synthetic graphite used in making anodes, electrodes, and crucibles and other vessels.

Water.—About midyear Union Oil Company of California joined with Magma-Thermal Power Project in the production of geothermal steam at The Big Geysers, Sonoma County. The agreement called for Union to operate the production facilities and the company began an aggressive drilling program on 14,000 acres in the area. Thermal Power Co. reported that 41 geothermal steam wells had been drilled in the area by the Magma-Thermal Project with an electrical potential of 200,000 kilowatts (kw). Pacific Gas & Electrical Co., contractor for the Magma-Thermal steam, completed its third generating unit, raising the generating capacity to 54,000 kw. A fourth unit of 27,000 kw was scheduled for completion in 1968. Land leasing in potential geothermal areas continued at a vigorous rate throughout 1967. Near The Geysers and Calistoga, Sonoma County, over 80,000 acres was leased, mainly to the above-mentioned companies, and Geothermal Resources International (G. R. I.) and Signal Oil and Gas Co. Geothermal tests were drilled by G. R. I. and Signal in 1967. The G. R. I. well, at 6,700 feet, was the deepest and westernmost well drilled to date and indicated a capability of producing steam to generate 9,000 kw.

In the Niland area, Imperial County, no geothermal steam energy had been developed. However, Morton International announced plans to construct a plant to recover sodium and calcium chloride from geothermal brines, using steam flashing in the final stages for drying sodium chloride, and Western Geothermal, Inc., continued production of calcium chloride, begun in 1966, from geothermal brines.

During 1967, the Federal Water Pollution Control Administration awarded $1,121,783 in grants and contracts to cities, counties, industries, universities, and individuals in California for water pollution research and development. The grants and contracts were made under programs authorized by the Clean Water Restoration Act of 1966. The largest grant, $564,000, was made to Los Angeles County to provide a 500,000-gallon-per-day advance waste treatment and water renovation facility which would provide water for recreation in an arid region.

In November, the U.S. Government and the Metropolitan Water District of Southern California signed a contract for design, construction, and operation of a nuclear desalting plant at Bolsa Island, a manmade island off the coast of southern California. The total capital cost of the project was estimated at $444 million. The Department of the Interior was to provide up to $45.7 million toward the capital cost, plus an additional $11.5 million for operation and maintenance. The Atomic Energy Commission was to provide up to $15 million toward various features involved in the total cost. Partial operation was expected in 1973.

METALS

Antimony.—No antimony ore was mined or shipped. The San Buena mine, San Bernardino County, which yielded a small tonnage in 1966, reported exploration and development work only.

Copper.—Virtually all copper produced was recovered as a byproduct in the treatment of other ores. Only two copper properties were active in 1967 and they yielded a combined output of only about 1 ton of metal. Most of the production was credited to four mines in Inyo County—Pine Creek tungsten mine, Darwin group of lead-zinc claims, Columbia (Shoshone group) lead-zinc mine, and Santa Rosa lead mine. Total output dropped 27 percent from 1966, partly because of a lengthy labor strike at nonferrous smelters.

Gold.—Gold production declined 37 percent from 1966, almost entirely because of greatly curtailed dredging operations in Yuba County. One bucketline dredge worked stream and ancient riverbed gravels on the Yuba River compared with three dredges in 1966. Output from the Yuba dredge and 17 byproduct recovery units at sand and gravel washing plants throughout the State accounted for 98 percent of the total placer gold recovered. The remaining 2 percent was recovered by individuals who used small-scale hand methods to work stream gravels in 15 counties.

Lode gold output was only 5 percent lower than in 1966 and came from the ores of 28 lode mines, 17 of which were classified as gold properties and yielded 77 percent of the total. Only two mines, both gold, produced more than 100

Table 19.—Mine production of gold, silver, copper, lead and zinc in 1967, by counties, in terms of recoverable metals

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value	Troy ounces	Value
Amador	---	(2)	2	$70	---	---
Butte	1	---	4	140	1	$2
Calaveras	---	(2)	10	350	4	6
Del Norte	---	1	2	70	---	---
El Dorado	---	(2)	27	945	1	2
Fresno	---	(2)	742	25,970	109	169
Inyo	6	---	169	5,915	134,663	208,727
Los Angeles	---	1	125	4,375	W	W
Mariposa	5	(2)	80	2,800	16	25
Merced	---	(2)	27	945	3	5
Nevada	1	5	300	10,500	27	42
Placer	1	5	72	2,520	8	12
Plumas	---	3	39	1,365	3	5
Sacramento	2	(2)	1,119	39,165	965	1,495
San Bernardino	4	(2)	7	245	311	482
Shasta	---	(2)	96	3,360	9	14
Sierra	1	3	801	28,035	180	279
Stanislaus	---	(2)	98	3,430	485	752
Tulare	---	(2)	18	630	2	3
Tuolumne	1	2	18	630	W	W
Yuba	---	1	35,892	1,256,220	791	1,226
Undistributed [3]	7	4	922	32,270	6,937	10,752
Total	29	25	40,570	1,419,950	144,515	223,998

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Amador	---	---	---	---	---	---	$70
Butte	---	---	---	---	---	---	142
Calaveras	---	---	---	---	---	---	356
Del Norte	---	---	---	---	---	---	70
El Dorado	---	---	---	---	---	---	947
Fresno	---	---	---	---	---	---	26,139
Inyo	W	W	3,247,800	$454,692	W	W	669,334
Los Angeles	---	---	---	---	---	---	4,375
Mariposa	---	---	---	---	---	---	2,825
Merced	---	---	---	---	---	---	950
Nevada	---	---	---	---	---	---	10,542
Placer	---	---	---	---	---	---	2,532
Plumas	---	---	---	---	---	---	1,370
Sacramento	---	---	---	---	---	---	40,660
San Bernardino	W	W	3,500	490	---	---	1,217
Shasta	---	---	---	---	---	---	3,374
Sierra	---	---	---	---	---	---	28,314
Stanislaus	300	$115	212,500	29,750	---	---	34,047
Tulare	---	---	---	---	---	---	633
Tuolumne	---	---	---	---	W	W	630
Yuba	---	---	---	---	---	---	1,257,446
Indistributed [3]	1,575,700	602,327	6,200	868	882,000	$122,095	768,312
Total	1,576,000	602,442	3,470,000	485,800	882,000	122,095	2,854,285

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

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

[2] From property not classed as a mine.

[3] Includes Alpine, Imperial, Kern, Riverside, San Joaquin, Siskiyou, and Trinity Counties and counties indicated by symbol W.

Table 20.—Gold produced at placer mines, by classes of mines and methods of recovery [1]

Class and method	Mines producing [2]	Numer of washing plants (dredges)	Material treated (thousand cubic yards)	Gold recovered		
				Troy ounces	Value	Average value per cubic yard
Surface placers: Gravel mechanically handled:						
Bucketline dredges:						
1963	2	6	12,817	77,448	$2,710,680	$0.212
1964	1	3	11,611	62,422	2,184,770	.188
1965	1	3	12,412	53,937	1,887,795	.152
1966	1	3	12,102	58,863	2,060,205	.170
1967	1	1	4,348	35,819	1,253,665	.288
Dragline dredges: [3]						
1963	3	3	256	1,109	38,815	.152
1964	1	1	132	545	19,075	.145
1965	2	2	540	1,096	38,360	.071
1966	3	3	191	1,314	45,990	.241
1967	2	2	54	150	5,250	.097
Suction dredges:						
1963	10	10	12	178	6,230	.498
1964	3	3	1	112	3,920	3.439
1965	1	1	(4)	8	280	.560
1966	2	2	10	52	1,820	.182
1967	3	3	(4)	15	525	.633
Nonfloating washing plants: [3 5]						
1963	2	19	(4)	1,349	47,215	r 2.267
1964	2	18	5	1,203	42,105	.381
1965	1	16	(4)	1,047	36,645	3.500
1966	1	19	(4)	2,028	70,980	.514
1967	1	18	180	2,394	83,790	.466
Gravel hydraulically handled:						
1963	4	-----	13	100	3,500	.279
1964	1	-----	2	73	2,555	1.278
1965	--	-----	--------	----------	----------	-------
1966	--	-----	--------	----------	----------	-------
1967	--	-----	--------	----------	----------	-------
Small-scale hand method: [6]						
1963	51	-----	54	2,612	91,420	1.701
1964	30	-----	54	1,420	49,700	.918
1965	21	-----	24	2,476	86,660	3.617
1966	16	-----	27	851	29,785	1.110
1967	17	-----	18	615	21,525	1.196
Underground placers: Drift:						
1963	7	-----	4	202	7,070	1.656
1964	1	-----	16	163	5,705	.352
1965	1	-----	(4)	7	245	4.900
1966	2	-----	(4)	13	455	7.583
1967	1	-----	(4)	15	525	5.250
Grand total placers:						
1963	79	-----	13,156	82,998	2,904,930	.221
1964	39	-----	11,821	65,938	2,307,830	.195
1965	27	-----	12,976	58,571	2,049,985	.158
1966	25	-----	12,330	63,121	2,209,235	.179
1967	25	-----	4,601	39,008	1,365,280	.297
1848–1967	--	-----	NA	68,453,191	1,531,599,331	NA

r Revised, NA Not Available.

[1] For historical data by years, see Minerals Yearbook, Review of 1940, p. 219.

[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.

[3] Includes commercial rock plants and tungsten mines that produced byproduct gold, from gravels; byproduct gold is included with gold recovered, but material treated and average value per cubic yard refer only to straight gold dredging.

[4] Less than ½ unit.

[5] Includes all placer operations using power excavator and washing plants both on dry land; when the washing plant is a movable outfit, it is termed "dryland dredge."

[6] Includes all operation in which hand labor is principal factor in delivering gravel to sluices, long toms.

Table 21.—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)
1963	50	79	21	86,867	$3,040	156,528	$200
1964	43	39	16	71,028	2,486	171,621	222
1965	51	27	20	62,885	2,201	196,787	254
1966	52	25	25	64,764	2,267	189,989	246
1967	29	25	15	40,570	1,420	144,515	224
1848–1967	--	-----	NA	106,234,677	2,420,317	120,009,676	98,223

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	916	$564	823	$178	101	$23	$4,005
1964	1,035	675	1,546	405	143	39	3,827
1965	1,165	825	1,810	565	225	66	3,911
1966	1,078	780	1,976	597	335	97	3,987
1967	788	602	1,735	486	441	122	2,854
1848–1967	644,914	212,550	271,766	54,677	151,820	35,893	2,821,660

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer operations); ore milled; old tailings or slimes retreated; tungsten ore; and ore, old tailings, slag, flue dust, and pyritic ore residue shipped to smelters during calendar year indicated.
[2] Excludes itinerant prospectors, "snipers," "high-graders," and others who gave no evidence of legal right to property.
[3] Does not include gravel washed.

Table 22.—Mine production of gold, silver, copper, lead, and zinc in 1967, by types of material processed and methods of recovery in terms of recoverable metal [1]

Type of material processed, and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation and cyanidation:					
Ore	400	65	----------	----------	---------
Old tailings	73	8	----------	----------	---------
Total	473	73	----------	----------	---------
Concentration and smelting of concentrates: Ore [2]	233	70,316	1,565,600	530,900	675,800
Direct smelting: Ore	856	72,136	10,400	2,939,100	206,200
Placer	39,008	1,990	----------	----------	---------
Grand total	40,570	144,515	1,576,000	3,470,000	882,000

[1] Includes gold recovered as "natural gold."
[2] Includes tungsten-ore concentrate.

ounces of recoverable gold each—the Oriental, Sierra County, and the Kelly, Trinity County.

Iron Ore.—Production and shipments of usable iron ore were only slightly lower than in 1966. A marked drop in direct shipping grade ore and a 13-percent decline in sinter production were offset by a 25-percent increase in the quantity of pellets shipped. Domestic shipments rose 17 percent; exports declined 22 percent. The Kaiser Steel Corp. Eagle Mountain mine, Riverside County, continued as the State's principal iron ore source and pellets from the company mine-site plant constituted more than one-third of all shipments. Pacific Western Industries, Inc. opened an iron deposit on the Tejon Ranch to supply ore for the company's

Table 23.—Mine production of gold, silver, copper, lead, and zinc in 1967, by classes of ore or other source materials in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Gold	17	2,093	1,204	254	---	---	100
Gold-silver	1	1,660	87	3,618	200	1,300	1,200
Silver	1	8	---	166	100	---	---
Copper and tungsten ore	2	[2] 15	42	20,733	1,553,700	---	---
Lead	5	3,317	42	64,769	4,700	2,774,100	153,800
Lead-silver	1	43	29	3,181	500	4,900	100
Lead-zinc	2	7,860	85	49,796	16,800	689,700	726,800
Total	29	14,996	1,489	142,517	1,576,000	3,470,000	882,000
Other lode material: Old tailings	(3)	32	73	8	---	---	---
Total lode material	29	15,028	1,562	142,525	1,576,000	3,470,000	882,000
Placer	25	(4)	39,008	1,990	---	---	---
Total all sources	54	15,028	40,570	144,515	1,576,000	3,470,000	882,000

[1] Detail will not necessarily add to total, because some mines produce more than one class of material.
[2] Tungsten-ore tonnage not included.
[3] From property not classed as a mine.
[4] 4,408,458 cubic yards. Does not include material washed at commercial gravel plants to produce 2,393 ounces of byproduct gold and 1,119 ounces of byproduct silver included in placer totals.

cement facility. Concentrate produced by American Exploration & Mining Co. at its Iron Age mine, San Bernardino County, was shipped to domestic steel plants and to customers for use in cement manufacture and for heavy aggregate. The Kaiser Steel Corp. Silver Lake mine, San Bernardino County, was idle in 1967 but shipments were made from stockpile to the company's integrated iron and steel facility at Fontana.

Lead.—As in preceding years, lead production came principally from Inyo County. Five mines—the Columbia (Shoshone) and Darwin groups of lead-zinc claims, and the Jubilee, Queen of Sheba, and Santa Rosa lead mines—yielded 94 percent of the total lead recovered. The Darwin property was not in production in 1966. About 240 tons less lead was recovered from all ores than in 1966, partly because of labor strikes at nonferrous smelters.

Mercury.—Mercury production rose by only 315 flasks despite a higher average unit value but shipments were up 13 percent from 1966, reflecting a liquidation of producer inventories. Although 78 mercury mines and prospects were active all or part of the year, only 17 properties yielded more than 100 flasks each. These 17 mines produced over 96 percent of the State total. The three major producers—New Idria Mining and Chemical Co., San Benito County; Buena Vista Mines, Inc., San Luis Obispo County; and Sonoma International, Inc., Sonoma County—recovered 66 percent of the mercury produced and made 67 percent of the shipments. New Idria continued as the largest individual domestic producer. Of the 82 operators reporting production and shipments, 15 used furnaces, or both furnaces and retorts, to recover the metal; 65 used retorts only, and two recovered the metal using placering methods in the vicinity of the old Oat Hill recovery plant, Napa County. Most of the mining activity and production was in the three counties where the major producers were located with 13 active properties in Sonoma County, 11 in San Luis Obispo County, and 10 in San Benito County representing 72 percent of the total output. Santa Clara County, where Guadalupe and Almaden mines are located, was the only other county where combined recoveries even approached 1,000 flasks of mercury.

Two new discoveries were made in 1967, both in the Basin Range province of eastern California. One, the Last Chance mine north of the Crater sulfur claims, Inyo County, was opened by El

Capitan Mining Co. The ore was trucked to and stockpiled at a plant near Keene, Kern County, where furnacing was to begin early in 1968. The other, the Chiefs mine near Bridgeport, Mono County, was producing ore and plans were made for treatment in a custom furnace in Aurora Canyon to be operated by American Mining and Chemical Co.

In June, Sonoma International, Inc., announced it would develop the Altoona mercury mine, Trinity County. Earlier the company had discontinued work at the Baker mine, Lake County.

Molybdenum.—Union Carbide Corp. recovered molybdenite and powellite as byproducts (as sulfide and oxide concentrates, respectively) in the treatment of tungsten ores from its Pine Creek mine, Inyo County. Molybdenite production was lower than in 1966 but shipments more than doubled. The reverse was true of powellite as production rose slightly and shipments dropped nearly 40 percent. All shipments were consigned to domestic customers.

Pig Iron, Sinter, and Ferrous Scrap.—Kaiser Steel Corp. produced all the State's pig iron in blast furnaces at Fontana, San Bernardino County. The furnaces used 14 percent less ore (concentrate) but 15 percent more agglomerate (sinter and pellets) in producing 1 percent less pig iron. The output was 95 percent basic pig iron and 5 percent direct castings. Kaiser steel furnaces consumed 23 percent more ore (concentrate), 91 percent less agglomerate, 2 percent less pig iron (hot metal), and 5 percent more scrap (home and purchased) than in 1966. United States Steel Corp. at Torrance, Los Angeles County, was the only other steel producer using pig iron in addition to scrap. All others operated on scrap alone. Overall consumption of ferrous scrap and pig iron was down 1 percent from 1966 while use at steel furnaces was virtually unchanged.

Platinum.—Byproduct platinum-group metals were recovered from stream and ancient riverbed gravels and from old tailings at the bucketline gold dredging operation of Yuba Consolidated Gold Fields on the Yuba River, Yuba County. The output was the only reported recovery of platinum in the State. The quantity recovered was 46 percent below that in 1966.

Table 24.—Mercury production, by methods of recovery

Year	Operating mines	Recovery method: Furnaced [1] Ore treated (short tons)	Furnaced [1] 76-pound flasks	Retorted Ore treated (short tons)	Retorted 76-pound flasks	Unclassified 76-pound flasks [2]	Total 76-pound flasks	Total Value [3]
1963	31	61,595	13,273	4,068	303	16	13,592	$2,575,004
1964	39	89,630	8,949	12,595	1,334	8	10,291	3,239,504
1965	84	137,079	11,219	21,060	2,168	17	13,404	7,650,333
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

[1] Includes ore and mercury from dumps not separable.
[2] Includes mercury recovered from miscellaneous dump material, placer, and cleanup operations.
[3] Value calculated at average New York price.

Table 25.—Ferrous scrap and pig iron consumption

(Thousand short tons)

Year	Ferrous scrap	Pig iron
1963	2,415	1,891
1964	2,575	2,250
1965	2,829	2,319
1966	2,991	2,267
1967	2,960	2,245

Rare-Earth Minerals. — Molybdenum Corporation of America (Molycorp) stated in its annual report that 25.5 million pounds of rare-earth oxides were contained in concentrates produced in its Mountain Pass, Calif., mine and mill in 1967 compared with 25.2 million pounds in 1966. Sales of rare-earth products rose about 2 percent. Over 8 million pounds of rare-earth oxides were shipped

Table 26.—Ferrous scrap and pig iron consumption by types of furnaces and miscellaneous uses

(Thousand short tons)

Ferrous scrap and pig iron charged to—	1966	1967
Steel furnaces: [1]		
Scrap	2,592	2,594
Pig iron	2,059	2,048
Total	4,651	4,642
Iron furnaces: [2]		
Scrap	379	353
Pig iron	208	197
Total	587	550
Miscellaneous uses: [3] Scrap	20	13
Total scrap	2,991	2,960
Total pig iron	2,267	2,245
Grand total	5,258	5,205

[1] Includes open hearth, electric furnace, and basic oxygen process.
[2] Includes cupola, air and direct castings.
[3] Includes rerolling, copper precipitation, nonferrous, and chemical uses.

in concentrate form, and 15 million pounds used at Mountain Pass in the production of cerium and europium oxides, and lanthanum hydrate. The total rare-earth oxides sold and used were about 4.4 million pounds less than in 1966.

Construction of rare-earth oxide plant facilities, initiated in 1965, was essentially completed in 1967. Cerium hydrate, lanthanum hydrate, and lanthanum carbonate circuits were installed at the Mountain Pass chemical plant.

Silver.—Ores from four Inyo County lode mines—one lead-zinc (Darwin), one tungsten (Pine Creek), and two lead (Jubilee and Santa Rosa)—yielded over 92 percent of the recoverable lode silver and 91 percent of all silver recovered in 1967. Lode silver production declined 24 percent and the quantity of placer silver (recovered as a coproduct in mining placer gold) dropped 44 percent. Less than 2,000 ounces of placer silver was recovered in 1967.

Despite the interest in silver on the national level, exploration for silver ores was reported at only six properties, two each in Alpine and San Bernardino Counties and one each in Kern and Madera Counties.

Tin.—Production and shipments of tin concentrate increased in 1967. All production was from the Meeke-Hogan mine, Kern County, by American Tin Corp. The entire output was consigned to a New York buyer.

Tungsten.—Although 30 mines and prospects contributed to the total output of tungsten ores and concentrates, two mines—Pine Creek mine of Union Carbide Corp., Inyo County, and Strawberry mine of New Idria Mining & Chemical Co., Madera County—accounted for most of the production and shipments. The Pine Creek mine continued as the largest domestic producer. Union Carbide purchased concentrates from smaller producers in Inyo, Madera, and San Bernardino Counties, and from producers and former producers in Nevada, Idaho, Montana, Utah, and Washington. Major purchases also were made from the Government stockpile. Some of the produced and purchased concentrates were converted to paratungstate in the Pine Creek plant but the company also shipped concentrates and paratungstate to customers in other States.

A number of small producers in Fresno, Inyo, Kern, Riverside, San Bernardino, and Tuolumne Counties sold concentrates to a Nevada tungsten carbide plant. The average price paid for tungsten concentrate was $38 per unit, $6.50 per unit higher than in 1966.

Zinc.—Four Inyo County mines that were also the major lead producers yielded over 99 percent of the zinc recovered in 1967. The Darwin mine was by far the largest producer, followed by the Santa Rosa. Ores from these two mines contained about 96 percent of the total recoverable zinc produced in the State. Overall production rose nearly 32 percent above that in 1966 despite labor strikes at nonferrous smelters. The increase was due largely to production from the Darwin mine which was idle in 1966, except for exploration and development.

Table 27.—Principal producers

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Asbestos:					
Atlas Asbestos Co	P.O. Box 805 Coalinga, Calif. 93210	Open pit mine	Fresno.		
Coalinga Asbestos Co., Inc	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		Plant in King City, Monterey County.
Barite:					
Calada Materials Co	3501 Dock St. Terminal Island, Calif. 93465	Grinding plant	Los Angeles.		
Macco Corp	P.O. Box 727 Paramount, Calif. 90723	do	Kern.		
Wilbur-Ellis Co	P.O. Box 1286 Fresno, Calif. 93700	do	Fresno		Custom grinder.
Yuba Minerals & Milling Co	1615 Bonanza St. Walnut Creek, Calif. 95496	Open pit mine	Shasta		Grinding plants in Sutter County, Calif., and out-of-State.
Boron minerals and compounds:					
American Potash & Chemical Corp.	P.O. Box 2294 Terminal Annex Los Angeles, Calif. 90054	Dry lake brines	San Bernardino	Bromine, lithium, potassium salts, sodium compounds.	
Stauffer Chemical Co	636 California St. San Francisco, Calif. 94119	do	do	Sodium compounds.	
United States Borax & Chemical Corp.	3075 Wilshire Blvd. Los Angeles, Calif. 90005	Open pit mine	Kern	do	Refineries in Kern and Los Angeles Counties, and Calif. out-of-State chemical plants.
Bromine and bromine compounds:					
American Potash & Chemical Corp.	P.O. Box 2294 Terminal Annex Los Angeles, Calif. 90054	Dry lake brines	San Bernardino	Boron, lithium, potassium salts, sodium compounds.	
FMC Corp	P.O. Box 344 Newark, Calif. 94560	Chemical plant	Alameda.		
Calcium chloride:					
Leslie Salt Co	P.O. Box 364 Newark, Calif. 94560	Dry lake brines	San Bernardino.		
National Chloride Company of America.	615 South Flower St. Los Angeles, Calif. 90017	do	do		
Carbon dioxide: Getty Oil Co	P.O. Box 2955 Terminal Annex Los Angeles, Calif. 90054	Natural gasoline processing plant.	Kern.		

See footnote at end of table.

Table 27.—Principal producers—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Cement:					
American Cement Corp	2404 Wilshire Blvd. Los Angeles, Calif. 90057	Dry process portland cement plants.	Riverside and San Bernardino.		2 plants at Crestmore and Oro Grande.
Calaveras Cement Co	315 Montgomery St. San Francisco, Calif. 94104	Wet and dry process portland cement plants.	Calaveras and Shasta.		2 plants at San Andreas and Redding.
California Portland Cement Co	612 South Flower St. Mobil Bldg. Los Angeles, Calif. 90017	Dry process portland cement plants.	Kern and San Bernardino.		2 plants at Mojave and Colton.
Ideal Cement Co	620 Denver National Bldg. Denver, Colo. 80202	Wet process portland cement plants.	San Benito and San Mateo.		2 plants at San Juan Bautista and Redwood City.
Kaiser Cement & Gypsum Corp	Permanente Road Permanente, Calif. 95014	----do----	San Bernardino and Santa Clara.		2 plants, at Lucerne Valley and Permanente.
Monolith Portland Cement Co	Box 65677 Glassell Station Los Angeles, Calif. 90065	----do----	Kern		Plant located at Monolith.
Pacific Cement & Aggregates Division. Lone Star Cement Corp.	400 Alabama St. San Francisco, Calif. 94110.	Dry process portland cement plant.	Santa Cruz		Plant at Davenport.
Pacific Western Industries, Inc	3810 Wilshire Blvd. Los Angeles, Calif. 9005	----do----	Kern		Plant near Lebec.
Southwestern Portland Cement Co.	1034 Wilshire Blvd. Los Angeles, Calif. 90017	Wet and dry process portland cement plant.	San Bernardino		Plant at Victorville.
Clays:					
Ball: Chas. Pfizer & Co., Inc	P.O. Drawer AD Victorville, Calif. 92394	Open pit mine	----do----		Bentonite from Inyo County deposit.
Bentonite: National Lead Co	P.O. Box 1675 Houston, Tex. 77001	----do----	----do----		
Fire:					
International Pipe & Ceramics Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	----do----	Amador, Placer, Riverside, San Bernardino, Sutter, Yuba.		Ball clay in San Bernardino County; miscellaneous clays, Sutter and Yuba Counties.
Lincoln Clay Products Co	P.O. Box 367 Lincoln, Calif. 95648	----do----	Placer.		
Los Angeles Brick & Clay Products Co.	1255 W. 4th St. Los Angeles, Calif. 90017	----do----	Riverside		Also produce miscellaneous clays.
Pacific Clay Products Co	1255 W. 4th St. Los Angeles, Calif. 90017	----do----	Amador, Calaveras, Orange, Riverside.		
Fuller's earth:					
Cyprus Mines Corp	P.O. Box 1201 Trenton, N.J. 08606	----do----	Inyo.		
Mason & Co	Olancha, Calif. 93549	----do----	----do----		
Kaolin: California Non-Metallics	P.O. Box 265 Trabuco Canyon, Calif. 92678	----do----	Orange.		

Miscellaneous clays: [1]					
Atkinson Brick Co	13633 South Central Ave. Los Angeles, Calif. 90059	----do----	Los Angeles.		
Davidson Brick Co	4701 East Floral Drve Los Angeles, Calif. 90022	----do----	----do----		
Excel Mineral Co	3451 East 26th St. Los Angeles, Calif. 90023	----do----	Kern.		
Richard Malugani	4611 Porter Creek Road Santa Rosa, Calif. 95404	----do----	Sonoma		
L. P. McNear Brick Co	P.O. Box 1380 San Rafael, Calif. 94902	----do----	Marin		
Mission Valley Brick Co., Inc	P.O. Box 3217 San Diego, Calif. 92103	----do----	San Diego.		
Port Costa Clay Products Co	P.O. Box 5 Port Costa, Calif. 94569.	----do----	Contra Costa.		
Expansible shale:					
Basalt Rock Co. Inc	8th and River Streets Napa, Calif. 94458	----do----	Napa.		
Crestlite Division of Susquehanna-Western, Inc.	Camino De Estrella San Clemente, Calif. 92672	----do----	Orange.		
The McNear Co	P.O. Box 1380 San Rafael, Calif. 94901	----do----	Marin.		
Ridgelite Products, Inc	650 So. Grand Ave. Los Angeles, Calif. 90017	----do----	San Bernardino and Ventura.	----------	2 pits.
Rocklite Products, Inc	P.O. Box 1535 Ventura. Calif. 93002	----do----	Ventura.		
Coal (lignite): American Lignite Products Co., Inc.	P.O. Box 787 Ione, Calif. 95640	Strip mine	Amador.		
Copper: Union Carbide Corp., Mining & Metals Division.	270 Park Ave., 38th Floor New York, N.Y. 10017	Underground mine.	Inyo	Gold, molybdenum, silver, tungsten.	Byproduct of tungsten production.
Diatomite:					
The Airox Co	307 W. 8th St. Los Angeles, Calif. 90014	Open pit mine	Santa Barbara.		
GREFCO, Inc	630 Shatto Place Los Angeles, Calif. 90005	----do----	----do----		
Johns-Manville Products Corp	Lompoc, Calif. 93436	----do----	----do----		
Feldspar:					
Del Monte Properties Co	P.O. Box 150 Pacific Grove, Calif. 93950	----do----	Monterey	----------	Feldspathic sands.
Owens-Illinois Glass Co	P.O. Box 1035-1036 Toledo, Ohio 43601	----do----	----do----	----------	Do.
Gold: Yuba Industries, Inc	Star Route Marysville, Calif. 95901	Dredging	Yuba	Silver, platinum.	
Gypsum:					
C. L. Fannin Agricultural Gypsum	Route 1, Box 7 Famosa Highway. Wasco, Calif. 93280	Open pit mine	Kern.		
H. M. Holloway, Inc	714 Sixth St. Wasco, Calif. 93280	----do----	----do----		

See footnote at end of table..

Table 27.—Principal producers—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Gypsum—Continued					
Temblor Gypsum Co	Carrisa Plains Star Route Box 70 Santa Margarita, Calif. 93453	Open Pit mine	Kern		
United States Gypsum Co	101 So Wacker Drive Chicago, Ill., 60606	----do	Imperial		Calcining and board plant at Plaster City.
Iron ore: Kaiser Steel Corp	Box 217 Fontana, Calif. 92335	----do	Riverside, San Bernardino.		Integrated steel plant at Fontana.
Lead:					
Paul Bare	P.O. Box 538 Lone Pine, Calif. 93545	Underground mine.	Inyo	Copper, gold, silver, zinc.	
Monte Cristo Mining Corp	P.O. Box 218 Las Vegas, Nev. 89101	----do	----do	Gold, silver, zinc.	
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.		2 plants at Richmond and Sonora.
FMC Corp	P.O. Box 344 Newark, Calif. 94560	Rotary kiln	Alameda.		
Holly Sugar Corp	220 W. 20th Ave. San Mateo, Calif. 94402	Shaft kilns and continuous hydrators.	Alameda, Glenn, Imperial, Orange, San Joaquin.		5 plants at Union City, Hamilton City, Brawley, Santa Ana, and Tracy.
Kaiser Aluminum & Chemical 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.		
Sierra Lime Products Corp	Route 1, Box 194 Pleasant Grove, Calif. 95668	Rotary kiln and continuous hydrator.	El Dorado.		
Spreckles Sugar Co	2 Pine St. San Francisco, Calif. 94111.	Shaft and rotary kilns.	Monterey, San Joaquin, Yolo.		3 plants at Spreckels, Manteca, and Woodland.
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.	P.O. Box 2294 Terminal Annex Los Angeles, Calif. 90054	Dry lake brines	San Bernardino	Boron, bromine, potassium salts, sodium compounds.	

Magnesium compounds:					
FMC Corp	P.O. Box 344 Newark, Calif. 94560	Salt works bitterns	Alameda, San Diego.	----------	2 plants at Newark and Chula Vista.
Kaiser Aluminum & Chemical Corp.	Moss landing, Calif. 95039	Seawater processing.	Monterey.		
Merck & Co., Inc	Rahway, N. J., 07065	----do----------	San Mateo.		
Mercury:					
Almaden Property Holders	16294 Ridgecrest Ave. Los Gatos, Calif. 95030	Underground mine.	Santa Clara	----------	Furnaces and retorts.
Buena Vista Mines, Inc	P.O. Box 753 Paso Robles, Calif. 93446	----do----------	San Luis Obispo	----------	Furnaces.
Knoxville Exploration & Mining	Box 2655 San Francisco, Calif. 94126	Open pit mine	Napa	----------	Furnaces and retorts.
W. C. McCulloch	P.O. Box 305 Middletown, Calif. 95461	Underground mine.	Lake	----------	Furnaces.
New Idria Mining & Chemical Co	Idria, Calif. 95027	Underground and open pit mines.	San Benito	----------	Do.
Sonoma International, Inc	P.O. Box 226 Guerneville, Calif. 95446	Underground mine.	Sonoma	----------	Do.
Mica: Western Industrial Minerals	Box 681 Winterhaven, Calif. 92283	Open pit mine	Imperial	----------	Also grinding plant.
Molybdenum: Union Carbide Corp., Mining & Metals Division.	270 Park Ave., 38th Floor New York, N.Y. 10017	Underground mine.	Inyo	Copper, gold, silver, tungsten.	Byproduct of tungsten production.
Natural gas:					
Amerada Petroleum Corp	Box 417 Rio Vista, Calif. 94571	Gas fields	Sacramento, San Joaquin, Solano.	Petroleum	9 producing fields.
Buttes Gas & Oil Co	2150 Franklin St. Oakland, Calif. 94612	----do----------	Butte, Glenn, Sutter, Tehama, Yolo.	----do----------	11 producing fields.
Cameron Oil Co	110 Kermac Bldg. Olkahoma City, Okla. 73102	----do----------	Sutter, Colusa	----------	1 producing field.
Great Basins Petroleum Co	1011 Gateway West, Century City Los Angeles, Calif. 90067	----do----------	San Joaquin	----------	2 producing fields.
Phillips Petroleum Co	3887 State St. Santa Barbara, Calif. 93109	----do----------	Santa Barbara Solano.	Petroleum	Do.
Natural gas liquids:					
The Atlantic Refining Co	555 South Flower St. Los Angeles, Calif. 90017	Natural gasoline plants.	Kern, San Luis Obispo, Santa Barbara, Ventura.	----------	4 plants.
Getty Oil Co	4201 Wilshire Blvd. Los Angeles, Calif. 90005	----do----------	Kern, Ventura	----------	3 plants.
Mobil Oil Co	P.O. Box 2122, Terminal Annex Los Angeles, Calif. 90054	----do----------	Fresno, Los Angeles.	----------	Do.

See footnote at end of table.

Table 27.—Principal producers—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Natural gas liquids—Continued					
Shell Oil Co	1008 West Sixth St. Los Angeles, Calif. 90054	Natural gasoline plants.	Kern, Los Angeles, Orange, Santa Barbara, Ventura.		5 plants.
Standard Oil Co. of Calif	225 Bush St. San Francisco, Calif. 94120	do	Kern, Kings, Los Angeles, Orange, Santa Barbara, Ventura.		16 plants.
Texaco Inc	3350 Wilshire Blvd. Los Angeles, Calif. 90005	do	Los Angeles, Santa Barbara, Ventura.		4 plants.
Union Oil Co. of Calif	P.O. Box 7600 Los Angeles, Calif. 90054	do	Fresno, Kern, Los Angeles, Orange, Santa Barbara, Ventura.		7 plants.
Peat:					
Peter J. Gambetta	Route 1, Box 78 Brentwood, Calif. 94513	Reed-sedge bog	Contra Costa.		
R. W. McClellan & Sons, Inc	151 Commercial Way Costa Mesa, Calif. 92626	Humus bog	Orange.		
Vita-Peat Co	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.		
Harborlite Corp	P.O. Box 458 Escondido, Calif. 92025	Expanding plant	San Diego.		
Marcus A. McClure Co	2416 Bedessen Ave. Los Angeles, Calif. 90022	do	Los Angeles.		
Metro Minerals	1447 West 178th St. Gardena, Calif. 90247	do	do		
Paramount Perlite Co., Inc	16236 South Illinois St. Paramount, Calif. 90723	do	do		
Perlite Materials	1271 Conn Valley Road St. Helena, Calif. 94574	Open pit mine	Napa		Also expanding plant at St. Helena.
Redco, Inc	11831 Vose St. North Hollywood, Calif. 91605	Expanding plant	Los Angeles.		
Petroleum:					
Atlantic Oil Co	523 West 6th St. Room 1116 Los Angeles, Calif. 90014	Oil fields	Kern, Los Angeles, Orange, Ventura.	Natural gas	12 producing fields, at yearend.
Atlantic Richfield Co	555 South Flower St. Los Angeles, Calif. 90054	do	Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.	do	38 producing fields at yearend.

Belridge Oil Co	1300 West 4th St. Los Angeles, Calif. 90017	----do----------	Kern, Santa Barbara.	----do----------	3 producing fields at yearend.
Chanslor-Western Oil & Development Co.	4549 Produce Plaza Los Angeles, Calif. 90058	----do----------	Kern, Los Angeles, Orange, Ventura.	----do----------	9 producing fields at yearend.
Getty Oil Co	3810 Wilshire Blvd. Los Angeles, Calif. 90005	----do----------	Fresno, Kern, Los Angeles, Monterey, Orange, Santa Barbara, Ventura.	----do----------	59 producing fields at yearend.
Gulf Oil Corp	P.O. Box 54064 Terminal Annex Los Angeles, Calif. 90054	----do----------	Fresno, Kern, Los Angeles, Orange, Ventura.	----do----------	25 producing fields at yearend.
Humble Oil & Refining Co	1800 Avenue of the Stars Los Angeles, Calif. 90067	----do----------	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.	----do----------	26 producing fields at yearend.
Long Beach (City of) Dept. of Oil Prop.	925 Harbor Plaza Long Beach, Calif. 90801	----do----------	Los Angeles-------	----do----------	3 producing fields at yearend.
Mobil Oil Corp	612 South Flower St. Los Angeles, Calif. 90054	----do----------	Fresno, Kern, Kings, Los Angeles, Monterey, Orange, San Benito, Santa Barbara, Ventura.	----do----------	34 producing fields at yearend.
Occidental Petroleum Corp	10889 Wilshire Blvd. Suite 1500 Los Angeles, Calif. 90024	----do----------	Contra Costa, Kern, Los Angeles, Santa Barbara, Santa Clara.	----do----------	14 producing fields at yearend.
Shell Oil Co	1008 West 6th St. Los Angeles, Calif. 90054	----do----------	Contra Costa, Fresno, Kern, Los Angeles, Orange, San Benito, Santa Barbara, Ventura	----do----------	41 producing fields at yearend.
Signal Oil and Gas Co	1010 Wilshire Blvd. Los Angeles, Calif. 90054	----do----------	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.	----do----------	24 producing fields at yearend.
Standard Oil Co of California	225 Bush St. San Francisco, Calif. 94120	Oil fields----------	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.	Natural gas------	78 producing fields at yearend.
Sunray DX Oil Co	1101 Wilco Bldg. Tulsa, Okla. 74102	----do----------	Fresno, Kern, Kings, Los Angeles, Santa Barbara.	----do----------	12 producing fields at yearend.

See footnote at end of table.

Table 27.—Principal producers—Continued

Commodity and company	Address	Type of activty	County	Other commodities	Remarks
Petroleum—Continued					
Texaco, Inc	3350 Wilshire Blvd. Los Angeles, Calif. 90005	Oil fields	Fresno, Kern, Los Angeles, Monterey, Orange, Santa Barbara, Ventura.	Natural gas	44 producing fields at yearend.
Union Oil Co	Box 7600 Terminal Annex Los Angeles, Calif. 90054	----do	Fresno, Kern, Los Angeles, Orange, San Luis Obispo, Santa Barbara, Ventura.	----do	59 producing fields at yearend.
Union Pacific Railroad Co	5480 Ferguson Drive Los Angeles, Calif. 90022	----do	Los Angeles	----do	1 producing field at yearend.
Platinum: Yuba Industries, Inc	Star Route Marysville, Calif. 95901	Dredging	Yuba	Gold, silver	Byproduct of gold production.
Potassium salts: American Potash & Chemical Corp.	P.O. Box 2294 Los Angeles, Calif. 90054	Dry lake brines	San Bernardino	Boron, bromine, lithium, sodium compounds.	
Pumice, pumicite, volcanic cinder:					
Aiken Builders Products	P.O. Box 878 Las Vegas, Nev. 89101	Open pit mine	----do		
California Block Supply	P.O. Box 307 Sonoma, Calif. 95476	----do	Lake.		
Cinder Products Co	3450 Lakeshore Ave. Oakland, Calif. 94610	----do	----do		
Glass Mountain Block, Inc	Box 10 Tulelake, Calif. 96134	----do	Siskiyou.		
Hellgren Sand & Gravel Co	P.O. Box 420 Clearlake Highlands, Calif. 95422	----do	Lake.		
Mt Lassen Cinder Co	704 Mill St. Susanville, Calif. 96130	----do	Lassen.		
Red Lava Products of Calif	Star Route Clearlake Oaks, Calif. 95423	----do	Lake.		
Silica Products, Inc	3147 El Cajon Blvd. San Diego, Calif. 92104	----do	Kern.		
Southern Pacific Co	65 Market St. San Francisco, Calif. 94105	Open pit mine	Siskiyou.		
U.S. Pumice Supply Co. (Featherrock, Inc.)	6331 Hollywood Blvd. Los Angeles, Calif. 90028	----do	Mono	----------	Mill at Lee Vining.
Rare-earth metals: Molybdenum Corporation of America.	Mountain Pass via Nipton, Calif. 92366	----do	San Bernardino.		
Salt:					
Leslie Salt Co	505 Beach St. San Francisco, Calif. 94111	Solar evaporation and open pit mine.	Alameda, Napa, San Bernardino, San Mateo.		

Metropolitan Water District of Southern California.	P.O. Box 64153 Los Angeles, Calif. 90054	Solar evaporation	San Bernardino.		
Western Salt Co	P.O. Box 149 San Diego, Calif. 92112	do	Kern, Orange, San Diego.		
Sand and gravel:					
American Cement Corp	P.O. Box 832 Riverside, Calif. 92501	Open pit mine	Riverside		Industrial sand.
Associated Rock Products, Inc	15th and Benson Sts. Upland, Calif. 91786	do	San Bernardino		Construction sand and gravel.
Azusa Western, Inc	P.O. Box 575 Azusa, Calif. 91702	do	Los Angeles		Do.
Baldwin Contracting Co., Inc	P.O. Box 311 Marysville, Calif. 95901	do	Butte, Yuba		2 plants. Construction sand and gravel.
Basalt Rock Co., Inc	8th and Rivers Sts. Napa, Calif. 94558	do	Sonoma		Construction sand.
Blue Diamond Concrete Metals	P.O. Box 2678 Los Angeles, Calif. 90054	do	Los Angeles, Orange.		5 plants. Construction sand and gravel.
Floyd Bradley & Associates	P.O. Box 116 Novato, Calif. 94947	do	Monterey		Industrial sand.
Brighton Sand & Gravel Co	P.O. Box 7001, Perkins Br. Sacramento, Calif. 95826	do	Sacramento		Construction sand and gravel.
Burris Sand & Gravel	15292 East Lincoln Anaheim, Calif. 92806	do	Orange		Do.
California Materials Co	P.O. Box 845 Sun Valley, Calif. 91352	do	Los Angeles		Construction sand and gravel.
California Nonmetallics	P.O. Box 265 Trabuco Canyon, Calif. 92678	do	Orange		Industrial and construction sand.
California Sand Co., Inc	P.O. Box 90725, Airport Station Los Angeles, Calif. 90009	do	Los Angeles		Do.
Cal Rock, Inc	19098 James Road Bakersfield, Calif. 93302	do	Kern		Construction sand and gravel.
Caswell & Co	2357 East Slauson Ave. Los Angeles, Calif. 90058	do	Los Angeles		Industrial sand.
Chandler's Palos Verdes Sand and Gravel Co.	P.O. Box 295 Lomita, Calif. 90717	do	do		Construction sand and gravel.
Joe Chevreaux	890 Grass Valley Highway Auburn, Calif. 95603	do	Placer		Industrial sand. Construction sand and gravel.
Coast Rock Products, Inc	1335 East Dunavan Rd. Santa Maria, Calif. 93454	do	Santa Barbara		Construction sand and gravel.
Consolidated Rock Products Co	2730 South Alameda St. Los Angeles, Calif. 90054	do	Los Angeles, Orange, San Bernardino, Ventura.		8 plants. Construction sand and gravel.
Crystal Silica Co	Ottawa, Ill. 61350	do	San Diego		Industrial and construction sand.
Del Monte Properties, Co	Box 567 Pebble Beach, Calif. 93953.	do	Monterey		Do.
H. G. Fenton Material Co	702 West Washington St. San Diego, Calif. 92112	do	San Diego		5 plants. Construction sand and gravel.
Granite Construction Co	P.O. Box 900 Watsonville, Calif. 95076	do	Monterey Sacramento, Yolo.		3 plants. Construction sand and gravel.

See footnote at end of table.

Table 27.—Principal producers—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Sand and gravel—Continued					
Hollister Sand & Gravel Co	P.O. Box 180 Hollister, Calif. 95023	Open pit mine	San Benito		2 plants. Construction sand and gravel.
International Pipe & Ceramics Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	do	Amador		2 plants. Industrial sand.
Kaiser Industries Corp	300 Lakeside Drive Oakland, Calif. 94612	do	Alameda Glenn, Santa Clara, Santa Cruz, Sonoma.		5 plants. Construction sand and gravel.
Kirst Construction Co	836 West Woodbury Rd. Altadena, Calif. 91001	do	Kern		Construction gravel.
Livingston—Graham Inc	5500 North Peck Road El Monte, Calif, 91731	do	Los Angeles, Orange, San Bernardino, Ventura.		7 plants. Construction sand and gravel.
Madison Sand & Gravel Co	P.O. Box 66 Madison, Calif. 95653	do	Yolo		Construction sand and gravel.
Manning Bros. Rock & Sand Co	P.O. Box 204 Irwindale, Calif. 91706	do	Los Angeles		Do.
Massey Sand & Rock Co	P.O. Drawer P Indio, Calif. 92201	do	Riverside		3 plants. Construction sand and gravel.
Monterey Sand Co	P.O. Box 928 Monterey, Calif. 93940	do	Monterey		2 plants. Industrial and construction sand.
Nelson & Sloan	P.O. Box 488 Chula Vista, Calif. 92010	do	San Diego		Construction sand and gravel.
Niles Sand & Gravel Co., Inc	P.O. Box 2248 Fremont, Calif. 94536	do	Alameda		Do.
Oceano Sand Co	P.O. Box 535 Oceano, Calif. 93445	do	San Luis Obispo		Industrial and construction sand.
Owen-Illinois Glass Co	P.O. Box 1035–1036 Toledo, Ohio 43601	do	Amador, Monterey, Riverside.		3 plants. Industrial sand.
Owl Rock Products Co	P.O. Box 47 Irwindale, Calif. 91707	do	Fresno, Los Angeles, Orange, Riverside, Ventura.		7 plants. Construction sand and gravel.
Owl-Service Rock Co	P.O. Box 309 Riverside, Calif. 92501	do	San Bernardino		2 plants. Construction sand and gravel.
Pacific Cement & Aggregates	400 Alabama St. San Francisco, Calif. 94110	do	Alameda, Fresno, Monterey, Sacramento, San Joaquin, San Mateo, Santa Cruz, Tulare, Yolo.		11 plants. Construction sand and gravel; industrial sand.
Pacific Rock & Gravel Co	P.O. Box 844 La Habra, Calif. 90631	do	Los Angeles, San Bernardino.		2 plants. Construction sand and gravel.
A. J. Raisch Paving Co	99 Pullman Way San Jose, Calif. 95111	do	Santa Clara		Construction gravel.

Rhodes & Jamieson, Ltd	P.O. Box 118 Oakland, Calif. 94604	----do	Alameda		2 plants. Construction sand and gravel.
San Diego Consolidated Co	P.O. Box 3098 San Diego, Calif. 92103	----do	San Diego		3 plants. Construction sand and gravel.
Santa Clara Sand & Gravel Co	P.O. Box 338 Cupertino, Calif. 95014	----do	Santa Clara		Construction sand and gravel.
W.A. Schoeppe Clay Co	Box 101 El Toro, Calif. 92630	----do	Orange		Construction and industrial sand.
Silver Sand Co	P.O. Box 5 Cowell, Calif. 94520	----do	Contra Costa		Do.
Southern Pacific Milling Co	3555 Vineyard Ave. Oxnard, Calif. 93030	----do	Santa Barbara, Ventura.		4 plants. Construction sand and gravel.
Standard Materials Co	P.O. Box 3171 Modesto, Calif. 95350	----do	Merced, Stanislaus		Do.
Sully-Miller Contracting Co	21401 East Chapman Ave. Orange, Calif. 92667	----do	Orange		5 plants. Construction sand and gravel.
Teichert Aggregates	P.O. Box 928 Sacramento, Calif. 95804	----do	Butte, Nevada, Placer, Sacramento, San Joaquin, Yolo, Yuba.		11 plants. Construction sand and gravel.
Terminal Rock Enterprises	P.O. Box 248 Littlerock, Calif. 93543	----do	Los Angeles		Construction sand and gravel.
Triangle Rock Products, Inc	P.O. Box 2083 San Bernardino, Calif. 92406	----do	Los Angeles, Riverside, San Bernardino.		5 plants. Construction sand and gravel.
Tri-City Concrete	P.O. Box 672 Redlands, Calif. 92373	----do	San Bernardino		Construction sand and gravel.
Ventura County Sand Co	876 Polaris Way Port Hueneme, Calif. 93041	----do	Ventura		Industrial sand.
Yuba River Sand Co	P.O. Box 307 Marysville, Calif. 95901	Dredge and stationary plant.	Yuba		Industrial sand; construction sand and gravel.
Silver:					
Paul Bare	P.O. Box 538 Lone Pine, Calif. 93545	Underground mine.	Inyo	Copper, gold, lead, zinc.	
Monte Cristo Mining Corp	P.O. Box 218 Las Vegas, Nev. 89101	----do	----do	Gold, lead, zinc.	
Union Carbide Corp., Mining & Metals Division.	270 Park Ave., 38th Floor New York N.Y. 10017	----do	----do	Copper, gold, molybdenum, tungsten.	Byproduct of tungsten production.
West Hill Exploration, Inc	Lone Pine, Calif. 93545	----do	----do	Copper, gold, lead, zinc.	
Sodium compounds:					
American Potash & Chemical Co	P.O. Box 2294 Terminal Annex Los Angeles, Calif 90054	Dry lake brines	San Bernardino	Boron, bromine, lithium, potassium salts.	
PPG Industries, Inc	Lone Pine, Calif. 93545	----do	Inyo.		
Stauffer Chemical Co	636 California St. San Francisco, Calif. 94119	----do	San Bernardino	Boron.	
United States Borax & Chemical Corp.	3075 Wilshire Blvd. Los Angeles, Calif. 90005	Open pit mine	Kern	----do	Refineries in Kern and Los Angeles Counties, Calif. Out-of-State chemical plants.

See footnote at end of table.

Table 27.—Principal producers—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Stone:					
American Canyon Aggregates Co., Inc.	P.O. Box 1272 Vallejo, Calif. 94590	Open quarry	Solano		Miscellaneous stone.
American Cement Corp	P.O. Box 832 Riverside, Calif. 92501	Open quarry and underground mine.	Los Angeles, Riverside, San Bernardino.		4 quarries and 1 underground mine. Limestone, quartzite, rhyolite.
G. Arnoldi	600 Olive St. Santa Barbara, Calif. 93101	Open quarry	Santa Barbara		Sandstone.
Basalt Rock Co., Inc	P.O. Box 2540 Napa, Calif. 94558	do	Marin, Napa		2 quarries. Basalt, sandstone.
Calaveras Cement Co	San Andreas, Calif. 95249	do	Calaveras, Shasta		3 quarries. Limestone.
California Portland Cement Co	612 South Flower St. Los Angeles, Calif. 90017	do	Kern, San Bernardino.		2 quarries. Limestone.
Canyon Rock Co	7525 Highway 12 Forestville, Calif. 95436	do	Sonoma		Miscellaneous stone.
Connolly-Pacific Co	1925 Water St. Long Beach, Calif. 90802	do	Los Angeles		Diorite and conglomerate.
Continental Granite Corp	Harmony Grove Rd. Escondido, Calif. 92025	do	San Diego		Granite.
V. R. Dennis Construction Co	P.O. Box 20068 San Diego, Calif. 92120	do	do		Miscellaneous stone.
East Bay Excavating Co., Inc	28814 Mission Blvd. Hayward, Calif. 94544	do	Alameda		2 quarries. Miscellaneous stone.
Einer Bros., Inc	P.O. Box 936 Escondido, Calif. 92025	do	San Diego		Decomposed granite.
El Dorado Limestone Co., Inc	P.O. Box 8 Shingle Springs, Calif. 95682	Underground mine.	El Dorado		Limestone.
Felton Quarry	326 Fall Creek Drive Felton, Calif. 95018	Open quarry	Santa Cruz		Granite.
Ferry Bros. Construction Co	P.O. Box 2218 El Cajon, Calif. 92021	do	San Diego		Do.
Fremont Land Co	P.O. Box 2716 Fremont, Calif. 94536	do	Alameda		Red rock.
Gallagher & Burke	344 High St. Oakland, Calif. 94601	do	do		Basalt.
Granite Rock Co	P.O. Box 151 Watsonville, Calif. 95076	do	San Benito		Granite.
Gerry Harn	P.O. Box 804 Soquel Calif. 95073	do	Santa Cruz		Do.
Hatch Rock Quarries, Inc	P.O. Box 765 Mountain View, Calif. 94040	do	Inyo		Sandstone.
Hein Bros. Basalt Rock Co	P.O. Box 162 Petaluma, Calif. 94952	Open quarry	Sonoma		Basalt.
Hester's Granite Pit	2094 Willow Glen Dr. El Cajon, Calif. 92020	do	San Diego		Decomposed granite.
Hillsdale Rock Co., Inc	500 Hillsdale Ave. San Jose, Calif. 95123	do	Santa Clara		Miscellaneous stone.

Hutchinson Co	7360 Schmidt Lane El Cerrito, Calif. 94530	----do----	Marin	----------	Sandstone.
Ideal Cement Co	620 Denver National Bldg. Denver, Colo. 80202	Open quarry and and dredge.	San Benito, San Mateo.	----------	Limestone, oystershells.
Kaiser Aluminum & Chemical Corp.	Moss Landing, Calif. 95039	Open quarry	Monterey	----------	Limestone.
Kaiser Cement & Gypsum Corp	Permanente Road Permanente, Calif. 95014	----do----	San Bernardino, Santa Clara.	----------	2 quarries. Limestone.
Kaiser Industries Corp	300 Lakeside Dr. Oakland, Calif. 94612	----do----	Contra Costa	----------	Miscellaneous stone.
John Kingman	P.O. Box 326 Mariposa, Calif. 95338	----do----	Mariposa	----------	Slate.
Art Kurth	P.O. Box 101 Joshua Tree, Calif. 92252	----do----	San Bernardino	----------	Marble.
M-& R Granite Co	10460 La Tuna Canyon Sun Valley, Calif. 91352	----do----	Los Angeles	----------	Decomposed granite.
George Metcalfe	Route 1, Box 601 Sonora, Calif. 95370	----do----	San Bernardino	----------	Marble.
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, Minn. 55101	----do----	Riverside	----------	Miscellaneous stone.
Monolith Portland Cement Co	Box 65677 Glassell Sta. Los Angeles, Calif. 90065	----do----	Kern	----------	Limestone.
National Quarries	P.O. Box 487 Escondido, Calif. 92025	----do----	San Diego	----------	Granite.
Neary Rock Quarry, Inc	11920 Stonebrook Ave. Los Altos, Calif. 94022	----do----	Santa Clara	----------	Miscellaneous stone.
Owl Base Materials Co	500 South Alameda St. Irwindale, Calif. 91707	----do----	Los Angeles	----------	Granite.
Pacheco Quarry Inc	118 C St. Pacheco, Calif. 94553	----do----	Contra Costa	----------	Sandstone.
Pacific Cement & Aggretates	400 Alabama St. San Francisco, Calif, 94110	----do----	Alameda, Contra Costa, San Mateo, Santa Cruz.	----------	4 quarries. Limestone, miscellaneous stone, sandstone.
Pacific Western Industries, Inc	3810 Wilshire Blvd. Los Angeles, Calif. 90005	----do----	Kern	----------	Limestone.
Page Mill Quarry Corp	3291 Park Blvd. Palo Alto, Calif. 94306	----do----	Santa Clara	----------	Miscellaneous stone.
Chas, Pfizer & Co., Inc	P.O. Drawer AD Victorville, Calif. 92392	----do----	San Bernardino	----------	Limestone.
Pioneer Shell Co	2772 Bromely Rd. San Carlos, Calif. 94070	Dredge	San Mateo	----------	Oystershells.
Placerville Slate Products Co	P.O. Box 63 Placerville, Calif. 95667	Open quarry	El Dorado	----------	Slate.
Premier Marble Properties	Lone Pine, Calif. 93545	----do----	Inyo	----------	Marble.
Quarry Products, Inc	P.O. Box 1147 Richmond, Calif. 94802	----do----	Contra Costa	----------	2 quarries. Sandstone.
Raymond Granite Co	Raymond, Calif. 93653	----do----	Fresno, Madera	----------	2 quarries. Granite.
Roggasch Bros. Quarry	13910 Saratoga Ave. Saratoga, Calif. 95070	----do----	Santa Clara	----------	Miscellaneous stone.
Select Base Materials	4166 Lankershim St. North Hollywood, Calif. 91602	----do----	Los Angeles	----------	Decomposed granite.

See footnote at end of table.

Table 27.—Principal producers—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Stone—Continued					
Silberberger Constructors, Inc	P.O. Box 608 Vista, Calif. 92083	Open quarry	San Diego		2 quarries. Granite.
Sonora Aggregates Co	111 South Maple St. South San Francisco, Calif., 94080	do	Tuolumne		Marble.
South Bay Dredging Co	Route 1, Box 78 Brentwood, Calif. 94513	Dredge	San Mateo		Oystershells.
South Coast Asphalt Co., Inc	P.O. Box 218 Carlsbad, Calif. 92008	Open quarry	San Diego		Decomposed granite.
Southwestern Portland Cement Co	1034 Wilshire Blvd. Los Angeles, Calif. 90017	do	San Bernardino		Limestone.
Stauffer Chemical Co	636 California St. San Francisco, Calif. 94119	do	Inyo		Do.
Union Granite Co	P.O. Box 819 Rocklin, Calif. 95677	do	Placer		Granite.
Whitewater Rock, & Supply Co	Box 254 Whitewater, Calif. 92282	do	Riverside		Quartzite.
Werner Wirz	P.O. Box 1345 Big Bear Lake, Calif. 92315	do	San Bernardino		Quartz and quartzite.
Lawrence L. Zollars	Highway 140 Mariposa, Calif. 95338	do	Mariposa		Slate.
Sulfur: Inyo Soil Sulphur Co	525 Eye St. Bakersfield, Calif. 93304	Open pit mine	Inyo.		
Talc, pyrophyllite, and soapstone:					
Cyprus Mines Corp	P.O. Box 1201 Trenton, N.J. 08606	Open pit and underground mines.	Inyo, San Bernardino.		Grinding plants at Keeler and Los Angeles, Calif.
Grantham Mines	1915 South Coast Highway. Laguna Beach, Calif. 92651	Underground mines.	Inyo		2 mines.
Chas, Pfizer & Co., Inc	P.O. Drawer AD Victorville, Calif. 92392	Open pit and underground mines.	Inyo, San Bernardino.		Grinding plants at Dunn and Victorville, Calif.
Pomona Tile Manufacturing Co	216 South Reservoir St. Pomona, Calif. 91766	do	San Bernardino		Entire production for own use.
Western Talc Co., Inc	1901 East Slauson Ave. Los Angeles, Calif. 90058	do	do		Grinding plants at Dunn and Los Angeles, Calif.
Tin: American Tin Corp	4073 Beverly Blvd. Los Angeles, Calif. 90004	Open pit mine	Kern.		

Tungsten: Union Carbide Corp., Mining & Metals Division.	270 Park Ave., 38th Floor New York N.Y. 10017	Underground mine.	Inyo----------	Copper, gold, molybdenum, silver.
Wollastonite: Chas, Pfizer & Co., Inc--	P.O. Drawer AD Victorville, Calif. 92394	Open pit mine-----	Riverside.	
Zinc: West Hill Exploration, Inc-----	Lone Pine, Calif. 93545---	Underground mine.	Inyo----------	Copper, gold, lead, silver.

[1] Excludes captive production cement companies.

The Mineral Industry of Colorado

By Carl L. Bieniewski [1] and William C. Henkes [2]

The value of mineral production in Colorado during 1967 was $346.2 million—a decline of $16.7 million, 5 percent below that of 1966. The State led the Nation in the production of molybdenum, pyrites, and vanadium and was second in the production of beryllium concentrate, tin, and tungsten concentrate.

Mica and manganiferous ore, of the 34 mineral commodities produced in Colorado in 1967, had no reported production

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

Table 1.—Mineral production in Colorado [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Carbon dioxide (natural)—thousand cubic feet	147,292	$25	182,701	$31
Clays—thousand short tons	r 599	r 1,315	596	1,274
Coal (bituminous)—do	5,222	26,075	5,439	25,920
Copper (recoverable content or ores, etc)—short tons	4,237	3,065	3,993	3,053
Feldspar—long tons	891	6	300	2
Gem stones	NA	80	NA	118
Gold (recoverable content of ores, etc.)—troy ounces	31,915	1,117	21,181	741
Gypsum—thousand short tons	75	269	77	265
Iron ore (usable)—thousand long tons, gross weight	164	1,133	W	W
Lead (recoverable content of ores, etc.)—short tons	23,082	6,978	21,923	6,133
Lime—thousand short tons	126	2,327	118	2,023
Manganese ore (5 to 35 percent Mn)—short tons, gross weight	-------	-------	321	3
Molybdenum (content of concentrate)—thousand pounds	57,289	88,851	52,040	84,723
Natural gas (marketed)—million cubic feet	136,667	17,767	116,857	15,542
Natural gas liquids:				
LP gases—thousand gallons	73,390	3,596	71,544	3,649
Natural gasoline and cycle products—do	59,420	3,565	51,845	3,215
Peat—short tons	37,111	278	21,988	204
Petroleum (crude)—thousand 42-gallon barrels	33,492	97,462	33,905	99,003
Pumice—thousand short tons	46	104	18	105
Sand and gravel—do	22,245	23,485	21,810	22,904
Silver (recoverable content of ores, etc.)—thousand troy ounces	2,086	2,697	1,818	2,817
Stone—thousand short tons	7,031	11,331	2,992	5,485
Tin (content of concentrate)—long tons	44	99	31	59
Tungsten concentrate (60-percent WO_3 basis)—short tons	1,494	3,626	1,276	3,039
Uranium [2] (recoverable content U_3O_8)—thousand pounds	2,651	21,205	2,537	20,299
Vanadium—short tons	3,697	15,888	3,317	14,260
Zinc (recoverable content of ores, etc.)—do	54,822	15,898	52,442	14,519
Value of items that cannot be disclosed: Beryllium concentrate, cement, fluorspar, mica (scrap 1967), perlite, pyrites, rare-earth metal concentrate, salt, and values indicated by symbol W	XX	14,699	XX	16,834
Total	XX	r 362,941	XX	346,235
Total 1957–59 constant dollars	XX	r 342,543	XX	321,175

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] Method of reporting changed from short tons of ore and f.o.b. mine value (AEC Circular 5, Revised, price schedule) to recoverable pounds of uranium oxide and f.o.b. mill value.

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

County	1966	1967	Minerals produced in 1967 in order of value
Adams	$4,854,704	$4,588,873	Sand and gravel, petroleum, natural gas, lime, gold, stone, silver.
Alamosa	332,791	173,062	Sand and gravel, peat.
Arapahoe	1,158,554	1,914,133	Sand and gravel, petroleum, stone.
Archuleta	240,500	565,242	Do.
Baca	1,252,601	1,258,312	Natural gas, petroleum, sand and gravel, stone.
Bent	r 72,714	99,868	Sand and gravel, natural gas, petroleum, clays.
Boulder	r 2,273,345	2,625,664	Sand and gravel, fluorspar, stone, lime, peat, gold, clays, tungsten concentrate, petroleum, silver, lead, copper.
Chaffee	812,439	720,791	Stone, sand and gravel, gypsum, peat, gold, silver.
Cheyenne	126,572	1,972	Stone, sand and gravel.
Clear Creek	668,566	W	Molybdenum, sand and gravel, lead, silver, gold, zinc, copper, stone, mica.
Conejos	37,929	47,347	Sand and gravel, silver, gold.
Costilla	116,578	104,518	Pumice, sand and gravel.
Crowley	63,948	10,000	Sand and gravel.
Custer	r 91,187	123,487	Sand and gravel, perlite, stone, clays.
Delta	2,248,247	2,961,354	Coal, sand and gravel, lime, stone.
Dolores	872,585	W	Zinc, lead, stone, sand and gravel, silver, copper, gold, pyrites.
Douglas	970,209	901,560	Sand and gravel, clays, stone.
Eagle	10,269,058	8,475,518	Zinc, sand and gravel, lead, silver, copper, stone, gold, pumice.
Elbert	114,862	302,974	Sand and gravel, clays, stone.
El Paso	2,412,395	2,015,583	Sand and gravel, stone, lime, clays.
Fremont	r 10,761,297	10,238,529	Cement, stone, coal, gypsum, sand and gravel, clays, petroleum, uranium, feldspar, lead, copper, silver, zinc, beryllium concentrate, gold.
Garfield	r 3,546,331	3,956,822	Vanadium, uranium, sand and gravel, lime, stone, natural gas, coal, petroleum.
Gilpin	10,695	33,355	Sand and gravel, peat, gold, zinc, lead, copper, silver.
Grand	312,302	237,532	Sand and gravel, stone.
Gunnison	4,752,730	4,388,483	Coal, zinc, lead, silver, sand and gravel, stone, copper, gold, manganese ore.
Hinsdale	32,752	81,862	Lead, zinc, silver, sand and gravel, copper, gold.
Huerfano	271,926	711,206	Sand and gravel, coal, clays, stone, copper, silver.
Jackson	892,000	712,000	Petroleum, natural gas, sand and gravel.
Jefferson	r 4,042,457	W	Uranium, sand and gravel, clays, stone, gold, silver.
Kiowa	1,034,000	2,759,000	Petroleum, natural gas, sand and gravel, natural gas liquids.
Kit Carson	473,297	62,212	Sand and gravel, stone.
Lake	92,932,806	86,365,332	Molybdenum, tungsten concentrate, sand and gravel, stone, pyrites, tin, rare-earth metal concentrate, peat.
La Plata	r 9,534,297	7,905,197	Natural gas, natural gas liquids, sand and gravel, coal, petroleum, stone, peat, gold, silver.
Larimer	r 10,265,968	11,335,187	Cement, stone, petroleum, sand and gravel, lime, natural gas liquids, natural gas, gypsum, beryllium concentrate.
Las Animas	5,571,654	4,981,941	Coal, sand and gravel, clays, stone.
Lincoln	168,051	71,150	Sand and gravel, stone.
Logan	11,985,129	10,176,000	Petroleum, natural gas liquids, natural gas, sand and gravel, lime.
Mesa	r 10,635,594	10,187,605	Uranium, vanadium, natural gas, coal, sand and gravel, natural gas liquids, stone.
Mineral	1,449,094	1,373,750	Zinc, lead, copper, silver, gold.
Moffat	6,281,631	9,061,406	Petroleum, natural gas, coal, sand and gravel, natural gas liquids, gold, silver.
Montezuma	r 3,145,506	2,066,671	Petroleum, natural gas, sand and gravel, carbon dioxide, stone.
Montrose	r 17,108,436	13,853,623	Uranium, vanadium, sand and gravel, coal, salt, stone.
Morgan	7,222,788	7,995,400	Petroleum, natural gas liquids, natural gas, sand and gravel, lime, stone.
Otero	445,256	447,407	Lime, sand and gravel, stone.
Ouray	2,287,982	W	Zinc, lead, copper, silver, gold, sand and gravel.
Park	r 203,242	115,400	Peat, sand and gravel, gold, stone, silver, lead.
Phillips	162,000	55,274	Sand and gravel, stone.
Pitkin	10,954,847	6,201,963	Coal, iron ore, natural gas, sand and gravel, stone, silver, lead, zinc, copper, gold.
Prowers	184,562	251,687	Sand and gravel, petroleum, stone.
Pueblo	r 3,302,109	1,967,250	Sand and gravel, lime, clays, zinc, lead, silver, stone, copper, gold.
Rio Blanco	r 60,620,930	60,366,541	Petroleum, natural gas, natural gas liquids, uranium, vanadium, coal, sand and gravel, stone.
Rio Grande	70,000	185,000	Sand and gravel.
Routt	5,627,187	6,608,997	Coal, petroleum, sand and gravel, stone, pumice.
Saguache	r 123,240	209,491	Sand and gravel, copper.
San Juan	r 4,554,820	4,679,184	Zinc, lead, silver, copper, gold, sand and gravel.

See footnotes at end of table.

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

County	1966	1967	Minerals produced in 1967 in order of value
San Miguel	r $19,156,078	$17,859,942	Uranium, vanadium, zinc, lead, copper, silver, gold, sand and gravel, iron ore, stone.
Sedgwick	165,000	136,800	Lime, sand and gravel, natural gas.
Summit	60,622	105,526	Sand and gravel, lead, zinc, stone, silver, copper, gold.
Teller	77,000	66,035	Peat, stone, sand and gravel.
Washington	14,383,000	12,815,000	Petroleum, natural gas liquids, sand and gravel, natural gas.
Weld	8,876,991	7,276,696	Petroleum, coal, sand and gravel, natural gas, lime, stone, natural gas liquids.
Yuma	188,000	206,000	Sand and gravel, petroleum.
Undistributed [2]	80,000	11,236,601	
Total	r 362,941,000	346,235,000	

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

[1] Denver County not listed because no production was reported.

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

Table 3.—Indicators of Colorado business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$5,700	$6,094	+6.9
Per capita		$2,916	$3,086	+5.8
Bank debits	millions	$40,772	$43,819	+7.5
Total State revenue	do	$769.7	$796.0	+3.4
Total State expenditures	do	$757.0	$782.3	+3.3
Natural gas used	billion cubic feet	182.9	189.3	+3.5
Electric power used	million kilowatt hours	5,638.1	6,045.3	+7.2
New construction:				
Total construction valuation	millions	$301.6	$259.7	−13.9
Residential	number	NA	8,410	--------
Residential value	millions	$127.9	$157.6	+23.2
Nonresidential	number	NA	1,078	--------
Nonresidential value	millions	$173.7	$102.1	−41.2
Highway construction contracts awarded	do	$55.4	$52.6	−5.2
Truck gross ton-mile tax	do	$9.0	$9.2	+2.2
Cash receipts from farm marketing	do	$826.2	$807.5	−2.3
Mineral production	do	$362.9	$346.2	−4.6
Work force (monthly average):				
Total labor force	thousands	789.3	811.5	+2.8
Total employment	do	763.6	785.2	+2.8
Total unemployment	do	25.3	26.3	+4.0
Unemployment rate	percent	3.2	3.2	--------
Employment:				
Total agricultural	thousands	47.1	48.2	+2.3
Total nonagricultural (wage and salary)	do	627.3	649.4	+3.5
Mining	do	12.8	12.8	--------
Contract construction	do	36.1	33.8	−6.4
Manufacturing	do	99.4	102.9	+3.5
Finance, insurance, real estate	do	31.6	33.1	+4.7
Transportation and utilities	do	45.9	46.8	+2.0
Trade	do	146.1	149.9	+2.6
Services and miscellaneous	do	106.0	110.3	+4.1
Government	do	149.4	159.8	+7.0

NA Not available.

Source: Business Research Division, Graduate School of Business Administration, University of Colorado, Boulder, Colorado 80302.

in 1966. Compared with 1966 values, 21 commodities decreased, 10 increased, and one remained unchanged. Substantial declines in value were recorded for natural gas ($2.2 million), molybdenum ($4.1 million), stone ($5.8 million), vanadium ($1.6 million), and zinc ($1.4 million); whereas, only petroleum had a substantial increase ($1.5 million). Petroleum contributed 29 percent of the total value of production in the State, and molybdenum, 24 percent. The production of metals comprised 44 percent of the State's total value of mineral production, fuels 42 percent, and nonmetals 14 percent.

Exploration for silver and uranium was

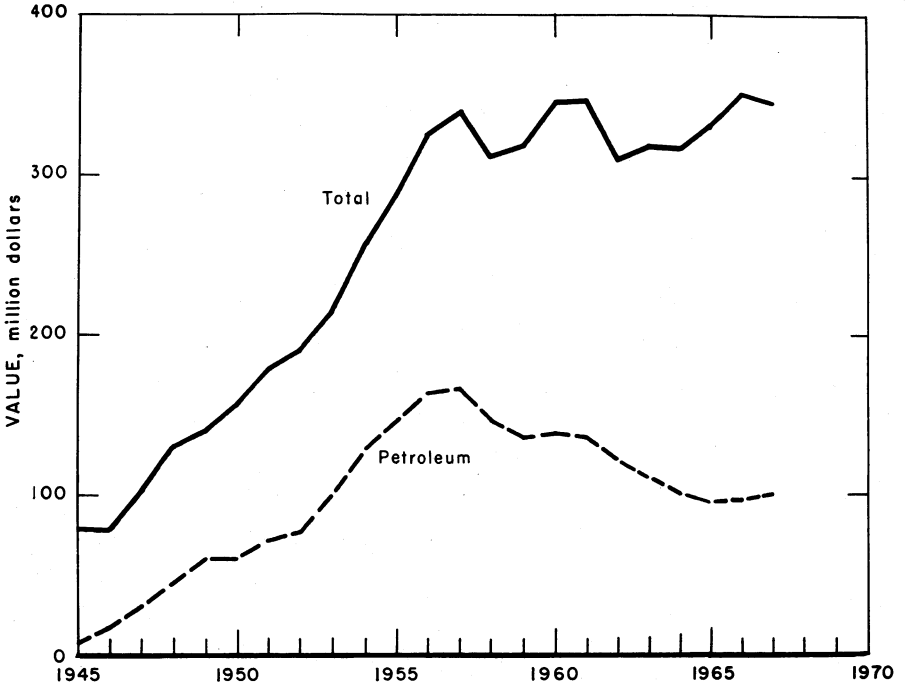

Figure 1.—Value of petroleum, and total value of mineral production in Colorado.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	1,485	225	334	2,628	5	122	48.33	12,618
Peat	21	164	3	23	----	----	----	----
Metal	4,782	271	1,297	10,384	8	393	38.62	6,565
Nonmetal	479	155	74	594	----	15	25.24	730
Sand and gravel	1,298	202	262	2,109	3	41	20.87	9,232
Stone	810	228	185	1,520	2	50	34.22	8,811
Total [1]	8,875	243	2,154	17,257	18	621	37.03	7,801
1967: [p]								
Coal	1,335	219	292	2,300	2	103	45.65	6,382
Peat	21	131	3	15	----	----	----	----
Metal	4,685	274	1,281	10,245	7	407	40.41	6,777
Nonmetal	480	159	76	610	----	4	6.55	383
Sand and gravel	1,370	182	250	2,014	2	42	21.85	6,319
Stone	500	242	121	978	----	24	24.53	3,973
Total [1]	8,390	241	2,024	16,162	11	580	36.57	6,246

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

on a definite upswing; the increased price of silver and the revised estimates of future uranium demands made in late 1966 provided the incentive. Several old silver mines were reopened. Three petroleum companies—Atlantic Richfield Co.,

Continental Oil Co., and Gulf Oil Corp.—opened offices in Denver for conducting uranium exploration in the Rocky Mountain area.

Molybdenum continued in the spotlight as Climax Molybdenum Co. Division, American Metal Climax, Inc., began production at its Urad mine near Empire and development of the Henderson deposit near the Urad mine.

Petroleum production reversed the downward trend of the last 6 years with a small (1.1 percent) increase. The greatest increase was in the Maudlin Gulch field, where a new pay zone in the Dakota formation was discovered and developed.

Employment and Injuries.—Preliminary data for 1967 and final data for 1966 compiled by the Federal Bureau of Mines for employment and injuries in the mineral industries, excluding the petroleum industry, are shown in table 4.

Legislation and Government Programs.—The Office of Minerals Exploration (OME) U.S. Geological Survey awarded five new contracts for mineral exploration work in Colorado. Richmond Hill Exploration Co., Inc., of Aspen obtained a contract to explore for silver-bearing ore bodies in the Leadville limestone in the Lenado area of Pitkin County. The work consisted of surface drilling estimated to cost $78,800. Ventura Oil Co. of Denver received a contract to explore for silver at the Mountain Top property in Ouray and San Miguel Counties. Estimated to cost $81,600, the work consisted of drifting, crosscutting, and diamond drilling for silver-bearing ore bodies in veins in the San Juan formation.

Great Eastern Mines, Inc., of Albuquerque, N. Mex., contracted to explore for silver on its Sioux City claims in San Juan County. The Great Eastern vein on the property was to be explored by surface drilling, followed by underground work. Exploration work was estimated to cost $81,200. Oxley Petroleum Co. of Tulsa, Okla., received a contract for silver and gold exploration at the Capital Prize mine in Clear Creek County. The work, estimated to cost $194,400, consists of tunneling in and along the Capital Prize vein system. Roy Pray and Associates of Lake City received a contract to explore by tunneling in and along the Palmetto vein for silver at the Palmetto property in Hinsdale County. The cost of the work was estimated at $64,640.

In contracts with Richmond Hill Exploration Co., Inc., Ventura Oil Co., Great Eastern Mines, Inc., and Roy Pray and Associates the Federal Government's financial participation was 75 percent of the estimated cost of the work and 62.5 percent with Oxley Petroleum Co.

Cotter Corp. obtained a contract from the U.S. Atomic Energy Commission (AEC) to process uranium ore from eligible small mining properties in areas remote from stretch-out mills. The ores would be processed at the company's uranium mill in Canon City. The contract covered a 2-year period from January 1, 1967, through December 31, 1968.

Several Federal Bureau of Mines publications concerning the mineral industry in Colorado were released. A comprehensive report was published on the effect of urbanization on the mineral-aggregate industry in the Denver Metropolitan Area.[3] Colorado was one of the eight States covered in a report about iron and steel scrap.[4] The Climax mine at Climax was used as the basis of a research study about scheduling production and development work in long-range mine planning.[5] As part of a program to evaluate potential locations for an in situ oil shale retorting test[6], details and findings were published of Colorado Corehole No. 2 drilled in the Green River oil shale.

Government-financed construction projects consumed most of the production of cement, sand and gravel, and stone. Contracts awarded for road construction totaled $79.4 million, $25.9 million more than in 1966, solely due to more road building in the National System of Interstate and Defense Highways. Construction work was continued throughout the year on the Ruedi and Silver Jack dams. Completed during the year were the Morrow Point and Rifle Gap dams.

[3] Sheridan, Matthew J. Urbanization and Its Impact on the Mineral Aggregate Industry in the Denver, Colo., Area. BuMines Inf. Circ. 8320, 1967, 51 pp.

[4] Bennett, Harold J. Iron and Steel Scrap in the Intermountain and Northwestern Plains States. BuMines Inf. Circ. 8344, 1967, 71 pp.

[5] Mathias, Adrian J. A Mine Production-Scheduling Model and Critical Path Analysis of Mine Development Work for Long-Range Mine Planning. BuMines Rept. of Inv. 6937, 1967, 48 pp.

[6] Dana, George F. Bureau of Mines—Atomic Energy Commission Colorado Corehole No. 2, Rio Blanco County, Colo. BuMines Open-File Report, 1967.

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—Colorado was the only State besides South Dakota that produced beryllium concentrate. Output in 1967 was only one-third that of 1966. Hand-cobbed beryl was obtained by Ralph J. Pierce from the Blackhawk mine in Fremont County and by Car Mona Mines from the Mona claims in Larimer County. A small quantity of hand-cobbed beryl from unknown producers was sold to Beryl Ores Co. which operated a plant in Arvada for producing beryllium compounds.

Cadmium, Indium, and Thallium.—From the processing of flue dust, dross, and byproduct materials obtained at smelters and other plants outside the State, American Smelting and Refining Co. (Asarco) recovered cadmium, indium, and thallium at its Globe smelter in Denver. Because the origin of these metals could not be determined, outputs were not included as part of any State mineral production.

Copper.—Of the 29 mines with copper production, the Idarado mine of Idarado Mining Co. in Ouray and San Miguel Counties was responsible for three-fourths of the State copper output. Although production at the Idarado mine was up 100 tons, the State output declined 6 percent or 244 tons below that of 1966.

Idarado Mining Co. operated the Idarado mine at nearly the 1966 level of production. However, the nationwide copper strike affected shipments of copper and lead concentrates after July, forcing the company to stockpile these concentrates. Zinc concentrate shipments, however, were made throughout the year.

The Emperius mine of Emperius Mining Co. in Mineral County had the second largest output with a slight 4-percent increase in production over that of 1966. Production at the third largest source, the Eagle mine of The New Jersey Zinc Co. a subsidiary of Gulf & Western Industries, Inc., in Eagle County, was only 39 percent that of 1966 due to a considerable reduction in mining copper ores; however, the quantity of zinc ore, the principal ore mined at this operation, was about the same as in 1966.

Seventeen counties had copper production, San Miguel County had 61 percent of the State output. Other counties that

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)
1963	47	19	975	33,605	$1,176	2,307	$2,951
1964	58	19	1,052	42,122	1,474	2,626	3,396
1965	58	13	1,021	37,228	1,303	2,051	2,652
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
1858–1967	NA	NA	NA	40,829,019	922,892	781,442	618,814

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	4,169	$2,568	19,918	$4,302	48,109	$11,065	$22,062
1964	4,653	3,034	20,563	5,388	53,682	14,602	27,894
1965	3,828	2,710	22,495	7,018	53,870	15,730	29,413
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
1858–1967	328,586	113,797	2,904,470	363,975	2,273,779	449,718	2,469,196

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes re-treated, and ore, old slag, or tailings shipped to smelters during the calendar year indicated.
[2] Does not include gravel washed.

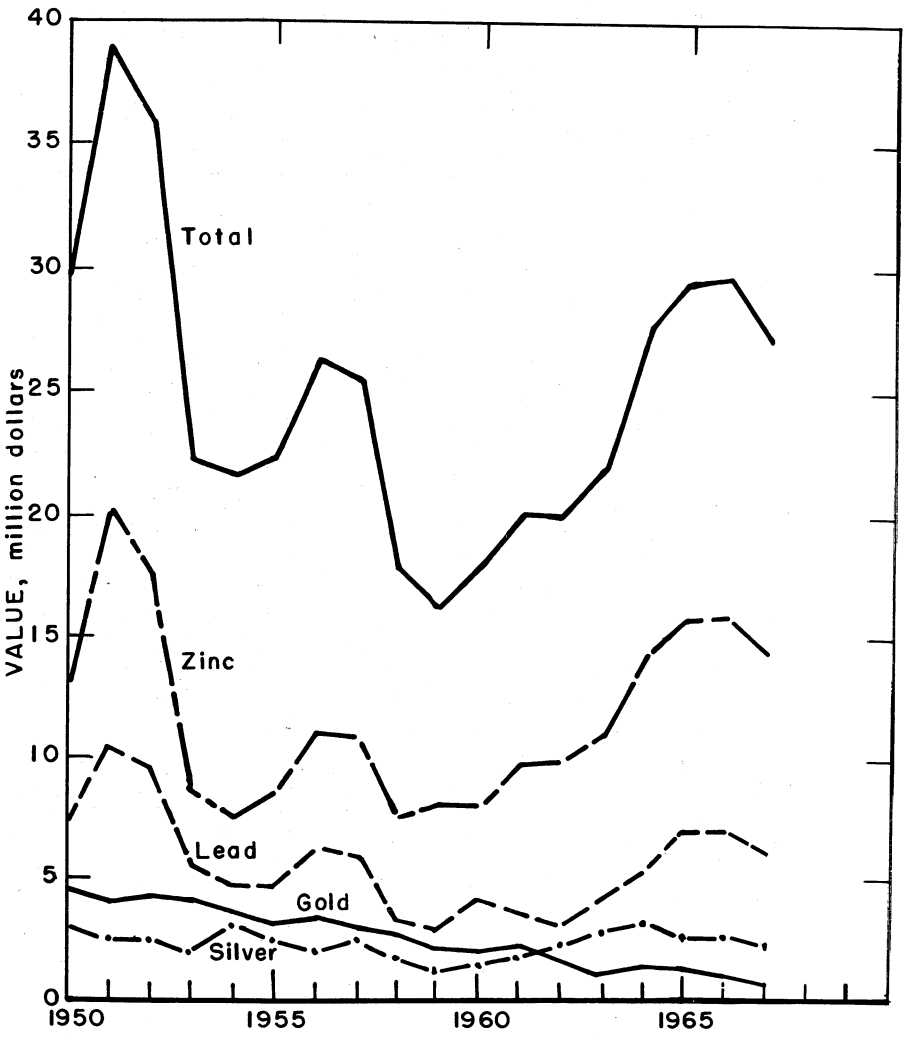

Figure 2.—Value of mine production of gold, silver, lead, and zinc and total value of these minerals (including copper) in Colorado.

had production exceeding 100 tons were, in order of output, Ouray, San Juan, Mineral, Eagle, and Gunnision.

The increase in the average price of copper from 36.17 cents per pound in 1966 to 38.23 cents was enough to offset the decline in output so that the value of production was virtually the same as that of 1966.

The Cleveland-Cliffs Iron Co. joined with the Union Pacific Railroad Co. and the W. S. Moore Company to develop a copper deposit at the old Summitville mine property at Summitville. Shaft sinking was begun during the year. According to the annual report of Cleveland-Cliffs, a 300-ton-per-day mill would be built, and production was expected in early 1969.

Gold.—Gold production declined one-third from the 1966 output of 31,915 troy

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1967, by counties, in terms of recoverable metals

County	Mines producing [1]		Material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Adams	-----	4	----------	[3] 901	[3] $31,535	[3] 116	[3] $180
Boulder	2	1	267	1,103	38,605	2,047	3,173
Chaffee	-----	2	[3]	[3]	[3]	[3]	[3]
Clear Creek	7	----------	14,776	142	4,970	8,033	12,451
Conejos	1	----------	[4] 259,614	[4] 2,844	[4] 99,540	[4] 285,849	[4] 443,065
Dolores	1	----------	[4]	[4]	[4]	[4]	[4]
Eagle	1	----------	225,019	696	24,360	230,959	357,986
Fremont	1	----------	[4]	[4]	[4]	[4]	[4]
Gilpin	2	2	2,144	135	4,725	535	829
Gunnison	3	----------	49,747	124	4,340	166,796	258,534
Hinsdale	1	----------	[4]	[4]	[4]	[4]	[4]
Huerfano	1	----------	52	----------	----------	10	16
Jefferson	-----	3	----------	379	13,265	61	94
La Plata	1	----------	[4]	[4]	[4]	[4]	[4]
Mineral	2	----------	44,135	446	15,610	111,365	172,616
Moffat	-----	1	----------	17	595	1	2
Ouray	1	----------	[4]	[4]	[4]	[4]	[4]
Park	1	1	9	468	16,380	161	250
Pitkin	1	----------	[4]	[4]	[4]	[4]	[4]
Pueblo	-----	----------	119	2	70	526	815
Saguache	1	----------	200	----------	----------	----------	----------
San Juan	8	----------	211,979	1,742	60,970	261,873	405,903
San Miguel	1	----------	363,291	12,171	425,985	748,768	1,160,590
Summit	3	1	1,541	11	385	599	929
Total:							
1967	39	15	1,172,893	21,181	741,335	1,817,699	2,817,433
1966	62	14	1,224,970	31,915	1,117,025	2,085,534	2,696,595

County	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Adams	-----	----------	----------	----------	----------	----------	[3] $31,715
Boulder	[5]	$76	[5]	$98	----------	----------	41,952
Chaffee	[3]	[3]	[3]	[3]	[3]	[3]	[3]
Clear Creek	3	2,026	53	14,742	16	$4,416	38,605
Conejos	[4] 559	[4] 427,061	[4] 3,472	[4] 971,838	[4] 4,692	[4] 1,299,137	[4] 3,240,641
Dolores	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Eagle	192	146,864	2,132	596,988	21,325	5,904,040	7,030,238
Fremont	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Gilpin	1	879	5	1,372	6	1,703	9,508
Gunnison	179	137,461	1,243	348,054	2,623	726,231	1,474,620
Hinsdale	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Huerfano	[5]	344	----------	----------	----------	----------	360
Jefferson	-----	----------	----------	----------	----------	----------	13,359
La Plata	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Mineral	241	184,326	1,451	406,378	2,148	594,820	1,373,750
Moffat	-----	----------	----------	----------	----------	----------	597
Ouray	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Park	-----	----------	[5]	42	----------	----------	16,672
Pitkin	[4]	[4]	[4]	[4]	[4]	[4]	[4]
Pueblo	1	612	4	1,190	47	12,902	15,589
Saguache	2	1,491	----------	----------	----------	----------	1,491
San Juan	369	281,840	5,527	1,547,602	8,542	2,364,869	4,661,184
San Miguel	2,445	1,869,251	8,013	2,243,724	13,021	3,604,925	9,304,475
Summit	1	497	23	6,412	22	6,049	14,272
Total:							
1967	3,993	3,052,728	21,923	6,138,440	52,442	14,519,092	27,269,028
1966	4,237	3,065,046	23,082	6,977,689	54,822	15,898,380	29,754,735

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines.
[2] Does not include gravel washed.
[3] Adams and Chaffee Counties combined to avoid disclosing individual company confidential data.
[4] Conejos, Dolores, Fremont, Hinsdale, La Plata, Ouray, and Pitkin Counties combined to avoid disclosing individual company confidential data.
[5] Less than ½ unit.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1967, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines[1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold and dry gold-silver[2]	[3] 7	3,520	827	8,221	2,500	10,800	12,300
Dry silver	6	150,478	5	32,522	5,500	167,600	71,300
Total	13	153,998	832	40,743	8,000	178,400	83,600
Copper	2	2,309	197	45,608	193,000	10,000	----------
Copper-lead-zinc	1	437,700	14,657	901,706	5,895,100	19,307,900	31,466,600
Lead	6	1,297	144	6,087	7,900	230,000	25,100
Lead-zinc and zinc[2]	[4] 18	577,437	2,911	822,553	1,879,300	24,105,600	73,195,300
Total	26	1,018,743	17,909	1,775,954	7,975,300	43,653,500	104,687,000
Other lode material:							
Lead cleanup	([5])	5	------	19	200	5,000	----------
Zinc cleanup	([5])	147	3	654	2,500	9,100	113,400
Total	---	152	3	673	2,700	14,100	113,400
Total lode material	39	1,172,893	18,744	1,817,370	7,986,000	43,846,000	104,884,000
Placer	15	---------	2,437	329	---------	----------	----------
Total all sources	54	1,172,893	21,181	1,817,699	7,986,000	43,846,000	104,884,000

[1] Detail will not necessarily add to totals, because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] Six dry gold mines and one dry gold-silver mine.
[4] Seventeen lead-zinc mines and one zinc mine.
[5] From properties not classed as mines.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1967, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation: ore	2,380	838	---------	----------	----------
Concentration, and smelting of concentrates: ore	15,667	1,764,849	7,788,100	43,732,800	104,759,300
Direct-smelting:					
Ore	694	51,010	195,200	99,100	11,300
Cleanup	3	673	2,700	14,100	113,400
Total	697	51,683	197,900	113,200	124,700
Placer	2,437	329	---------	----------	----------
Grand total	21,181	1,817,699	7,986,000	43,846,000	104,884,000

ounces. Output was reported from 34 lode and 15 placer mines in 22 counties, compared with 43 and 14, respectively, in the same number of counties in 1966. The lode mines accounted for 18,744 troy ounces or 88 percent of the State output, and placer mines, 2,437 troy ounces or 12 percent in 1967. Eight of the placer mines were sand and gravel operations at which gold was recovered as a byproduct.

Chaffee, Fremont, and Pitkin Counties were credited with gold production in 1967, whereas they had none last year; Lake, Montrose, and Saguache Counties had production last year but not in 1967. San Miguel County—57.5 percent of the State output—was the only county with output greater than 10,000 troy ounces. However, yield from this county was about 8,000 ounces less than in 1966. Ouray County, the second most productive county, also had a significant decline in produc-

tion. The main cause of the decline in these two counties as well as in the State, was that the Idarado mine, situated in both counties and the largest source of gold in the State, had a decrease of 10,000 troy ounces from the 1966 output. Although the ore tonnage mined at the Idarado mine was about the same as that of last year; the gold content was 0.024 troy ounces less per ton. The only other counties with production exceeding 1,000 troy ounces were San Juan and Boulder. Nine counties had production between 100 and 1,000 troy ounces; nine had less than 100 troy ounces.

Iron Ore.—Iron ore production was significantly greater than that of 1966 mainly because of greater output from the Copper Basin mine of Pitkin Iron Corp., Pitkin County. Under a lease agreement with Pitkin, the magnetite ore mined by Morrison-Knudsen Co., Inc., was shipped to the Pueblo steel plant of CF&I Steel Corp. Brown ore mined from the Iron Springs placer of Chas. Pfizer & Co., Inc., in San Miguel County was shipped to a company plant for use as a paint pigment. Theresa B. Robinson shipped brown ore from a stockpile at the Iron Lode No. 3 mine in San Miguel County for use locally as a soil additive.

Industrial Chemicals Division, Allied Chemical Corp., produced agglomerates (cinders) from processing pyrites at its sulfuric acid plant in Denver. Containing 65 percent iron, the agglomerates were sold for use in making steel and cement. However, the output was not considered as mineral production, because the material was classed as a secondary product.

Lead.—Output declined 1,159 tons or 5 percent below that for 1966, because five of the seven leading sources had reduced production. Two principal operations with increases in production were the fourth-ranked Brenneman mine of Standard Metals Corp. in San Juan County which had an output almost twice that of 1966, and the fifth-ranked Rico Argentine mine of Rico Argentine Mining Co. in Dolores County, which had production one-third more than the 1966 output. However, the production gains of these two mines were offset by declines in production from the other five principal operations: the Idarado mine (first) in Ouray and San Miguel Counties, Sunnyside (second) also of Standard Metals Corp. in San Juan County, Eagle (third) in Eagle County, Emperius (sixth) of Emperius Mining Co. in Mineral County, and Keystone (seventh) of McFarland & Hullinger in Gunnison County. The seven leading mines, each with production exceeding 1,000 tons, yielded 93 percent of the State output; the Idarado mine alone accounted for 44 percent. Twenty-five other mines had lead production ranging from 100 pounds to 369 tons. There were only 32 producing mines, compared with 51 in 1966.

Of the 16 counties with production, San Miguel and San Juan, in that order, were the leading counties with production totaling 13,540 tons of lead, 63 percent of the State output. Output from San Miguel County came from that part of the Idarado mine in the county and that from San Juan County was attributed to eight mines. Only five other counties had production exceeding 1,000 tons.

The average price of lead declined 1.1 cents, from 15.1 to 14.0 cents per pound. This drop in price and the decrease in output resulted in a 12-percent drop in the overall value of lead production.

Operated by McFarland & Hullinger, the Keystone mine and mill near Crested Butte were closed down indefinitely on September 2; however, exploration work continued. The Keystone operation had been one of the leading base metal mines in the State since the mine was reopened in 1963. A large quantity of lead concentrates had to be stockpiled at the mine after the lead smelters were shut down due to a strike.

Asarco and Resurrection Mining Co., a wholly owned subsidiary of Newmont Mining Corp., continued joint venture exploration and development work in the Irene-Sunday-Hellena area, in the Leadville district. According to Newmont's 1967 annual report high-grade lead-zinc mineralization with significant silver and gold values was encountered. An evaluation of the ore potential was being made with a view to bringing this property into production.

Manganiferous Ore.—Hotchkiss Mining Corp. shipped stockpiled manganiferous ore from the Crest mine in Gunnison County; the 20-percent-manganese ore was used as a soil nutrient in fertilizer.

Molybdenum.—Colorado was responsible for 64 percent of the Nation's molybdenum production in 1967 and the Climax Molybdenum Co. produced the entire State output. Although production exceeded that of the previous year, shipments were 5.2 million pounds less due to a strike from July 1 to November 24 at Climax's molybdenum refinery at Langeloth, Pa. At year-end a relatively large quantity of molybdenum concentrates was stockpiled at the Climax mine in Lake County.

The newly developed Urad mine near Empire in Clear Creek County was dedicated by Climax in September. About 1.5 million pounds of molybdenum were produced by the end of the year. The operation, scheduled for full production in 1968, was designed and developed for mining 5,000 tons of ore per day and producing 7 million pounds of molybdenum annually.

Climax awarded a $5 million contract to Boyles Bros. Drilling Co. to sink the first shaft and to do initial drifting on the Henderson molybdenum deposit located near the Urad mine. Discovery of the Henderson deposit was first announced by Climax in June 1965. The deposit was considered to be the second largest molybdenum deposit found in the world; Climax is the largest. According to the company's 1967 annual report the molybdenum contained in the deposit matches the remaining reserves in the deposit at the Climax mine. Work commenced on the 23-foot-diameter shaft early in the year; at year-end the shaft was down 650 feet of the total depth of 2,410 feet. Tentative company plans were to develop by the mid-1970's a mining operation of 30,000 tons per day with an annual capacity of approximately 50 million pounds of molybdenum.

Surpassing the previous production high of 15.2 million tons set in 1966, a new yearly record of 15.4 million tons of ore was obtained at Climax, the largest underground mine in the world based on ore production. Approximately 42,900 tons were mined daily. Over half of the ore came from the Storke level; the balance came from the Phillipson level and Ceresco Ridge area. Development work was continued on the 600-foot level; production from this level is expected about 1971 when that part of ore body mined from the Phillipson level will be depleted. The molybdenum oxide plant, placed in operation in 1966, was operated at nearly its designed annual capacity of 3 million pounds. Approximately 5,600 tons of the 42,900 tons mined daily were treated at the plant for the recovery of molybdenum in oxide minerals.

Rare-Earth Metals.—Monazite (a combination of rare-earth phosphates) was recovered as a byproduct from mill tailings by Climax Molybdenum Co. at the Climax mine. The output was 41 percent greater than that of 1966.

Molybdenum Corporation of America (Molycorp) purchased the remaining interest in Yttrium Corporation of America and then merged the company into Molycorp. In 1966 Yttrium Corp. began operating a million-dollar plant at Louviers for producing yttrium oxide. To produce other high-purity rare-earth oxides Molycorp placed into operation during 1967 a plant adjacent to the yttrium oxide facility. The plant had the capacity for an annual production of 700,000 pounds of lanthanum oxide, 200,000 pounds of neodymium oxide, and 60,000 pounds of praseodymium oxide.

Silver.—Although the quantity of silver produced was down 268,000 troy ounces, the value was up $120,000 due to a substantial increase in silver prices. The average price was $1.55 per troy ounce, compared with $1.293 in 1966. As with gold, most of the silver was obtained as a byproduct from processing base-metal ores. The only sizeable operations at which silver ore was obtained were the Smuggler mine dump of The Aspen Consolidated Mining Co., a subsidiary of McCulloch Oil Corporation of California, in Pitkin County, and the Brownville Slide dump of Cotter Corp., in Clear Creek County. Placer operations accounted for only 329 troy ounces. The largest single source, the Idarado mine in Ouray and San Miguel Counties, yielded half of the State's output of silver. Production at this mine increased 117,000 troy ounces above that of 1966; ore grade was up about one-third of an ounce per ton. The only other mines with production exceeding 100,000 troy ounces were, in order of output, the Eagle mine in Eagle County, Keystone in Gunnison County, Sunnyside in San Juan County, and Emperius in Mineral County. However, each of these mines had production

below that of 1966. Production at the Keystone mine was only half that of 1966. Two mines that had significant increases were the Brenneman in San Juan County with a 59 percent gain and the Rico Argentine in Dolores County with a 37 percent gain. The Brenneman mine was ranked sixth in production, and the Rico Argentine, seventh.

Twenty-three counties, one more than in 1966, had silver production. Chaffee, Fremont, Huerfano, and Moffat Counties had production this year but not last year; Custer, Lake, and Saguache had production last year but not this year. The only counties with production exceeding 100,000 troy ounces, in order of output, were San Miguel, San Juan, Eagle, Ouray, Gunnison, and Mineral.

According to its annual report, Homestake Mining Co. decided to erect a 300-ton-per-day mill and to place in production the Bulldog property, a silver-lead prospect near Creede; underground development and metallurgical testing were done during the year.

Tin.—Shipments of tin contained in concentrates declined 13 long tons below those of 1966. The tin concentrates obtained by Climax Molybdenum Co. from treating mill tailings at its Climax molybdenum operation were sold to Fred H. Lenway & Co., Inc., for upgrading at its mill near Boulder.

Tungsten.—The output of tungsten was below that of the previous year due to a slight drop in shipments from the Climax mine. Tungsten concentrates were produced as a byproduct from milling molybdenum ore by the Climax Molybdenum Co. Canyon Mining Corp. mined tungsten ore from the Eureka mine in Boulder County. The only other output of tungsten ore was recovered by Colorado Tungsten Corp. from the Beddig mine dump in Boulder County.

Uranium.—The Bureau of Mines changed its method of reporting uranium production from short tons of ore and f.o.b. mine value to recoverable pounds of uranium oxide (U_3O_8) and f.o.b. mill value. The comparisons of 1967 and 1966, shown in tables 1 and 9, were determined by using the new method. The f.o.b. mill value for the 2 years was based on $8.00 per pound of U_3O_8.

Uranium production declined 114,000 pounds of U_3O_8, 4 percent below that of 1966. The U_3O_8 was recovered from 615,585 tons of ore, averaging 0.22 percent. The ore was processed at uranium mills of Union Carbide Corp. at Rifle and Uravan; Climax Uranium Co. Unit, American Metal Climax, Inc., at Grand Junction; Cotter Corp. at Canon City; Foote Mineral Co. at Shiprock, N. Mex.; and Atlas Corp. in Moab, Utah.

The mine output came from 262 operations in seven counties, compared with 354 operations in 15 counties in 1966. Montrose County had the largest production, 37 percent of the State output, and most of the operations, 156.

Uranium ore shipments were made by 52 operators, 17 less than in 1966. Four operators each had output exceeding 100,000 pounds of U_3O_8; together they accounted for 89 percent of the State's output. Nine operators had production between 10,000 and 100,000 pounds; 15, between 1,000 and 10,000 pounds; and 24,

Table 9.—Uranium (recoverable content U_3O_8), by counties

County	1966			1967		
	Number of operations	Pounds	Value [1]	Number of operations	Pounds	Value [1]
Mesa	65	616,372	$4,930,978	41	632,202	$5,057,621
Montrose	195	1,234,049	9,872,390	156	943,895	7,551,160
San Miguel	72	577,065	4,616,522	53	530,826	4,246,611
Other counties [2]	22	223,157	1,785,256	12	430,399	3,443,187
Total	354	2,650,643	21,205,146	262	2,537,322	20,298,579

[1] F.o.b. mill value; based on $8 per pound of U_3O_8 contained in concentrate.
[2] 1966: Boulder (1 operation), Custer (1), Fremont (4), Garfield (3), Jefferson (2), La Plata (1), Larimer (1), Montezuma (2), Park (1), Rio Blanco (3), Saguache (2), and San Juan (1); 1967: Fremont (4), Garfield (3), Jefferson (3), and Rio Blanco (2).

less than 1,000 pounds. The four largest operators, in order of output, were Union Carbide Corp., Climax Uranium Co., Cotter Corp., and Foote Mineral Co.

Vanadium Corporation of America, a substantial producer of uranium and vanadium in the State, was merged into Foote Mineral Co. on August 31.

Exploration drilling continued at a high pace, with 803,076 feet reported drilled during the year; rotary drilling accounted for almost half of the footage.

Vanadium.—Although vanadium production declined 380 tons, 10 percent below the 1966 output, Colorado provided two-thirds of the Nation's output. The vanadium, obtained from 571,866 tons of uranium-vanadium ores averaging 1.34 percent V_2O_5, was recovered at the uranium mills of Union Carbide Corp. in Rifle and Uravan; Climax Uranium Co. in Grand Junction; Foote Mineral Co. in Shiprock, N. Mex., and Atlas Corp. in Moab, Utah. In order of output counties with mine production were Montrose, San Miguel, Mesa, Garfield, and Rio Blanco.

Zinc.—Output of zinc was 4 percent in quantity and 9 percent in value below the figures of 1966. An 0.7-cent drop in the price of zinc, from 14.5 to 13.8 cents per pound, was the reason for the different percentage changes in quantity and value.

The seven mines that were the principal producers of lead were also the leading zinc sources. However, based upon zinc output the Eagle mine was the leading source, then came Idarado, Sunnyside, Brenneman, Keystone, Emperius, and Rico Argentine. These mines, the only ones with outputs exceeding 1,000 tons of zinc, yielded 97 percent of the State's zinc output. There were 25 producing mines, including the seven leading ones, compared with 36 in 1966.

Fourteen counties, the same as in 1966, had production. Leading counties in order of output were Eagle, San Miguel, and San Juan; the total output of these three counties was 42,888 tons, 82 percent of the State total.

MINERAL FUELS

Asphalt and Related Bitumens (Gilsonite).—American Gilsonite Co. produced gasoline, diesel fuel, high-grade metallurgical coke, and other products at its gilsonite refinery near Fruita. Gilsonite was transported by pipeline to the refinery from the company mining operations at Bonanza, Utah. To remove the last remaining mineral impurities in melted gilsonite and recycle oil, a final vacuum filtering system was installed before the delayed coker section so that high-grade coke could be produced.

Carbon Dioxide.—Because of expanding markets by Colorado Carbonics, Inc., output of carbon dioxide from the McElmo field, Montezuma County, increased 24 percent. Production was from the Mississippian formation in the field.

Ten billion cubic feet of carbon dioxide produced with oil from the McCallum field, Jackson County, was unmarketable owing to entrained hydrocarbons. After separation from the oil, the gas was vented to the atmosphere.

Coal (Bituminous).—Coal production, 4 percent or 217,000 tons greater than that of 1966, surpassed the 5-million-ton mark for the second consecutive year. The value of the output was the third highest of all mineral commodities produced in the State. Of the 5.4 million tons produced, electric utility companies consumed 60 percent for power generation. Thirty-eight percent of the output was sent to steel companies for producing coke, and the balance was shipped to sugar beet plants and small individual consumers. About 1.4 million tons was shipped out of State, mostly for steelmaking.

Coal output was reported from the same 14 counties as in 1966. Nine of the counties had production exceeding 100,000 tons. Routt County had the largest production; with one-third of the State output, 1.8 million tons, the county was the only one with output greater than 1 million tons. The county also had the greatest increase (274,000 tons) in output. Four other counties had increases over their 1966 output. Pitkin County had the largest decrease (88,000 tons), followed closely by Las Animas County (87,000 tons).

Coal production was reported by eight fewer mines than in 1966. Of the 63 mines with production, seven strip mines including one operation that used both stripping and augering methods, accounted for 34.2 percent of the State output; 55 underground mines, 65.7 percent; and one auger operation, 0.1 percent. Twenty-eight un-

Table 10.—Coal (bituminous) sold or used in 1967, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operating				Sold or used (short tons)			
	Underground	Strip	Auger	Total	Underground	Strip	Auger	Total
Delta	4	-----	-----	4	397,770	----------	-------	397,770
Fremont	15	[1]2	[1]1	18	257,110	6,279	3,819	267,208
Garfield	2	-----	-----	2	3,821	----------	-------	3,821
Gunnison	4	-----	-----	4	440,783	----------	-------	440,783
Huerfano	2	-----	-----	2	24,899	----------	-------	24,899
La Plata	5	-----	-----	5	21,181	----------	-------	21,181
Las Animas	5	-----	-----	5	756,912	----------	-------	756,912
Mesa	5	-----	-----	5	118,164	----------	-------	118,164
Moffat	2	1	-----	3	214,997	1,000	-------	215,997
Montrose	---	1	-----	1	----------	53,845	-------	53,845
Pitkin	2	-----	-----	2	629,815	----------	-------	629,815
Rio Blanco	2	-----	-----	2	4,964	----------	-------	4,964
Routt	2	3	-----	5	30,893	1,800,569	-------	1,831,462
Weld	5	-----	-----	5	672,459	----------	-------	672,459
Total	55	7	1	63	3,573,768	1,861,693	3,819	5,439,280

[1] One mine strip and auger included in mine count of strip only.

derground, three strip, and one auger mine had production between 1,000 and 10,000 tons; 17 underground and one strip mine, between 10,000 and 100,000 tons; eight underground and one strip mine, between 100,000 and 500,000 tons; and two underground and two strip mines, between 500,000 and 1,000,000 tons. In Las Animas County the Allen underground mine of CF&I Steel Corp. had the largest production of all coal mines in the State. The other three mines with production exceeding 500,000 tons were, in order of output, the Edna strip mine of The Pittsburg & Midway Coal Mining Co. in Routt County, the Somerset underground mine of United States Steel Corp. (USS) in Delta and Gunnison Counties, and the Seneca strip mine of Seneca Coals, Ltd., in Routt County. Coal from the Allen and Somerset mines was used for steelmaking, and that from the Edna and Seneca mines for electric-power generation.

The average price per ton of coal produced from underground mines was $5.50, and that from strip mines, $3.36 compared with $5.73 and $3.37, respectively, in 1966.

The status of the Hayden powerplant was clarified by a contract between the Colorado-Ute Electric Association, Inc., and Public Service Company of Colorado (PSCo), which was approved by the Colorado Public Utilities Commission on December 22. Colorado-Ute will own and operate the plant and serve all its present members. PSCo will sell varying quantities of wholesale power to Colorado-Ute as well as provide transmission service for deliveries of power to two of Colorado-Ute's customers. Under the contract PSCo was given the right and obligation, between 1968 and 1974, to buy annually a block of surplus power from the Hayden plant at a favorable price. Coal for the Hayden plant was supplied from the Seneca strip mine operated by Seneca Coals, Ltd.

After 28 years of operation the Washington underground mine of Clayton Coal Co. was closed on May 12 for lack of mineable coal. The mine, 19 miles north of Denver in Weld County, first attained production in November 1940. Total output during the life of the mine was 4.4 million tons, with most of the production sent to powerplants in the Denver area.

Natural Gas.—Marketed natural gas decreased 14 percent in quantity and 13 percent in value. The Colorado Oil and Gas Conservation Commission[7] reported natural gas production of 125.5 billion cubic feet, 5.6 percent less than in 1966.

The four leading counties in marketed natural gas were unchanged: La Plata, 41.8 billion cubic feet; Rio Blanco, 18.8 billion; Moffat, 18.1 billion; and Mesa,

[7] The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics, 1967. Part II. All field natural gas and petroleum production figures cited in the chapter are from this work.

8.9 billion. Morgan and Baca Counties also had gas sales of 5 billion cubic feet or more.

The Ignacio-Blanco field, La Plata County, was the most productive dry-gas field in the State; output of 33.8 billion cubic feet was from three reservoirs (Dakota, Fruitland-Pictured Cliffs, and Mesaverde, all of Cretaceous age). Other major dry-gas fields were: Piceance Creek, 9.9 billion cubic feet; Divide Creek, 6.4 billion; and West Hiawatha, 4.9 billion. Production from the Piceance Creek field more than doubled owing to additional drilling in and production from the Wasatch A and Wasatch G reservoirs.

The Rangely-Weber reservoir yielded the largest quantity of wet-gas, 14.5 billion cubic feet. Of this output, 6.7 billion cubic feet were reinjected after the liquids were removed. Output of Powder Wash field was 4.7 billion cubic feet. The Wilson Creek field had wet-gas production of 3.9 billion cubic feet, of which 2.7 billion were reinjected after extraction of fluids.

The American Gas Association Inc, (AGA) and the American Petroleum Institue (API)[8] estimated that the gas reserves in the State totaled 1.8 trillion cubic feet, a 7.1-percent increase. Extensions and revisions of existing fields accounted for 159.6 billion cubic feet of the additional gas; new fields and pools accounted for 76.7 billion cubic feet.

The five natural gas storage projects, with an ultimate capacity of 25 billion cubic feet, contained at yearend 15.4 billion cubic feet.[9] With 13.6 billion cubic feet in storage at the beginning of the year, 6.8 billion cubic feet were injected and 5 billion withdrawn. Largest of the projects was the Fort Morgan field, owned by Colorado Interstate Gas Co. (CIG). Its capacity was 13.9 billion; at yearend, it had in storage 9.8 billion cubic feet. Next in size and storage was the Springdale field, Logan County, owned by Kansas-Nebraska Natural Gas Co. In Jefferson County the Leyden mine of PSCo was ranked third, followed by the company's Asbury Creek field in Mesa County and by the House Creek field, Montezuma County, owned by Plateau Natural Gas Co.

In the spring CIG built 57 miles of 16-inch gas pipeline from its Fort Morgan storage field to Denver. The $1.96 million line was to deliver 64 million cubic feet of gas per day to supplement pipeline supplies during periods of peak demand.

One of the significant discoveries of the year was the Andy's Mesa field discovered by Union Oil Company of California. The discovery well, Union's No. 1 Andy's Mesa-Federal, sec 34, T 44 N, R 16 W (NMPM), San Miguel County, was drilled to 8,509 feet and completed from the Hermosa group (Pennsylvanian) from the interval 5,386 to 8,442 feet. Daily initial potential production was 3.1 million cubic feet. At yearend the field had three shut-in gas wells and was to be supplied with a pipeline outlet.

Natural Gas Liquids.—Production of natural gas liquids declined 7 percent; the output value, however, was down only 4 percent.

The 16 plants in the State processed 88.8 billion cubic feet of gas which yielded 2.98 million barrels of liquids.[10] The API and AGA estimated natural-gas liquids reserves at yearend to be 22.9 million barrels, a 2.7-million-barrel, 11-percent decline.

Late in 1966 Texaco Inc. commenced operations at its new Wilson Creek plant, Rio Blanco County; the refrigeration process plant had a daily input capacity of 10.5 million cubic feet. The Bijou plant of Associated Oil & Gas Co., Morgan County, was not operated after April; the McWood Corp. plant at Roggen-Southwest, Weld County, was operated only in January.

Continental Oil Co. planned a 22.9-million-cubic-foot-per-day adsorption plant in Rio Blanco County. With completion planned in late 1968 anticipated daily output will be 18,300 gallons.

Oil Shale.—In January the U.S. Department of the Interior proposed a five-point policy for developing oil shale in Colorado, Utah, and Wyoming: (1) Action to clear title to public oil shale lands burdened with mining claims; (2) possible exchanges of scattered private oil shale lands for concentrated blocks of public land;

[8] 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, 1967. V. 22, May 1968, p. 125.

[9] Reference cited in footnote 7, Part III, p. 16.

[10] Reference cited in footnote 7, Part IV, p. 5.

Table 11.—Gas input and products at natural gas liquids extraction plants in 1967

Plant	County	Owner	Gas input (million cubic feet)	Products (thousand barrels)
Adena	Morgan	Union Oil Company of Calif	6,215	521
Bijou	do	Associated Oil & Gas Co	170	29
Buck Peak	Moffat	Western Slope Gas Co	67	1
Fort Morgan	Morgan	Natural Gas Producers, Inc	802	11
Fruita	Mesa	Continental Oil Co	5,301	99
Little Beaver	Washington	do	805	133
Loveland	Larimer	Associated Oil & Gas Co	199	25
McClave	Kiowa	Fleetwood Drilling Co	1,119	29
Minto	Logan	Sunray-DX Oil Co	73	10
Padroni	do	Associated Oil & Gas Co	357	14
Rangely	Rio Blanco	Chevron Oil Co	14,184	748
Roggen-Southwest	Weld	McWood Corp	4	(1)
San Juan	La Plata	El Paso Natural Gas Co	52,188	731
Vallery	Morgan	Associated Oil & Gas Co	827	68
Wilson Creek	Rio Blanco	Texaco Inc	3,448	232
Yenter	Logan	Associated Oil & Gas Co	3,082	327

[1] Less than ½ unit.

Source: The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics, 1967. Part IV: Gasoline and Extraction Plants, 5 pp.

(3) establishment of provisional leasing to permit private firms to do research and development; (4) cooperation between private industry, the AEC, and the Department on testing underground nuclear explosions as a means for extracting shale oil; and (5) expanded research programs involving the Federal Geological Survey, Bureau of Mines, and Bureau of Land Management. Public response to the proposal, including hearings before a Senate committee, was varied—some people demanded Federal Government development of the oil shale; others urged private development; some wanted quick development; others urged a go-slow policy.

On May 7 the Secretary of the Interior announced regulations governing oil shale leasing. Among the regulations were provisions limiting the initial leases to 5,120 acres and to 10-year terms, royalty rates ranging from 3 to 50 percent, and requirements that all research discoveries and patents be the property of the United States Government. Industry, in general, rejected the principles of sliding-scale royalty and disclosure of research developments. The governors of Colorado, Utah, and Wyoming joined in urging revisions of the regulations to make them more attractive to private development. At yearend the Department was analyzing comments and opinions from interested groups and individuals.

Research on the recovery of oil from oil shale was continued at the Government-owned Anvil Points facility under lease to the Colorado School of Mines Research Foundation, Inc. The experimental work under stage II of the initial program was completed on September 15. Pilot plant studies were conducted using retort No. 3, to determine the effect of shale particle size and size range, shale throughput, and gas rates on process yields and operability. The retort was shut down on August 31. The mining of shale for the retort, rock mechanics studies, and mine equipment evaluation were done in the mine until the operations under the joint account were halted on September 15. On December 1, five of the six participating oil companies began a comprehensive engineering evaluation were done in the mine until the mining operations under the joint account work. During the evaluation and until March 1, 1968, the Anvil Points facilities were to be held on a standby basis. The cost of the research work during the year was $2.1 million bringing the total expenditures to $7.3 million since the project was started in 1964.

In cooperation with Sohio Petroleum Co. and The Cleveland-Cliffs Iron Co., The Oil Shale Corp. (TOSCO) continued operations of the oil shale pilot plant and mine near Grand Valley. According to the TOSCO 1967 annual report, between November 1966 and November 1967 the Parachute Creek plant processed 75,000 tons of oil shale from which 66,000 barrels of shale oil were produced; the oil

was used in the company's research programs.

On April 6–7 the Fourth Symposium on Oil Shale was held in Denver. Papers presented at the symposium were published by the Colorado School of Mines, one of the sponsoring organizations.[11]

In October the U.S. Department of the Interior and the AEC ordered negotiations with industry for a joint nuclear test, called Project Bronco, aimed at eventual in situ retorting of oil shale. Preliminary studies indicated the feasibility of the proposed test, which called for detonation of a 50-kiloton nuclear device in oil shale, followed by in situ combustion of the fractured shale to extract the oil. Eighteen companies were to pay seven-eighths of the cost of the experiment; total cost was estimated to be $6 million.

Peat.—The output of peat declined 15,123 tons, 41 percent below that of 1966. Peat was produced at 14 operations, one less than in 1966; all except four had less production than in 1966. Boulder and Park Counties each had three operations; Teller and Gilpin Counties, two; and Alamosa, Chaffee, Lake, and La Plata Counties, one. Teller County had the largest production.

Of the 21,988 tons of peat produced, 16,388 tons were used for general soil improvement and 5,600 tons for mixed fertilizers and packing material. The types of peat mined were moss, 45.1 percent; humus, 41.3 percent; and reed-sedge, 13.6 percent. Only 3,468 tons of the total output were processed. Except for 726 tons that were packaged, the peat was bulk shipped; average price per ton was $9.29.

Petroleum.—Petroleum continued to be the most valuable single mineral commodity produced in Colorado, comprising 29 percent of the State's total value. The downward trend characterizing production in the State since 1960 was reversed when 1967 output reached 33.9 million barrels, 413,000 barrels more than in 1966. The small increase was more the result of improved recovery techniques than of new discoveries.

Yielding 47 percent of the crude oil, the most productive oil reservoir in the State was again the Rangely Weber pool. Although its cumulative production at yearend reached 401.2 million barrels, output from the field declined slightly (164,000 barrels) during 1967.

Arapahoe County joined the list of oil-producing counties with discovery of the Black Jack field. Rio Blanco County, however, retained its first-place rank with output from Rangely and Wilson Creek fields, followed in order by Washington and Logan Counties.

A total of 48 fluid-injection projects was underway in the State: 45 were waterfloods, two were combined gas- and water-injection, and one was gas-injection. Four new projects, all waterfloods, were approved: Cache field, Ismay reservoir, Montezuma County; Bobcat field, "D" sandstone reservoir, Washington County; Moccasin field, "J–1" sandstone reservoir, Adams County; and Powder Wash field, Wasatch (A4H sandstone) reservoir, Moffat County. Of these, only the Moccasin-field project was begun in 1967, on December 2. The Buckingham "D" sandstone waterflood, approved in 1966, was begun on March 5, 1967. Several injection programs were inoperative all or part of the year: Aztec Wash, Azure, Bijou, Danforth Hills (Morrison reservoir), Keota, Liberty, Luft, Phegley, and Winston. Total water injected in the projects was 134.8 million barrels (17,373 acre-feet).

API and AGA[12] estimated that the State reserves of crude oil at yearend were 339.9 million barrels, a decline of 3.6 million barrels (1 percent). Additions from revisions and extensions amounted to 26.5 million barrels; new fields and pools added 3.3 million barrels.

Although total drilling was approximately the same as in 1966 exploratory drilling increased by 15 wells (5.7 percent); development drilling, however, declined. Success ratio of the wildcat drilling was 16.2 percent, an improvement over the 12.2 percent of the previous year. Development drilling was 55.6 percent successful.

The Denver basin again accounted for 71 percent of the exploratory drilling; the Colorado part of the Paradox basin was next with 19 wells in Montezuma County, two in San Miguel, and one in La Plata. Sixty-nine percent of the discoveries were in the Denver basin, also the site of 42 percent of the development drilling. Rio Blanco, however, was the leading county

[11] Fourth Symposium on Oil Shale. Quarterly of the Colorado School of Mines. V. 62, No. 3, July 1967, 173 pp.

[12] Reference cited in footnote 7, pp. 30–31.

Table 12.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1966	1967	Principal fields in 1967, in order of production
Adams	434	391	Badger Creek, Moccasin, Middlemist, West Badger Creek, Beacon
Arapahoe	------	253	Black Jack.
Archuleta	64	60	Price Gramps.
Baca	121	97	Flank.
Bent	1	2	McClave.
Boulder	2	2	Boulder.
Fremont	20	21	Florence-Canon City.
Jackson	273	229	McCallum, Battleship.
Kiowa	205	771	Brandon.
La Plata	23	24	Red Mesa.
Larimer	366	410	Wellington, Loveland.
Logan	3,415	2,885	Saber, Mount Hope, Northwest Graylin, Bonanza, Minto, West Padroni.
Moffat	931	1,940	Maudlin Gulch, Powder Wash, Danforth Hills, Iles.
Montezuma	825	529	Cache, Flodine Park.
Morgan	1,326	1,802	Adena, Boxer, Sand River, Zorichak.
Prowers	------	5	Comanche.
Rio Blanco	19,273	19,006	Rangely, Wilson Creek, Nine Mile.
Routt	101	99	Grassy Creek, North Sage Creek, Tow Creek.
Washington	4,553	4,137	Plum Bush Creek, Rush Willadel, Bison, Big Beaver, Lindon, Westfork, Little Beaver.
Weld	1,555	1,241	Black Hollow, Pierce, Saber.
Yuma	4	1	Eastward.
Total	33,492	33,905	

Source: The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics, 1967. Part II: Oil and Gas Production, 86 pp.

Table 13.—Principal oilfields in 1967

Field	County	Production, 1967		Cumulative production to Jan. 1, 1968	
		Oil (barrels)	Gas (thousand cubic feet)	Oil (barrels)	Gas (thousand cubic feet)
Rangely (Weber)	Rio Blanco	16,048,852	14,475,322	401,177,432	647,903,294
Wilson Creek	----do	2,342,955	3,938,797	63,011,382	40,184,135
Maudlin Gulch	Moffat	1,078,567	159,800	2,502,267	503,450
Boxer	Morgan	810,522	1,466,236	1,061,797	1,794,995
Brandon	Kiowa	765,868	----------	1,043,000	----------
Plum Bush Creek	Washington	539,245	78,281	16,792,515	1,906,517
Black Hollow	Weld	501,167	21,958	8,353,029	246,505
Adena	Morgan	487,129	3,871,337	58,501,568	71,509,631
Rangely (Mancos)	Rio Blanco	408,072	----------	10,888,856	22
Rush Willadel	Washington	313,312	638	2,152,099	12,044
Bison	----do	304,377	----------	2,950,598	2,467
Big Beaver	----do	292,258	43,143	9,928,302	1,465,780
Cache	Montezuma	278,682	1,078,219	2,118,245	4,201,844
Saber	Logan	265,833	1,103,897	854,006	5,019,079
Pierce	Weld	262,620	19,387	6,200,106	183,652
Black Jack	Arapahoe	246,662	1,141	246,662	1,141
Lindon	Washington	241,007	----------	2,228,296	10,462
Westfork	----do	232,159	44,283	2,337,366	888,049
Mount Hope	Logan	214,559	27,236	6,039,795	6,865,170
Powder Wash	Moffat	208,552	4,715,497	4,184,132	77,498,895
Little Beaver	Washington	197,473	408,739	15,807,534	18,053,686
Danforth Hills	Moffat	195,801	46,584	2,503,807	195,556
Graylin, NW	Logan	194,798	34,979	11,346,378	11,026,653
Bonanza	----do	187,907	210,661	593,089	352,875
Nine Mile	Rio Blanco	184,674	----------	249,259	----------

Source: The Oil and Gas Conservation Commission of the State of Colorado. Colorado Oil and Gas Statistics, 1967. Part II: Oil and Gas Production, 86 pp.

Table 14.—Oil and gas well drilling in 1967, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Adams	3	1	12	16	89,384
Arapahoe	---	4	13	17	95,538
Archuleta	---	---	4	4	7,479
Baca	1	---	6	7	32,715
Bent	---	---	2	2	9,948
Delta	---	---	1	1	7,206
Elbert	---	---	3	3	18,265
Gunnison	---	---	1	1	5,600
Huerfano	---	---	1	1	2,305
Kiowa	---	1	10	11	51,696
La Plata	---	---	1	1	9,915
Larimer	---	---	4	4	17,739
Logan	4	2	36	42	216,599
Mesa	---	1	1	2	16,524
Moffat	2	2	11	15	96,229
Montezuma	1	---	18	19	81,966
Morgan	6	4	23	33	184,631
Park	---	---	1	1	880
Phillips	---	---	1	1	4,108
Prowers	1	1	4	6	27,500
Pueblo	---	---	1	1	1,782
Rio Blanco	1	1	4	6	23,539
Routt	---	---	1	1	4,969
San Miguel	---	2	---	2	17,053
Sedgwick	---	1	1	2	7,775
Washington	2	1	57	60	280,091
Weld	2	1	15	18	121,113
Total	23	22	232	277	1,432,549
Development completions:					
Adams	1	3	5	9	51,625
Arapahoe	3	---	6	9	49,967
Archuleta	---	2	---	2	16,020
Baca	---	3	2	5	20,411
Kiowa	13	---	2	15	68,536
La Plata	1	7	---	8	54,051
Larimer	7	2	7	16	80,188
Logan	6	1	12	19	98,414
Mesa	---	---	1	1	5,140
Moffat	10	8	11	29	151,904
Montezuma	5	---	6	11	33,292
Montrose	---	---	1	1	7,320
Morgan	19	3	16	38	223,235
Pitkin	---	3	---	3	15,139
Prowers	---	---	1	1	4,648
Rio Blanco	33	10	31	74	283,430
Routt	---	1	---	1	1,428
Washington	4	---	13	17	78,272
Weld	---	---	2	2	13,546
Total	102	43	116	261	1,256,566
Total all drilling	125	65	348	538	2,689,115

Source: Committee on Statistics of Drilling, American Association of Petroleum Geologists.

in such drilling. Average drilling depth for exploratory wells was 5,172 feet, nearly 100 feet deeper than the average for 1966, but slightly less than the national average of 5,242 feet.

Fourteen sales of oil and gas lease were held during the year—10 on State land, three on public domain, and one on Indian lands. The 10 State-land sales involved 127,193 acres which brought bonuses of $77,153 (an average of $0.61 per acre); highest bid, $10.92 per acre, was made on lands at a sale in January. The three public-domain sales brought bonuses totaling $30,508 for 5,416 acres—an average of $5.63 per acre; highest bid was made in August, $11.41 per acre. The Indian land sale covered 33,499 acres for which $93,302 was received—average bid was $2.78; the highest was $6.37.

One of the most significant oil discoveries was the Black Jack field. The discovery well, Tiger Oil Co. UPRR-Cronk No. 2, sec 9, T 4 S, R 57 W, Arapahoe County, was completed in February for a daily initial potential of 252 barrels of 42° API oil from the "J" sandstone (Cretaceous) at 5,399 to 5,409 feet. At yearend the field had six producing wells and had yielded 246,662 barrels of oil.

On the western slope, rework of an old well in the Maudlin Gulch field, Moffat County, discovered a profitable new pay zone. The well, Texaco Inc. Unit No. 2, sec 27, T 4 N, R 95 W, pumped 205 barrels of oil daily from Dakota formation (Cretaceous) perforations at 5,752 to 5,796 feet. By yearend the operator had produced 1.0 million barrels of Dakota oil from 11 wells, an elevenfold increase.

In December Don M. Rounds Co. discovered oil in the "J" sandstone in drilling the Sheetz No. 1 well, sec 14, T 3 S, R 52 W, Washington County. The well was completed for a daily pump gage of 288 barrels of oil from the interval 4,293 to 4,298 feet; the field was named Cimarron.

The southeastern corner of the State on the Las Animas arch was again one of the active areas. Development drilling in the Brandon field resulted in 13 more wells. The exploratory effort was not unusually successful—Baca County had a new pay gas discovery in the Vilas field; Kiowa County had a small gas discovery.

The State had five active refineries—two in Denver, one in Grand Junction, one in Fruita, and one in the Rangely field. The two in Denver—Continental Oil Co. and

Table 15.—Oil and gas discoveries in 1967

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks [1]
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Adams County:												
Wildcat	No. 1 Carlson	Badger Oil Co	11	1 S	57 W	"J" Sandstone	5,471–5,476	5,537	16	400	Jan. 11	Flowed. New field.
Beryl	No. 1 Fahk	States Oil Co	4	2 S	57 W	do	5,697–5,700	5,774	48	—	Mar. 5	Pumped. New oil pool. OWWO.
Do	No. 3 Fahk	do	4	2 S	57 W	"D" Sandstone	5,610½–5,620¼	5,794	90	—	Aug. 4	Pumped. New pay.
Noonen Ranch	No. 1 Noonen	Anschutz Oil Corp., Inc.	14	3 S	59 W	do	6,112–6,120	6,296	93	—	Oct. 10	Pumped. New pool.
Arapahoe County: Black Jack	No. 2 UPRR-Cronk	Tiger Oil Co	9	4 S	57 W	"J" Sandstone	5,399–5,409	5,550	252	—	Feb. 7	Pumped. New field.
Baca County: Vilas	No. 1-20 Rollins-Rutherford	Falcon Seaboard Drilling Co., W. C. McBride, Inc.	20	31 S	44 W	Wabaunsee	3,080–3,088	3,421	—	6,160	May 22	Flowed. New pay.
Kiowa County: Wildcat	No. 1 Weisenberger-A	Cabot Corp., Jack Grynberg	29	19 S	48 W	Morrow	4,629–4,638	5,573	—	1,500	June 7	Flowed. New field. OWDD.
Logan County:												
Yo Yo	No. 1 Wilson	Bander & Couch	24	8 N	53 W	"J" Sandstone	4,686–4,692	4,784	17	1,525	May 24	Flowed. New field.
Emerald	No. 1 Davis-Vance	Chandler & Associates	27	9 N	54 W	do	5,272–5,276	5,337	100	—	Dec. 13, 1966	Pumped. New field.
Toro	No. 1 Smith	Buffalo Oil Co., Inc, Fundamental Oil Corp., Braden-Gear Drilling Co.	17	11 N	53 W	"D" Sandstone	5,386–5,388	5,546	15	5,150	Nov. 14, 1966	Flowed. New field.
Moffat County:												
Wildcat	No. 1 Union et al Government	Wolf Exploration Co.	21	12 N	95 W	Fort Union	3,498–3,502	9,732	—	4,300	July 6	Do.
Round Table	No. 1 Kemmerer-Government	J. M. Huber Corp	14	12 N	96 W	do	5,123–5,127	6,610	18	—	July 8	Pumped. New field.
Morgan County:												
Chaparral	No. 1 Clasey	Midwest Oil Corp	7	1 N	58 W	"D" Sandstone	5,946–5,951	6,091	15	1,850	June 10	Flowed. New field. OWWO.
Roundup	No. 1 Layne	Pan American Petroleum Corp.	27	2 N	60 W	"J" Sandstone	6,423–6,428	6,500	—	1,934	Aug. 4	Flowed. New field.

Rio Blanco County:												
Wildcat	No. 22-17 Government.	Shell Oil Co	17	2 N	97 W	Weber	14,483–15,274	15,857	110	1,128	May 29	Do.
North Douglas Creek.	No. 1 North Douglas Creek-Government.	Continental Oil Co.	2	2 S	102 W	Mancos	2,515– 2,888	3,000	40	-----	Dec. 10	Pumped. New pool.
San Miguel County: Andy's Mesa.	No. 1 Andy's Mesa-Federal.	Union Oil Company of California.	34	44 N	16 W	Cutler, Honaker Trail & Ismay.	5,386– 8,442	8,509	---	3,075	Mar. 9	Flowed. New field.
Washington County:												
Sioux	No. 1 Miller	Frank H. Walsh	6	2 N	51 W	"D" Sandstone	4,468– 4,471	4,653	25	-----	May 17	Pumped. New field. OWWO.
Fiesta	No. 1 Kincheloe	Pan American Petroleum Corp., Alexander C. Boardman.	32	2 S	53 W	"J" Sandstone	4,772– 4,775	4,855	188	-----	Aug. 1	Pumped. New field.
Cimarron	No. 1 Sheetz	Don M. Rounds Co.	14	3 S	52 W	----do	4,293– 4,298	4,360	288	-----	Dec. 4	Do.
Poco	No. 1 Ingersoll	States Oil Co	13	3 S	53 W	----do	4,478– 4,481	4,585	17	-----	Jan. 31	Pumped. New field. OWWO.
Weld County:												
Rattlesnake	No. 1 Federal 17-	Juniper Oil & Gas Co., Buttes Gas & Oil Co.	17	11 N	56 W	----do	6,395– 6,400	6,445	114	-----	Sept. 7	Pumped. New field.
Wildcat	No. 1 Moyer	Okmar Oil Co	29	12 N	56 W	----do	6,409– 6,411	6,493	36	-----	July 15	Do.

[1] OWWO–Old well workover; OWDD-Old well drilled deeper.

Source: Petroleum Information Corp., 1967 Resume, Oil and Gas Operations in the Rocky Mountain Region.

Tenneco Oil Co.—were the largest, with daily crude-oil capacities of 25,500 and 10,000 barrels, respectively. The American Gilsonite Co. refinery at Fruita processed only gilsonite from company operations in Utah; the Morrison Refining Co. plant in Grand Junction was a small topping plant producing mainly gasoline and diesel fuel. The fifth refinery, Lubco Oil & Refining Co., Rangely, had a daily capacity of 5,000 barrels of crude oil.

Continental was building a sulfur-recovery unit at its Denver refinery. To be completed in April 1968 at an estimated cost of $500,000, the unit was designed for a daily capacity of 18 long tons of sulfur.

Refineries in the State processed 13.4 million barrels of crude oil; 11.9 million barrels were from out of State. Wyoming provided most of the out-of-State oil, 11.1 million barrels, followed by Montana, Utah, and New Mexico. Of the 33.6 million barrels produced in Colorado, 31.9 million were shipped out of State. Utah with its Salt Lake City refining and marketing complex received 18.6 million barrels, chiefly from Rangely and other northwestern Colorado fields. Other recipients included Ohio (7.5 million barrels), Kansas (1.8 million), Wyoming (1.5 million), and Indiana (1.3 million).

NONMETALS

Cement.—Portland and masonry cements were produced and shipped by Ideal Cement Co., Ideal Basic Industries, Inc., from its plants near Laporte in Larimer County and at Portland in Fremont County. Shipments of portland and masonry cements were 2 percent and 5 percent greater, respectively, than those of 1966.

Ready-mixed concrete companies purchase about two-thirds of the portland cement. Other customers, in order of quantities of portland cement purchased, were highway contractors, concrete product manufacturers, building material dealers, other contractors, and other miscellaneous customers. Sixty-eight percent of portland cement production shipped from plants was by truck, and the balance, by rail; 92 percent shipped was in bulk form, and 8 percent in containers.

On December 31, 1967, Potash Company of America was merged into Ideal Cement Co., forming Ideal Basic Industries, Inc. Each company will continue to operate its own business, using its former name, as a division of the parent company. Both companies and the parent company have their executive offices in Denver.

Martin Marietta Corp. engaged Kaiser Engineers Division, Kaiser Industries Corp., to design the proposed cement plant near Lyons for its subsidiary, Rocky Mountain Cement Co. Peter Kiewit Sons' Co. was selected as the general contractor for construction of a plant with an annual capacity of 2.5 million barrels. A rail spur to the 1,083-acre plantsite was started at the yearend.

Clays.—The output of clay was virtually the same as that of 1966, even though there were four fewer operations than in 1966. Four-fifths of the output was captive production. Twenty-four producers from 59 operations were responsible for the output. Twenty-two operations were in Jefferson County, nine in Pueblo County, seven each in Douglas and Fremont Counties, four in Boulder County, three each in Elbert and El Paso Counties, and one each in Bent, Custer, Huerfano, and Las Animas Counties.

Jefferson County produced 68.7 percent of the output. The largest operator was The Idealite Co. in Jefferson County; the company mined shale for lightweight aggregate. Idealite, with only one mine, was the only operator producing more than 100,000 tons. Eleven operators each had production between 10,000 and 100,000 tons; 10, between 1,000 and 10,000 tons; and 2, less than 1,000 tons.

Miscellaneous clay and shale comprised 75.8 percent of the clay production; fire clay, 23.9 percent; and bentonite, 0.3 percent. Bentonite was used for lining reservoir ponds; fire clay, for making firebrick and block, building brick, and vitrified sewer pipe; and miscellaneous clay, for making art pottery, building brick, vitrified sewer pipe, and lightweight aggregate.

Feldspar.—Output of feldspar, only about one-third that of 1966, was produced by Lockhart & Sons from the Mica Lode in Fremont County.

Fluorspar.—Fluorspar production was virtually unchanged from that of last year. The output, consisting of acid-grade fluorspar, was produced by Allied Chemical

Table 16.—Clay production by counties

County	1966		1967	
	Short tons	Value	Short tons	Value
Bent	------	----------	173	$868
Boulder	23,373	$43,033	15,864	31,132
Custer	857	W	W	W
Douglas	38,564	92,049	40,107	105,000
Elbert	W	W	W	W
El Paso	16,317	W	W	W
Fremont	11,829	45,953	33,396	93,861
Huerfano	W	W	W	W
Jefferson	398,974	586,009	409,639	560,114
Las Animas	11,456	44,381	W	W
Pueblo	r 75,674	r 386,276	60,081	373,748
Undistributed	21,860	117,600	37,238	108,976
Total	r 598,904	r 1,315,301	596,498	1,273,699

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

Corp. at its Valmont mill from crude ore obtained from the company's Burlington mine in Boulder County. The fluorspar was used for making hydrofluoric acid.

Gypsum.—The output of gypsum increased 2,000 tons, 3 percent above the 1966 production. The increase was due to greater production at the Fibreboard Corp. operation near Coaldale in Fremont County. The gypsum was sent to the company's fiberboard plant at Florence. Although there were two fewer producing operations in 1967 the decline in output resulting from these closures was less than 1,000 tons. Ernest W. Monroe produced gypsum in Larimer County for use as a portland-cement retarder; that produced by Colorama Rock Products Co. in Chaffee County and U.S. Soil Conditioning Co. in Fremont County was used for agricultural purposes.

Lime.—The output of lime declined 8,000 tons, 6 percent below that of 1966. Two of the 15 lime producing facilities in 1966 were not operated in 1967—the Windsor sugar plant of The Great Western Sugar Co. in Weld County and the Sugar City sugar plant of The National Sugar Manufacturing Co. in Crowley County.

The Great Western Sugar Co. produced lime for sugar refining at its plants in Brighton (Adams County), Eaton (Weld County), Fort Morgan (Morgan County), Greeley (Weld County), Longmont (Boulder County), Loveland (Larimer County), Ovid (Sedgwick County), and Sterling (Logan County). Lime was produced also for sugar refining by Holly Sugar Corp. at its Delta plant in Delta County and by American Crystal Sugar Co. at its Rocky Ford plant in Otero County. CF&I Steel Corp. produced lime at its Pueblo steel plant for use as a refractory material (dead-burned dolomite) and as a flux in the basic oxygen method of steelmaking.

The only lime production that was not captive was by Basic Chemical Corp. at its plant in Garfield County and by Colorado Lime Co., Inc., at its plant in El Paso County. Lime produced by Colorado Lime was sold for use in soil stabilization and treatment of sewage and trade wastes. Output by Basic Chemical was used for the same purposes and also for water treatment and metallurgical processing.

Mica.—A small quantity of scrap mica was produced by Georgetown Lumber & Timber Co. from the JBT mine in Clear Creek County. This was the first mica produced in the State since 1963.

Perlite.—Persolite Products, Inc., the only producer of crude perlite in Colorado, reported a slight increase in output from its Rosita mine in Custer County. Part of the production was sold and part sent to the company's expanding plant in Florence. Crude perlite was also expanded at a plant in Antonito by Grefco, Inc., and in Denver by W. R. Grace & Co. Expanded perlite was used mostly for making building plaster, filter aids, loose-fill insulation, filler, and fire base; as a concrete aggregate; for soil conditioning; and oil-well cementing.

Pumice.—The output of pumice-type material dropped substantially from 46,000 to 18,000 tons. The decrease was due primarily to less demand for pumice-type material for concrete aggregate and railroad ballast. Other uses were for roofing aggregate, road construction, and rock gardens.

Scoria was produced by Colorado Aggregate Co., Inc., in Costilla County and McCoy Aggregate Co. in Routt County, and volcanic cinders were produced by Dotsero Block Co. and Roaring Fork Pumice Co. in Eagle County.

Pyrites.—Climax Molybdenum Co. produced most of the output as a byproduct from molybdenum ore mined at the Climax mine in Lake County. The output, 13 percent less than in 1966, was sold mostly for use in manufacturing sulfuric acid. Rico Argentine Mining Co. sold a small quantity of pyrites produced from the Rico Argentine mine in Dolores County.

Salt.—Output of salt, slightly less than that in 1966, was obtained by Union Carbide Corp. from a brine well in Montrose. The product was used at the company's Uravan mill in processing uranium-vanadium ores.

Sand and Gravel.—The value and output of sand and gravel declined 2 percent. Based on value, sand and gravel was the fourth highest of all mineral commodities produced in the State—$22.9 million, 6.6 percent of the total State mineral output value.

Only 1.3 million tons of sand and gravel were produced as pit-run material. The balance of the total output of 21.8 million tons underwent some processing—washing, screening, crushing—before it left the pit. Gravel production was 18.0 million tons, 83 percent of the total; that of sand, 3.8 million tons or 17 percent. The average price per ton for gravel was $1.04 and for sand $1.11.

Road construction and maintenance required 15.2 million tons of sand and gravel, 472,000 tons below that of 1966. Sand and gravel used for building construction was 4.5 million tons, 700,000 tons less than that in 1966. Engine sand, fill, filtration, railroad ballast, and miscellaneous purposes absorbed the remaining 2.1 million tons.

Table 17.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Adams	3,057	$3,133	La Plata	385	$418
Alamosa	222	172	Larimer	1,099	1,102
Arapahoe	1,011	1,141	Las Animas	83	94
Archuleta	350	346	Lincoln	92	71
Baca	146	147	Logan	359	363
Bent	75	79	Mesa	463	627
Boulder	1,789	1,715	Moffat	158	191
Chaffee	192	200	Montezuma	212	204
Cheyenne	(1)	(1)	Montrose	772	782
Clear Creek	143	234	Morgan	272	317
Conejos	W	W	Otero	W	W
Costilla	W	W	Ouray	75	74
Crowley	10	10	Park	31	31
Custer	90	87	Phillips	47	55
Delta	240	322	Pitkin	218	241
Dolores	124	124	Prowers	185	230
Douglas	754	742	Pueblo	1,033	1,131
Eagle	1,691	1,322	Rio Blanco	W	W
Elbert	238	266	Rio Grande	154	185
El Paso	1,023	1,200	Routt	104	123
Fremont	68	129	Saguache	212	208
Garfield	217	320	San Juan	18	18
Gilpin	W	W	San Miguel	107	87
Grand	242	237	Sedgwick	61	58
Gunnison	164	196	Summit	72	89
Hinsdale	6	6	Teller	W	W
Huerfano	497	497	Washington	256	251
Jackson	12	12	Weld	525	456
Jefferson	1,620	1,936	Yuma	207	204
Kiowa	144	172	Undistributed	222	268
Kit Carson	59	59			
Lake	204	222	Total	21,810	22,904

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 classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	2,057	$2,511	2,072	$2,364
Paving	330	390	385	487
Railroad ballast	------	--------	[1] 19	[1] 24
Fill	120	113	329	328
Other	15	7	(1)	(1)
Industrial:				
Blast	------	--------	3	11
Fire or furnace	------	--------	(1)	(1)
Engine	11	42	8	30
Total	2,533	3,063	2,816	3,244
Gravel:				
Construction:				
Building	2,784	3,590	2,353	3,132
Paving	4,447	4,759	5,144	5,640
Railroad ballast	1	1	24	22
Fill	540	412	452	298
Other	26	30	--------	--------
Miscellaneous	65	77	318	416
Total	7,863	8,869	8,291	9,508
Total sand and gravel	10,396	11,932	11,107	12,752
Government-and-contractor operations:				
Sand:				
Building	7	7	186	209
Paving	1,470	1,457	739	711
Fill	22	22	55	61
Other	------	--------	1	1
Total	1,499	1,486	981	982
Gravel:				
Building	374	333	518	527
Paving	9,436	9,283	7,146	6,775
Fill	540	451	2,054	1,866
Other	------	--------	4	2
Total	10,350	10,067	9,722	9,170
Total sand and gravel	11,849	11,553	10,703	[2] 10,150
All operations:				
Sand	4,032	4,549	3,797	4,226
Gravel	18,213	18,936	18,013	18,678
Total	22,245	23,485	21,810	22,904

[1] Railroad ballast, "Other (construction)," and fire or furnace sand combined to avoid disclosing individual company confidential data.
[2] Data does not add to total shown because of independent rounding.

The output was divided almost evenly between commercial producers and Government-crews-and contractors with production from them being 11.1 million tons and 10.7 million tons, respectively. Of 395 producing operations, 161 were worked by commercial producers and 234 by Government-crews or contractors. In order of output, the leading commercial producers were Western Paving Construction Co., Cooley Gravel Co., The Brannan Sand & Gravel Co., Broderick & Gibbons, Inc., Pre-Mix Concrete, Inc., Flatiron Sand & Gravel Co., Asphalt Paving Co., and Boulder Gravel Products, Inc. Each had outputs exceeding 400,000 tons; total output was 5 million tons, 23 percent of the State output.

Of the 63 counties in the State, only Denver and Mineral Counties had no production; in 1966 Denver, Gilpin, and San Juan Counties reported none. Comparing the counties that had production both years, 32 had decreases in output, 26 had

increases, one (Yuma) was unchanged. Twenty-one counties each had production less than 100,000 tons; 32 had between 100,000 and 1 million tons; seven between 1 million and 2 million tons; and one between 3 million and 4 million tons. Adams County had the highest output with 3,057,000 tons followed, in order of quantity, by Boulder, Eagle, Jefferson, Larimer, Pueblo, El Paso, and Arapahoe Counties. These eight counties produced 56.5 percent of the State output. There were four counties with substantial changes of 500,000 tons or more. Production in Eagle County increased 1.6 million tons due mainly to the construction of Ruedi dam of the Fryingpan-Arkansas Project; 1.2 million tons of sand and gravel were used just for fill. Construction of the Morrow Point dam of the Upper Colorado River Storage Project, was mainly responsible for the 564,000-ton increase in Montrose County; most of the sand and gravel was used to make concrete. A decrease in building and road construction was the main cause for the decline of about 1 million tons in Pueblo County, and reduced road construction, for the decrease of 579,000 tons in Jefferson County.

Colorado Industries, Inc., purchased for approximately $1 million the sand and gravel operations of Boise Cascade Corp. and Pre-Mix Concrete, Inc., in the Denver area; the operations were then leased to Pre-Mix for use in that company's ready-mix concrete business. In 1967 Pre-Mix was the fifth largest sand and gravel producer in the State.

Stone.—Mainly because of completion of dam construction in Eagle and Pitkin Counties, output of stone was 4.0 million tons less than in 1966. Output in these two counties totaled 4.3 million tons in 1966, dropping to 109,000 tons in 1967. Fremont County, with 822,000 tons, had the greatest output of the 43 counties reporting production. The only other counties exceeding 100,000 tons were Larimer, El Paso, Chaffee, and Lake. Fifteen counties had production between 10,000 and 100,000 tons; 15 between 1,000 and 10,000 tons; and eight below 1,000 tons.

Of the 3 million tons of stone produced 74.0 percent was classed as crushed and broken limestone; 9.4 percent as crushed and broken granite; 8.9 percent as crushed and broken sandstone; 7.0 percent as crushed and broken miscellaneous stone; 0.5 percent as dimension sandstone; and 0.2 percent as crushed and broken basalt, dimension granite, dimension limestone, crushed marble, and dimension marble.

Crushed basalt, produced only in Grand County, was used for riprap. Crushed granite produced in Archuleta, Chaffee, Dolores, Fremont, Grand, Gunnison, Jefferson, Lake, La Plata, Larimer, Montezuma, Park, Pitkin, Pueblo, and Summit Counties, was used for riprap, as an aggregate for concrete, roads, and precast panels. Dimension granite produced in Fremont, Larimer, and Teller Counties was used for making monumental stone. Baca, Chaffee, Douglas, El Paso, Fremont, Garfield, Gunnison, Larimer, and Summit Counties were sources of crushed limestone, used mainly in making cement and lime, as an aggregate for concrete and roads, and as a flux in the steelmaking process. The product was also used for asphalt filler, coal dust, mineral food, and riprap. Dimension limestone, used as building stone, was produced in Douglas and Jefferson Counties. Dimension marble from Fremont County was used as dressed building stone. Crushed marble produced in Chaffee and Fremont Counties was used for terrazzo and for agricultural purposes. Crushed sandstone was produced in Boulder, Dolores, Douglas, Eagle, El Paso, Fremont, Grand, Gunnison, Jefferson, Larimer, San Miguel, and Summit Counties. The output was used as an aggregate for concrete and roads, in making precast panels, for manufacturing cement, as foundry sand and riprap, and for landscaping. Boulder, Eagle, Fremont, Larimer, and Mesa Counties produced dimension sandstone which was used as flagging or building stone. Crushed miscellaneous stone produced in 37 counties was used for riprap, as an aggregate for concrete, roads, and precast panels, and as a filter media.

Ideal Cement Co. was the largest single producer of stone. The company quarried limestone and sandstone in Fremont County for use in making cement at its plant at Portland and limestone in Larimer County for use in making cement at its plant near Laporte. The

Table 19.—Stone production in 1967, by counties

County	Short tons	Value	County	Short tons	Value
Adams	2,980	$4,470	La Plata	34,338	$42,957
Arapahoe	23,422	35,133	Larimer	727,478	1,446,061
Archuleta	39,164	44,242	Las Animas	50	74
Baca	28,867	57,312	Lincoln	100	150
Boulder	45,042	147,907	Mesa	7,656	31,761
Chaffee	W	W	Montezuma	15,641	19,612
Cheyenne	1,136	1,704	Montrose	2,736	5,884
Clear Creek	529	793	Morgan	267	400
Custer	W	W	Otero	1,110	1,665
Delta	3,147	8,070	Park	W	W
Dolores	92,103	141,183	Phillips	183	274
Douglas	17,929	54,560	Pitkin	34,568	52,299
Eagle	74,350	113,376	Prowers	4,458	6,687
Elbert	W	W	Pueblo	W	W
El Paso	W	W	Rio Blanco	W	W
Fremont	821,735	1,398,237	Routt	19,361	30,828
Garfield	W	W	San Miguel	3,300	4,950
Grand	292	532	Summit	1,239	2,254
Gunnison	53,556	143,734	Teller	700	10,500
Huerfano	3,674	5,511	Weld	52,267	78,400
Jefferson	58,270	172,258	Undistributed	705,338	1,272,525
Kit Carson	2,141	3,212			
Lake	115,145	145,540	Total	2,992,272	5,485,055

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

Table 20.—Stone sold or used by producers, by kinds

Year	Basalt and related rocks (traprock)		Granite		Limestone		Marble	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1963	72,915	$83,173	73,580	$199,984	2,139,431	$4,170,148	8,749	$64,063
1964	5,535	5,535	483,361	858,884	2,272,932	4,412,764	10,105	72,666
1965	W	W	2,058,617	3,089,379	2,203,606	4,066,926	2,230	32,597
1966	44,768	47,895	2,789,362	4,357,513	2,191,457	3,910,903	3,474	35,039
1967	W	W	283,708	418,359	[1] 2,214,396	[1] 3,822,707	2,739	26,087

	Sandstone		Other stone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1963	107,731	$635,054	107,271	$540,743	2,509,677	$5,693,165
1964	95,155	733,577	350,204	721,883	3,217,292	6,805,309
1965	189,329	832,623	335,065	616,028	4,788,847	8,637,553
1966	1,663,858	2,443,467	338,198	536,290	7,031,117	11,331,107
1967	280,598	847,466	[2] 210,831	[2] 370,436	2,992,272	5,485,055

W Withheld to avoid disclosing individual company confidential data; included with "Other stone."
[1] Excludes dimension limestone which is included with "Other stone."
[2] Includes dimension limestone.

Table 21.—Stone sold or used by producers, by uses

Use	1966		1967	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction and rubble, short tons	2,595	$37,781	5,786	$61,409
Rough architectural, cubic feet	(1)	(1)	28,394	38,139
Dressed architectural, do	[1] 67,377	[1] 138,679	37,932	85,424
Rough monumental, do	10,079	34,525	8,810	12,860
Dressed monumental, do	----------	----------	5,000	28,980
Flagging, do	55,268	60,227	40,573	41,244
Total (approximate), short tons	13,000	271,212	15,300	268,056
Crushed and broken stone:				
Concrete and roadstone, do	852,489	1,152,402	765,826	1,085,532
Lime, do	181,193	415,375	154,772	357,611
Metallurgical, do	297,316	703,008	302,682	704,440
Riprap, do	210,049	417,689	370,155	624,973
Other, do	[2] 5,477,046	[2] 8,371,421	[3] 1,383,541	[3] 2,444,443
Total, do	7,018,093	11,059,895	2,976,976	5,216,999
Total stone (approximate), do	7,031,100	11,331,107	2,992,300	5,485,055

[1] Rough architectural and dressed architectural stone combined to avoid disclosing individual company confidential data.

[2] Includes stone used in abrasives, aggregates, asphalt filler, cement, coal dust, concrete aggregates, dam fill, decorator rock, erosion control, filter media, foundry, landscaping, poultry grit, precasting, rock gardens, roofing granules, rotary drilling, stone sand, terrazzo, and traffic control barricades.

[3] Includes stone used in aggregate facings, aggregates, agriculture, asphalt filler, cement, coal dust, filter media, foundry, landscaping, mineral food, precasting, and terrazzo.

second largest producer was Castle Concrete Co., which quarried and sold limestone near Colorado Springs for use as riprap, concrete aggregate, and roadbase material. CF&I Steel Corp. had the third largest output, producing crushed limestone in Chaffee and Fremont Counties for use as flux and for making lime at its steel plant in Pueblo. These three large producers accounted for about two-thirds of the total stone output.

Vermiculite.—W. R. Grace & Co. produced exfoliated vermiculite at its expanding plant in Denver. Crude vermiculite used at the plant came from the company's mine in Montana. The exfoliated product was sold for use as loose-fill insulation, concrete and building-plaster aggregate, and for agricultural purposes.

Table 22.—Principal producers and processing plants in 1967

Commodity and company	Address	Type of activity	County or principal fields [1]	Other commodities	Remarks
Carbon dioxide, natural:					
Tenneco Oil Co	Box 1714 Durango, Colo. 81301	Well	Montezuma (McElmo field).		
Cement:					
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Denver National Bldg. Denver, Colo. 80202	Two plants	Fremont, Larimer	Stone	Wet-process, two-rotary-kiln cement plant at Portland; dry-process, two-rotary-kiln plant near Laporte.
Clays:					
Colorado Brick Co	Box 727 Longmont, Colo. 80501	Three open pit mines.	Boulder, Jefferson		Two mines in Boulder County, one in Jefferson County.
The Idealite Co	420 Denver National Bldg. Denver, Colo. 80202.	Open pit mine and plant.	Jefferson		Expanding plant.
Robinson Brick & Tile Co	500 S. Santa Fe Drive Denver, Colo. 80223	Eight open pit and two underground mines.	Douglas, Elbert, El Paso, Jefferson.		One underground, three open-pit mines in Douglas County; one open-pit mine in Elbert County; two open-pit mines in El Paso County; one underground, two open-pit mines in Jefferson County.
Coal, bituminous:					
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Underground mine and plant.	Las Animas		Mine near Weston, Jeffrey-baum-jig washery plant at Minnequa, near Pueblo.
Energy Coal Co	2850 N. Meridian Street Indianapolis, Ind. 46208	Strip mine and plant.	Routt		Mechanical crushing plant.
Mid-Continent Coal & Coke Co.	Carbondale, Colo. 81623	Two underground mines and plant.	Pitkin		Wet-washing-method plant.
The Pittsburg & Midway Coal Mining Co.	Hanover Bldg., 15 W. 10th Street Kansas City, Mo. 64105	Strip mine and plant.	Routt		Mechanical crushing and oil treatment plant.
Seneca Coals, Ltd	301 N. Memorial Drive St. Louis, Mo. 63102	----do	----do		Mechanical crushing plant.
United States Steel Corp., Western District—Coal.	Box 807 Dragerton, Utah 84520	Underground mine	Delta, Gunnison		Mine on county line near Somerset.
Copper:					
Idarado Mining Co	Ouray, Colo 81427	*See* Zinc.	Ouray, San Miguel.	Gold, silver, lead, zinc.	
Fluorspar:					
Allied Chemical Corp., Industrial Chemicals Division	Box 70 Morristown, N.J. 07960	Underground mine and plant.	Boulder		Mine at Jamestown; flotation mill at Valmont.
Gold:					
Idarado Mining Co	Ouray, Colo. 81427	*See* Zinc.	Ouray, San Miguel.	Silver, copper, lead, zinc.	
Gypsum:					
Fibreboard Corp	1789 New Montgomery Street San Francisco, Calif. 94106	Open pit mine and and plant.	Fremont		Mine and crushing, grinding, and screening plant at Coaldale; calcining equipment, wallboard plant at Florence.

See footnote at end of table.

Table 22.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County or principal fields [1]	Other commodities	Remarks
Iron ore:					
Pitkin Iron Corp. (Morrison-Knudsen Co., Inc., lessee)	105 W. Adams Street Chicago, Ill. 60603	Open pit mine	Pitkin		
Lead:					
Emperius Mining Co	Creede, Colo. 81130	*See* Zinc.	Mineral	Gold, silver, copper, zinc.	
Idarado Mining Co	Ouray, Colo. 81427	do	Ouray, San Miguel.	do	
McFarland & Hullinger	Box 238 Tooele, Utah 84074	do	Gunnison	do	
The New Jersey Zinc Co	160 Front Street New York, N.Y. 10038	do	Eagle	do	
Rico Argentine Mining Co	605 Kearns Bldg. Salt Lake City ,Utah 84101	do	Dolores	do	
Standard Metals Corp	333 Petroleum Club Bldg. 110 16th Street Denver, Colo. 80202	do	San Juan	do	
Lime:					
Basic Chemical Corp	Box 249 Glenwood Springs, Colo. 81601	Plant	Garfield	Stone	One-rotary-kiln, one-continuous-hydrator lime plant.
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	do	Pueblo	do	Natural-frequency-vibrating-kiln lime plant.
Colorado Lime Co., Inc	Route 1 Colorado Springs, Colo 80907	do	El Paso	do	Lime plant with three shaft kilns and one continuous hydrator.
The Great Western Sugar Co	Box 5308 Denver, Colo. 80217	Thirteen limekilns	Adams, Boulder, Larimer, Logan, Morgan, Sedgwick, Weld.		Longmont, Loveland, and Sterling beet-sugar plants—each has one shaft kiln; Brighton, Fort Morgan, Ovid, Eaton, and Greeley plants— each has two shaft kilns.
Molybdenum:					
American Metal Climax, Inc., Climax Molybdenum Co. Division.	1270 Avenue of the Americas New York, N.Y. 10020	Two underground mines, two mills, and two plants.	Clear Creek, Lake	Monazite, pyrites, tungsten, tin.	Mine and flotation mill, by-products plant, and molybdic oxide plant at Climax; mine and flotation mill near Empire.
Natural gas and petroleum:					
Bright & Schiff	107 Mercantile Continental Bldg. Dallas, Tex. 75201	Crude oil and gas wells.	Saber		
Champlin Petroleum Co	Box 9365 Fort Worth, Tex. 76107	do	Bison, Boxer, Ramp, Westfork.		
Chevron Oil Co., Western Division.	Box 599 Denver Colo. 80201	Crude oil and gas wells and plant.	Black Hollow, Pierce, Rangely.		Natural gas processing plant, Rangely field.
Continental Oil Co	Box 2197 Houston, Tex. 77001	Crude oil and gas wells and plants.	Big Beaver, Bobcat, Little Beaver, McCallum, Plum Bush Creek.		Natural gas processing plants, Fruita, Little Beaver fields; refinery, Denver.

Gulf Oil Corp	Gulf Bldg. Pittsburgh, Pa. 15219	Crude oil and gas wells.	Northwest Graylin Lewis Creek, West Peetz Yenter.	----------	
Monsanto Co., Hydrocarbons & Polymers Division.	800 N. Lindbergh Boulevard St. Louis, Mo. 63116	----do----------	Battleship, Little East Beaver Marble Wash, Nugget.	----------	
Okmar Oil Co----------	Box 548 Marietta, Ohio 45750	Crude oil wells-----	Bison----------	----------	
Pan American Petroleum Corp.	Box 591 Tulsa, Okla. 74101	Crude oil and gas wells.	Big Beaver, Black Jack, Cache.	----------	
R. E. Hibbert Oil Properties---	1142 Houston Club Bldg. Houston, Tex. 77002	Crude oil wells-----	Cody, Monte, Noria.	----------	
Shell Oil Co----------	50 West 50th Street New York, N.Y. 10020	Crude oil and gas wells.	Divide, Mount Hope.	----------	
Sinclair Oil & Gas Co---------	Box 521 Tulsa, Okla. 74102	----do----------	Cliff, West Padroni.	----------	
Stuarco Oil Co., Inc---------	2117 First National Bank Bldg. Denver, Colo. 80202	----do----------	Bonanza, Boots Hill, Cody, Ranger, Wellington.	----------	
Texaco Inc----------	1570 Grant Street Denver, Colo 80203	----do----------	Danforth Hills, Maudlin Gulch, Wilson Creek.	----------	Natural gas processing plant, Wilson Creek field.
Union Oil Company of California (Northern Division)	1700 Broadway Denver, Colo. 80210	----do----------	Adena----------	----------	Natural gas processing plant, Adena field.
Union Texas Petroleum Corp--	Box 2120 Houston, Tex. 76101	Crude oil wells-----	Blade, Lindon, Ranger, Ring, Rush Willadel.	----------	
Peat:					
McCoy & Jensen----------	9800 Morrison Road Morrison, Colo. 80465	Two strip mines----	Boulder, Park-----	----------	Mine near Nederland and mine near Fairplay.
Perlite:					
Persolite Products, Inc--------	1440 W. 13th Avenue Denver, Colo. 80204	Open pit mine and plant.	Custer, Fremont--	----------	Mine at Rosita, expanding plant at Florence.
Pumice:					
Colorado Aggregate Co., Inc---	Mesita, Colo 81142----------	----do----------	Costilla----------	----------	Crushing, grinding, and screening plant.
Dotsero Block Co----------	Box 390 Glenwood Springs, Colo. 81601	----do----------	Eagle----------	----------	Crushing, grinding, and screening plant.
McCoy Aggregate Co---------	Steamboat Springs, Colo. 80477--	----do----------	Routt----------	----------	Crushing, grinding, and screening plant.
Pyrites:					
Climax Molybdenum Co------	1270 Avenue of the Americas New York, N.Y. 10020	*See* Molybdenum.	Lake----------	Molybdenum, monazite, tungsten, tin.	
Rare-earths, monazite:					
Climax Molybdenum Co------	----do----------	----do----------	----do----------	Molybdenum, pyrites, tungsten, tin.	

See footnote at end of table.

Table 22.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Sand and gravel, commercial:					
Asphalt Paving Co	14802 W. 44th Avenue Golden, Colo. 80401	Six pits and two plants.	Arapahoe, Boulder, Elbert, Jefferson, Lincoln, Pueblo.		One portable crushing and screening plant; one stationary plant near Golden.
Boulder Gravel Products	Box 229 Boulder, Colo. 80902	Pit and plant	Boulder		Stationary crushing and screening plant near Boulder.
The Brannan Sand & Gravel Co.	4800 Brighton Boulevard Denver, Colo. 80216	Eleven pits and nine plants.	Adams, Arapahoe, Jefferson.		Five portable crushing and screening plants; one stationary plant near Welby and two near Denver, Adams County; and one stationary plant near Golden.
Broderick and Gibbons, Inc	Box 313 Pueblo, Colo. 81002	Two pits and two plants.	El Paso, Pueblo		Two portable crushing and screening plants.
Cooley Gravel Co	5631 Tennyson Street Arvada, Colo. 80002	Four pits and plants.	Adams, Arapahoe		Four portable crushing and screening plants.
Flatiron Sand & Gravel Co	2344 Spruce Street Boulder, Colo. 80302	Two pits and two plants.	Boulder		One portable crushing and screening plant and one stationary plant near Boulder.
Pre-Mix Concrete, Inc., Pre-Mix Sand & Gravel Division.	1500 W. 12th Avenue Denver, Colo. 80204	do	Adams, Douglas		One stationary crushing and screening plant near Commerce City and one near Waterton.
Western Paving Construction Co.	5105 Washington Street Denver, Colo. 80216	Nine pits and four plants.	Adams, Arapahoe, Gilpin, Jefferson, Weld.		Four portable crushing and screening plants.
Silver:					
Emperius Mining Co	Creede, Colo. 81130	*See* Zinc	Mineral	Gold, copper, lead, zinc.	
Idarado Mining Co	Ouray, Colo. 81427	do	Ouray, San Miguel.	do	
McFarland & Hullinger	Box 238 Tooele, Utah 84074	do	Gunnison	do	
The New Jersey Zinc Co	160 Front Street New York, N.Y. 10038	do	Eagle	do	
Rico Argentine Mining Co	605 Kearns Bldg. Salt Lake City, Utah 84101	do	Dolores	do	
Standard Metals Corp	333 Petroleum Club Bldg. 110 16th Street Denver, Colo. 80202	do	San Juan	do	
Stone:					
Castle Concrete Co	Box 2379 Colorado Springs Colo. 80901	Quarry and plant	El Paso		Stationary crushing and screening plant.
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Two quarries and two plants.	Chaffee, Fremont	Lime	One quarry and stationary crushing and screening plant near Garfield and one near Canon City.

Frank H. Norberg Co	703 Guaranty Bank Bldg. Denver, Colo 80202	Three quarries and three plants.	Garfield, Larimer		One quarry and stationary crushing and screening plant near Glenwood Springs and two near Livermore.
Ideal Cement Co	620 Denver National Bldg. Denver, Colo. 80202	Two quarries and two plants.	Fremont, Larimer	Cement	One quarry and stationary crushing and screening plant near Laporte and one at Portland.
Tin:					
Climax Molybdenum Co	1270 Avenue of the Americas New York, N.Y. 10020	*See* Molybdenum.	Lake	Molybdenum, monazite, pyrites, tungsten.	
Tungsten:					
Climax Molybdenum Co	----do----	----do----	----do----	Molybdenum, monazite, pyrites, tin.	
Uranium:					
American Metal Climax, Inc., Climax Uranium Co.	Box 1629 Grand Junction, Colo. 81501	Eighteen underground mines	Garfield, Mesa, Montrose, San Miguel.	Vanadium	One mine, Garfield County; eight mines, Mesa County; four mines, Montrose County; five mines, San Miguel County.
Do	----do----	Grand Junction mill.	Mesa		Acid leach with vanadium recovery circuit.
Cotter Corp	Box 751 Canon City, Colo. 81212	One underground mine and mill.	Jefferson		Mine near Golden; alkaline leach processing mill near Canon City.
Foote Mineral Co. (Vanadium Corporation of America)	200 Park Avenue New York, N.Y. 10017	Forty underground mines.	Mesa, Montrose, San Miguel.	Vanadium	Two mines, Mesa County; 30 mines, Montrose County; 8 mines, San Miguel County.
Union Carbide Corp	270 Park Avenue New York, N.Y. 10017	One hundred seven underground mines.	Garfield, Mesa, Montrose, San Miguel.	----do----	Two mines, Garfield County; 12 mines, Mesa County; 80 mines, Montrose County; 13 mines, San Miguel County.
Do	----do----	Rifle and Uravan mills.	Garfield, Montrose.		Acid leach with vanadium recovery circuit.
Vanadium:					
Climax Uranium Co	Box 1629 Grand Junction, Colo. 81501	*See* Uranium.	Garfield, Mesa, Montrose, San Miguel.	Uranium	
Foote Mineral Co. (Vanadium Corporation of America).	200 Park Avenue New York, N.Y. 10017	----do----	Mesa, Montrose, San Miguel.	----do----	
Union Carbide Corp	270 Park Avene New York, N.Y. 10017	----do----	Garfield, Mesa, Montrose, San Miguel.	----do----	
Zinc:					
Emperius Mining Co	Creede, Colo 81130	Underground mine and mill.	Mineral	Gold, silver, copper, lead.	Flotation mill.
Idarado Mining Co	Ouray, Colo 81427	----do----	Ouray, San Miguel.	----do----	Portal of mine and Pandora flotation mill at Telluride.
McFarland & Hullinger	Box 238 Tooele, Utah 84074	----do----	Gunnison	----do----	Flotation mill.

See footnote at end of table.

Table 22.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Zinc—Continued					
The New Jersey Zinc Co	160 Front Street New York, N.Y. 10038	Underground mine, mill, and plant.	Eagle	Gold, silver, copper, lead.	Mine and flotation mill underground at Gilman; zinc roasting plant at Canon City.
Rico Argentine Mining Co	605 Kearns Bldg. Salt Lake City, Utah 84101	Underground mine and mill.	Dolores	----do----	Flotation mill.
Standard Metals Corp	333 Petroleum Club Bldg. 110 16th Street Denver, Colo. 80202	Three underground mines.	San Juan	----do----	
Do	----do----	Shenandoah mill	----do----		Flotation mill; treats company and some custom ore.

[1] Entries for natural gas and petroleum are principal fields.

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 Historical Survey for collecting information on all minerals except fuels.

By Curtis D. Edgerton [1]

Value of mineral production in Connecticut declined 3 percent from that of 1966. Most of the decrease was attributed to lower sales in the stone, sand and gravel, and lime industries although small decreases in sales also occurred in the feldspar and mica industries. The mineral commodity which produced the greatest revenue was stone, followed closely by sand and gravel. Sales of these commodities declined about 3 percent each, largely owing to a lessening in construction activity.

Hartford County led the State in value of minerals produced, followed by New Haven, Litchfield, Middlesex, New London, Windham, and Fairfield Counties. Operations in Tolland County produced relatively small quantities of sand and gravel.

The Federal Geological Survey published bedrock geological maps of the Uncasville, New London, Columbia, Montville, Niantic, Watch Hill, and Springfield South Quadrangles. In addition, the Survey published a surficial geologic map of the Roxbury Quadrangle, and issued a Hydrologic Investigations Atlas of the Connecticut River Basin. Nine reprints of topographic maps were issued by the Survey, and the Naugatuck Quadrangle was revised. The Federal Survey, in cooperation with the Connecticut Geological and Natural History Survey, published a report entitled "The Engineering Geology of the Northeast Corridor, Washington, D.C., to Boston, Mass." The Connecticut Survey published Quadrangle Reports on the bedrock geology of the Old Lyme Quadrangle, and the bedrock geology of the Waterbury Quadrangle. The Survey also issued a report on the surficial geology of the Hartford South Quadrangle, and one on the stratigraphy and structure of the western part of the New Haven Quadrangle.

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Connecticut [1]

Mineral		1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays	thousand short tons	192	$296	191	$334
Gem stones		NA	8	NA	8
Sand and gravel	thousand short tons	9,561	8,963	8,320	8,710
Stone	do	5,618	10,482	5,097	10,141
Value of items that cannot be disclosed: Feldspar, lime, mica (scrap), and peat (1966)		XX	1,597	XX	1,426
Total		XX	21,346	XX	20,619
Total 1957–59 constant dollars		XX	20,652	XX	p 20,056

p Preliminary. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

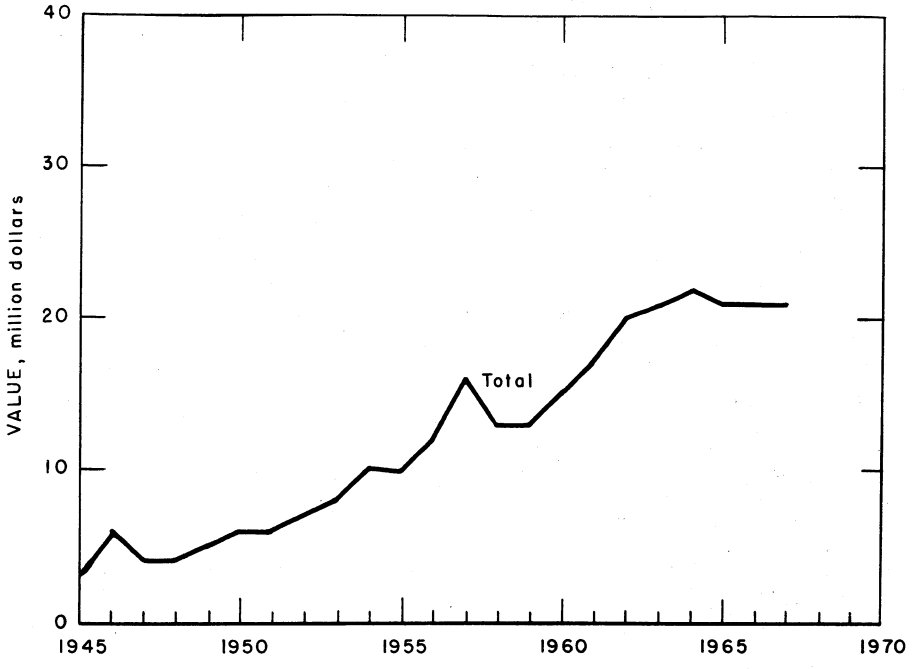

Figure 1.—Value of mineral production in Connecticut

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Fairfield	$1,087	$1,092	Sand and gravel.
Hartford	7,006	6,189	Stone, sand and gravel, clays.
Litchfield	2,543	2,207	Stone, sand and gravel, lime,
Middlesex	1,580	1,656	Feldspar, sand and gravel, stone, clays, mica.
New Haven	5,463	6,053	Stone, sand and gravel, clays.
New London	1,097	1,265	Stone, sand and gravel.
Tolland	W	W	Sand and gravel.
Windham	W	W	Stone, sand and gravel.
Undistributed [1]	2,570	2,157	
Total	21,346	20,619	

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.

Table 3.—Indicators of Connecticut business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$10,621	p $11,306	+6.4
Per capita		$3,690	p $3,865	+4.7
Construction activity:				
Construction contract	thousand employees	51.1	48.9	−4.3
Cement shipments to and within Connecticut	thousand 376-pound barrels	4,322	p 3,695	−14.5
Mineral production	thousands	$21,346	$20,619	−3.4
Employment:				
Civilian work force	thousands	1,255	1,294	+3.1
Total civilian employment	do	1,215	1,246	+2.5
Unemployment	percent of work force	3.2	3.3	
Manufacturing:	millions	$472	$480	+1.7
Durable goods	do	$350	$360	+2.8
Non-durable goods	do	$122	$120	−1.6

p Preliminary.

Source: U.S. Department of the Interior, Bureau of Mines; U.S. Department of Labor, Bureau of Employment Security; U.S. Department of Commerce.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Nonmetal and peat	177	286	50	413		8	19.37	395
Sand and gravel	555	233	130	1,053	1	24	23.73	6,438
Stone	394	247	97	851		26	30.56	484
Total	1,126	246	277	2,317	1	58	25.46	3,175
1967: p								
Nonmetal	135	272	37	302		4	13.25	172
Sand and gravel	520	211	110	896		14	15.62	594
Stone	370	241	89	772	1	13	18.14	8,197
Total	1,025	230	235	1,970	1	31	16.25	3,508

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—There were no producers of cement in Connecticut. Shipments of portland cement into the State totaled about 3.7 million barrels; masonry cement shipments totaled about 145,000 barrels. These figures reflect decreases of approximately 14 and 4 percent respectively, from shipments received during 1966.

Clays and Shales.—Production of clays and shales decreased less than 1 percent from that of 1966; the unit value increased about 14 percent to $1.75 per short ton. Four companies produced clays and shales from pits in Hartford, Middlesex, and New Haven Counties. Most of the output was consumed in the manufacture of brick. Smaller amounts were used for pottery.

Feldspar.—Three operations, one of which closed during the year, produced ground feldspar in Middlesex County. Although total production declined about 5 percent from that of 1966, unit value increased. Most of the production was sold to glass and ceramic manufacturers; a small quantity was used in the manufacture of sweeping compounds.

Gem Stones.—Collection of gem stones from mine dumps, quarries, and pegmatite deposits was done by mineralogical societies, dealers, and individuals. The total quantity cannot be determined, but was undoubtedly small.

Gypsum.—National Gypsum Co., the State's only producer of gypsum, imported the crude gypsum supply from out-of-State sources and calcined the mineral at the New Haven plant. The calcined gypsum was used in the manufacture of building supplies.

Lime.—The Minerals, Pigments, & Metals Division of Charles Pfizer & Co., Inc., produced quicklime and hydrated lime at its plant in Litchfield County. The quicklime was used for the manufacture of chemicals. Hydrated lime was used for construction and agricultural purposes. Production was down slightly from that of 1966.

Mica.—Ground mica was produced as a byproduct at the Feldspar Corp. plant in Middlesex County. The product was used chiefly in roofing material.

Sand and Gravel.—Commercial and Government-and-contractor production of sand and gravel continued a decline which commenced in 1964. Total production was 8.3 million tons, of which 6.6 million tons came from commercial operations. Eighty-five percent of the commercial sand and gravel was processed, whereas 97 percent of the Government-and-contractor sand and gravel was processed. Sand and gravel was produced in all of the State's eight counties with the greatest production coming from Hartford County. There were 68 plants in operation during the year, 60 stationary and eight portable.

Stone.—Production of stone declined both in quantity and value from that of 1966. Basalt was the major source of crushed stone and accounted for 84 percent of all stone produced. The average unit value of crushed basalt rose 10 cents

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	1,823	$2,071	1,707	$2,063
Paving	1,716	1,757	1,476	1,632
Fill	183	107	393	236
Other [1]	285	286	317	339
Total	4,007	4,221	3,893	4,270
Gravel:				
Structural	1,412	2,202	1,288	2,316
Paving	882	1,072	794	981
Fill	541	260	407	210
Other [2]	162	199	236	278
Total	2,997	3,733	2,725	3,785
Total sand and gravel	7,004	7,954	6,618	8,055
Government-and-contractor operations:				
Sand:				
Paving	102	37	194	73
Other	27	13	40	25
Total	129	50	234	98
Gravel:				
Paving	2,362	916	1,374	499
Fill	66	43	94	58
Total	2,428	959	1,468	557
Total sand and gravel	2,557	1,009	1,702	655
All operations:				
Sand	4,136	4,271	4,127	4,368
Gravel	5,425	4,692	4,193	4,342
Total	9,561	8,963	8,320	8,710

[1] Includes molding, filter, grinding and polishing, and other sand.
[2] Includes railroad ballast (1967), miscellaneous, and other gravel.

per ton to $1.70. The total value of crushed basalt was $7,278,828. Nearly the entire output of basalt was used for concrete aggregate and roadstone, and less than 2 percent was used for railroad ballast and riprap. Production of crushed basalt was confined to Hartford, Litchfield, and New Haven Counties, in which 10 companies operated 11 plants.

Crushed limestone was produced by four companies whose operations were all in Litchfield County. The combined production was 199,000 tons valued at $957,000. The product was used as a soil neutralizer, in whiting, as a filler, and as metallurgical flux.

Crushed sandstone was produced by two companies operating in Middlesex and New London Counties. About 5 percent of the total output was used for concrete aggregate; the use of the remainder was not specified. Small amounts of quartz were produced in Middlesex and New London Counties for use in the manufacture of abrasives and glass. Dimension sandstone was produced in Windham County. Most of the output was sold for use in rough construction and as rubble; a small amount was sold as sawed stone.

MINERAL FUELS

Coke.—Connecticut Coke Co. operated a merchant coke plant in New Haven County. Ammonium sulfate, coal tar, and crude and intermediate light oils were produced as byproducts.

Peat.—The one producer of peat in Middlesex County was idle throughout the year.

METALS

Carpenter Steel of New England, Inc., processed and fabricated steel shapes. Approximately 20 metal foundries were in operation in the State, producing a wide variety of castings. Scrap metal collection and distribution continued to be active throughout the State, with most of the tonnage exported. Small amounts were sold to steel mills in the Eastern United States.

Charles Pfizer & Co., Inc., produced calcium at its plant at Canaan, Litchfield County. This operation was formerly conducted by a subsidiary, Nelco Metals, Inc.

Table 6.—Principal producers

Company	Type of activity	County	Address
Clays:			
The Michael Kane Brick Co	Pit	Middlesex	654 Newfield St., Middletown, Conn.
The Keller Pottery Co	do	Hartford	North Wales, Pa.
The Kelsey Ferguson Brick Co	do	do	East Windsor Hill, Conn.
Plasticrete Corp., Stiles Brick Div.	do	New Haven	P.O. Box 248, North Haven, Conn.
Feldspar:			
Eureka Feldspar Mining & Milling Co., Inc.	do	Middlesex	190 West State St., Trenton, N.J.
The Feldspar Corp [1]	do	do	Spruce Pine, N.C.
Lime:			
Minerals, Pigments & Metals Div., Chas. Pfizer & Co., Inc.	Plant	Litchfield	Daisy Hill Road, Canaan, Conn.
Gypsum (calcined): National Gypsum Company.	do	New Haven	325 Delaware Ave., Buffalo, N.Y.
Sand and gravel:			
The Balf Co	Pit	Hartford	190 Huyshope Ave., Hartford, Conn.
Beard Sand & Gravel Co., Inc	do	New Haven	127 Boston Post Rd., Milford, Conn.
C. W. Blakeslee & Sons, Inc	do	Middlesex	58 Waverly St., New Haven, Conn.
The D. J. Carten Sand & Gravel Co.	do	New Haven	299 Park St., Stratford, Conn.
Connecticut Sand & Stone Corp.	do	Hartford	7 West Main St., Plainsville, Conn.
D'Addario Sand & Gravel	do	Fairfield	513 Boston Ave., Bridgeport, Conn.
Danbury Sand & Gravel Co., Inc.	do	do	Mill Plain Dist., Danbury, Conn.
Dunning Sand & Gravel Co., Inc.	do	Hartford	Brickyard Rd., Farmington, Conn.
The Hamden Sand & Gravel Co	do	New Haven	375 Mather St., Hamden, Conn.
Helming Brothers	do	Hartford	67 West Street, Bristol, Conn.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Company	Type of activity	County	Address
John Lomazzo & Sons Corp	Pit	Fairfield	Route 57, Weston Rd., Weston, Conn.
The New Haven Trap Rock Co.	do	Windham	265 Church St., New Haven, Conn.
Roncari Industries, Inc	do	Hartford	1776 South Main St., East Granby, Conn.
Sega Sand & Gravel, Inc	do	Litchfield	271 Danbury Rd., New Milford, Conn.
Waterbury Sand & Gravel Co	do	New Haven	551 S. Leonard St., Waterbury, Conn.
Stone:			
Basalt, crushed:			
The Balf Co	Quarry	Hartford	190 Huyshope Ave., Hartford, Conn.
Chas. W. Blakeslee & Sons, Inc.	do	New Haven	58 Waverly St., New Haven, Conn.
A. N. Farnham, Inc	do	New Haven	90 Pine Rock Ave., New Haven, Conn.
The New Haven Trap Rock Co.	do	do	265 Church St., New Haven, Conn.
Roncari Industries, Inc	do	Hartford	1776 South St., E. Granby, Conn.
Angelo Tomasso, Inc	do	do	P.O. Box 76, New Britain, Conn.
Tomasso of Farmington, Inc	do	do	P.O. Box 76, New Britian, Conn.
The York Hill Trap Rock Quarry Co.	do	New Haven	Westfield Rd., Meriden, Conn.
Granite:			
Dimension:			
Castellucci & Sons, Inc.	do	do	West River St., Providence, R.I.
R. B. Marriott & Sons	do	Windham	Oneco, Conn.
Tower Hill Granite Co.	do	Hartford	305 Manchester Rd., E. Glastonbury, Conn.
Crushed: The New Haven Trap Rock Co.	do	Windham	265 Church St., New Haven, Conn.
Limestone, crushed:			
Allyndale Corp	do	Litchfield	East Canaan, Conn.
The Conklin Limestone Co., Inc.	do	do	Canaan, Conn.
Minerals, Pigments & Metals Div., Chas. Pfizer & Co., Inc.	do	do	Daisy Hill Rd., Canaan, Conn.
United States Gypsum Co. (Falls Village).	do	do	101 S. Wacker Dr. Chicago, Ill.
Sandstone, quartz, and quartizite:			
Crushed: Ottawa Silica Co., Connecticut Silica Div.[2]	do	New London	Box 226, Mystic, Conn.
Dimension:			
Helene Stone Corp.[3]	do	Windham	Danielson, Conn.
Hughes Stone Co	do	do	R.D. Box 150, Dayville, Conn.
Robert V. Olson	do	do	Box 684, Danielson, Conn.

[1] Also quartz and scrap mica.
[2] Quartz.
[3] Quartzite.

The Mineral Industry of Delaware

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

By Samuel A. Gustavson [1]

Mineral production in Delaware was valued at $2.4 million in 1967. Minerals produced in the State included common or miscellaneous clay, sand and gravel, stone, and a small amount of mineral specimens. Producers of clay and stone reported no change in output from 1966, while sand and gravel producers, in aggregate, reported an increased output of about 22 percent in tonnage and 28 percent in value.

[1] Physical science administrator, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Delaware [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays—thousand short tons	11	$11	11	$11
Gem stones	NA	1	NA	1
Sand and gravel—thousand short tons	1,610	1,443	1,966	1,846
Stone—do	210	525	210	525
Total	XX	1,980	XX	2,383
Total 1957–59 constant dollars	XX	1,918	XX	p 2,324

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

	1966	1967 p	Change (percent)
Personal income:[1]			
Total—millions	$1,811	$1,935	+6.8
Per capita	$3,529	$3,700	+5.8
Construction activity:			
Cement shipments to Delaware—thousand 376-pound barrels	1,136	1,126	−.9
Mineral production—thousands	$1,980	$2,383	+20.4
Annual average labor force and employment:[2]			
Employment—do	192.7	196.1	+1.8
Manufacturing—do	70.6	71.1	+.7
Durable goods—do	17.7	17.5	−1.1
Nondurable goods—do	52.9	53.6	+1.3
Non-manufacturing—do	122.1	125.0	+2.4

p Preliminary.
[1] Bureau of Census, U.S. Department of Commerce.
[2] Bureau of Employment Security, U.S. Department of Labor.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Nonmetal	11	296	3	26	------	------	------	------
Sand and gravel	69	191	13	105	------	------	------	------
Stone	10	218	2	20	------	------	------	------
Total	90	207	19	151	------	------	------	------
1967:p								
Nonmetal	15	250	3	26	------	1	38.46	154
Sand and gravel	75	220	17	134	------	1	7.45	171
Stone	10	218	2	20	------	------	------	------
Total	100	223	22	180	------	2	11.12	150

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Miscellaneous clay was produced by Delaware Brick Co. from an open pit mine near New Castle, New Castle County. All production was used by the company in the manufacture of common red building brick. Under a cooperative agreement between the Delaware State Geologist and the Federal Bureau of Mines, samples from about 30 clay deposits in the State were taken and given preliminary tests to determine suitability for various ceramic and other uses. Results of the tests are on open file at the State Geologist's office, University of Delaware, Newark, Del.

Sand and Gravel.—Sand and gravel was produced in all three counties of the State; the largest production came from New Castle County. Sand and gravel continued to be the principal mineral of value produced in the State. Production was reported by 16 companies, seven with preparation plants and nine that ship bank-run material.

Of the total sand and gravel production, sand accounted for 29 percent of tonnage and 33 percent of value. A total of 568,000 tons of sand was sold in 1967, compared with 558,000 tons in 1966. Sand was used chiefly for building and paving; about 312,000 tons was sold for building purposes and 225,000 tons for highway use; the remainder was used principally for fill and as engine traction sand. The average value, f.o.b. plant, remained at $1.07 per ton. Values ranged from $0.80 to $1.47 for building and paving sand to $0.35 for fill. Most of the sand for building and paving use was processed. The tonnage sold as "pit-run" was chiefly for fill and engine traction. Virtually all of the sand was delivered by truck.

Gravel production amounted to 1,398,000 tons, a 33-percent increase over the 1966 production of 1,052,000 tons. Chief use was in highway construction; smaller quantities were used for building, fill, and other purposes. The average value of gravel, f.o.b. plant, was $0.89 per ton, compared with $0.81 per ton in 1966. Washed gravel ranged in price from $0.75 to $4 per ton, and pit-run (unprocessed) gravel ranged from $0.35 to $0.75 per ton. Most of the gravel was shipped by truck.

Stone.—Output and value of stone (gabbro) was about the same as in 1966. Gabbro was quarried near Wilmington, New Castle County; the stone was classified as granite for statistical purposes. Most of the production was crushed and sized as a concrete aggregate or as stone sand; a small quantity was sold for riprap.

In addition to the stone produced in the State, a sizable tonnage of crushed stone, used chiefly for highway construction, was purchased from sources in Pennsylvania and Maryland.

Table 4.—Principal producers

Commodity and company	Type of activity	County	Address
Clay: Delaware Brick Co	Pit	New Castle	1220 Centerville Rd. Wilmington, Del.
Sand and gravel:			
Atkins Brothers	do	Sussex	Route 113, Millsboro, Del.
Clough & Caulk Sand & Gravel	do	Kent	P.O. Box 129, Route 1, Wyoming, Del.
Delaware Sand & Gravel Co	do	New Castle	R.D. No. 2, New Castle, Del.
Parkway Gravel, Inc	do	do	4048 New Castle Ave., New Castle, Del.
Petrillo Brothers, Inc	do	do	5 Edgemoor Rd., Wilmington, Del.
St. Jones River Gravel Co	do	Kent	Box 426, Dover, Del.
Whittington's Sand & Gravel Co	do	New Castle	U.S. Route 40, Bear, Del.
Woodlawn Gravel Co	do	do	P.O. Box 2501, Wilmington, Del.

The Mineral Industry of Florida

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

By John W. Sweeney [1] and Robert O. Vernon [2]

Mineral production in Florida totaled almost $310 million in 1967, $14 million above that of the previous record set in 1966, and continued the upward trend in mineral production that began in 1962. In 1967, value increased for most mineral commodities, while quantity produced decreased slightly for many of the same commodities.

For the 74th consecutive year, Florida led the Nation in phosphate rock output, total marketable production increasing slightly over that of 1966, setting a record high. Florida also ranked first among the States in the production of fuller's earth and zircon, second in ilmenite, and was the only producer of staurolite.

Table 1.—Mineral production in Florida [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	762	$11,408	756	$11,574
Lime—do	135	1,966	155	2,425
Natural gas—million cubic feet	212	30	123	18
Peat—short tons	11,500	91	22,180	155
Petroleum (crude)—thousand 42-gallon barrels	1,799	W	1,568	W
Sand and gravel—thousand short tons	7,403	6,417	6,912	6,479
Stone [2]—do	35,023	38,167	33,971	38,723
Value of items that cannot be disclosed: Cement, magnesium compounds, natural gas liquids, phosphate rock, rare-earth metal concentrates, staurolite, stone (dimension limestone 1967), titanium concentrates, zirconium concentrates, and values indicated by symbol W	XX	237,368	XX	250,423
Total [3]	XX	295,447	XX	309,797
Total 1957–59 constant dollars	XX	r 279,222	XX	p 284,579

p Preliminary. r Revised. XX Not applicable.
W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."
[1] Production as measured by mine shipments, sales or marketable production (including consumption by producers).
[2] Excludes dimension limestone; included with "Value of items that cannot be disclosed."
[3] Data may not add to totals shown because of independent rounding.

The Florida phosphate industry continued to be the major supplier of phosphate rock for domestic markets and a leading exporter for international markets. Exports of phosphate rock from Florida ports increased 9 percent in tonnage over that of 1966 with all phosphate exports moving through the ports of Tampa, Boca Grande, and Jacksonville. Shipments were made to 36 foreign countries, with Canada, West

[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.
[2] Director, Division of Geology, Florida Board of Conservation, Tallahassee, Fla.

Germany, Italy, and Japan each receiving shipments totaling over 1 million short tons of phosphate rock. Domestic shipments were somewhat curtailed owing to inclement spring weather in the Midwest where fertilizer inventories in storage increased.

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

County	1966	1967	Minerals produced in 1967 in order of value
Alachua	$1,804,101	$2,186,995	Limestone.
Baker	----------	9,000	Sand and gravel.
Bay	W	W	Do.
Bradford	W	----------	
Brevard	27,000	W	Limestone, sand and gravel.
Broward	5,560,322	4,865,192	Do.
Citrus	W	W	Limestone, phosphate rock, miscellaneous clay.
Clay	W	W	Ilmenite, zircon, sand and gravel, staurolite, miscellaneous clay, peat.
Collier	W	W	Petroleum, limestone.
Columbia	W	W	Limestone.
Dade	W	W	Cement, limestone, sand and gravel.
Duval	W	W	Oystershell, monazite, zircon.
Escambia	W	W	Sand and gravel, miscellaneous clay.
Flagler	W	----------	
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	26,497,868	24,345,220	Cement, phosphate rock, oystershell, sand and gravel, peat.
Indian River	19,000	7,000	Sand and gravel.
Jackson	63,000	93,000	Limestone.
Lafayette	24,000	----------	
Lake	1,124,000	1,083,000	Sand and gravel.
Lee	W	W	Limestone, oystershell.
Leon	W	----------	
Levy	657,238	1,024,369	Limestone.
Manatee	W	W	Do.
Marion	W	W	Limestone, fuller's earth, phosphate rock, sand and gravel.
Monroe	W	W	Limestone.
Orange	W	184,040	Sand and gravel, peat.
Palm Beach	848,716	630,809	Limestone, sand and gravel.
Pinellas	579,000	517,500	Oystershell, sand and gravel.
Polk	171,471,900	183,764,600	Phosphate rock, sand and gravel.
Putnam	W	W	Kaolin, sand and gravel, peat.
St. Lucie	W	W	Sand and gravel.
Sarasota	W	W	Limestone.
Sumter	W	W	Limestone, lime.
Suwannee	W	W	Limestone.
Taylor	----------	70,797	Do.
Volusia	W	W	Sand and gravel.
Wakulla	68,000	----------	
Walton	W	W	Oystershell, sand and gravel.
Washington	12,000	6,000	Sand and gravel.
Undistributed [2]	86,690,855	91,009,478	
Total	295,447,000	309,797,000	

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

[1] The following counties are not listed because no production was reported. Calhoun, Charlotte, De Soto Dixie, Franklin, Hardee, Highlands, Holmes, Jefferson, Liberty, Madison, Martin, Nassau, Okaloosa, Okeechobee, Osceola, Pasco, St. Johns, Santa Rosa, Seminole, and Union.

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

Table 3.—Indicators of Florida business activity

		1966	1967	Change (percent)
Population		5,945,300	6,081,500	+2.2
Personal income:				
Total	millions	$15,410	$16,765	+8.8
Per capita		$2,614	$2,796	+6.9
Construction activity:				
Housing units authorized		58,910	67,775	+15.0
Value of construction	thousands	$658,825	$784,225	+19.0
New business incorporations		12,125	12,390	+2.2
Sales of electric energy, kwhr	millions	31,417	34,608	+10.1
Mineral production	do	$295.4	$309.8	+4.8
Foreign trade, Florida customs district:				
Value of exports	millions	$700.9	$749.6	+6.9
Value of imports	do	$540.3	$591.7	+9.5
Annual average labor force and employment:				
Total nonagricultural employment	thousands	1,728	1,821	+5.4
Manufacturing	do	275.2	292.6	+6.3
Mining	do	10.0	9.2	−8.0
Nonmetallic minerals, except fuels	do	9.1	8.4	−7.7
Phosphate rock	do	6.7	6.2	−7.5
Contract construction	do	134.0	128.2	−4.3

Sources: Bureau of Economics and Business Research, University of Florida; Florida Industrial Commission; Survey of Current Business, U.S. Department of Commerce.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Non-fatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1966:								
Peat	14	264	4	29	-----	-----	-----	-----
Metal	164	346	57	453	-----	-----	-----	-----
Nonmetal	3,664	336	1,231	9,854	4	138	14.41	2,819
Sand and gravel	369	251	93	845	-----	18	21.31	1,300
Stone	2,142	297	636	5,654	-----	117	20.69	1,574
Total [1]	6,353	318	2,020	16,836	4	273	16.45	2,244
1967:[p]								
Peat	19	255	5	42	-----	1	23.55	1,130
Metal	145	350	51	411	-----	-----	-----	-----
Nonmetal	3,785	299	1,130	9,051	3	73	8.40	3,385
Sand and gravel	335	257	86	761	-----	24	31.54	619
Stone	2,200	289	636	5,637	2	105	18.98	2,735
Total [1]	6,485	294	1,909	15,903	5	203	13.08	2,929

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

Increasing electrical energy requirements continued to place heavy demands on suppliers of electric power in the State. Tampa Electric Company completed its sixth generating unit of 425,000 kilowatts at the Francis J. Gannon station at Port Sutton. The company has another coal-fired station under development at Big Bend with construction slated to begin in early 1968. The first 450,000-kilowatt generating unit is scheduled to go into operation in 1970, the second in 1971. Florida Power Corp.'s Crystal River plant began producing electric energy from generating unit No. 1 with a capacity of 421,000 kilowatts; the unit will consume approximately 850,000 tons of coal per year. Construction also began on unit No. 2 which will have a capacity of 510,000 kilowatts and which will also be coal-fired. The company made application to the Atomic Energy Commission to construct two nuclear powerplants in Citrus County. The facilities, designated Crystal River Units 3 and 4 Nuclear Generating Stations, would use two pressurized water reactors; each unit would have an initial gross capacity of 885,000 kilowatts. The

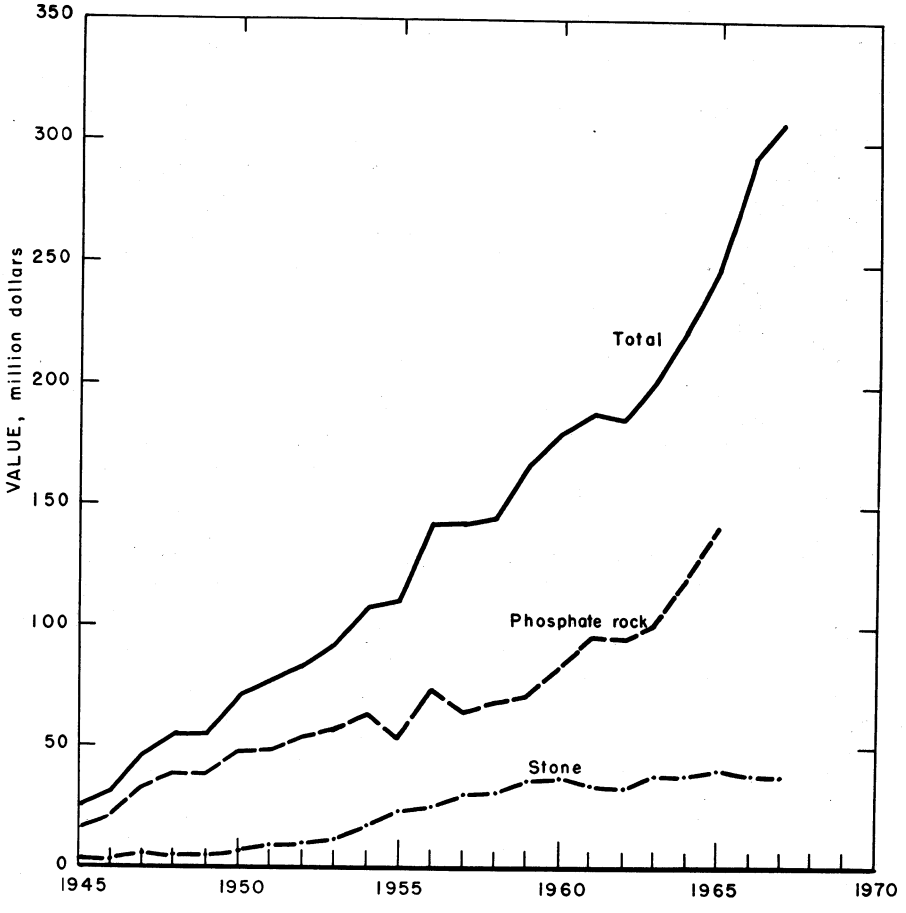

Figure 1.—Value of phosphate rock, stone, and total value of mineral production in Florida.

company estimates the total cost of the project, including the initial fuel cores for the units, to be $279 million.

Major port expansions were planned to help alleviate congestion from increased tonnages of both imports and exports. The Seaboard Coastline Railroad announced plans to construct phosphate loading facilities on the east side of Tampa Bay; construction of the East Bay Complex would phase out the railroad's other phosphate terminals. At the East Bay location, the railroad will also provide a site for the Ohio River Co., a barge line, to construct a new wet phosphate rock terminal. Total capacity of the Complex will be about 12 million tons per year and the total estimated cost is $15 million. Planning began on a $33 million barge port and phosphate terminal on the Cross-Florida Barge Canal at Inglis; Inglis is expected to become a major barge center in Florida. Chemical Terminal and Transport of Tampa announced plans to construct a $2 million phosphate and chemical products terminal at Tampa.

A steep rise was noted for most of Florida's business activity indicators, with the exception of mining employment; the drop in employment can be related to the decreased output of some of the bulk construction mineral commodities. Reduced phosphate sales to domestic markets and related depressed prices, resulting in some

mine closures and cutbacks at others, also contributed to this drop in employment.

Maule Industries, a Miami crushed limestone producer, announced plans to construct a 2 million barrel per year cement plant in the Miami area.

Mobil Oil Corp. drilled a test well in the Gulf of Mexico about 6 miles off Gasparilla Island, Charlotte County; the well was a dry hole, and was terminated at 12,931 feet. Mobil also drilled two other wells in the Gulf, one about 8 miles south of Cedar Key and the other 15 miles southwest of Yankeetown; the Yankeetown well, a dry hole, was abandoned after reaching a depth of 4,735 feet.

Legislation and Government Programs.—The U.S. House Appropriations Committee approved nearly $32 million for planning and construction of Florida water projects; of this total, $11.4 million was approved for the Cross-Florida Barge Canal, the completion date of which was extended to 1974. A bill was signed admitting Florida into the Tennessee-Tombigbee Waterway Authority.

On the State level, bills relating to strip mining in Sarasota County and to subsurface rights in the State became law. Other acts by the Florida Legislature created the Tallahassee-Wakulla Port Authority and the Lee-Charlotte Port Authority. The Manatee County Planning Commission adopted a mining ordinance raising land reclamation bonds from $300 to $750 per acre.

The Division of Geology, Florida Board of Conservation, continued studies of mineral resources throughout the State; results of water resource studies were published during the year.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for 94 percent of the State's total mineral production value, compared with 95 percent in 1966. The principal nonmetals produced, listed in order of value, were phosphate rock, stone, cement, clays, and sand and gravel.

Cement.—The quantity of portland cement shipped increased 5 percent with a 6 percent increase in value while masonry cement shipments increased 2 percent in quantity and 1 percent in value. General Portland Cement Co. operated plants near Tampa and Miami, and Lehigh Portland Cement Co. operated a plant near Miami.

Types I and II (general-use and moderate - heat), Type III (high - early - strength), and white cements were produced. Most of the shipments were made within the State, but shipments were also made to Georgia, Tennessee, North Carolina, Alabama, and other States. Masonry cement shipments were mainly made within the State, with small amounts also shipped to Georgia and South Carolina. Cement shipments, chiefly in bulk form, were made by truck (74 percent) and by rail (26 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, and sand.

Ten rotary kilns were operated at the three plants which had a total capacity of about 12 million barrels per year. All used the wet process. A total of about 215 million kilowatt-hours of electrical energy was consumed in the manufacture of cement, 90 percent purchased and the remainder home generated.

Clays.—Total clay output decreased 0.8 percent in tonnage, but value increased 2 percent. Increases in value were noted for all clays, but miscellaneous clay was the only clay showing increased output.

Florida, for the 10th consecutive year, continued to lead the Nation in fuller's earth production. Fuller's earth output decreased 3 percent in tonnage, but the value increased 1 percent. Three producers were active in Gadsden County and one producer in Marion County. The material was used for insecticides (39 percent), absorbents (35 percent), drilling mud (14 percent), mineral oils (7 percent), and paper soil, and vegetable uses (3 percent); about 2 percent was exported.

A highlight of the year was the merger of Minerals & Chemicals Philipp Corp. into Engelhard Industries Inc.; the new company will be known as Engelhard

Minerals & Chemicals Corp. The Minerals & Chemicals Division of this new company specializes in the mining, processing, and sale of kaolin and attapulgite clays (fuller's earth), lime and limestone, and activated bauxite.

Kaolin output decreased 4 percent, but value increased 6 percent over 1966 figures. Kaolin was produced by two companies in Putnam County; principal uses were in whiteware and pottery.

Miscellaneous clay output increased 2 percent in both tonnage and value owing to increased consumption in the manufacture of cement and lightweight aggregate.

Gypsum.—Three companies calcined imported crude gypsum for manufacture of gypsum building products. Two firms operated plants near Jacksonville, Duval County; and the third firm operated a plant near Tampa, Hillsborough County. The three plants used nine calcining kettles, two rotary kilns, and three board machines in the processing and manufacture of gypsum and gypsum products; total capacity of the plants was in excess of 500,000 tons of calcined product. Crude ore for the operations was transported by ship from company owned deposits in Nova Scotia.

Lime.—Primary lime sold or used established a new record—155,000 tons valued at $2.4 million representing increases of 15 and 23 percent, respectively, over 1966 levels. Michigan Chemical Corp. manufactured quicklime for use in recovery of magnesia from sea water. Two other companies produced primary lime in the form of quicklime and hydrated lime for various chemical uses. The major market area was Florida, with a small amount being sold in Georgia. Six companies in six counties recovered 467,000 tons of regenerated lime valued at $7.6 million for use principally in manufacturing paper and alkalies and for water treatment.

Magnesia.—Michigan Chemical Corp. near Port St. Joe produced magnesium compounds from sea water. Some of the principal uses of the magnesium compounds were for refractories, building materials, rubber, and chemicals.

Perlite.—Three companies expanded perlite in three counties from ore mined in Colorado; total output was about 7,900 tons valued at 539,000, a slight decrease from 1966 figures. The expanded material was used for building plaster, concrete aggregate, soil conditioning, and insulation.

Phosphate Rock.—Florida led the Nation for the 74th consecutive year in marketable phosphate rock production, and established a new high for output within the State.

Florida's 1967 production 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 1967 was 31.9 million short tons valued at $207.7 million representing 80 percent of the total national output. This was a 4-percent increase over the 29.8 million short tons valued at $195.1 million produced in 1966. Marketable production sold or used totaled 29.8 million tons valued at $193.5 million, of which agricultural uses accounted for 20.4 million tons, or 69 percent; industrial uses 349,000 tons, or 1 percent; and exports 9 million tons, or 30 percent. The exports were valued at $58.7 million. Agricultural uses were for ordinary superphosphate, triple superphosphate, wet process phosphoric acid, 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 117.6 million short tons with a phosphorus pentoxide (P_2O_5) content of 16.7 million tons.

Monsanto Co. acquired phosphate rights from Owens-Illinois Co. on property located north of Lake City, Columbia County; supplementing other Monsanto phosphate interests in the northern portion of the county. The company has reportedly been doing exploratory drilling in the area for some time.

Kerr-McGee Oil Industries, Inc., which previously announced plans for a large mining complex in Polk County, has apparently abandoned plans for mining in the area.

Several papers describing Florida phos-

phate mining and reclamation practices were published.[3]

Land-pebble phosphate rock was produced at 21 mines by 11 companies in three counties.

Hard-rock phosphate was not produced in the State during the year.

Soft-rock phosphate was produced by five companies at seven mines in three counties. Total mine production was 35,000 tons, with a P_2O_5 content of 7,500 tons, valued at $263,000. The material was used for direct application to the soil, stock and poultry feed, and fertilizer filler. Producing companies were Howard Phosphate Co., Kellogg Co., Loncala Phosphate Co., Soil Builders, Inc., and Sun Phosphate Co.

The new Chicora mine and phosphate-processing complex of American Cyanamid Co. with a capacity of 1.5 million tons was placed in operation. During the year the company also installed air scrubbers at its Brewster plant to lower the emission of gaseous fluorides. Late in the year the company closed its Sydney mine for about 2 months, reportedly for control of its phosphate rock inventory.

Armour Agricultural Chemical Co. operated two mines in Polk County. Development of the Rockland mine near Fort Meade a joint venture of Armour and Freeport Sulphur Co.'s, began; a contract was also awarded for construction of a phosphate rock washer-beneficiation plant at the mine site. This plant will supply phosphate both to Armour's Fort Meade phosphoric acid facility, and to a new Freeport Sulphur Co. processing plant being constructed at Convent, La. A 15-year contract between Freeport Sulphur Co. and Eastern Gas and Fuel Associates will provide for barge transportation of approximately 2.25 million tons per year of phosphate rock from the Armour-Freeport complex in Florida to fertilizer chemical plant at Convent, La.

Borden Chemical Co. operated its Tenoroc mine throughout the year and its new fertilizer complex near Piney Point was placed in operation during the year; the company also announced construction of additional warehouse facilities and installation of an automatic fertilizer bagging plant.

W. R. Grace & Co., Agricultural Products Division, continued operation of its Bonny Lake mine. A scrubbing system for recovery of fluorides from granular superphosphate storage was placed in operation at the company's fertilizer complex near Bartow; the four-stage system will reduce fluoride emission by 95 percent in a 35,000-ton storage building.

International Minerals & Chemical Corp. (IMC) operated three mines, all in Polk County. The Achan mine reported no production during the year. The company began production at its new $4 million feed-grade phosphate plant at Bartow for production of diammonium phosphate and two types of calcium phosphate; this new plant increased the company's total feed-grade product capacity in Florida to more than 500,000 tons per year.

Mobil Chemical Co. operated three mines, all in Polk County, during the year. Output from the mines was used in the manufacture of ordinary superphosphate, triple superphosphate, phosphoric acid; for direct application to the soil; and in electric furnace manufacture of elemental phosphorus.

Occidental Corporation of Florida operated its Suwannee River mine in Hamilton County, and announced plans to expand its phosphate mining operations in Hamilton and Columbia Counties beginning in 1968, and also to develop port facilities along the gulf coast. Other engineering studies were in progress for new facilities to increase mining capacity by 50 percent at the Suwanee River mine.

Swift & Company operated the Watson and Silver City mines and plants, both in Polk County, during the year.

Minerals Recovery Corp. processed tailings from previous operations at its Sand Mountain recovery plant near Bartow.

U.S. Phosphoric Products, Division Tennessee Corporation (a subsidiary of Cities Service Oil Co.) began operations of its new Tencor mine and phosphate ore beneficiation plant near Fort Meade during the year. Plant capacity is rated at 2 million tons per year, and the new facilities included a preparation plant

[3] Cross, W. C. Florida Phosphate Mining Methods. Min. Cong. J., v. 53, No. 10, October 1967, pp. 27–31.
Engineering and Mining Journal. Mine Plan for Total Resource Management. V. 168, No. 7, July 1967, pp. 77–82.
Trauffer, Walter E. Phosphate Industry Expanding at a Record Rate. Pit and Quarry, v. 59, No. 10, June 1967, pp. 70–74, 79–86, 133–146.

with washing and sizing section, a flotation plant, a 200,000-ton wet-rock storage facility, a fluid-solids drying system, and a 10,000-ton dry-rock facility. The fluid-solids drying system is designed to handle 300 tons per hour of phosphate rock to produce a dried product of less than 1.5 percent moisture.

Sand and Gravel.—Sand and gravel output was 6.9 million tons valued at $6.5 million in 1967; output declined 7 percent, but value increased 1 percent. Of the total tonnage, 95 percent was produced by commercial operators and 5 percent by Government-and-contractor producers. There were 42 commercial sand and gravel operations during the year; of these, 11 produced 200,000 to 600,000 tons; 18 produced from 50,000 to 200,000 tons; and 13 plants produced up to 50,000 tons. Of the output, 68 percent was transported by truck and 32 percent by rail. The sand and gravel was used mainly for construction purposes, with a small amount going into industrial uses. The value per ton of commercial sand and gravel ranged from $0.62 to $7.46 and averaged $0.94 per ton. A new sand deposit of Polk City Sand and Silica Co. was described.[4]

Staurolite.—Staurolite was recovered as a byproduct of ilmenite production by E. I. du Pont de Nemours & Co., Inc., at its Highland and Trail Ridge plants in Clay County. Output and value both decreased 8 percent from 1966 figures. Florida is the only State with recorded production of staurolite.

[4] McDonough, E. W. Huge Sand Deposit Unearthed by Polk City Sand and Silica Co. Dixie Contractor, v. 42, No. 2, May 5, 1967, pp. 31–32.

Table 5.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1966			1967		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Baker	----	----------	----------	1	11	$9
Brevard	1	27	$27	1	24	25
Broward	4	469	338	4	321	324
Escambia	5	426	397	5	468	437
Gadsden	1	238	W	1	241	W
Glades	1	154	W	1	W	W
Hendry	1	205	W	1	W	W
Indian River	1	20	19	1	8	7
Lake	5	1,588	1,124	5	1,496	1,083
Marion	1	11	32	1	11	32
Orange	1	135	93	1	151	104
Palm Beach	1	130	72	1	84	68
Pinellas	1	7	5	1	7	5
Polk	8	2,076	1,886	8	2,065	1,983
Putnam	4	526	461	5	626	476
St. Lucie	3	W	W	2	84	W
Wakulla	1	80	68	-----	----------	----------
Washington	1	13	12	1	8	6
Undistributed [1]	10	1,298	1,883	7	1,307	1,920
Total	50	7,403	6,417	47	6,912	6,479

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Bay, Clay, Dade, Hillsborough, Leon (1966), Volusia, and Walton Counties, and counties indicated by symbol W.

Table 6.—Sand and gravel sold or used by producers, by uses
(Thousand short tons and thousand dollars)

Use	1966			1967		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	5,689	$4,319	$0.76	4,975	$3,937	$0.79
Paving	445	361	.81	773	594	.77
Fill	514	302	.59	482	299	.62
Blast	62	428	6.90	54	403	7.46
Other sands [1]	399	W	W	W	W	W
Total sand	7,109	W	W	W	W	W
Gravel:						
Structural	294	W	W	W	W	W
Fill	----	----	----	W	W	W
Total gravel	294	W	W	W	W	W
Total sand and gravel	7,403	6,417	.87	6,912	6,479	.94

W Withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."
[1] Includes glass, molding (1967), engine, filtration, fertilizer filler (1967), and other sands.

Stone.—Stone output, excluding dimension limestone, was 34 million tons valued at $39 million. The output of both crushed limestone and crushed oystershell declined, however, the value of crushed limestone increased 3 percent, accounting for a total increase in the value for stone.

Crushed limestone output was 32.6 million tons valued at $36.7 millon, a decrease of 3 percent in tonnage, but an increase of 3 percent in value over that of 1966. Output came from 74 quarries in 19 counties, compared with 74 quarries in 18 counties in 1966. The three leading producing counties were Dade, Hernando, and Broward, which supplied 61 percent of the tonnage and 60 percent of the value. Ten quarries produced over 1 million tons of crushed limestone each. Of the total crushed limestone output, 88 percent was used for concrete and roads, 2 percent for agriculture, and 10 percent for other uses. Crushed limestone was transported 66 percent by truck, 31 percent by rail, 1 percent by water, and 2 percent unspecified. A highlight during the year was the acquisition of Dixie Lime & Stone Co. by New York & Honduras Rosario Mining Co.

Table 7.—Crushed limestone sold or used by producers, by counties

County	1966			1967		
	Number of quarries	Short tons	Value	Number of quarries	Short tons	Value
Alachua	5	2,151,202	$1,804,101	5	2,273,618	$2,186,995
Broward	11	4,432,861	5,222,322	11	4,114,107	4,541,192
Collier	3	678,000	531,192	5	1,025,660	829,003
Dade	13	10,025,662	10,016,888	12	9,580,811	9,859,593
Hernando	8	5,418,505	6,158,091	8	6,201,468	7,551,782
Jackson	1	21,000	63,000	1	31,000	93,000
Lafayette	1	21,000	24,000	----	----	----
Lee	3	707,133	W	2	W	W
Levy	3	497,611	657,238	3	544,707	1,024,369
Marion	6	1,684,089	1,373,675	7	1,002,472	1,894,889
Palm Beach	4	796,402	776,716	3	629,218	562,809
Sumter	3	3,498,251	2,461,777	3	2,760,312	2,619,265
Taylor	----	----	----	1	70,797	70,797
Undistributed [1]	13	3,610,729	6,678,824	13	4,383,590	5,435,903
Total	74	33,542,445	35,767,824	74	32,617,760	36,669,597

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Brevard (1967), Citrus, Columbia, Flagler (1966), Manatee, Monroe, Sarasota, and Suwannee Counties, and counties indicated by symbol W.

Table 8.—Crushed limestone sold or used by producers, by uses

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	29,514,572	$30,712,720	$1.04	28,884,733	$30,737,421	$1.06
Agricultural stone	880,381	2,048,052	2.33	776,967	2,412,194	3.10
Other uses [1]	3,147,492	3,007,052	.96	2,956,060	3,519,982	1.19
Total	33,542,445	35,767,824	1.07	32,617,760	36,669,597	1.12

[1] Includes railroad ballast, riprap, lime, cement, fill, and other uses.

Oystershell was dredged and crushed by five companies in five counties on State leases. Total output was 1.3 million tons valued at $2.0 million, a decrease of 9 percent in tonnage and 13 percent in value compared with 1966 figures. Most of the oystershell was used for roads and in concrete, and a smaller tonnage was used for poultry grit and other uses. The shell was transported 54 percent by water, 43 percent by truck, and 1 percent by rail.

Bradenton Stone Co., Manatee County, was the only dimension limestone producer reporting output during the year. The company produced a small tonnage of cut stone for decorative uses.

Vermiculite. — Exfoliated vermiculite was produced at three plants of W. R. Grace & Co. in Duval, Hillsborough, and Palm Beach Counties, and by Verlite Co. at a plant near Tampa, Hillsborough County. Principal uses of the material were for building plaster, concrete aggregate, loose fill insulation, and agricultural purposes.

METALS

Metals accounted for 3 percent of the State's total mineral production value.

Ferroalloys.—Agrico Chemical Co. at Pierce and Mobil Chemical Co. at Nichols produced ferrophosphorus as a byproduct of elemental phosphorus manufacture. The value of ferroalloys is not included in the total State value.

Rare-Earth Minerals.—National Lead Co. reclaimed rare-earth metal concentrates from tailings at its Jacksonville mine. Shipments of concentrates increased considerably over those of 1966.

Titanium Concentrates.—Shipments of ilmenite concentrate increased considerably over those of 1966. E. I. du Pont de Nemours & Co., Inc. operated during the year, making shipments from its Highland and Trail Ridge mines in Clay County.

Zirconium Concentrates.—Florida led the Nation in zircon output. Shipments of zirconium concentrate decreased 1 percent in tonnage, but value increased 5 percent over the 1966 figure. Zirconium concentrates were recovered from ilmenite mining by E. I. duPont de Nemours & Co., Inc., at its Trail Ridge operation, and by National Lead Co. at its Jacksonville operation.

FUELS

Mineral fuels production consisted of natural gas, crude petroleum and its derivatives, and peat and accounted for 3 percent of the State's total mineral production value.

Natural Gas.—All natural gas production came from the Humble Oil and Refining Co., Sunniland field, Collier County, and was used in company operations as fuel for pumping crude petroleum. Production reports indicate a decrease in output compared with the 1966 figure.

Peat.—Peat production and value increased considerably compared with 1966. Six companies in four counties produced 22,000 tons of reed-sedge and/or humus peat valued at $155,000; most of the material was shredded and sold in bulk for soil improvement purposes.

Petroleum.—Crude petroleum production from the State's two oilfields de-

creased 13 percent below that of 1966; cumulative production from both fields totaled 13.1 million barrels. Humble Oil and Refining Co.'s Sunniland field in Collier County and Sun Oil Co.'s Sunoco-Felda field in Hendry County produced a total of 1,568,000 barrels of oil during the year. Cumulative production, 1943–67, from the Sunniland field was 10.5 million barrels of low gravity oil; production in 1967 came from 16 wells. In 1967, 26 pumping wells in the Sunoco-Felda field yielded 983,000 barrels of oil with a gravity of about 24° API; the cumulative production 1964–67, of the field is 2.6 million barrels. No wells were drilled in the field during the year.

Table 9.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1967

County	Drilling [1]					Geophysical, crew-weeks [2] (reflection seismograph method)
	Exploratory wells			Total		
	Oil	Gas	Dry	Wells	Footage	
Broward			1	1	12,500	5.5
Charlotte			1	1	12,931	
Charlotte (offshore)			1	1	6,041	1.5
Citrus (offshore)			3	3	36,485	24.0
Collier			1	1	11,510	4.0
Dade						13.0
Franklin						3.5
Hendry			2	2	7,629	
Hernando						5.0
Lee			1	1	4,735	.5
Levy (offshore)						4.0
Palm Beach			1	1	6,600	1.0
Santa Rosa						
Total			11	11	98,431	62.0

[1] American Association of Petroleum Geologists.
[2] International Oil Scouts Association, Austin, Texas.

In 1967, a total of 98,000 feet was drilled in 11 exploratory wells, including a 12,900-foot test drilled offshore from Charlotte County by Mobil Oil Co. All of these wells have been plugged and abandoned.

The interest in Florida geophysical activity which began in 1964 continues to the present, with the bulk of the work in State and Federal waters of the Gulf of Mexico. In 1967, 23 permits were issued for geophysical surveys of these bottoms.

There were no changes in the legal code governing the conservation of oil and gas in Florida in 1967. As an administrative action, however, the State required that the Mobil Oil Co. post a $500,000 bond to assure performance of remedial action in the event that the beaches should be contaminated during the drilling of three oil tests located offshore from the west coast of the State.

Table 10.—Principal producers

Commodity and company	Name of operation	County	Address	Remarks
Cement: Portland and masonry:				
General Portland Cement Co	Dade County plant	Dade	Box 1528 Tampa, Fla. 33601	Miscellaneous clay and crushed limestone.
Do	Tampa plant	Hillsborough	do	Do.
Lehigh Portland Cement Co	Miami plant	Dade	718 Hamilton St. Allentown, Pa. 18105	
Clay:				
Fuller's earth:				
Dresser Magcobar	Havana mine	Gadsden	Box 6504 Houston, Tex. 77005	
Engelhard Minerals & Chemicals Corp.	Midway mine	do	Menlo Park Edison, N.J. 08817	
Do	La Camelia mine	do	do	
Floridin Company (Pennsylvania Glass Sand Co.)	Quincy mine	do	General Operations Dept. Hancock, W. Va. 25424	
Mid-Florida Mining Co	Lowell mine	Marion	Box 68–F Lowell, Fla. 32663	
Kaolin:				
Cyprus Mines Corp	No. 4 mine	Putnam	101 Oakland St. Trenton, N.J. 08618	
Edgar Plastic Kaolin Co	Edgar mine	do	130 Central Ave. Lake Wales, Fla. 33853	
Miscellaneous:				
Appalachee Correctional Institute	Chattahoochee mine	Gadsden	Box 127 Chattahoochee, Fla. 32324	For structural clay products.
Florida Solite Co	Russell mine	Clay	Box 297 Green Cove Springs, Fla. 32043	For lightweight aggregate.
General Portland Cement Co	Citrus County mine	Citrus	Box 1528 Tampa, Fla. 33601	For cement.
Taylor Brick & Tile Co., Inc	Barth mine	Escambia	Box 318 Barth, Fla. 32532	For structural clay products.
Gypsum, calcined:				
Kaiser Gypsum Co	Jacksonville plant	Duval	300 Lakeside Drive Oakland, Calif. 94612	For manufacture of gypsum building products.
National Gypsum Co	Tampa plant	Hillsborough	325 Delaware Ave. Buffalo, N.Y. 14202	Do.
U.S. Gypsum Co	Duval County plant	Duval	101 South Wacker Drive Chicago, Ill. 60606	Do.
Lime:				
Primary:				
Chemical Lime, Inc	Brooksville plant	Hernando	Box 250 Ocala, Fla. 32670	
Dixie Lime & Stone Co	Sumterville plant	Sumter	Box 910 Ocala, Fla. 32670	
Michigan Chemical Corp	Port St. Joe plant	Gulf	Box 160 Port St. Joe, Fla. 32456	Also magnesium compounds.

Regenerated:				
Alton Box Board Co	Jacksonville plant	Duval	Jacksonville, Fla. 32201	
Buckeye Cellulose Corp	Foley plant	Taylor	Foley, Fla. 32347	
Hudson Pulp & Paper Corp	Palatka plant	Putnam	Palatka, Fla. 32077	
International Paper Co	Panama City plant	Bay	Box 2487 Panama City, Fla. 32402	
St. Joe Paper Co	Port St. Joe plant	Gulf	Port St. Joe, Fla. 32456	
Magnesium compounds:				
Michigan Chemical Corp	----do	----do	----do	Also primary lime.
Peat:				
Daetwyler Peat Mine	Orlando mine	Orange	Rt. #7, Box 56 Orlando, Fla. 32805	
Jack O. Holmes, Inc	----do	----do	Box 17157 Tampa, Fla. 33612	
Raymond Johnson	Zelwood mine	----do	555 North Ryan Ave. Apopka, Fla. 32703	
Tomes Peat Humus	Tomes mine	Clay	Rt. #1, Box 480 Keystone Heights, Fla. 32656	
Traxler's Peat Co	Florahome mine	Putnam	Box 10 Florahome, Fla. 32635	
Perlite, expanded:				
Airlite Processing Corp	Processing plant	Indian River	Building 9 Air Base Vero Beach, Fla. 32960	
Chemrock Corp	Jacksonville plant	Duval	End of Osage St. Nashville, Tenn. 37208	
W. R. Grace & Co	Hialeah plant	Dade	62 Whittmore Ave. Cambridge, Mass. 02138	
Petroleum:				
Humble Oil & Refining Co	Sunniland field	Collier	Box 2024 Houston, Tex. 77001	
Sun Oil Co	Sunoco-Felda field	Collier and Hendry	Box 2880 Dallas, Tex. 75221	
Phosphate rock:				
Agrico Chemical Co	Boyette mine	Hillsborough	5050 Poplar Ave. Memphis, Tenn. 38117	
Do	Palmetto mine	Polk	Do.	
Do	Payne Creek mine	----do	Do.	
American Cyanamid Co	Sydney mine	Hillsborough	Berdan Ave. Wayne, N.J. 07472	
Do	Chicora mine	Polk	Do.	
Do	Orange Park mine	----do	Do.	
W. R. Grace & Co	Bonny Lake mine	----do	Box 471 Bartow, Fla. 33830	
International Minerals & Chemical Corp	Dredge mine	----do	Old Orchard Road Skokie, Ill. 60079	
Do	Kingsford mine	----do	Do.	
Do	Noralyn mine	----do	Do.	
Mobil Chemical Co	Clear Springs mine	----do	Box 1136 Richmond, Va. 23208	
Do	Fort Meade mine	----do	Do.	
Do	Homeland mine	----do	Do.	

Table 10.—Principal producers—Continued

Commodity and company	Name of operation	County	Address	Remarks
Phosphorus, elemental:				
Agrico Chemical Co	Pierce furnace	Polk	5050 Poplar Ave. Memphis, Tenn. 38117	Also ferroalloys.
Mobil Chemical Co	Nichols furnace	do	Box 1136 Richmond, Va. 23208	Do.
Rare-earth metal concentrates:				
National Lead Co	Jacksonville mine	Duval	Room 1900, 111 Broadway New York, N.Y. 10006	Also zirconium concentrates.
Sand and gravel:				
All Florida Sand Co	Keystone Heights mine	Clay	Box 4667 Jacksonville, Fla. 32201	
E. R. Jahna Industries, Inc	Clermont mine	Lake	First & East Tillman Lake Wales, Fla. 33853	
Eustis Sand Co	Eustis mine	do	Box 940 Leesburg, Fla. 32748	
Polk City Sand & Silica Co., Inc	Polk City mine	Polk	Drawer 338 Polk City, Fla. 33868	
Standard Sand & Silica Co	Standard mine	do	Box 35 Davenport, Fla. 33837	
Staurolite:				
E. I. du Pont de Nemours & Co., Inc	Highland plant	Clay	Du Pont Building Wilmington, Del. 19898	Also titanium and zirconium concentrates.
Do	Trail Ridge plant	do	Do.	
Stone:				
Limestone, crushed:				
Dixie Lime & Stone Co	Lebanon quarry	Levy	Box 910 Ocala, Fla. 32670	
Do	Zuber quarry	Marion	Do.	
Do	Lehigh quarry	do	Do.	
Do	Reddick quarry	do	Do.	
Do	Coleman No. 2 quarry	Sumter	Do.	
Florida Rock Products Corp	Diamond Hill quarry	Hernando	Box 4667 Jacksonville, Fla. 32201	
Houdaille-Duval Wright Co	Haile quarry	Alachua	Box 8068 Fort Lauderdale, Fla. 33310	
Do	Green quarry	Broward	Do.	
Do	Deerfield quarry	do	Do.	
Do	Wright quarry	do	Do.	
Do	Meekins quarry	Dade	Do.	
Maule Industries, Inc	Prospect quarry	Broward	Box 2601 Hialeah, Fla. 33012	
Do	Pennsuco quarry	Dade	Do.	
Seminole Rock Products, Inc	Medley quarry	do	Box 543 Miami, Fla. 33144	
Limestone, dimension:				
Bradenton Stone Co	Oneco quarry	Manatee	Box 1220 Bradenton, Fla. 33506	

Oystershell:				
Bay Dredging & Construction Co	Lease No. 2233, dredge	Hillsborough	Box 1484 Tampa, Fla. 33601	
Benton & Company, Inc	Lease No. 1788, dredge	Pinellas	Box 1347 St. Petersburg, Fla. 33731	
Fort Myers Shell & Dredging Co	Lease No. 2235, dredge	Lee	Box 973 Fort Myers, Fla. 33902	
Houdaille-Duval Wright Co	White Shell, dredge	Duval	Box 1588 Jacksonville, Fla. 32201	
Radcliff Materials, Inc	Lease No. 1718, dredge	Walton	Mobile, Ala. 36601	
Titanium concentrates:				
E. I. du Pont de Nemours & Co., Inc	Highland mine	Clay	Du Pont Building Wilmington, Del. 19898	Also staurolite and zirconium concentrates.
Do	Trail Ridge mine	do	do	Do.
Vermiculite, exfoliated:				
W. R. Grace & Co	Boca Raton plant	Palm Beach	62 Whittmore Ave. Cambridge, Mass. 02138	
Do	Jacksonville plant	Duval	Do.	
Do	Tampa plant	Hillsborough	Do.	
Verlite Co	do	do	Box 11385 Tampa, Fla. 33610	
Zirconium concentrates:				
E. I. du Pont de Nemours & Co., Inc	Trail Ridge plant	Clay	Du Pont Building Wilmington, Del. 19898	Also titanium and staurolite.
National Lead Co	Jacksonville plant	Duval	Room 1900, 111 Broadway New York, N.Y. 10006	Also rare-earth metal concentrates.

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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 Robert G. Hobbs [1] and A. S. Furcron [2]

Total value of mineral production in Georgia for 1967 increased 3.3 percent over that of 1966, indicating a leveling off from the 9.1 percent of annual expansion rates during 1962–66. Quantity increases were reported for eight of the 15 mineral commodities produced, while total value increased for 11.

Nonmetallic minerals accounted for about 97 percent of the total production value; metals and peat accounted for the balance.

Georgia ranked first among the States in the production of kaolin, second in fuller's earth, rare-earth concentrates, and scrap mica, third in bauxite and kyanite, fourth in barite and ilmenite, and fifth in feldspar.

Leading companies in the mineral industry of the State were American Industrial Clay Co. (kaolin), Englehard Minerals & Chemicals Corp. (kaolin and fuller's earth), Freeport Kaolin Co. (kaolin), Georgia Marble Co. (granite, marble, and feldspar), J. M. Huber Corp. (kaolin), and Vulcan Materials Co. (granite).

Economic expansion continued in all sectors of the State's economy. Personal income expanded at a rate of 7.1 percent; per capita income increased, moving the State in rank to 38th in the Nation. Gains were made in the number of new business incorporations, construction activity increased, and increased employment was prevalent in all areas except agriculture.

[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.
[2] Director, Georgia Department of Mines, Mining and Geology, Atlanta, Ga.

Table 1.—Mineral production in Georgia [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays—thousand short tons	5,128	$73,685	4,953	$77,314
Iron ore (usable)—thousand long tons, gross weight	447	2,200	267	1,450
Mica (scrap)—short tons	17,000	380	17,158	291
Sand and gravel—thousand short tons	3,915	4,185	3,787	4,206
Stone—do	24,690	48,193	23,417	49,953
Talc—short tons	41,000	255	46,150	292
Value of items that cannot be disclosed: Barite, bauxite, cement, feldspar, kyanite, peat, rare-earth metals concentrates, titanium concentrate, and zirconium concentrate	XX	19,699	XX	19,952
Total	XX	148,597	XX	153,458
Total 1957–59 constant dollars	XX	r 142,054	XX	p 146,048

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 Georgia, by counties [1]

County	1966	1967	Minerals produced in 1967 in order of value
Baldwin	W	W	Kaolin.
Bartow	$4,578,206	$3,968,987	Barite, limestone, slate, iron ore, iron oxide pigments, miscellaneous clay.
Bibb	W	W	Sand and gravel, miscellaneous clay.
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	W	W	Sand and gravel.
Crawford	W	W	Do.
Dade	W	W	Limestone.
Decatur	W	W	Fuller's earth.
De Kalb	W	W	Granite, feldspar, sand and gravel.
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	28,000	28,000	Sand and gravel.
Fayette	W	W	Granite.
Floyd	W	W	Limestone, bauxite, miscellaneous clay.
Fulton	6,448,475	6,053,222	Cement, granite, miscellaneous clay, sand and gravel.
Gilmer	W	W	Marble.
Glynn	W	W	Sand and gravel.
Gordon	16,700	15,200	Miscellaneous clay.
Greene	162,000	W	Sand and gravel.
Gwinnett	W	W	Granite.
Hall	W	W	Do.
Hancock	W	----	
Hart	W	W	Mica.
Henry	W	W	Granite.
Houston	W	W	Cement, limestone, miscellaneous clay.
Jasper	W	W	Felsdpar, mica, sandstone.
Jefferson	990,000	1,231,700	Fuller's earth.
Jones	W	W	Granite.
Lamar	W	W	Do.
Lincoln	W	W	Kyanite.
Long	W	W	Sand and gravel.
Lowndes	W	W	Peat.
Madison	W	W	Granite.
Marion	W	W	Iron ore.
Mitchell	W	W	Limestone.
Monroe	W	W	Granite.
Montgomery	25,000	20,000	Sand and gravel.
Murray	255,100	291,700	Talc.
Muscogee	W	W	Granite, sand and gravel.
Oglethorpe	W	877,615	Granite.
Pickens	W	W	Marble, sandstone.
Polk	W	W	Cement, slate, iron ore, miscellaneous clay, sandstone.
Quitman	W	W	Iron ore.
Rabun	W	W	Granite.
Richmond	5,632,071	4,283,789	Sandstone, kaolin, miscellaneous clay, sand and gravel.
Rockdale	----	W	Sand and gravel.
Spalding	W	W	Granite.
Stephens	W	W	Do.
Stewart	1,536,300	902,400	Iron ore.
Sumter	W	W	Kaolin, bauxite.
Talbot	W	W	Sand and gravel.
Taylor	W	W	Do.
Telfair	9,000	W	Do.
Thomas	W	W	Fuller's earth, sand and gravel.
Twiggs	W	W	Kaolin, fuller's earth.
Upson	W	----	
Walker	W	W	Limestone, miscellaneous clay.
Ware	23,000	W	Sand and gravel.
Warren	W	W	Granite, kaolin.
Washington	29,827,975	28,573,353	Kaolin.
Webster	----	W	Iron ore.
White	4,000	----	
Whitfield	W	W	Limestone.

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

County	1966	1967	Minerals produced in 1967 in order of value
Wilkinson	$4,128,338	$14,694,152	Kaolin.
Undistributed	94,932,835	92,517,882	
Total	148,597,000	153,458,000	

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

[1] The following counties are not listed because no production was reported: 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, Dawson, Dodge, Lumpkin, Macon, McDuffie, McIntosh, Meriwether, Miller, Morgan, Newton, Oconee, Paulding, Pickens, Candler, Carroll, Catoosa, Chattahoochee, Clay, Clinch, Coffee, Colquitt, Coweta, Crisp, Dawson, Dodge, Lumpkin, Macon, McDuffie, McIntosh, Meriwether, Miller, Morgan, Newton, Oconee, Paulding, Pickens, Pierce, Pike, Pulaski, Putnam, Randolph, Schley, Screven, Seminole, Taliaferro, Tattnall, Terrell, Tift, Toombs, Towns, Treutlen, Troup, Turner, Union, Walton, Wayne, Wheeler, Wilcox, Wilkes and Worth.

Table 3.—Selected economic indicators of Georgia business activity

	1966	1967	Change (percent)
Personal income:			
Total—millions	$10,579	$11,330	+7.1
Per capita	$2,379	p $2,513	+5.6
New business incorporations	3,899	4,201	+7.7
Mineral production—millions	$148.6	$153.5	+3.3
Construction activity:			
Housing units—private:			
Number	23,092	31,003	+34.3
Value—millions	$251	$327	+30.3
Total private construction (excluding private housing)—do	$245	$319	+30.2
Cement shipments to and within Georgia:			
Portland (includes high-early-strength)—thousand 376-pound barrels	9,226	9,436	+2.3
Masonry—thousand 280-pound barrels	1,255	1,189	−5.3
Cash receipts—farm:			
Marketing—thousands	$1,015.8	$1,029.2	+1.3
Average annual labor force:			
Total work force available—do	1,711.2	1,758.5	+2.8
Total unemployed—do	57.6	59.9	+4.0
Employment:			
Agricultural—do	95.8	90.4	−5.6
Nonagricultural—do	1,345.1	1,387.2	+3.1
Mining—do	6.1	6.5	+6.6
Contract construction—do	73.2	74.8	+2.2
Service (excludes gas and sanitary)—do	151.2	156.4	+3.4
Government (all)—do	242.7	258.9	+6.7
Total manufacturing—do	430.5	437.2	+1.6

p Preliminary.

Sources: U.S. Department of Commerce, Office of Business Economics, U.S. Bureau of Mines; Georgia Department of Labor; Georgia Department of Highways.

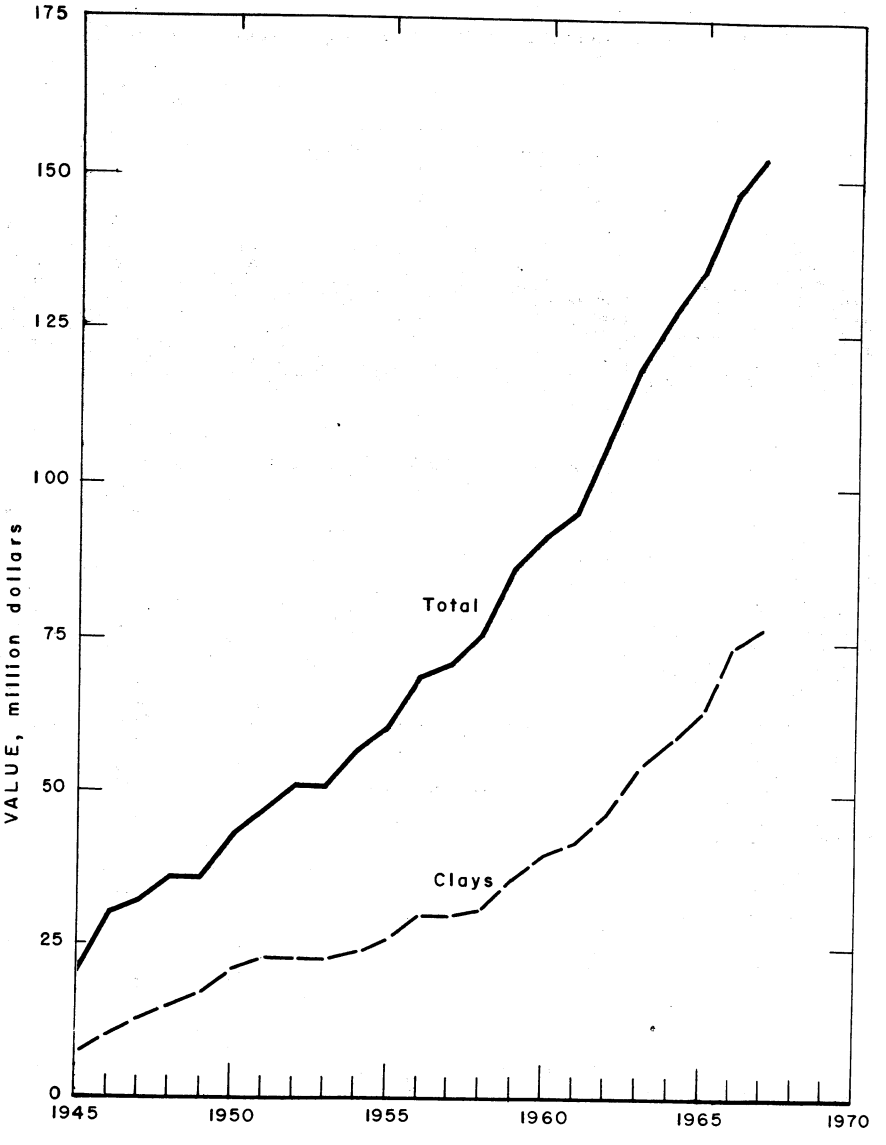

Figure 1.—Value of clays, and total value of mineral production in Georgia.

The kaolin mining industry continued to expand with three more mines in 1967. Also, dimension granite production showed a steady increase in value. Iron ore production decreased significantly; six mines closed in 1967.

Legislation and Government Programs.—The Georgia Department of Mines, Mining and Geology continued its South Georgia Minerals Program. Exploration for phosphate, heavy minerals, and industrial and high-alumina clays was conducted.

Of the total Interstate highway mileage in the State, 234.8 miles was under construction in 1967, 521.2 miles was open to traffic, and 350.5 miles or 32 percent was yet to be built. This construction program was a significant consumer of nonmetallic minerals produced in Georgia.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1966:								
Metal	244	271	66	571	-----	13	22.77	482
Nonmetal and peat	3,241	316	1,023	8,174	-----	216	26.43	1,945
Sand and gravel	233	265	62	549	1	12	23.66	11,364
Stone	3,073	263	808	6,762	2	160	23.96	3,431
Total [1]	6,791	288	1,958	16,056	3	401	25.16	2,842
1967: [p]								
Metal	180	280	51	406	-----	11	27.07	276
Nonmetal and peat	4,000	288	1,153	9,334	-----	284	30.43	1,191
Sand and gravel	245	261	64	571	-----	15	26.26	527
Stone	2,980	259	771	6,445	-----	163	25.29	1,262
Total [1]	7,405	275	2,038	16,756	-----	473	28.23	1,173

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Barite.—Primary barite was produced by four companies in Bartow County; Paga Mining Co. was the leading producer. Most of the barite was used in drilling muds, barium chemicals, and paint and rubber fillers.

Cement.—Cement continued to rank third in value in the State's mineral production. Shipments of portland cement decreased 12 percent in quantity and 5 percent in value, but those of masonry cement increased 9 percent in quantity and 14 percent in value. Eighty-five percent of the portland cement was shipped to Georgia destinations. Out-of-State shipments were principally to Alabama, Florida, North Carolina, and South Carolina with minor amounts to U.S. possessions and territories and foreign countries. Portland cement shipments went to the following consuming industries: Ready-mix concrete plants (57 percent), highway contractors (13 percent), concrete product manufacturers (10 percent), building material dealers (9 percent), and government agencies and other users (10 percent).

Clays.—Clay comprised 50 percent of the total value of mineral production; kaolin alone accounted for more than 45 percent. Kaolin production decreased 6 percent in quantity and increased 3 percent in value; fuller's earth production increased 15 percent in quantity and 26 percent in value. Miscellaneous clay production decreased less than 1 percent in quantity while the value increased 5 percent.

Table 5.—Kaolin sold or used by producers, by counties

County	1966			1967		
	Number of mines	Short tons	Value	Number of mines	Short tons	Value
Twiggs	6	1,170,988	$29,000,518	5	879,661	$22,215,947
Washington	9	1,371,630	29,827,975	10	1,202,956	28,573,353
Wilkinson	4	221,063	4,128,338	6	577,504	14,694,152
Other counties [1]	6	442,773	4,199,526	7	348,762	3,843,472
Total	25	3,206,454	67,156,357	28	3,008,883	69,326,924

[1] Includes Baldwin, Floyd (1966), Richmond, Sumter, and Warren (1967) Counties.

Table 6.—Kaolin sold or used by producers, by uses

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Pottery and stoneware:						
Whiteware	97,711	$1,681,680	$17.21	93,027	$1,875,405	$20.16
Floor and wall tile	32,579	323,300	9.92	W	W	W
Refractories:						
Firebrick and block	469,964	3,636,530	7.74	278,378	2,589,492	9.30
Fillers:						
Paper filling	678,136	12,411,412	18.30	655,001	14,804,795	22.60
Paper coating	1,251,664	36,176,061	28.90	1,256,525	34,051,851	27.10
Rubber	99,631	1,132,400	11.37	101,271	1,599,002	15.79
Paint	96,054	2,280,900	23.75	105,266	2,796,671	26.57
Fertilizers	29,013	431,900	14.89	11,924	225,778	18.93
Portland and other hydraulic cements	W	W	W	55,413	113,187	2.04
Chemicals	28,247	611,200	21.64	W	W	W
Exports	211,963	5,433,000	25.63	202,916	5,758,921	28.38
Other uses [1]	211,492	3,037,974	14.36	249,162	5,511,822	22.12
Total	3,206,454	67,156,357	20.94	3,008,883	69,326,924	23.04

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes stoneware; art pottery (1966), flower pots and glaze slip (1966); enameling; mortar; glass refractories; foundries, and steelwork; kiln furniture; other refractories; linoleum and oilcloth; insecticides and fungicides; plastics, organic; other fillers; catalysts (oil refining); other uses; and uses indicated by symbol W.

Table 7.—Miscellaneous clay sold or used by producers, by counties

County	1966			1967		
	Number of mines	Short tons	Value	Number of mines	Short tons	Value
Bartow	----	----------	----------	1	4,680	$4,100
Fulton	3	323,108	$201,000	3	320,717	199,000
Gordon	1	27,840	16,700	1	24,480	15,200
Other counties [1]	12	1,334,817	822,353	12	1,323,513	875,465
Total	16	1,685,765	1,040,053	17	1,673,390	1,093,765

[1] Includes Bibb, Columbia, Floyd, Houston, Polk, Richmond, and Walker Counties.

Kaolin was mined by 18 companies from 28 mines in eight counties. Seven companies produced fuller's earth from seven mines in four counties, and 14 companies mined miscellaneous clay in 10 counties. In all, clay was produced by 37 companies with 52 operations in 19 counties.

Feldspar.—Flotation concentrate was produced by Feldspar Corp. at its Monticello mill from feldspathic rock mined in Jasper County. Georgia Marble Co. produced a feldspar-quartz flotation concentrate as a byproduct of fines from granite crushing operations at Lithonia. The concentrate was used for glass and pottery, and the feldspar-silica mixture for glass only. Production and value of feldspar were again higher than in the previous year.

Gypsum.—Imported crude gypsum was calcined at three plants for use in manufacturing wallboard and other building products.

Kyanite.—Production of kyanite increased over 27 percent; its principal use was in refractories.

Lime.—Six firms, principally pulp and paper companies, in Camden, Chatham, Glynn, Lowndes, Richmond, and Wayne Counties regenerated lime. A total of 355,000 tons, valued at $6.7 million, was recovered by burning calcium carbonate sludge in rotary kilns. The lime was used in manufacturing processes.

Mica.—Scrap mica was produced in Cherokee, Hart, and Jasper Counties.

The dry-ground mica was used principally in the paint, roofing, and rubber industries. Ground mica production increased slightly in tonnage and decreased 25 percent in value.

Perlite.—Crude perlite shipped into the State was expanded and used principally for building plaster, concrete aggregate, and horticultural applications.

Sand and Gravel.—Sand and gravel ranked fourth in value in mineral production; tonnage decreased 3 percent, but value increased slightly. Construction sand output and value remained about the same as in 1966.

Twenty companies produced sand from 23 pits in 19 counties, and four companies mined both sand and gravel in three counties. Of the 27 sand and gravel plants, one produced more than 600,000 tons, six between 200,000 and 400,000 tons, six between 100,000 and 200,000, and 14 less than 100,000.

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

(Thousand short tons and thousand dollars)

County	1966			1967		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Chatham	1	15	W	1	W	W
Cook	1	143	W	1	W	W
Crawford	1	677	W	1	W	W
Dougherty	2	87	W	2	W	W
Effingham	1	174	W	1	W	W
Evans	1	19	$28	1	19	$28
Glynn	1	9	W	1	W	W
Greene	1	130	162	1	100	W
Long	1	46	W	1	W	W
Montgomery	1	34	25	1	20	20
Muscogee	2	375	W	2	W	W
Richmond	1	114	W	1	W	W
Telfair	1	8	9	1	W	W
Thomas	1	197	W	1	W	W
Ware	1	29	23	1	W	W
White	1	3	4	-----	-------	-------
Undistributed [1]	11	1,855	3,934	10	3,648	4,158
Total	29	3,915	4,185	27	3,787	4,206

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Bibb, De Kalb, Fulton, Rockdale (1967), Talbot, Taylor, Upson (1966), 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	1966			1967		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,951	$2,565	$0.87	2,852	$2,558	$0.90
Paving	474	340	.72	493	341	.69
Other sands	[1] 264	[1] 909	[1] 3.44	W	W	W
Total	3,689	3,814	1.03	W	W	W
Gravel	[2] 226	[2] 371	[2] 1.64	W	W	W
Total sand and gravel	3,915	4,185	1.07	[3] 3,787	[3] 4,206	[3] 1.11

W Withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."
[1] Includes glass, molding, blast, fill, and foundry sands.
[2] Includes gravel used for structural and paving purposes.
[3] Includes glass, molding, blast, engine, filtration, fill and other sands; structural, paving, fill and other gravel.

Stone.—Stone ranked second in value in the State's mineral production. Total crushed stone production decreased 10 percent in tonnage but less than 1 percent in value. Crushed limestone, marble, and sandstone (quartzite) production decreased in both tonnage and value. Crushed granite output was less, but its value showed a subtantial increase. Crushed slate tonnage and value decreased. Dimension marble and sandstone were higher in both tonnage and value; dimension granite production decreased in quantity and increased in value.

Table 10.—Crushed granite sold or used by producers, by uses

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roadstone	15,682,753	$20,891,308	$1.33	15,357,472	$22,069,682	$1.43
Railroad ballast	1,017,506	1,267,729	1.25	W	W	W
Riprap	162,728	257,607	1.58	W	W	W
Other uses [1]	733,464	1,270,851	1.73	1,975,571	2,811,057	1.42
Total	17,596,451	23,687,495	1.35	17,333,043	24,880,739	1.43

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes stone sand, poultry grit, filter stone, other uses, and uses indicated by symbol W.

Table 11.—Dimension granite sold or used by producers, by counties

County	1966				1967			
	Number of quarries	Cubic feet	Short tons (equivalent)	Value	Number of quarries	Cubic feet	Short tons (equivalent)	Value
De Kalb	5	667,744	73,009	$941,440	5	739,000	59,139	$943,015
Elbert	16	543,942	43,516	1,485,497	13	450,000	36,013	1,312,890
Hancock	1	W	W	W	------	----------	-------	---------
Madison	2	W	W	W	2	W	W	W
Oglethorpe	10	W	W	W	9	W	W	W
Other counties	----	656,280	52,617	1,430,531	------	709,000	56,660	1,897,615
Total	34	1,867,966	169,142	3,857,468	29	1,898,000	151,812	4,153,520

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

Table 12.—Dimension granite sold or used by producers, by uses

Use	1966			1967		
	Cubic feet	Value		Cubic feet	Value	
		Total	Average per cubic foot		Total	Average per cubic foot
Rough monumental	1,147,162	$2,757,028	$2.40	943,467	$2,090,937	$2.21
Dressed monumental	W	W	W	197,239	1,119,568	5.67
Rubble	361,704	145,966	.40	W	W	W
Other uses [1]	359,100	954,474	2.66	757,294	943,015	1.25
Total	1,867,966	3,857,468	2.06	1,898,000	4,153,520	2.19

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes rough construction, architectural stone, curbing and flagging, and uses indicated by symbol W.

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

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roadstone	2,809,477	$4,097,420	$1.46	2,331,909	$3,517,518	$1.50
Agstone	158,632	250,434	1.58	200,826	385,441	1.91
Other uses [1]	1,144,782	1,617,204	1.41	967,262	1,450,702	1.49
Total	4,112,891	5,965,058	1.45	3,499,997	5,353,661	1.52

[1] Includes cement, riprap, fluxing stone, and other uses.

Stone was produced at 79 quarries in 35 counties by 50 companies and one government agency. Dimension granite was produced in four counties from 29 quarries by 24 companies. Crushed granite was produced in 19 counties from 24 quarries by 10 companies. Crushed limestone was produced from 12 quarries in eight counties by 10 companies and one government agency. Crushed marble and dimension marble were produced in Pickens County, and crushed marble only was produced in Chattooga and Gilmer Counties. Crushed slate was mined in Bartow and Polk Counties, quartzite in Richmond County, byproduct quartz in Jasper County, crushed sandstone in Polk County, and dimension sandstone in Pickens County.

Talc.—Georgia Talc Co., Murray County, the only producer, mined, crushed, and ground talc principally for asphalt filler, insecticides, and roofing. Production and value of both crude and ground talc increased.

Vermiculite.—W. R. Grace & Co. exfoliated vermiculite, shipped into the State, at its Atlanta plant. Production and value were lower than in 1966.

METALS

Bauxite.—American Cyanamid Co., the only bauxite producer, continued to mine and ship crude ore from its mines in Floyd and Sumter Counties to its drying plant at Adairsville (Halls Station), Bartow County, and to other consumers.

Iron Ore.—Brown iron ore shipments decreased 40 percent in tonnage and 34 percent in value. Eighty-one percent of the output was mined in the southern part of the State below the fall line, in Marion, Quitman, and Stewart Counties. Eleven operations were active in this area, six fewer than in 1966. Three companies, including one producing crude iron oxide pigments, operated in Bartow County, and one in Polk County; both counties are in the northwestern part of the State. Iron ore was shipped to steel plants in Birmingham and Gadsden, Ala. Production of both crude iron oxide pigments and finished pigments decreased in tonnage and value.

Rare-Earth Minerals.—Monazite sand concentrate was obtained as a coproduct at Humphreys Mining Co.'s plant near Folkston.

Titanium.—Humphreys Mining Co. continued to produce titanium concentrates from its new operation northeast of Folkston in Charlton County.

Zirconium.—Zircon was recovered as a byproduct in the production of titanium concentrate at the Humphreys Mining Co. plant near Folkston.

MINERAL FUELS

Peat.—Humus and reed-sedge peat were produced in Lowndes County. Output increased 37 percent over that of 1966.

Table 14.—Principal producers

Commodity and company	Name of operation	County	Address
Barite:			
Primary:			
B. R. Cain	Cain mine	Bartow	Box 304 Cartersville, Ga. 30120.
Milchem, Inc	Cartersville mine	do	3920 Essex Lane Houston, Tex. 77027
New Riverside Ochre Co	Barite mine	do	Box 387 Cartersville, Ga. 30120
Paga Mining Co	Paga mine	do	Cartersville, Ga. 30120
Crushed and ground:			
Paga Mining Co	Paga plant	do	Do.
Bauxite:			
American Cyanamid Co	Halls Station plant	do	Berdan Ave. Wayne, N.J. 07472
Do	Hight 134 mine	Floyd	Do.
Do	Easterlin mine	Sumter	Do.
Cement:			
Marquette Cement Manufacturing Co. [1]	Rockmart plant	Polk	20 N. Wacker Dr. Chicago, Ill. 60606
Penn-Dixie Cement Corp.[2]	Clinchfield plant	Houston	Box 152 Pittsburgh, Pa. 18064
Southern Cement Co [2]	Atlanta plant	Fulton	16th Floor, Bank for Savings Bldg. Birmingham, Ala. 35203
Clay:			
Fuller's earth:			
Cairo Production Co., Inc	Cairo mine	Thomas	Box 358 Cairo, Ga. 31728
Engelhard Minerals & Chemicals Corp.	Amsterdam mine	Decatur	Menlo Park, Edison, N.J. 08817
Georgia-Tennessee Mining & Chemical Co.	Wrens mine	Jefferson	Box 307 Wrens, Ga. 30833
General Reduction Corp	Pikes Peak mine	Twiggs	212 W. Monroe Chicago, Ill. 60606
Waverly Petroleum Products Co.	Meigs mine	Thomas	Meigs, Ga. 31765
Kaolin:			
American Industrial Clay of Sandersville.	Poss mine	Warren	Sandersville, Ga. 31082
Do	Deepstep mine	Washington	Do.
Engelhard Minerals & Chemicals Corp.	Washington County mine.	do	Menlo Park, Edison, N.J. 08817
Do	Klondyke mine	Wilkinson	Do.
Freeport Kaolin Co	Griffin mine	Twiggs	405 Lexington Ave. New York, N.Y. 10017
Do	Gordon mine	Wilkinson	Do.
Georgia Kaolin Co	Dry Branch mine	Twiggs	433 N. Broad St. Elizabeth, N.J. 07208
J.M. Huber Corp	Huber mine	do	630 3rd Ave. New York, N.Y. 10017
Do	Palmer mine	Warren	Do.
Miscellaneous:			
Burns Brick Co	Macon mine	Bibb	Box 4787 Macon, Ga. 31208
Chattahoochee Brick Co.	Chattahoochee mine.	Fulton	3195 Brick Plant Rd. Atlanta, Ga. 30321
Do	Martin mine	Floyd	Do.
Cherokee Brick & Tile Co	No. 1 mine	Bibb	Box 4567 Macon, Ga. 31208
Georgia-Carolina Brick & Tile Co.	Augusta mine	Richmond	Route 1, Box 10 Augusta, Ga. 30906
Merry Brothers Brick & Tile Co.	do	do	415 Masonic Bldg. Augusta, Ga. 30902
Feldspar, crude:			
The Feldspar Corp.[3]	Monticello mine	Jasper	Spruce Pine, N.C. 28777
Georgia Marble Co.[3]	Rock Chapel plant	De Kalb	Lithonai, Ga. 30058
Gypsum, calcined:			
The Flintkote Co	Savannah plant	Chatham	Oak St. and Central Ave. East Rutherford, N.J. 07070
Georgia-Pacific Corp	do	Glynn	Commonwealth Bldg. Portland, Oreg. 97207
National Gypsum Co	Chatham County plant.	Chatham	325 Delaware Ave. Buffalo, N.Y. 14202
Iron ore:			
Camellia Mining Co	Camellia mine	Quitman	Morris, Ga. 31767
Davis Bros	Lumpkin mine	Stewart	Brantley, Ala. 36009
Dunbar & Layton	do	do	Lumpkin, Ga. 31815
Phillips Holmes Mining Co	Cedartown mine	Polk	Cedartown, Ga. 30125
Pope Mining Co	Buena Vista mine	Marion	Buena Vista, Ga. 31803

See footnotes at end of table.

Table 14.—Principal producers—Continued

Commodity and company	Name of operation	County	Address
Iron oxide pigment materials:			
New Riverside Ochre Co	New Riverside mine.	Bartow	Box 387 Cartersville, Ga. 30120
Kyanite:			
Aluminum Silicates, Inc	Graves Mountain mine.	Lincoln	Box 649 Washington, Ga. 30673
Lime, regenerated:			
Brunswick Pulp & Paper Co	Brunswick limekiln	Glynn	Brunswick, Ga. 31520
Continental Can Co., Inc	Savannah limekiln	Chatham	Port Wentworth, Ga. 31407
Do	Augusta limekiln	Richmond	Old Savannah Rd. Augusta, Ga. 30901
Gilman Paper Co	St. Mary's limekiln	Camden	St. Mary's, Ga. 31558
Owens-Illinois Glass Co	Valdosta limekiln	Lowndes	Owens-Illinois Bldg. Toledo, Ohio 43601
Rayonier, Inc	Jesup limekiln	Wayne	Jesup, Ga. 31545
Mica, scrap:			
The Feldspar Corp	Monticello mine	Jasper	Spruce Pine, N.C. 28777
Glenn-Ray Corp	Waleska mine	Cherokee	Box 278 Chatsworth, Ga. 30705
Jones Mining Co., Inc	Brady mine	----do	Jasper, Ga. 30143
The Ruberoid Co. [4]	Hartwell mine	Hart	Hartwell, Ga. 30643
Mica grinders:			
Thompson-Weinman & Co.[5]	Cartersville plant	Bartow	Cartersville, Ga. 30120
Peat:			
Georgia Peat Moss Co	Lake Park mine	Lowndes	Route 2 Lake Park, Ga. 31636
Lake Park Peat Moss Co	Lake Park mine	----do	Lake Park, Ga. 31636
Perlite, expanded:			
W. R. Grace & Co	Atlanta plant	Fulton	62 Whittemore Ave. Cambridge, Mass. 01109
Rare-earth metals:			
Humphreys Mining Co	Folkston mine	Charlton	Box 8 Folkston, Ga. 31537
Sand and gravel:			
Atlanta Sand & Supply Co	Rollo Sand mine	Crawford	605 Forsyth Bldg. Atlanta, Ga. 30303
Brown Bros. Sand Co	Howard mine	Talbot	Howard, Ga. 31039
Drake Eye Mining Co	Lithonia mine	Rockdale	Box 236 Lithonia, Ga. 30058
Howard Sand Co	Howard mine	Taylor	Howard, Ga. 31039
Taylor County Sand Co	Taylor County mine.	Talbot	Junction City, Ga. 31812
Stone:			
Granite, crushed:			
Dixie Lime & Stone Co	Clayton quarry	Clayton	Box 910 Ocala, Fla. 32670
Do	Tyrone quarry	Fayette	Do.
Do	Yatesville quarry	Lamar	Do.
Do	No. 6 quarry	Monroe	Do.
Do	Griffin quarry	Spalding	Do.
Georgia Marble Co	Rock Chapel quarry.	De Kalb	Lithonia, Ga. 30058
Do	Douglasville quarry.	Douglas	Do.
Stone Mountain Grit Co., Inc.	Big Ledge quarry	De Kalb	Box 458 Lithonia, Ga. 30058
Vulcan Materials Co	Kennesaw quarry	Cobb	Box 12078, N. Side Station Atlanta, Ga. 30305
Do	Lithia Springs quarry.	Douglas	Do.
Do	Red Oak quarry	Fulton	Do.
Do	Norcross quarry	Gwinnett	Do.
Do	Stockbridge quarry	Henry	Do.
Do	Barin quarry	Muscogee	Do.
Weston & Brooker Co	Ruby quarry	Jones	Box 335 Gray, Ga. 31032
Do	Camak quarry	Warren	Box 180 Thomas, Ga. 30824
Granite, dimension:			
Coffey Granite Co	Crossley mine	De Kalb	Lithonia, Ga. 30058
Coggins Granite Industries, Inc.	No. 2 Blue Diamond quarry.	Elbert	Box 250 Elberton, Ga. 30635
Do	Piedmont quarry	Madison	Do.
Comolli Granite Co	Royal Blue quarry	Elbert	Box 898 Elberton, Ga. 30635
Davidson Granite Co., Inc.	Pine Mountain quarry.	De Kalb	Lithonia, Ga. 30058
Stone Mountain Granite Corp.	Stone Mountain quarry.	----do	Stone Mountain, Ga. 30083

See footnotes at end of table.

Table 14.—Principal producers—Continued

Commodity and company	Name of operation	County	Address
Stone—Continued			
Limestone, crushed:			
Dalton Rock Products Co.	Dalton Rock quarry.	Whitfield	Box 1608 Dalton, Ga. 30720
Georgia Rock Products Co.	Spring Creek quarry.	Early	Arlington, Ga. 31713
Lambert & Lambert Stone Co. Inc.	Rossville quarry	Walker	3814 Tennessee Ave. Chattanooga, Tenn. 37409
Penn-Dixie Cement Corp.	Clinchfield quarry	Houston	Box 152 Nazareth, Pa. 18064
Ready-Mix Concrete Co.	Ledbetter-Johnson quarry.	Floyd	401 E. 1st Ave. Rome, Ga. 30161
Marble, crushed:			
Georgia Marble Co.	Goble mine	Gilmer	Tate, Ga. 30177
Do.	Whitestone mine	do.	Do.
Do.	Cove Mountain mine.	Pickens	Do.
Do.	New York mine	do.	Do.
Marble Products Co. of Georgia.	Summerville mine	Chattooga	67 Peachtree Park Dr. Atlanta, Ga. 30309
Do.	Whitestone mine	Pickens	Do.
Marble, dimension:			
Georgia Marble Co.	Tate quarry	do.	Tate, Ga. 30177
Sandstone, crushed:			
The Feldspar Corp.	Monticello mine	Jasper	Spruce Pine, N.C. 28777
Marquette Cement Manufacturing Co.	Braswell Silica quarry.	Polk	20 N. Wacker Dr. Chicago, Ill. 60606
Superior Stone Co.	Dan quarry	Richmond	Box 2568 Raleigh, N.C. 27602
Sandstone, dimension:			
Johnson, Carl S.	Johnson quarry	Pickens	Route 1 Talking Rock, Ga. 30175
Johnson, Hardy L.	Flagstone quarry	do.	Route 2 Jasper, Ga. 30143
Slate, crushed:			
Georgia Lightweight Aggregate Co.	Galite quarry	Polk	Box 19781, Station N. Atlanta, Ga. 30325
The Ruberoid Co.	Fairmount mine	Bartow	Fairmount, Ga. 30139
Titanium concentrates:			
Humphreys Mining Co.	Folkston mine	Charlton	Box 8 Folkston, Ga. 31537
Vermiculite, exfoliated:			
W. R. Grace & Co.	Atlanta plant	Fulton	Cambridge, Mass. 02138
Zirconium:			
Humphreys Mining Co.	Folkston mine	Charlton	Box 8 Folkston, Ga. 31537

[1] Also portland and masonry cement.
[2] Also portland cement.
[3] Also feldspar grinders.
[4] Also mica grinders.
[5] Also grinders of barite, marble, and other fillers.

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 total value of Hawaii's mineral output in 1967 amounted to $16.9 million, a decrease of 20 percent from that of 1966 and the lowest since 1963. The substantial setback resulted from sharp reductions in the volume of minerals produced for the building trades, which were adversely affected by a tight money situation, strikes, and inclement weather.

Mill shipments of portland cement declined 20 percent to 1.4 million barrels. Production of pumice and volcanic cinder, sand and gravel, and stone for concrete aggregate and fill declined 22 percent, 8 percent, and 19 percent, respectively. Lime sales dropped, owing to the State's lower yield of cane sugar. The recovery of salt from seawater was curtailed by a change in plant location. Gains in output were recorded only in the collection of black coral gem material for the tourist trade and in clay mining by a clay products company in its second year of operation.

[1] Mineral specialist, Bureau of Mines, San Francisco, Calif.

Table 1.—Mineral production in Hawaii [1]

Mineral		1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Cement	thousand 376-pound barrels	1,749	$9,046	1,395	$7,360
Lime	thousand short tons	10	320	8	265
Pumice, pumicite, and volcanic cinder	do	374	716	290	562
Sand and gravel	do	511	1,591	469	1,467
Stone	do	5,079	9,482	4,100	7,207
Value of items that cannot be disclosed: Clays, gem stones, and salt		XX	98	XX	75
Total		XX	21,253	XX	16,936
Total in 1957–59 constant dollars		XX	r 20,592	XX	p 16,519

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

County	1966	1967	Minerals produced in 1967, in order of value
Hawaii	$1,886,000	$2,097,000	Stone, pumice and volcanic cinder, sand and gravel.
Honolulu	17,342,000	12,693,000	Cement, stone, sand and gravel, lime, salt, clays.
Kauai	582,000	712,000	Stone, sand and gravel, volcanic cinder.
Maui	1,443,000	1,434,000	Sand and gravel, stone, volcanic cinder, lime, gem stones.
Total	$21,253,000	16,936,000	

Table 3.—Economic indicators

		1966	1967 p
Personal income:			
Total	millions	$2,230.0	$2,411.0
Per capita		$3,124.0	$3,326.0
Defense expenditures	millions	$517.1	$600.0
Mineral production	do	$21.3	$16.9
Visitors:			
Arrivals	thousands	710.6	1,000.0
Expenditures	millions	$302.0	$420.0
Manufacturing	do	$211.3	$225.7
Sugar	do	$191.0	$192.0
Pineapple	do	$113.9	$124.5
Construction:			
Put-in-place	do	$394.3	$354.8
Building permits on Oahu	do	$255.2	$210.4
Employment	thousands	274.2	283.2

p Preliminary.
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 National Bank of Hawaii.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Nonmetal	95	102	10	76	----	1	13.22	489
Sand and gravel	52	128	7	53	----	1	18.82	527
Stone	573	264	151	1,211	----	57	47.08	5,985
Total [1]	720	233	168	1,340	----	59	44.05	5,458
1967: p								
Nonmetal	110	81	9	70	----	----	------	------
Sand and gravel	20	155	3	26	----	1	38.44	884
Stone	525	240	126	1,035	----	33	31.88	673
Total [1]	660	210	139	1,131	----	34	30.06	637

p Preliminary.
[1] Data may not add to total due to rounding.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Two plants on Oahu Island produced 1,444,000 barrels of portland cement. They shipped 1,395,000 barrels —1,151,000 barrels in bulk and 244,000 barrels in paper bags. Seventy-three percent went to ready-mixed-concrete companies, 9 percent to concrete product manufacturers, 8 percent to building material dealers, 6 percent to contractors, and 4 percent to government agencies and miscellaneous customers.

Cement shipments were 354,000 barrels less than in 1966; exports decreased 147,000 barrels and shipments for use in Hawaii dropped 207,000 barrels. Total consumption of cement in Hawaii, including white and other special types received from the U.S. mainland and 2,825 barrels from Japan, amounted to 1,344,000 barrels, 13 percent less than in 1966.

Raw materials used in cement production were 326,000 tons of coral limestone and 65,000 tons of basalt and trachyte from quarries on Oahu. Silica sand, gypsum, and grinding aids were imported. The two plants used 39.7 million kilowatt-hours of electrical energy.

Clays.—Clays were mined on Oahu at a pit near Waimanalo and hauled to a plant at Barbers Point for use in the manufacture of brick, tile, hollow block,

and flower pots. After acquiring the plant in 1966, the operating company improved the equipment and production methods and reported an increase in output and sales.

Gem Stones.—A large quantity of black coral gem material was collected by scuba divers working off sampans anchored to ledges in deep channel waters off Lahaina, Maui Island. The divers made descents of nearly 200 feet, collected and tied the coral trees to the anchor chain, and raised the anchor and the day's find by filling plastic bags with air from the scuba tanks. Several hundred pounds of gem-quality pink coral, was gathered off Oahu by fishermen who dragged nets along the ocean floor. Lapidaries and jewelers near tourist destination areas cut, polished, and mounted the black and pink coral in rings, brooches, and earrings.

Lime.—Total production of quicklime and hydrated lime declined from 9,700 tons in 1966 to 8,250 tons in 1967, owing to decreased demands by sugar mills and by the building trade. Sugar mills consumed 75 percent of the total output in clarifying cane juice. Other outlets for lime were for water purification, sewage treatment, and steel flux. Lime was produced at two plants; both operated a rotary kiln and a continuous hydrator. Purchased limestone was used at the Waianae plant on Oahu, and coral beach sand was used as raw material at the Lower Paia lime plant on Maui.

Pumice and Volcanic Cinders.—Production of pumice and volcanic cinders totaled 290,000 tons. About 60 percent was used for construction and maintenance of tertiary roads, primarily on the island of Hawaii. The remainder was prepared for use as lightweight concrete aggregate, as roofing granules, and in decorative landscaping. Output of volcanic cinders on Hawaii Island came from deposits near Pepeekeo, Keaau, Pahoa, Pahala, Naalehu, and Kamuela. Cinders were produced near Koloa, Eleele, and Kaumakani on Kauai; at Olowalu, Lahaina, and Honokohau on Maui; and near Kaunakakai on Molokai. Lightweight concrete aggregate, for use on Oahu, was supplied from a pumice quarry at Puuwaawaa on Hawaii Island and from a volcanic cinder deposit at Waieli on the island of Molokai.

Salt.—Crude salt was produced at a small commercial facility near the Barbers Point barge harbor on Oahu. Sea water was pumped to a distillation unit and the brine was solar-evaporated in ponds and also artificially evaporated in wood-fired kettles and pans. On Kauai, an association of native families produced salt for its own use on the saline mud flat near the old Port Allen airport. Brackish water from shallow wells was scooped into mud-lined ponds to produce salt by solar evaporation. The coarse crystals of salt produced in Hawaii were used in drying fish and seasoning meats.

Sand and Gravel.—Sand comprised the major portion of the 469,000 tons of sand and gravel produced in 1967. Principal production of sand occurred on Molokai at Papohaku Beach. The sand was trucked to Lono Harbor and barged to Oahu for use in concrete and concrete products. Appreciable tonnages of sand from beach, dune, and streambed deposits was produced at Maili on Oahu; Kealia, Kapaa, and Bonham on Kauai; near Kaanapali, Kahului, and Wailuku on Maui; at Moomomi on Molokai; and at Polihua on Lanai. Coral sand from the beach near Lower Paia on Maui was calcined to produce lime. Alluvial gravels were mined from the foothills near Waikapu on Maui for local use as base material and concrete aggregate.

Stone. — Stone producers quarried 2,624,000 tons of basalt, 921,000 tons of coral limestone, and 555,000 tons of miscellaneous stone. The total output of 4.1 million tons was nearly 1 million tons less than that of 1966. Nearly 75 percent of the volume was produced on Oahu, 18 percent on Hawaii, and 7 percent on Kauai, Lanai, Maui, and Molokai. The quantity processed for use as concrete aggregate and base material amounted to 3.6 million tons, compared with 4.5 million tons in 1966.

Basalt rock was quarried at Kaena, Kapaa, Halawa, and Palailai on Oahu; at Hilo and near Kona on Hawaii; near Puhi on Kauai; at Camp 10 on Maui; and at Manawainui on Molokai. Coral limestone was produced primarily at Barbers Point, Lualualei, Waimanalo, and in the

Laie area on Oahu for base and concrete aggregate and as a raw material for making cement and lime; from near Koloa on Kauai for aggregate; and from the dredged stockpile at Kawaihae Harbor on Hawaii for aggregate and agricultural liming. Output of miscellaneous stone consisted mainly of aa rock and decorative lava slabs produced on the island of Hawaii; moss rock near Waianae and riprap at Hawaii-Kai on Oahu; and unconsolidated volcanic rocks quarried on Kauai, Maui, and Lanai for road maintenance.

Vermiculite.—Vermiculite from mines in Montana was expanded in a vertical furnace on Oahu for lightweight plaster and concrete aggregate, insulation, and agricultural uses.

MINERAL FUELS

Crude oil from foreign oilfields was utilized by Standard Oil Co. of California at its Barbers Point refinery on Oahu, to produce asphalt, fuel oil, gasoline, jet fuel, liquefied gas, and other petroleum products. The specially designed refinery complex included an Isomax unit to obtain a greater yield of light distillates for the mid-Pacific market, which has little or no use for fuel oils such as those used for railroad and heating purposes.

Hawaii's demand for most refinery products was appreciably greater than in 1966. The largest gain was for jet fuel used in commercial aircraft. Sales of automotive gasolines, residual fuel oil for electric power generation, and liquefied gas for cooking and refrigeration also increased. Demand for asphalt in 1967 dropped to less than that in 1964, indicating a substantial reduction in paving and roofing projects.

Table 5.—Principal producers

Commodity and company	Address	Type of activity	Island	Remarks
Cement:				
Hawaiian Cement Corp.	Suite 686, Alexander Young Bldg. Honolulu, Hawaii 96813	Dry process portland cement plant.	Oahu	
Kaiser Cement & Gypsum Corp.	Permanente Road Permanente, Calif. 95014	Wet process portland cement plant.	do	
Clays: Pacific Clay Corp.	547 Halekauwila St. Honolulu, Hawaii	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	
James W. Glover, Ltd.	P.O. Box 275 Hilo, Hawaii 96784	do	Hawaii	
Grove Farm Co., Ltd.	Puhi Rural Station Lihue, Hawaii 96766	do	Kauai	
HC&D, Ltd.	P.O. Box 190 Honolulu, Hawaii 96810	do	Molokai	
James Kuwana	Box 306 Pahoa, Hawaii 96778	do	Hawaii	
Kuwaye Bros. Inc.	P.O. Box 707 Hilo, Hawaii 96720	do	do	
McBryde Sugar Co., Ltd.	Eleele, Hawaii 96705	do	Kauai	
Volcanite, Ltd.	224 Central Pacific Bank Bldg. Honolulu, Hawaii 96817	do	Hawaii	Pumice.
Walker-Moody Const. Co., Ltd.	2927 Mokumoa St. Honolulu, Hawaii 96819	do	Molokai	
Salt: Tamotsu Tanaka	968 D Akepo Lane Honolulu, Hawaii 96817	Solar evaporation.	Oahu	
Sand and gravel:				
Concrete Industries, Inc.	P.O. Box 86 Puunene, Hawaii 96784	Open pit mine	Maui	Construction sand.
Hale Kauai, Ltd.	Nawiliwili, Hawaii 96766	do	Kauai	Do.
HC&D, Ltd.	P.O. Box 190 Honolulu, Hawaii 96810	do	Molokai	Construction and industrial sand.
Lihue Plantation Co., Ltd.	P.O. Box 751 Lihue, Hawaii 96766	do	Kauai	Construction sand.
Maui Concrete & Aggregates, Inc.	8 Central Ave. Wailuku, Hawaii 96793	do	Maui	Construction sand and gravel.
Pacific Concrete & Rock Co., Ltd.	2344 Pahounui Dr. Honolulu, Hawaii 96819	do	Oahu	Construction sand.

Table 5.—Principal producers—Continued

Commodity and company	Address	Type of activity	Island	Remarks
Stone:				
Allied Aggregates Corp	2827 Kaihikapu St. Honolulu, Hawaii 96819	Open quarry	do	Limestone.
Concrete Industries, Inc	P.O. Box 86 Puunene, Hawaii 96784	do	Maui	Basalt.
James W. Glover, Ltd	P.O. Box 275 Hilo, Hawaii 96720	do	Hawaii	Basalt and aa rock.
Grove Farm Co., Inc	Puhi Rural Station Lihue, Hawaii 96766	do	Kauai	Basalt and limestone.
Hawaiian Bitumuls & Paving Co., Ltd	P.O. Box 2240 Honolulu, Hawaii 96804	do	Oahu	Basalt.
Hawaiian Cement Corp	Suite 686, Alexander Young Bldg. Honolulu, Hawaii 96813	do	do	Limestone.
HC&D, Ltd	P.O. Box 190 Honolulu, Hawaii 96810	do	Oahu	Basalt.
Kaiser Cement & Gypsum Corp	Permanente Road Permanente, Calif. 95014	do	do	Limestone.
Joe's Moss Rock Co	1446 Meyers St. Honolulu, Hawaii 96819	do	do	Moss rock.
James Kuwana	Box 306 Pahoa, Hawaii 96778	do	do	Lava slabs.
Kuwaye Brothers, Inc	P.O. Box 707 Hilo, Hawaii 96720	do	Hawaii	Aa rock and limestone.
Laie Concrete & Aggregate, Inc	Laie, Hawaii 96762	do	Oahu	Limestone.
Pacific Cement & Aggregates Co	400 Alabama St. San Francisco, Calif. 94110	do	do	Basalt.
Pacific Concrete & Rock Co., Ltd	2344 Pahounui Dr. Honolulu, Hawaii 96819	do	do	Basalt and limestone.
J. M. Tanaka Construction, Inc	P.O. Box 67 Kailua-Kona, Hawaii 96740	do	Hawaii	Basalt.
Walker-Moody Constr. Co., Ltd	2927 Mokumoa St. Honolulu, Hawaii 96819	do	Molokai	Do.
Yamada Sons, Inc	P.O. Box 577 Hilo, Hawaii 96720	do	Hawaii	Aa rock and limestone.
Vermiculite: 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] Ronald P. Collins,[2] and Norman S. Petersen [1]

Idaho mineral production dipped $5.5 million (4.8 percent) in value in 1967 to $109.4 million. Silver again was the leading mineral product in terms of value in the State. Phosphate rock, lead, zinc, and silver together accounted for nearly three-fourths of the total mineral output value. The value of lead and zinc production was down owing to a combination of factors—strike-bound smelters and lower average annual prices. Gold and copper output, recovered principally from ores mined in the Coeur d'Alene area, also declined. Production of construction materials was mixed; cement and stone declined, but sand and gravel was up 49 percent.

After the U.S. Treasury Department removed the ceiling price from silver in July, efforts by the producers for additional production were thwarted by labor disputes.

Mercury production was down in spite of a $47 price increase to $489 per flask measured as an average annual figure. Output was primarily from the Idaho-Almaden mine.

[1] Mineral specialist, Bureau of Mines, Albany, Oreg.
[2] Economist, Bureau of Mines, Albany, Oreg.

Table 1.—Mineral production in Idaho [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate, short tons, antimony content	834	W	823	W
Clays [2], thousand short tons	23	$22	19	$16
Cobalt (content of concentrate), thousand pounds	1	6	------	--------
Copper (recoverable content of ores, etc.), short tons	4,961	3,589	4,210	3,219
Gem stones	NA	180	NA	180
Gold (recoverable content of ores, etc.), troy ounces	5,056	177	4,838	169
Iron ore (usable), thousand long tons	11	97	W	W
Lead (recoverable content of ores, etc.), short tons	72,334	21,867	61,387	17,188
Mercury, 76-pound flasks	1,134	501	898	439
Peat, short tons	W	W	2,040	16
Pumice, thousand short tons	55	107	W	W
Sand and gravel, do	7,544	6,672	11,246	11,490
Silver (recoverable content of ores, etc.), thousand troy ounces	19,777	25,571	17,033	26,402
Stone, thousand short tons	2,694	5,415	1,986	4,833
Tungsten ore and concentrate (60 percent WO_3 basis), short tons	2	1	68	175
Zinc (recoverable content of ores, etc.), do	60,997	17,689	56,528	15,650
Value of items that cannot be disclosed: Cement, garnet (abrasive), lime, peat, perlite, phosphate rock (marketable production), titanium (1966), vanadium, and values indicated by symbol W	XX	r 32,991	XX	29,631
Total	XX	r 114,885	XX	109,408
Total 1957–59 constant dollars	XX	r 100,185	XX	p 92,387

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, kaolin, and bentonite (1966); included with "Value of items that cannot be disclosed."

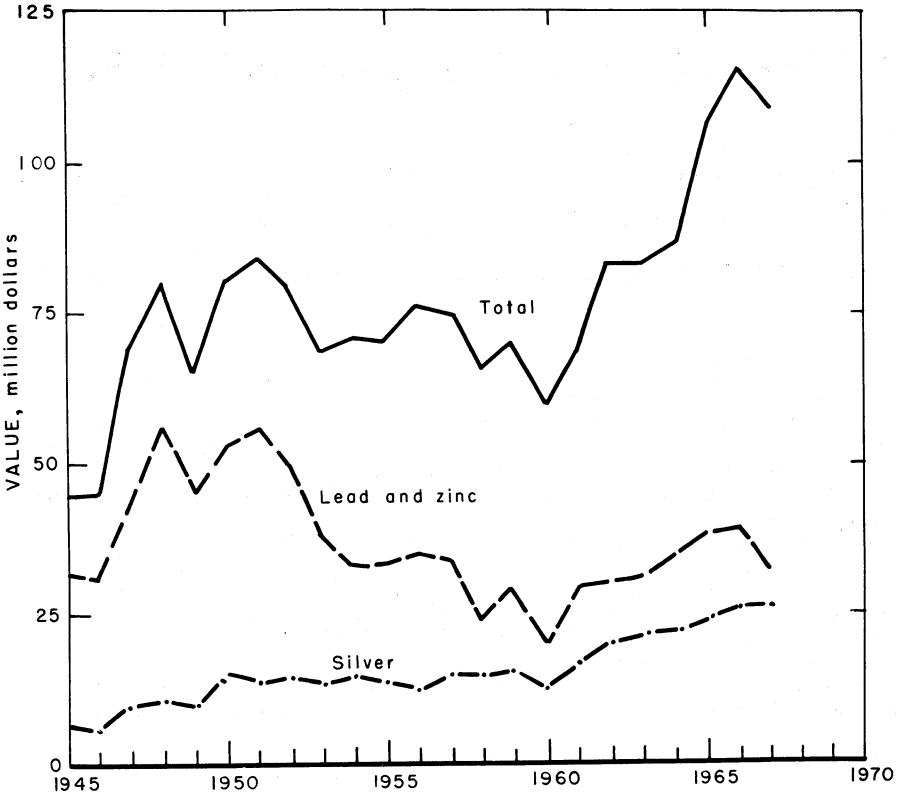

Figure 1.—Value of silver, lead, and zinc, and total value of mineral production in Idaho.

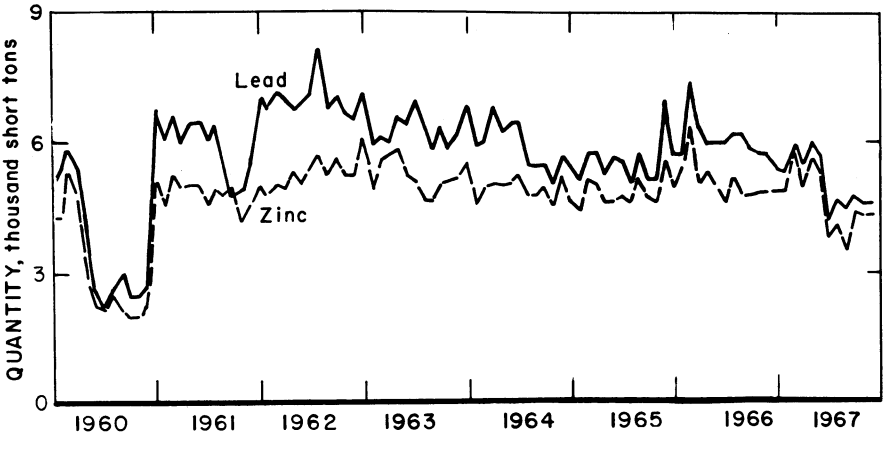

Figure 2.—Mine production of lead and zinc in Idaho, by months, in terms of recoverable metals.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Ada	$538	$398	Sand and gravel, stone, clays.
Adams	24	-------	
Bannock	2,734	W	Cement, sand and gravel, stone, peat, copper, lead, silver.
Bear Lake	153	229	Sand and gravel, stone.
Benewah	W	W	Garnet, sand and gravel.
Bingham	W	W	Phosphate rock, vanadium, sand and gravel, stone.
Blaine	2,086	1,574	Lead, silver, zinc, gold, copper.
Boise	130	54	Sand and gravel, gold, silver.
Bonner	39	82	Sand and gravel, silver, lead, zinc, copper.
Bonneville	727	725	Sand and gravel, lime, stone, pumice, clays.
Boundary	66	28	Sand and gravel, lead, silver, zinc.
Butte	W	W	Lead, sand and gravel, silver, zinc, copper, gold.
Camas	W	19	Sand and gravel.
Canyon	638	1,221	Sand and gravel, lime, pumice.
Caribou	W	W	Phosphate rock, vanadium, stone, sand and gravel.
Cassia	122	979	Sand and gravel, clays.
Clark	897	16	Sand and gravel.
Clearwater	1,347	1,605	Stone, sand and gravel.
Custer	830	1,051	Silver, lead, sand and gravel, tungsten, zinc, copper, gold.
Elmore	209	201	Sand and gravel, stone, clays, gold, silver.
Franklin	76	263	Sand and gravel, stone.
Fremont	7	-------	
Gem	249	239	Sand and gravel.
Gooding	27	-------	
Idaho	815	237	Sand and gravel, stone, gold, silver.
Jefferson	126	794	Stone, sand and gravel, clays.
Jerome	15	2,035	Sand and gravel, gold, silver.
Kootenai	394	165	Sand and gravel, stone.
Latah	W	1,540	Clays, stone, sand and gravel.
Lemhi	W	1,211	Copper, gold, sand and gravel, silver.
Lewis	28	-------	
Lincoln	35	168	Sand and gravel.
Madison	47	-------	
Minidoka	253	263	Lime, sand and gravel, clays.
Nez Perce	328	527	Sand and gravel, stone.
Oneida	W	70	Pumice, sand and gravel, perlite.
Owyhee	238	-------	
Payette	155	147	Sand and gravel.
Power	24	92	Do.
Shoshone	65,759	59,603	Silver, lead, zinc, copper, antimony, gold, sand and gravel, stone.
Teton	80	132	Sand and gravel.
Twin Falls	W	W	Sand and gravel, lime.
Valley	68	99	Stone, tungsten, iron ore, mercury.
Washington	1,062	945	Stone, mercury, iron ore, sand and gravel, copper, silver.
Undistributed [1]	r34,559	32,696	
Total	r 114,885	109,408	

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

[1] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

Production of crude and marketable phosphate rock and manufacturing of phosphate fertilizer products declined somewhat during the year but continued to represent a substantial segment of the State's mineral industry. Activity was centered in Caribou and Bingham Counties where six major firms were engaged in one or more of the following operations: Mining of phosphate rock, manufacturing phosphate fertilizer products, or reducing phosphate rock to elemental phosphorus.

The story of early mining discoveries and the history of mining development in the Coeur d'Alene mining region in northern Idaho was published.[3]

Also, a nationwide guide to mines or mining operations that may be observed or visited was published.[4] The pamphlet is intended to aid tourists and students interested in mining.

Consumption, Trade, and Markets.—Most key indicators of Idaho business activity rose during 1967. Measurements of percentage growth in total and per capita income (7.0 and 6.7 percent, respectively) were almost three times the

[3] Harrison, Lester S., and Russell A. Bankson. Beneath These Mountains. Vantage Press, Inc., New York, 1967.

[4] Bureau of Mines. Mining and Mineral Operations in the United States, A Visitor's Guide, 1967, 89 pp.

figures for 1966. Heavy engineering awards decreased from the 1966 levels, which had included a large single contract for the Dworshak Dam. Building permits registered gains that should reflect the easing of the money market, a constraint on business activity that has persisted for the last 2 years.

Employment.—Mining industry employment and wages were surprisingly firm when considered against the background of a nationwide strike of copper workers. Since 1963, the annual average weekly earnings and hourly pay for production workers in the mining industry had both risen about 25 percent.

Probably as a consequence of curtailed activity brought on by the strike and declines in employment for the construction and wood products industries, unemployment was up 11 percent from the 1966 figure.

Table 3.—Indicators of Idaho business activity

		1966	1967 p	Change, percent
Personal income:				
Total	millions	$1,704.0	$1,823.0	+7.0
Per capita		$2,445.0	$2,608.0	+6.7
Construction activity:				
Building permits	millions	$37.1	$42.2	+13.7
Heavy engineering awards	do	$167.9	$59.4	−64.6
State highway commission:				
Value of contracts awarded	do	$18.6	$34.2	+83.9
Value of contract work performed	do	$35.5	$27.5	−22.5
Cement shipments to and within Idaho	thousand 376-pound barrels	1,354.0	1,130.3	−16.5
Cash receipts from farm marketings	millions	$541.9	$537.2	−0.9
Mineral production	do	$114.9	$109.4	−4.8
Factory payrolls	do	$198.5	$209.7	+5.6
Annual average labor force and employment:				
Total labor force	thousands	278.4	282.2	+1.4
Unemployment	do	11.1	12.3	+10.8
Employment:				
Construction	do	10.2	9.9	−2.9
Lumber/wood products	do	12.0	11.7	−2.5
Food products	do	13.4	13.2	−1.5
All manufacturing	do	35.6	35.3	−.8
All industries	do	267.0	269.7	+1.0

p Preliminary.

Sources: Survey of Current Business, Construction Review, Pacific Builder and Engineer, Idaho State Highway Commission, The Farm Income Situation, Idaho Labor Market, Labor Force and Employment in Idaho, Distribution by Industry of Wages Paid for Covered Employment in Idaho, and Bureau of Mines.

Table 4.—Annual employment and wages paid in the mineral industries

Year	Mining							
	Metals		Nonmetal		Fuels		Total	
	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)	Annual average employment	Annual payroll (thousands)
1963	2,926	$17,650	285	$1,519	13	$84	3,224	$19,253
1964	2,951	18,310	327	1,901	14	82	3,292	20,293
1965	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 p	2,718	20,089	637	4,432	3	9	3,358	24,530

Year	Manufacturing							
	Stone and clay products		Primary metals		Phosphate fertilizers, elemental phosphorus, and sulfuric acid		Total	
1963	823	$4,369	971	$5,694	1,217	$8,342	3,011	$18,405
1964	757	4,138	1,032	6,425	1,106	8,086	2,895	18,649
1965	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 p	930	5,959	1,302	9,850	1,490	12,613	3,722	28,422

p Preliminary.

Source: Idaho Employment Security Agency; employment covered by unemployment insurance. Industry groups may not correspond with those in the Bureau of Mines canvass.

Table 5.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1966:								
Metal	2,523	259	655	5,236	10	317	62.45	13,733
Nonmetal and peat	574	237	136	1,161	1	38	33.59	5,893
Sand and gravel	411	169	70	545	—	11	20.18	349
Stone	286	146	42	356	—	7	19.69	1,392
Total	3,794	238	902	7,298	11	373	52.62	10,885
1967: p								
Metal	2,520	237	598	4,782	7	242	52.07	11,638
Nonmetal and peat	710	232	165	1,365	—	22	16.12	352
Sand and gravel	190	174	33	264	—	5	18.94	788
Stone	325	120	39	327	—	7	21.42	1,441
Total [1]	3,745	223	835	6,737	7	276	42.00	8,432

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

Table 6.—Hours and earnings of production workers in mining

Annual average	1963	1964	1965	1966	p 1967
Weekly earnings	$110.21	$114.91	$116.22	$122.99	$136.52
Hourly earnings	$2.79	$2.88	$3.00	$3.18	$3.48
Weekly hours	39.5	39.9	38.8	38.7	39.2

p Preliminary.
Source: Idaho Employment Security Agency.

Table 7.—Office of Minerals Exploration contracts active during 1967

County and contractor	Commodity	Contract		
		Date	Total amount	Government participation, percent
Custer:				
Beardsley Gulch Mining Co	Silver	July 14, 1966	$44,680	75
Owyhee:				
Continental Quicksilver, Inc [1]	Gold and silver	Feb. 28, 1966	61,360	62.5
Sidney Mining Co.[1]	do	Feb. 28, 1966	40,208	62.5

[1] In recess for all of 1967.

REVIEW BY MINERAL COMMODITIES

METALS

Antimony.—Byproduct antimony from silver ore produced at the Sunshine mine, near Kellogg, Shoshone County, continued to be the State's only source of antimony.

Copper.—Production of copper declined 15 percent from the 1966 total. Output, largely a byproduct of silver production from Coeur d'Alene region mines, was adversely affected by the nationwide copper strike which started in mid-July and resulted in closure of all copper smelters in the Pacific Northwest.

Copper ore was mined at the Blackbird mine (Machinery Center, Inc.), Lemhi County, but Shoshone County silver and lead-zinc mines supplied nearly 64 percent of the State total. Idaho Mining Co. took over operation of the Blackbird mine during the summer and began a 2-year development and exploration program aimed at expanding mine operations and establishing a treatment plant. Total production at the Blackbird mine was 60,808 tons of ore containing 2,916,200 pounds of copper, 1,880 ounces of gold, and 3,387 ounces of silver.

Gold.—Conditions similar to the previous year—increased mining costs and a static market price—again resulted in a record low gold output. The situation was further aggravated by the nationwide copper strike which cut into the byproduct production from Coeur d'Alene region lead, zinc, and silver ores. Total gold production in the State, from both lode and placer operations, was 4,838 ounces, down 4.3 percent from the 1966 record low. Total placer production from two small-scale hand operations was only 26 ounces.

Iron Ore.—Iron ore production declined from the 1966 output. The largest source continued to be magnetite from the Rock Island Gypsum Co.'s Iron Mountain mine, which was used in making cement. Porter Bros. Co., which became a division of Michigan Chemical Corp. during 1967, also shipped magnetite from a stockpile at Lowman.

Lead.—A 15-percent decline in lead output from that of 1966 resulted from strikes at mines and smelters hit by the nationwide copper strike. Coeur d'Alene region mines, including the Bunker Hill, Lucky Friday, Star-Morning Unit area, and Page mines, accounted for most of the State total.

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)
1963	57	16	1,535	5,477	$192	16,711	$21,375
1964	55	7	1,649	5,677	199	16,483	21,313
1965	70	5	1,783	5,078	178	18,457	23,865
1966	52	6	1,995	5,056	177	19,777	25,571
1967	52	2	1,773	4,838	169	17,033	26,402
1863–1967 [3]	----------	----------	151,640	8,332,884	194,790	841,024	691,139

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	4,172	$2,570	75,759	$16,364	63,267	$14,551	$55,052
1964	4,666	3,042	71,312	18,684	59,298	16,129	59,367
1965	5,140	3,639	66,606	20,781	58,034	16,946	65,409
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
1863–1967 [3]	202,224	91,919	7,443,498	1,073,009	2,635,787	562,613	2,613,470

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings re-treated, and ore, old slag, and mill cleanings shipped to smelters during the calendar year indicated. 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)
1963	5	8	90	11	4	54	16	12	144
1964	3	9	80	4	2	24	7	11	104
1965	----	----	----	5	3	31	5	3	31
1966	1	[3]	6	5	2	61	6	3	67
1967	----	----	----	2	1	26	2	1	26

[1] Combined to avoid disclosing individual company confidential data.
[2] Date 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 1967, 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)
Bannock	2	----	------	------	2	(1)
Blaine	5	----	229	$8	312,705	$485
Boise	4	----	162	6	55	(1)
Custer	3	----	56	2	226,880	352
Elmore	2	----	18	1	14	(1)
Jerome	----	1	22	1	1	(1)
Lemhi	2	----	1,880	66	3,390	5
Shoshone	26	----	2,444	86	16,483,477	25,549
Undistributed [2]	8	1	27	1	6,806	11
Total [3]	52	2	4,838	169	17,033,330	26,402

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Bannock	(1)	(1)	(1)	(1)	------	------	(3)
Blaine	5	$4	2,625	$735	1,239	$343	$1,574
Boise	------	------	------	------	------	------	6
Custer	28	22	815	228	469	130	753
Elmore	------	------	--------	--------	--------	--------	1
Jerome	------	------	--------	--------	--------	--------	1
Lemhi	1,458	1,115	------	------	------	------	1,186
Shoshone	2,714	2,075	57,587	16,124	54,807	15,174	59,008
Undistributed [2]	4	3	360	101	14	4	119
Total [3]	4,210	3,219	61,387	17,188	56,528	15,650	62,628

[1] Less than ½ unit.
[2] Includes values and quantities that cannot be shown separately for Bonner, Boundary, Butte, Idaho, and Washington Counties.
[3] Data may not add to totals shown because of independent rounding.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1967, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	7	204	190	74	----------	----------	----------
Dry gold-silver	1	(2)	6	50	----------	----------	----------
Dry silver	6	434,898	576	11,919,437	4,308,800	3,027,300	1,116,300
Total	14	435,102	772	11,919,561	4,308,800	3,027,300	1,116,300
Copper	4	60,887	1,880	3,532	2,924,200	----------	----------
Lead	15	239,424	1,415	2,853,147	393,000	39,503,700	6,611,800
Lead-zinc	12	676,355	711	1,965,752	622,500	67,750,900	85,911,000
Zinc	7	26,178	20	28,574	6,400	1,472,600	4,483,600
Total	38	1,002,844	4,026	4,851,005	3,946,100	108,727,200	97,006,400
Other lode material: Gold mill cleanings, silver old tailings, lead-zinc mill cleanings, and lead-zinc old tailings [3]	7	270,127	14	222,396	800	7,841,800	2,446,800
Zinc slag	1	65,359	------	40,367	164,300	3,177,700	12,486,500
Total	8	335,486	14	262,763	165,100	11,019,500	14,933,300
Total lode	52	1,773,432	4,812	17,033,329	8,420,000	122,774,000	113,056,000
Placer	2	(4)	26	1	----------	----------	----------
Total all sources	54	1,773,432	4,838	17,033,330	8,420,000	122,774,000	113,056,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Less than ½ unit.
[3] Combined to avoid disclosing individual company confidential data.
[4] 515 cubic yards.

Table 12.—Mine production of gold, silver, copper, lead, and zinc in 1967, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Amalgamation	163	51	---	---	---
Concentration and smelting of concentrates	4,613	16,986,157	8,246,600	119,479,800	100,521,600
Total	4,776	16,986,208	8,246,600	119,479,800	100,521,600
Direct smelting:					
Ore	22	3,541	8,300	47,400	7,600
Mill cleanings	14	3,074	800	64,500	34,100
Old tailings	---	139	---	4,600	6,200
Old slag	---	40,367	164,300	3,177,700	12,486,500
Total	36	47,121	173,400	3,294,200	12,534,400
Placer	26	1	---	---	---
Grand total	4,838	17,033,330	8,420,000	122,774,000	113,056,000

Demand remained excellent throughout the year, and mine operators continued extensive exploration and development programs in the Coeur d'Alene region. Hecla Mining Co. began a program to extend the Star No. 4 shaft at the Star-Morning Unit mine at Burke to the 9000 level, with the installation of a new hoist at the 2000 level. In the Bunker Hill mine, a two-compartment timbered raise was completed between the 21 and 19 levels in the "J" vein area which will permit mining lead-silver ore of the west "J" vein.

A study of the lead-zinc industry of the Pacific Northwest was published as a Bureau of Mines Information Circular.[5]

Fifteen lead and 12 lead-zinc mines in the State reported production of 53,627 tons of lead. Significant developments included the following:

Mineral Hill District (Blaine County).—Federal Resources Corp. continued to be the major Blaine County producer at its Silver Star-Queens mine at Bellevue. Ore production of 29,270 tons, off 16 percent from that of 1966, yielded 2,037 tons of lead, 252,908 ounces of silver, and 775 tons of zinc. Development ore was taken from a winze sunk 182 feet on an ore shoot below the 700 level.

Hunter District (Shoshone County).—The Star-Morning Unit area mines, owned 70 percent by The Bunker Hill Co. and 30 percent by Hecla Mining Co., produced 228,021 tons of lead-zinc ore, down 7.4 percent from 1966. According to Hecla, the decrease in tonnage mined was mainly attributable to the effort expended on the No. 4 shaft project, which involved excavating a new shaft and installing new ore and waste facilities. The $3.5 million project, which included installation of a large new hoist on the Star 2000-level tunnel capable of hoisting 7,100 feet in a single vertical lift, was scheduled to be completed in the latter part of 1969. Ore containing 10,515 tons of lead, 560,077 ounces of silver, 18,665 tons of zinc, and 75 tons of copper was recovered.

Production from Hecla's Lucky Friday mine totaled 145,471 tons of ore yielding 15,080 tons of lead, 2,414,191 ounces of silver, 1,069 tons of zinc, and 187 tons of copper. The 19-percent reduction from 1966 total was primarily because of a strike at the mine which began in October. Prior to the strike, the Lucky Friday shaft was deepened to a point 50 feet above the proposed 4050 level, and development was completed on the 3450 level. At yearend, ore reserves were 677,000 tons compared with 658,000 tons on January 1.

[5] Knostman, Richard W. An Analysis of the Pacific Northwest Lead-Zinc Industry. BuMines Inf. Circ. 8327, 1967, 53 pp.

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							
1963	16	-----	1,463	3,427	16,523	3,332	74,794	63,118	$53,980
1964	18	-----	1,482	2,952	16,122	3,336	69,586	58,054	57,146
1965	21	-----	1,592	2,713	17,918	3,540	63,474	56,443	62,054
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
1884–1967	--	-----	[2] 115,969	449,542	738,915	122,184	6,958,983	2,498,993	2,213,518

[1] Does not include gravel washed.
[2] Complete data not available 1884–1904.

Placer Center District (Shoshone County).—The main shaft of the Dayrock mine was deepened 200 feet, new station and pocket facilities were established at the 1450 level, and a 775-foot crosscut was driven to the Ohio vein. Production came from development of the 1450 level and limited stoping above the 1250 level. According to the Day Mines, Inc., annual report, production totaled 19,758 tons of ore averaging 6.6 percent lead, 6.5 ounces of silver per ton, and 0.7 percent zinc. Ore reserves at the end of the year were estimated at 86,000 tons.

Yreka District (Shoshone County).—The Bunker Hill Co. in its annual report to stockholders disclosed that 1967 production at the Bunker Hill mine was 366,025 tons of ore containing 25,331 tons of lead, 21,803 tons of zinc, and 1,440,471 ounces of silver. Ore reserves were estimated to be 4,483,576 tons. At the metallurgical units, production of lead, zinc, and sulfuric acid was an all-time high, and inventories remained adequate for capacity operations.

Mercury.—Production of mercury fell 21 percent, but the value declined only 12 percent as the average market price rose to $489 per flask from $442 in 1966. As in the previous year, production was largely from the Idaho-Almaden mine near Weiser, although ore also was mined and processed at the Hermes property in Valley County.

Silver.—Silver production continued high through the first part of the year in response to strong demand; further impetus was added when the Treasury Department removed its $1.29-per-ounce ceiling price in July, and the price rose over 45 percent. The effect of the copper strike in mid-July, however, cut into production, and as a result, the yearly total output dropped 14 percent to 17 million ounces. Mines in the Coeur d'Alene mining region yielding substantial quantities of silver included the Sunshine, Galena, Lucky Friday, Bunker Hill, Star-Morning Unit, Crescent, Page, and Silver Summit. The Clayton mine, Custer County, yielded over 200,000 ounces of silver.

In the Coeur d'Alene region, the silver price increase spurred exploration activity. At the "Coeur Project" on the Rainbow property near Wallace, American Smelting and Refining Company (Asarco) continued deepening the shaft beyond 4,000 feet. Plans were announced to explore the property with a lateral at the 3,475-foot station to connect with a lateral driven into the southern portion of the property by Hecla Mining Co. from its Silver Summit mine. Plans to increase the milling capacity at the Galena mine from 500 to 800 tons daily and to deepen the No. 3 shaft from the 3700 level to the 4600 level were interrupted by the strike. Installation of a new 1,750-horsepower hoist for the No. 3 shaft was completed.

Sunshine Mining Co. increased silver production at the Sunshine mine to 7.7 million ounces of silver compared with 7.4 million ounces in 1966, and maintained its position as the largest single silver producer in the United States. A new administration building was occupied in May, and a 14,400-volt powerline was tied in to the Sunshine mine in June as part of its long-range expansion program.

The Bunker Hill Co. stockpiled Crescent mine silver concentrates because of the strike at Asarco's East Helena smelter. The $215,000 aircooling plant on the 3100 level of the Crescent mine went into operation in August. Bunker Hill began the first of three long diamond-drill holes to test a mineralized area on Yreka United ground.

Six silver mines in the State reported production of 434,898 tons of ore containing 11,919,437 ounces of silver. Significant development included the following districts.

Evolution District (Shoshone County).—Production of silver from the Sunshine mine was 5 percent higher than in 1966. Approximately 150 ounces of gold, 1,156 tons of copper, 584 tons of lead, and 122 tons of zinc also were recovered from 239,915 tons of ore. The No. 10 shaft was deepened to below the 5200 level, and pockets and stations were completed on the 5000 and 5100 levels. A new service hoist was installed, and development work continued on the 4800 level.

Sunshine Mining Co. continued work on the exploration crosscut to the Bismarck property from the 2700 level of the Sun Con area, completing over 3,000 feet toward the projected Bismarck vein.

Hecla Mining Co. recovered 528,000 ounces of silver and 129 tons of copper from 26,869 tons of ore from the Silver Summit mine. Development work was limited to the 3600, 3800, and 4000 levels. Production decreased from the previous year, but the average grade of ore improved as a large proportion of the production came from stoping rather than from development work.

Placer Center District (Shoshone County).—Asarco recovered over 2 million ounces of silver concentrates and 730 tons of copper from the Galena mine prior to shutdown as a result of the strike on July 15. A program for expansion of mine facilities, centered on the new No. 3 shaft, was nearing completion when interrupted by the strike.

Yreka District (Shoshone County).—The Bunker Hill Co. reported to its stockholders that the Crescent mine produced 25,383 tons of ore averaging 56.13 ounces of silver per ton. Approximately three-fourths of the silver produced in this period came from one high-grade vein developed on the 3300 and 3500 levels. Installation of a new refrigeration unit was completed at the mine during the year.

Bayhorse District (Custer County).—Increased production of 68,500 tons of silver ore resulted in another record high year for the Clayton Silver Mines Clayton mine. Approximately 226,000 ounces of silver, 28 tons of copper, 812 tons of lead, and 400 tons of zinc were recovered from the Clayton ore. Mining continued throughout the year in the 800 level North stope. The smelters to which Clayton sells its lead and zinc concentrates were shut down by the copper strike, but the Clayton mine continued operating and stockpiled the concentrates during the interim.

Tungsten.—Value of Idaho tungsten ore production increased from $1,000 in 1966 to $175,000 in 1967 as 68 tons of tungsten concentrates was produced from three mines. Salmon River Scheelite Corp. accounted for over 80 percent of the production from the Tungsten Jim mine in Custer County. Two Valley County properties, the Golden Gate mine and the Skipper mine, accounted for the rest of the State's total.

Vanadium.—Output of vanadium was 24 percent above that produced in 1966. Ferrophosphorus from the Monsanto Co. elemental phosphorus plant at Soda Springs was processed at the nearby Kerr-McGee facility. Vitro Chemical Co. utilized a similar ferrophosphorus byproduct from the FMC Corp. operation in Power County for use at its Salt Lake City, Utah, vanadium recovery plant. The raw material for the Power County plant was derived from phosphate deposits in Bingham County.

Zinc.—Output of zinc declined 7 percent, following the trend of its coproduct lead, and lower prices resulted in a $2 million decline in value, down 12 percent from the 1966 value. The Bunker Hill mine, combined with Hecla Mining Co.'s Star-Morning Unit area, accounted for over half of the State's output.

At the Bunker Hill zinc plant, major items of the planned expansion were completed and placed in operation. A 350-ton-per-day flash roaster, electrolytic zinc plant cooling towers, and a continuous leach circuit were completed. Zinc concentrates were unloaded at a new materials handling building, and construction

was begun on new sulfuric acid storage tanks which would triple the existing storage capacity.

The zinc circuit in the Clayton Silver Mines mill went into operation on March 16.

Seven zinc mines in the State reported production of 26,178 tons of ore containing 2,242 tons of zinc. The major portion was obtained from the Monitor and Mountain Goat mines in the Beaver mining district of Shoshone County. According to the Day Mines, Inc., report to the stockholders, 10,643 tons of ore containing 8.2 percent zinc was milled at the Monitor mine; the Mountain Goat lease, in the same part of the Monitor mine, also produced 11,085 tons of ore averaging 9.7 percent zinc. Development work consisted of 500 feet of drifting and 131 feet of raising in the Monitor mine.

NONMETALS

Cement.—Production and shipments of portland cement declined 8 percent compared with respective totals for the previous year. Output and shipments, from the plant of Idaho Portland Cement Co., Inkom, Bannock County, were mainly to destinations within the State; out-of-State markets also were served in the Rocky Mountain area. Limestone requirements for the plant continued to be supplied from the nearby company-operated Inkom quarry.

Clays.—The quantity and value of clays sold or used by producers advanced 14 and 30 percent, respectively, compared with totals of the previous year. Greater production of fire clay and kaolin accounted for the increase. Miscellaneous clay output, 19 percent lower than for the previous year, was from pits in Ada, Bonneville, Cassia, Elmore, and Minidoka Counties. Fire clay for refractories manufacture was produced at an operation near Helmer, Latah County, by A. P. Green Refractories Co. J. R. Simplot Co. continued mining and processing kaolin at operations near Bovill, Latah County, for use as filler clay by the paper industry in the Pacific Northwest.

Garnet.—Shipments of garnet declined 3 percent, with output from operations of Emerald Creek Garnet Milling Co. and Idaho Garnet Abrasive Co. (a division of Sunshine Mining Co.), both near Fernwood, Benewah County, marketed mainly for use as an airblast abrasive. According to the Sunshine Mining Co. annual report to shareholders, 5,706 tons of garnet was processed in 1967, and garnet sales were 4,943 tons for the year. There were no shipments by Porter Bros. Co., Lowman, Boise County.

Gem Stones.—The value of gem materials collected in the State was estimated at $180,000. Star and faceting-grade garnet from deposits near Fernwood, Benewah County, was the principal gem material sought by the public. The star garnet was designated as the official State gem by an act of the 1967 legislative assembly. Other materials, such as metallic ore specimens and varieties of quartz, also were gathered by numerous collectors.

Gypsum.—Rock Island Gypsum Co. continued to supply agricultural gypsum (land plaster) for local markets. Shipments from stocks at the firm's Rock Creek mine near Weiser were lower than for the previous year.

Lime.—Limestone was calcined to lime at beet-sugar refineries in Bonneville, Canyon, Minidoka, and Twin Falls Counties. Captive production, for interplant use at the respective beet-sugar plants, increased 4 percent over the total for 1966. Secondary lime was produced from calcining calcium-carbonate sludge at a kraft-paper plant in Nez Perce County.

Peat.—Production continued from operations of Idaho Peat, Inc., near Downey, Bannock County. Shipments, mainly in bulk form for horticultural and general soil improvement uses, declined sharply from the 1966 total.

Perlite.—Production of perlite by Oneida Perlite Corp. was increased sharply compared with output of the previous year. Crude perlite, mined at an open pit north of Malad, Oneida County, was screened, sized, and shipped to the firm's storage and expanding facilities at Malad. Shipments of crude perilte to expanding firms were up sharply from the total of 1966. Production and shipments of expanded perlite also were increased. The expanded perlite was sold for use in loose-fill insulation, concrete and building plaster aggregate, and for soil conditioning.

Phosphate Rock.—Mine production of phosphate rock totaled 3.3 million short tons, a decline of 28 percent from the 4.6-million-ton total for 1966. Production of marketable phosphate rock registered a similar decline. Phosphate rock was mined at five operations in two counties. J. R. Simplot Co. continued production from the Gay and Conda mines, in Bingham and Caribou Counties, respectively. Monsanto Co. mined phosphate rock from the Ballard property, and El Paso Products Co. produced phosphate from the Mabie Canyon mine, both in Caribou County. J. A. Terteling Co. began mining phosphate deposits leased by Stauffer Chemical Co. northeast of Soda Springs, Caribou County. Mining was on a contract basis with the Stauffer firm, and production was shipped to Silver Bow, Mont., for use in manufacturing elemental phosphorus. Announced long-range plans of Stauffer include construction of beneficiating and calcining facilities to produce acidulation-grade phosphate rock for fertilizer manufacture.

The quantity of phosphate rock sold or used by producers was 3 percent lower than for 1966. The largest quantities continued to be used for manufacturing elmental phosphorus, a demand which dropped 3 percent from that of the previous year. The quantity of phosphate rock used for manufacturing phosphate fertilizers and wet-process phosphoric acid also declined.

Phosphate rock was reduced to elemental phosphorus at plants of FMC Corp., Mineral Products Division, at Pocatello, and Monsanto Co. at Soda Springs. Both firms continued expansion programs begun earlier for increasing productive capacity at the respective plants.

J. R. Simplot Co. continued manufacturing phosphate fertilizer products at the firm's Pocatello fertilizer works. El Paso Products Co. manufactured phosphate fertilizer products at its Agrichemical Complex near Conda, Caribou County, but in July, it announced suspension of operations at the Conda complex. The fertilizer manufacturing plant was shut down by year-end; however, the machinery and buildings were being maintained on a standby condition. While the closure affected approximately 350 employees engaged in mining, hauling, and processing phosphate rock, mining operations were continued into the fall months with output being stockpiled for possible future use and/or sale. The rising cost of raw materials, particularly sulfur, and unfavorable fertilizer prices reportedly were the reasons for the closure.

Mountain Fuel Supply Co. began processing purchased phosphate rock at the firm's newly constructed beneficiating and calcining facilities near Soda Springs, Caribou County. The processed rock was to be marketed to fertilizer manufacturers in the Western States.

The Bunker Hill Co. continued manufacturing phosphoric acid and phosphate fertilizer products at Kellogg, Shoshone County. Purchased calcined phosphate rock and sulfuric acid produced at the company's nearby Kellogg zinc smelter were used as raw materials for fertilizer manufacture.

Pozzolan.—El Paso Natural Gas Co. continued producing and shipping pozzolan from operations near Weiser, Washington County. Calcined opalite, a waste product of the firm's adjacent mercury furnacing operation, was used as a raw material for the pozzolan plant. Thirty-five thousand tons was shipped mainly for use as a concrete additive at dam construction projects in the Pacific Northwest.

Pumice.—Pumice sold or used by producers declined sharply from the 55,000-ton total of the previous year. Pumice was mined at operations in Bonneville and Oneida Counties, and volcanic cinder was mined in Canyon County. Volcanic cinder output remained substantially the same as in 1966. Both commodities were used mainly as a lightweight aggregate in manufacturing precast concrete building products.

Sand and Gravel.—Production of sand and gravel registered a 49-percent increase over the 7.5 million-ton total for 1966. The sharp increase was due to greater requirements for these commodities at State highway department projects (6.2 million tons versus 2.7 million tons in 1966). Total Government-and-contractor output (largely production by contractors for Federal, State, county, and municipal agencies) increased 77

percent. Output by commercial producers (2.1 million tons) was moderately lower than for the previous year, reflecting a general curtailment in the light construction industry.

Del Monte Properties Co., a producer of quality sand for plaster, glass, abrasive, and other specialty uses, began constructing a $400,000 sand beneficiation plant west of Emmett, Gem County. Productive capacity of the new plant will be more than double that of the older facility, which was scheduled for replacement.

Production exceeded 1 million tons each in Jerome, Canyon, and Twin Falls Counties owing largely to State highway department projects underway in the respective counties. Sand and gravel production was reported from operations in 36 of the 44 counties in the State; however, significant tonnages also were produced which could not be assigned to a specific county of origin.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	603	$932	434	$668
Road material	1,484	1,253	1,302	1,170
Fill	154	146	148	98
Other [1]	149	243	261	276
Total	2,390	2,574	2,145	2,212
Government-and-contractor operations:				
Building	102	75	34	44
Road material	4,489	3,690	7,965	8,637
Fill	550	320	1,006	526
Other [1]	13	13	96	71
Total	5,154	4,098	9,101	9,278
All operations:				
Building	705	1,007	468	712
Road material	5,973	4,943	9,267	9,807
Fill	704	466	1,154	624
Other [1]	162	256	357	347
Grand total	7,544	6,672	11,246	11,490

[1] Includes special sands, railroad ballast, and sand and gravel used for miscellaneous purposes.

Stone.—Production of stone for all purposes declined 26 percent (708,000 tons) from the 1966 total. Curtailed production by commercial producers and reduced demand by the State highway department, Bureau of Public Roads, and U.S. Forest Service all contributed to the decline. Production for commercial markets totaled 724,000 tons, a 24-percent drop from the 946,000-ton total of the previous year. Government-and-contractor tonnages (largely production by contractors for Federal, State, county, and municipal agencies) was 1.3 million tons compared with 1.7 million tons in 1966.

Basalt was quarried in the greatest tonnages. Output was used mainly as a road base and surfacing material; smaller quantities were used as rubble and riprap. Limestone production increased moderately and was used principally in sugar refining and for cement manufacture. Sandstone and quartzite production dropped sharply owing largely to reduced demand by State and Federal agencies. Stone production was reported from 17 counties; in addition, significant tonnages were produced which could not be assigned to specific counties of origin.

Table 15.—Principal producers of metals and minerals

Commodity and company	Type of activity	County	Address	Remarks
Metals:				
Antimony:				
Sunshine Mining Co	Plant	Shoshone	Kellogg, Idaho.	
Copper:				
Idaho Mining Co. (Machinery Center, Inc.)	Mine and mill	Lemhi	Cobalt, Idaho	Sold to Idaho Mining Co. in June 1967.
Gold:				
A. W. Josue	Mine	Boise	Garden Valley, Idaho.	
Earl Rice	Placer	Idaho	Elk City, Idaho.	
John and Thea Steward	----do	Jerome	Burley, Idaho.	
Iron Ore:				
Rock Island Gypsum Co	Mine	Washington	Weiser, Idaho	Used for cement.
Lead:				
American Smelting and Refining Company	Mine and mill	Shoshone	Wallace, Idaho.	
Dale Aslett	Mine	Blaine	Twin Falls, Idaho.	
The Bunker Hill Co	Mine, mill, smelter	Shoshone	Kellogg, Idaho.	
Clayton Silver Mines	Mine and mill	Custer	Clayton, Idaho.	
Day Mines, Inc	----do	Shoshone	Wallace, Idaho.	
Federal Resources Corp	----do	Blaine	Mine—Hailey, Idaho. Mill—Bellevue, Idaho.	
Hecla Mining Co	----do	Shoshone	Wallace, Idaho.	
Mercury:				
Electronic Metals, Inc	Mine and plant	Valley	Boise, Idaho.	
El Paso Natural Gas Co	----do	Washington	El Paso, Texas (Weiser, Idaho).	
Silver:				
American Smelting and Refining Company	Mine and mill	Shoshone	Wallace, Idaho.	
The Bunker Hill Co	----do	----do	Kellogg, Idaho.	
Hecla Mining Co	----do	----do	Wallace, Idaho.	
Sunshine Mining Co	----do	----do	Kellogg, Idaho.	
Tungsten:				
Salmon River Scheelite	Mine and plant	Custer	Clayton, Idaho.	
Electronic Metals, Inc	----do	Valley	Boise, Idaho.	
Vanadium:				
Kerr-McGee Corp	Plant	Caribou	Soda Springs, Idaho	Processed ferro-phosphorus from Idaho.
Zinc:				
American Smelting and Refining Company	Mine and mill	Shoshone	Wallace, Idaho.	
The Bunker Hill Co	Mine, mill, smelter	----do	Kellogg, Idaho.	
Day Mines, Inc	Mine and mill	----do	Wallace, Idaho.	
Golconda Mining Corp	----do	----do	Do.	
Hecla Mining Co	----do	----do	Do.	

Nonmetals:				
Cement:				
Idaho Portland Cement Co	Plant and quarry	Bannock	Inkom, Idaho.	
Clay:				
Burley Brick and Sand Co	Pit and plant	Cassia	Burley, Idaho.	
Burley Brick and Sand Co	do	Minidoka	Do.	
A. P. Green Refractories Co	do	Latah	Troy, Idaho.	
Idaho Falls Brick and Tile Co	do	Bonneville	Idaho Falls, Idaho.	
Idaho Falls Brick and Tile Co	do	Jefferson	Do.	
Pullman Brick Co., Inc	do	Ada	Boise, Idaho.	
Pullman Brick Co., Inc	do	Elmore	Do.	
J.R. Simplot Co	do	Latah	Bovill, Idaho	Paper-filler clay.
Garnet:				
Emerald Creek Garnet Milling Co	Mine and plant	Benewah	Kellogg, Idaho.	
Idaho Garnet Abrasive Co	do	do	Do.	
Peat:				
Idaho Peat, Inc	Bog	Bannock	Downey, Idaho.	
Perlite:				
Oneida Perlite Corp	Pit	Oneida	Malad City, Idaho.	
Expanded Perlite:				
Oneida Perlite Corp	Plant	do	Do.	
Phosphate Rock:				
El Paso Products Co	Mine and plant	Caribou	Conda, Idaho	Plant closed in 1967.
FMC Corp., Mineral Products Division	Plant	Power	Pocatello, Idaho	Produces elemental phosphorus.
Monsanto Co	Mine and plant	Caribou	St. Louis, Missouri	Do.
Mountain Fuel Supply Co	do	do	Soda Springs, Idaho	Calcined phosphate rock.
J.R. Simplot Co	Mine	Bingham	Pocatello, Idaho	Produces agricultural fertilizer products.
J.R. Simplot Co	Mine and plant	Caribou	Conda, Idaho.	
The Terteling Co	Mine	do	Boise, Idaho.	
Pumice:				
Melvin Hess Pumice Products	Mine and plant	Oneida	Malad City, Idaho.	
Idaho Concrete Products, Inc	do	Bonneville	Idaho Falls, Idaho.	
Western Block, Inc	do	Canyon	Nampa, Idaho.	
Sand and Gravel:				
Bannock Paving Co	Pit and plant	Bannock	Pocatello, Idaho.	
DeAtley Corp	do	Various	Lewiston, Idaho.	
Idaho Concrete Pipe Co	do	Canyon	Caldwell, Idaho.	
Morrison Knudson Co., Inc	do	Ada	Boise, Idaho.	
Overman Construction Co	do	Nez Perce	Lewiston, Idaho.	
Quinn Robbins Co., Inc	do	Ada	Boise, Idaho.	
Bryon C. Rambo	do	Canyon	Nampa, Idaho.	
Wesley Shockley	do	Elmore	Eagle Point, Idaho.	
Twin Falls Construction Co	do	Twin Falls	Twin Falls, Idaho.	
Stone:				
Frank G. Baulne	Quarry and plant	Clearwater	Spokane, Washington.	
Carl Carbon, Inc	do	Latah	Do.	
DeAtley Corp	do	Various	Lewiston, Idaho.	
Idaho Portland Cement Co	Quarry	Bannock	Inkom, Idaho.	
Monsanto Co	do	Caribou	St. Louis, Missouri.	

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 Robert G. Bottge [1]

Illinois mineral production in 1967 was valued at $636.8 million, nearly 3 percent more than in 1966. Increases in total value of production were recorded for portland cement, coal, fluorspar, fuller's earth, lime, natural gas liquids, peat, sand and gravel, stone, tripoli, and zinc. Declines in total value were recorded for masonry cement, clays (excluding fuller's earth), lead, natural gas, and petroleum. Mineral fuels accounted for 72 percent of the total production value, nonmetals 27 percent, and metals 1 percent.

In 1967, Illinois ranked first among the eight States producing fluorspar, furnishing 71 percent of the Nation's total. The State ranked fourth in the Nation in coal output, seventh in sand and gravel output, and third in crushed stone production. Illinois also ranked high in the processing of mineral raw materials.

[1] Mining engineer, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Illinois [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	9,203	$28,617	9,069	$30,186
Masonry—thousand 280-pound barrels	614	1,868	591	1,851
Clays [2]—thousand short tons	1,894	3,996	1,881	3,799
Coal (bituminous)—do	63,571	244,837	65,133	252,975
Fluorspar—short tons	176,175	8,002	210,207	9,859
Lead (recoverable content of ores, etc)—do	2,285	691	2,384	668
Natural gas—million cubic feet	7,230	860	5,144	602
Peat—short tons	44,374	565	49,716	697
Petroleum (crude)—thousand 42-gallon barrels	61,982	185,947	[3] 60,115	[3] 181,581
Sand and gravel—thousand short tons	38,237	43,201	38,801	44,175
Stone—do	46,157	60,961	48,458	66,757
Zinc (recoverable content of ores, etc.)—short tons	15,192	4,406	20,416	5,652
Value of items that cannot be disclosed: Fuller's earth, gem stones, lime, natural gas liquids, and tripoli	XX	34,362	XX	37,999
Total	XX	618,313	XX	636,801
Total 1957–59 constant dollars	XX	627,461	XX	p 631,189

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."
[3] Final figure; supersedes figure given in commodity chapter, volume I-II.

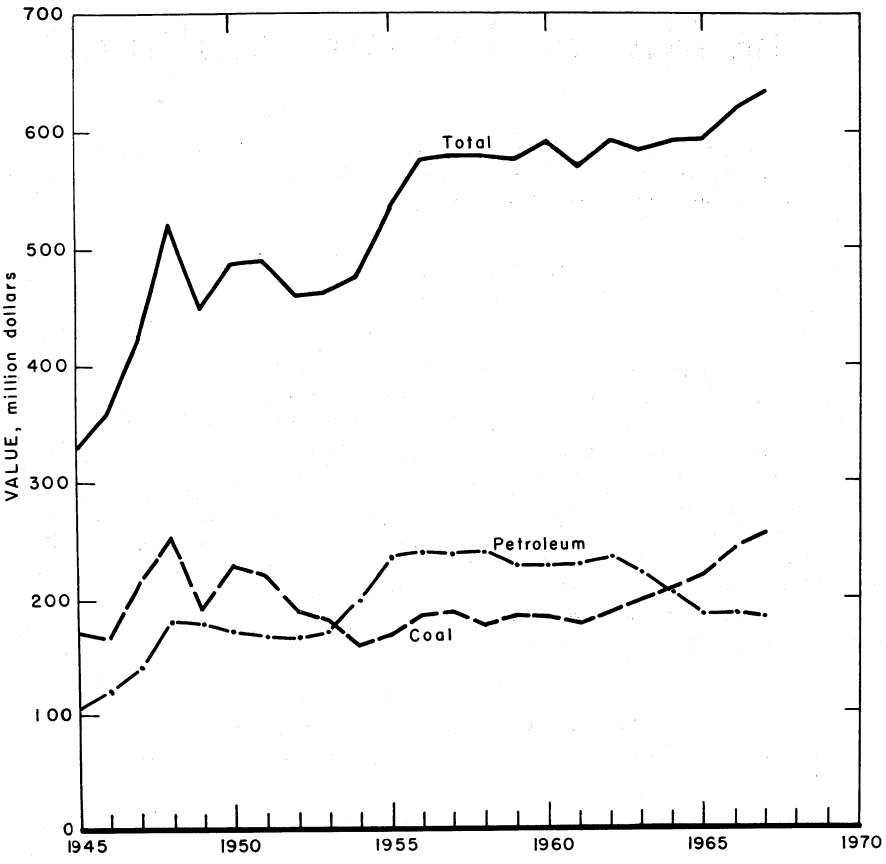

Figure 1.—Value of coal, petroleum, and total value of mineral production in Illinois.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Adams	$2,397	$2,525	Stone, lime, coal, sand and gravel, petroleum.
Alexander	266	272	Tripoli, sand and gravel, stone.
Bond	737	555	Petroleum, sand and gravel, clays.
Boone	403	583	Stone, sand and gravel.
Brown	100	106	Stone, sand and gravel, petroleum, clays.
Bureau	514	1,485	Sand and gravel.
Calhoun	W	49	Stone.
Carroll	419	218	Stone, sand and gravel.
Cass	-------	4	Sand and gravel.
Champaign	588	708	Sand and gravel, petroleum.
Christian	W	W	Coal, petroleum, stone.
Clark [2]	3,082	3,041	Petroleum, stone, sand and gravel.
Clay	8,757	W	Petroleum, stone.
Clinton	W	W	Petroleum, stone, sand and gravel.
Coles	W	W	Do.
Cook	33,673	36,100	Stone, lime, sand and gravel, clays, peat.
Crawford	W	W	Petroleum, sand and gravel.
Cumberland [2]	193	503	Stone, sand and gravel.
De Kalb	823	768	Do.
De Witt	W	W	Petroleum, sand and gravel.
Douglas	W	W	Coal, petroleum, stone.
Du Page	W	W	Stone, sand and gravel.
Edgar	190	272	Petroleum.
Edwards	2,941	2,652	Do.
Effingham	1,288	W	Petroleum, sand and gravel.
Fayette	27,082	W	Petroleum, stone, sand and gravel, clays.
Ford	239	281	Sand and gravel.
Franklin	W	W	Coal, petroleum.
Fulton	30,904	28,064	Coal, sand and gravel.
Gallatin	3,598	4,627	Petroleum, coal, sand and gravel.
Greene	488	W	Stone, coal, clays.
Grundy	5,291	4,735	Sand and gravel, coal, clays.
Hamilton	12,963	16,833	Petroleum.
Hancock [2]	610	653	Stone, petroleum.
Hardin	12,986	16,489	Fluorspar, zinc, stone, lead.
Henderson	558	448	Stone, sand and gravel.
Henry	336	W	Do.
Iroquois	W	17	Sand and gravel.
Jackson	2,352	2,508	Coal, stone, sand and gravel.
Jasper	5,118	4,366	Petroleum.
Jefferson	W	W	Coal, petroleum, stone.
Jersey	185	146	Stone.
Jo Daviess	1,592	2,295	Zinc, stone, lead, sand and gravel.
Johnson	915	W	Stone.
Kane	3,296	3,463	Sand and gravel, stone.
Kankakee	W	W	Stone, clays, sand and gravel.
Kendall	493	570	Sand and gravel, stone.
Knox	W	W	Coal, stone, clays, sand and gravel.
Lake	778	709	Sand and gravel, peat.
La Salle	30,276	30,567	Cement, sand and gravel, stone, clays.
Lawrence	21,261	20,711	Petroleum, sand and gravel.
Lee	W	W	Cement, stone, sand and gravel, clays.
Livingston	2,843	3,203	Stone, clays, sand and gravel.
Logan	800	675	Stone, sand and gravel, coal.
McDonough [2]	W	W	Stone, clays.
McHenry	4,211	4,047	Sand and gravel, stone.
McLean	764	W	Sand and gravel.
Macon	W	W	Sand and gravel, petroleum.
Macoupin	1,725	1,692	Coal, petroleum.
Madison	2,389	2,209	Stone, petroleum, sand and gravel.
Marion	W	W	Petroleum, stone.
Marshall	546	325	Sand and gravel, clays.
Mason	23	17	Sand and gravel.
Massac	W	W	Cement, stone, sand and gravel.
Menard	W	W	Stone, sand and gravel.
Mercer	292	282	Stone, coal, clays, sand and gravel.
Monroe	W	W	Stone.
Montgomery	W	W	Coal, stone, petroleum.
Morgan	2	-------	
Moultrie	36	37	Petroleum, sand and gravel.
Ogle	1,986	2,193	Sand and gravel, stone.
Peoria	9,358	9,482	Coal, stone, sand and gravel.
Perry	30,825	37,812	Coal, petroleum.
Pike	720	718	Stone, sand and gravel.
Pope	2	W	Sand and gravel.
Pulaski	W	W	Stone, clays, sand and gravel.
Putnam	57	W	Sand and gravel.
Randolph	13,306	11,882	Coal, stone, petroleum, sand and gravel.
Richland	6,384	5,763	Petroleum.
Rock Island	2,134	W	Stone, sand and gravel.
St. Clair	26,782	28,639	Coal, stone, clays, sand and gravel.

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

County	1966	1967	Minerals produced in 1967 in order of value
Saline	$18,895	W	Coal, petroleum.
Sangamon	1,355	$1,100	Sand and gravel, petroleum, clays.
Schuyler	W	W	Stone, sand and gravel.
Scott	W	244	Stone, clays.
Shelby	W	280	Petroleum, sand and gravel.
Stark	W	W	Coal.
Stephenson	565	730	Stone, sand and gravel.
Tazewell	1,544	1,543	Sand and gravel, clays.
Union	W	W	Stone, sand and gravel.
Vermilion	5,377	4,832	Coal, stone, clays, sand and gravel.
Wabash	8,475	8,105	Petroleum, sand and gravel.
Warren	W	W	Stone.
Washington	2,412	2,367	Petroleum, stone, coal.
Wayne	18,097	16,976	Petroleum.
White	18,753	18,987	Petroleum, sand and gravel.
Whiteside	950	1,115	Peat, stone, sand and gravel.
Will	9,112	9,710	Stone, sand and gravel, coal.
Williamson	23,479	24,861	Coal, petroleum.
Winnebago	2,119	2,394	Sand and gravel, stone.
Woodford	W	111	Sand and gravel.
Undistributed [3]	184,304	247,146	
Total [4]	618,313	636,801	

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." Piatt County is not listed because no production was reported.

[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, some petroleum and sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[4] Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Illinois business activity

		1966	1967	Percent change
Personal income:				
Total	millions	$38,089	p $40,575	+6.5
Per capita		$3,532	p $3,725	+5.5
Construction activity:				
Building permits:				
Valuation of authorized residential and nonresidential private construction	millions	$1,392.6	$1,313.6	−5.7
Number of private and public residential building permits issued		43,754	51,332	+17.3
Contract construction work performed:				
Total	millions	$2,575	$3,279	+27.3
Nonresidential building	do	$1,165	$1,317	+13.0
Residential building	do	$940	$1,153	+22.7
Nonbuilding	do	$471	$810	+72.0
State highway division:				
Contracts awarded	do	$186.8	$294.7	+57.8
Construction contract expenditures	do	$142.2	$170.0	+19.5
Portland cement shipments to and within Illinois	thousand 376-pound barrels	18,333	19,060	+4.0
Cash receipts from farm marketings	millions	$2,763.1	$2,606.2	−5.7
Mineral production	do	$618.3	$636.8	+3.0
Raw steel production	thousand tons	10,960.0	10,649.0	−2.8
Manufacturing payrolls	millions	$9,774.0	$10,072.6	+3.1
Annual average labor force and employment: [1]	thousands	4,774.6	4,899.9	+2.6
Total labor force	do	152.4	143.8	−5.6
Agricultural employment	do	4,480.2	4,594.8	+2.6
Nonagricultural employment [2]	do	1,393.4	1,392.8	([3])
Manufacturing	do	170.0	175.7	+3.4
Construction	do	194.5	196.7	+1.1
Transportation	do	25.2	24.9	−1.2
Mining, quarrying, and petroleum production	do	8.6	8.8	+2.3
Bituminous coal mining	do	8.1	7.8	−3.7
Crude petroleum and natural gas	do	8.5	8.4	−1.2
Other mining and quarrying	do	38.9	38.8	−.3
Stone, clay, and glass products	do	113.2	110.9	−2.0
Primary metal industries	do			

p Preliminary.

[1] Adjusted to March 1967 benchmark levels.

[2] Includes nonagricultural, self-employed, and unpaid family workers, and domestic workers in private households.

[3] Less than 0.05 percent.

Sources: Survey of Current Business, Construction Review, Statistical Abstract of the United States, Illinois Department of Public Works and Buildings (Division of Highways), Farm Income Situation, and Illinois Department of Labor in cooperation with the U.S. Department of Labor.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	8,367	255	2,132	16,629	8	652	39.69	4,561
Peat	19	117	2	19	----	1	52.65	53
Metal	65	251	16	130	----	19	145.78	675
Nonmetal	1,210	274	331	2,690	1	87	32.72	3,650
Sand and gravel	1,659	227	377	3,248	----	41	12.62	999
Stone	3,513	270	948	7,819	3	122	15.99	2,900
Total [1]	14,833	257	3,807	30,534	12	922	30.59	3,660
1967: [p]								
Coal	8,500	254	2,156	16,720	19	700	43.00	8,618
Peat	23	217	5	46	----	2	43.50	174
Metal	50	252	13	105	----	4	38.23	210
Nonmetal	1,245	261	325	2,652	----	113	42.60	707
Sand and gravel	1,515	233	353	3,047	4	51	18.05	11,954
Stone	3,695	269	995	8,235	----	135	16.39	639
Total [1]	15,030	256	3,846	30,805	23	1,005	33.37	6,093

[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 65.1 million tons valued at $253.0 million, representing slight increases over the 1966 figures. The value of bituminous coal production contributed 40 percent to the total value of minerals produced in the State.

Illinois consumed over 58 percent of its coal production. About 41 percent was shipped to consumers in Indiana, Michigan, Wisconsin, Minnesota, Iowa, Missouri, and Kentucky. Electric utilities consumed nearly 70 percent of the output, general manufacturing and processing industries nearly 24 percent, and retail dealers and coke and gas plants about 3 percent each. Sales to electic utilities increased nearly 3 million tons over those of 1966, while sales to general manufacturing and processing industries declined nearly 1 million tons. Shipments to coke and gas plants were about the same as in 1966. Shipments to all other consumers declined.

About 82 percent of the coal was shipped by rail, about 8 percent by truck, 5 percent by water, and 5 percent by other means, including that transported from the mine to point of use by conveyor or tram. Over one-fourth of the rail shipments were by unit trains.

Total Illinois coal consumption was 46.7 million tons, of which 38.5 million tons came from within the State. Total consumption was up less than 1 percent, but that portion supplied by Illinois coal mines increased over 2 percent. Much of the increase in consumption was due to electric utilities which increased their rate of use over 6 percent, to 29.5 million tons.

Production was reported from 75 mines in 25 counties, excluding mines with less than 1,000 tons of annual production. Over 93 percent of the total output came from 12 counties with production in excess of 1 million tons each. Those counties, in order of rank, were Perry, Franklin, St. Clair, Fulton, Williamson, Christian, Montgomery, Saline, Jefferson, Randolph, Knox, and Peoria.

The 43 strip mines accounted for 57 percent of the total State production, and the 32 underground mines contributed the remainder. Production from strip mines increased 3 percent over that of 1966 and that from underground mines increased 2 percent. The average mine value was $3.88 per ton, up from $3.85 in 1966.

All but a minor fraction of the coal produced underground was loaded by machines; these included 75 mobile loaders and 65 continuous miners. Equipment used in strip mines included 126 power shovels,

Table 5.—Coal (bituminous) production in 1967, 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	--	16	16	$109
Christian	1	--	5,721	--	5,721	W
Douglas	1	--	747	--	747	W
Franklin	4	--	7,577	--	7,577	W
Fulton	--	7	--	6,771	6,771	27,400
Gallatin	1	2	127	273	399	W
Greene	--	1	--	2	2	8
Grundy	--	1	--	262	262	W
Jackson	--	5	--	715	715	2,171
Jefferson	2	--	3,031	--	3,031	W
Knox	--	2	--	2,528	2,528	W
Logan	1	--	19	--	19	W
Macoupin	1	--	412	--	412	1,682
Mercer	1	--	14	--	14	W
Montgomery	2	--	3,549	--	3,549	W
Peoria	1	3	2	1,488	1,490	7,185
Perry	--	4	--	11,041	11,041	37,730
Randolph	1	1	882	1,814	2,696	W
St. Clair	2	2	389	6,449	6,838	W
Saline	3	3	1,767	1,672	3,438	W
Stark	--	1	--	572	572	W
Vermilion	2	2	51	574	625	3,093
Washington	1	--	33	--	33	W
Will	--	1	--	493	493	W
Williamson	8	7	3,625	2,517	6,142	24,732
Total [1]	32	43	27,948	37,185	65,133	252,975

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)

Year and use	District of origin [1]							Total
	2	3 and 6	4	7 and 8	9	10	11	
1963:								
Electric utilities	--	-----	----	2	2,898	17,670	354	20,924
Coke and gas plants	--	-----	----	1,997	--------	801	--------	2,798
Retail dealers	2	33	5	1,463	1,258	2,316	211	5,288
All others	1	40	----	435	390	8,513	697	10,076
Total	3	73	5	3,897	4,546	29,300	1,262	39,086
1964:								
Electric utilities	--	-----	----	35	2,852	19,706	402	22,995
Coke and gas plants	--	-----	----	2,387	--------	922	--------	3,309
Retail dealers	--	45	4	1,295	1,093	2,203	169	4,809
All others	--	41	2	588	424	8,565	733	10,353
Total	--	86	6	4,305	4,369	31,396	1,304	41,466
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

[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, southwestern Virginia, southern West Virginia, and north-central Tennessee; 9, western Kentucky; 10, Illinois; 11, Indiana.

draglines, and wheel excavators. Nearly 81 percent of the total production was cleaned by the 45 cleaning plants that operated during the year.

Nine companies and their subsidiaries each produced over 1 million tons in 1967, accounting for over 96 percent of the State production. Those companies were Ayrshire Collieries Corp., Bell & Zoller Coal Co., Freeman Coal Mining Corp., Old Ben Coal Corp., Peabody Coal Co., Sahara Coal Co., Inc., Truax-Traer Coal Division (Consolidation Coal Co., Inc.), Southwestern Illinois Coal Corp., and The United Electric Coal Cos. The Captain strip mine in Perry County, owned by the Southwestern Illinois Coal Corp., ranked first in the Nation in production. The No. 10 underground mine in Christian County, owned by Peabody Coal Co. ranked second in production, but was the largest underground mine. Peabody's River King strip mine in St. Clair County was the Nation's fourth largest producer and the second largest strip mine.

Shaft sinking operations were begun by Freeman Coal Mining Corp., a subsidiary of General Dynamics Corp., at its 3-million-ton-per-year Orient No. 6 mine in Jefferson County. Production was expected to begin late in 1968.

Coke.—Almost 2.4 million tons of coke, valued at over $47.7 million, was produced at six plants. This represented a decrease of about 8 percent, both in quantity and value compared with 1966. Consumption of coke by producing companies decreased about 5 percent to 2.4 million tons. Nearly

98 percent of the coke produced was used in blast furnaces. About 3.4 million tons of coal was carbonized at Illinois coke plants, of which 38 percent came from Illinois and 60 percent came from Kentucky and West Virginia, combined.

Producing plants recovered about 177,000 tons of coke breeze valued at nearly $1.4 million, representing a 17-percent decrease in quantity and a 16-percent decrease in value from 1966. Other products of coke-oven plants included coke-oven gas, tar, ammonia, crude light oil, and light-oil derivatives.

Peat.—Peat was produced by five companies in Cook, Lake, and Whiteside Counties. Sales increased 12 percent in quantity and over 23 percent in value. Humus was sold in bulk form, while moss and reed-sedge peat were sold in bulk and packaged form. Nearly 87 percent of all sales were in packaged form. Nearly all the peat was used for general soil conditioners; a small amount was used for packing flowers and shrubs.

Petroleum, Natural Gas, and Natural Gas Liquids.—Crude petroleum production declined 3 percent, while value decreased over 2 percent from 1966 levels. The value of crude petroleum provided over 28 percent of the total State mineral output value, down from 30 percent in 1966. Water-flood oil production accounted for 72 percent of the total petroleum output.

Table 7.—Crude petroleum production, by counties

(Thousand 42-gallon barrels and thousand dollars)

County	1966 Quantity [1]	1966 Value [2]	1967 Quantity [1]	1967 Value [2]
Adams	4	$11	2	$5
Bond	134	403	108	327
Brown	3	10	3	9
Champaign	3	8	2	6
Christian	712	2,135	532	1,606
Clark [3]	724	2,173	700	2,114
Clay	2,842	8,525	3,045	9,197
Clinton	951	2,854	923	2,787
Coles	708	2,124	556	1,678
Crawford	3,469	10,406	3,164	9,557
Cumberland	(3)	(3)	(3)	(3)
De Witt	283	848	240	726
Douglas	95	286	92	279
Edgar	63	190	90	272
Edwards	980	2,941	878	2,652
Effingham	426	1,278	598	1,805
Fayette	8,917	26,751	7,512	22,692
Franklin	1,449	4,346	1,650	4,984
Gallatin	887	2,662	973	2,938
Hamilton	4,321	12,963	5,573	16,833
Hancock [3]	35	106	39	117
Jasper	1,694	5,081	1,446	4,366
Jefferson	1,337	4,012	1,607	4,854
Lawrence	7,024	21,072	6,774	20,462
McDonough	(3)	(3)	(3)	(3)
Macon	18	54	11	34
Macoupin	4	11	3	10
Madison	249	748	216	652
Marion	5,477	16,432	4,847	14,640
Montgomery	1	3	1	3
Moultrie	6	18	7	20
Perry	24	72	27	82
Randolph	103	309	109	328
Richland	2,128	6,384	1,908	5,763
Saline	1,001	3,004	1,105	3,338
Sangamon	167	501	115	346
Shelby	65	196	52	158
Wabash	2,779	8,336	2,633	7,953
Washington	567	1,701	532	1,606
Wayne	6,032	18,096	5,620	16,976
White	6,188	18,564	6,224	18,799
Williamson	30	89	43	129
Unassigned production	80	241	159	480
Total [4]	61,982	185,947	60,115	181,581

[1] Source: Illinois Geological Survey.
[2] County values calculated by using State average value per barrel; $3.00 for 1966 and $3.02 for 1967.
[3] Production of Cumberland County included with Clark County, and McDonough County with Hancock County because actual source of production cannot be identified.
[4] Data may not add to totals shown because of independent rounding.

The Illinois State Geological Survey reported the completion of 1,124 wells in 1967; 570 were producing oil wells, one was a gas well, 311 were dry holes in pools, and 242 were unsuccessful wildcats. Total footage drilled was 2,662,848, of which 54 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 totaled 335 million barrels, a 27-million-barrel decrease from 1966. Proved reserves of natural gas on December 31 totaled nearly 259,000 million cubic feet, according to the American Gas Association. This is an increase of 23,000 million cubic feet from 1966 estimates. Proved recoverable reserves of natural gas liquids totaled 2.3 million barrels on December 31, according to the American Gas Association.

NONMETALS

Cement.—Portland and masonry cements were produced by four companies with plants in La Salle, Lee, and Massac Counties. Portland cement shipments declined over 1 percent, but increased over 5 percent in value. Shipments of masonry cement declined nearly 4 percent, but total value declined only about 1 percent. Nearly 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 94 percent of the portland cement was shipped in bulk, the remainder in bags. About 65 percent of the shipments were by truck and the remainder by rail. A small amount was consumed at the plants. Nearly three-fourths of the portland cement shipments were to ready-mixed concrete companies. Over 10 percent went to highway contractors, 9 percent to concrete product manufacturers, and nearly 5 percent to dealers in building materials.

About 68 percent of the portland cement shipments were to consumers in Illinois, 13 percent to Wisconsin, and 14 percent to Indiana, Iowa, Kentucky, and Tennessee, combined. Of the masonry cement shipped, 33 percent went to consumers in Illinois, 33 percent to Wisconsin, and over 25 percent to Tennessee. Approximately 12.9 million barrels of portland cement were shipped into Illinois from plants outside the State, mostly from Indiana, Michigan, and Missouri. In addition, 534,000 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
1963	5	9,465	9,281	$30,577
1964	4	9,978	9,790	32,191
1965	4	9,235	9,358	30,622
1966	4	9,108	9,203	28,617
1967	4	9,608	9,069	30,186

Over 2.7 million tons of limestone and 418,000 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 272.5 million kilowatt-hours of electricity was used in the manufacturing process; nearly 63 percent was purchased, while the remainder was home-generated.

Clays.—Total production of fire clay and miscellaneous clay and shale declined nearly 1 percent in quantity and 5 percent in value. The production of fire clay used in refractories increased over 1 percent, while that for heavy clay products declined 16 percent. Miscellaneous clay and shale used in heavy clay products increased 4 percent, while that used in lightweight aggregate and cement declined about 3 percent. The production of fuller's earth for absorbent uses increased 12 percent.

Production of clay and shale was reported from 20 counties. Fire clay was pro-

duced by 10 companies operating in Greene, Grundy, La Salle, McDonough, Marshall, and Scott Counties.

Fluorspar.—Illinois ranked first among the eight producing States in the Nation, supplying 71 percent of the total domestic fluorspar output. Total Illinois shipments increased over 19 percent in quantity and 23 percent in value. Acid-grade fluorspar accounted for 57 percent of the sales; ceramic grade, 41 percent; and metallurgical grade, less than 2 percent. Sales of acid grade increased over 16 percent, and those for ceramic grade 21 percent. Sales of metallurgical-grade fluorspar nearly doubled.

About 726,000 tons of crude ore was milled to produce 211,000 tons of finished fluorspar as well as byproduct lead and zinc concentrates. All of the finished fluorspar was produced in Hardin County, although crude ore came from Hardin and Pope Counties in Illinois and from Kentucky. A small amount of Illinois crude ore was processed in Kentucky. Producers included Hastie Mining Co., Minerva Oil Co., Ozark-Mahoning Co., J. W. Patton & Sons, J. D. Quarant, Ridge Fluorspar Mining Co., and Shawnee Fluorspar Mining Co. The Aluminum Company of America and 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 increased about 1 percent. Over 61 percent was used for chemical and industrial purposes, 33

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	6,823	$6,181	6,575	$6,139
Paving	5,615	4,920	6,374	5,464
Railroad ballast	25	25	W	W
Glass (unground sand only)	1,745	3,655	1,999	4,313
Molding (unground sand only)	1,203	3,916	1,036	3,571
Other [1]	2,824	6,613	3,417	6,625
Total	18,235	25,310	19,401	26,112
Gravel:				
Building	7,513	6,715	6,936	6,519
Paving	10,058	9,723	9,500	9,707
Railroad ballast	235	163	250	252
Fill	1,211	682	1,260	713
Other	10	13	--------	--------
Total	19,027	17,296	17,946	17,191
Total sand and gravel	37,262	42,606	37,347	43,303
Government-and-contractor operations:				
Sand:				
Paving	207	114	248	144
Fill	------	--------	484	262
Total	207	114	732	406
Gravel:				
Paving	751	475	722	466
Fill	17	6	----------	----------
Total	768	481	722	466
Total sand and gravel	975	595	1,454	872
All operations:				
Sand	18,442	25,424	20,133	26,518
Gravel	19,795	17,777	18,668	17,657
Total	38,237	43,201	38,801	44,175

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

[1] Includes fire or furnace (1966), abrasives, blast, chemical, enamel, engine, fill, filler, filtration, foundry, glass (ground), grinding and polishing, oil (hydrafrac), pottery, porcelain, tile, and other construction and industrial sands.

Table 10.—Production of sand and gravel and stone in 1967, 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	W	W	755	$1,392	Livingston	41	$47	1,850	$2,879
Alexander	116	W	1	3	Logan	228	W	W	W
Bond	150	$167	-----	-----	McDonough	------	------	W	W
Boone	W	W	362	W	McHenry	5,496	4,035	9	12
Brown	W	W	W	W	McLean	W	W	------	------
Bureau	2,338	1,485	-----	-----	Macon	W	W	------	------
Calhoun	-----	-----	29	49	Madison	221	186	726	1,372
Carroll	16	W	193	W	Marion	------	------	W	W
Cass	6	4	-----	-----	Marshall	244	W	------	------
Champaign	727	702	-----	-----	Mason	18	17	------	------
Christian	-----	-----	W	W	Massac	91	74	W	W
Clark	319	W	W	W	Menard	5	3	W	W
Clay	-----	-----	139	W	Mercer	W	W	W	W
Clinton	5	3	W	W	Monroe	------	------	W	W
Coles	228	W	W	W	Montgomery	------	------	984	1,424
Cook	1,177	1,064	W	W	Moultrie	25	17	------	------
Crawford	301	W	-----	-----	Ogle	807	1,664	456	529
Cumberland	265	W	W	W	Peoria	1,214	1,090	841	1,207
De Kalb	382	W	W	W	Pike	W	W	419	W
De Witt	W	W	-----	-----	Pope	W	W	------	------
Douglas	-----	-----	W	W	Pulaski	11	6	W	W
Du Page	W	W	W	W	Putnam	W	W	------	------
Effingham	W	W	-----	-----	Randolph	W	W	1,210	1,435
Fayette	118	84	W	W	Rock Island	W	W	W	W
Ford	291	281	-----	-----	St. Clair	W	W	1,912	2,980
Fulton	537	664	-----	-----	Sangamon	649	W	------	------
Gallatin	271	W	-----	-----	Schuyler	W	W	41	W
Greene	-----	-----	246	W	Scott	------	------	110	W
Grundy	2,135	W	-----	-----	Shelby	135	122	------	------
Hancock	-----	-----	390	536	Stephenson	185	179	514	551
Hardin	-----	-----	1,691	2,177	Tazewell	1,261	1,516	------	------
Henderson	3	3	286	445	Union	17	14	867	W
Henry	W	W	W	W	Vermilion	173	W	W	W
Iroquois	21	17	-----	-----	Wabash	155	152	------	------
Jackson	W	W	W	W	Warren	------	------	W	W
Jefferson	-----	-----	78	168	Washington	------	------	313	W
Jersey	-----	-----	92	146	White	194	188	------	------
Jo Daviess	67	42	450	385	Whiteside	92	W	261	312
Johnson	-----	-----	W	W	Will	3,285	W	2,552	3,547
Kane	3,229	2,638	478	825	Winnebago	1,522	1,470	850	924
Kankakee	5	4	W	W	Woodford	106	111	------	------
Kendall	323	W	W	W	Undistributed [2]	3,684	13,479	26,405	40,749
Knox	W	W	W	W					
Lake	1,066	W	-----	-----	Total [3]	38,801	44,175	48,458	66,757
La Salle	4,271	12,398	1,739	1,467					
Lawrence	299	249	-----	-----					
Lee	276	W	1,203	1,241					

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

[1] All stone production consisted of limestone, except in Alexander County where stone production consisted entirely of sandstone. No sand and gravel or stone production reported from the following counties: Edgar, Edwards, Franklin, Hamilton, Jasper, Macoupin, Morgan, Perry, Piatt, Richland, Saline, Stark, Wayne, and Williamson.

[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.

percent for refractory purposes, and the remainder in construction. Of that portion used for chemical and industrial purposes, 80 percent was used in metallurgical processes and 13 percent in water purification. About 31 percent of the lime was shipped to consumers in Illinois, while 57 percent went to Indiana. Nearly 780,000 tons of lime was shipped into and within the State.

Perlite.—Crude perlite mined outside the State was expanded by six companies with plants in Champaign, Cook, DeKalb, Lake, and Will Counties. Production of the expanded product increased nearly 2 percent in quantity and 8 percent in value. Principal uses included roof insulation, 72 percent; loose fill insulation, 6 percent; filter aid, 5 percent; building plaster, 3 percent; and other uses, 14 percent. Three companies with plants in Cook, Kankakee, and Will Counties had no production in 1967.

Sand and Gravel.—Illinois ranked seventh in the Nation in quantity, and fourth in value, of sand and gravel produced. Total production increased about 2 percent in both quantity and value. Production was reported from 71 counties in which there were 225 commercial and 100 Government-and-contractor operations. Commercial operations accounted for 96 percent of the total production. About three-fourths 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, 43 percent was used as paving material, 35 percent as building material, and the remainder as industrial sands, railroad ballast, and fill. Most use categories showed minor fluctuations from 1966. A 6-percent decrease in building sand and gravel, and a 1-percent increase in paving material, along with an increase of fill material exceeding 1 million tons, resulted in a net 600,000-ton increase in total sand and gravel production. Bureau, Cook, Grundy, Kane, Lake, La Salle, McHenry, Peoria, Tazewell, Will, and Winnebago counties each had production exceeding 1 million tons and provided over two-thirds of the State production.

Stone.—Illinois ranked third in the Nation in stone production and value. Although nearly all production was limestone, a small amount of sandstone (ganister) was mined in Alexander County. Total production increased 5 percent in quantity and 10 percent in value. Over three-fourths of the production was used in concrete aggregate and roadstone; other major uses were for agricultural purposes and cement. The use of limestone for agricultural purposes declined 21 percent, while use in concrete aggregate and roadstone increased 10 percent, and use in cement increased nearly 7 percent. About 88 percent of the crushed and broken stone was shipped by truck, 9 percent by rail, and 3 percent by water.

Table 11.—Limestone sold or used by producers, by uses

Use		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:					
Rubble	thousand short tons	2	$14	2	$19
House stone veneer	thousand cubic feet	23	106	22	51
Cut stone	do	------	--------	3	26
Flagging	do	12	9	13	14
Total	approximate thousand short tons [1]	5	129	5	110
Crushed and broken:					
Riprap	thousand short tons	645	941	636	1,203
Concrete aggregate and roadstone	do	34,521	45,381	37,958	52,264
Railroad ballast	do	552	581	561	630
Agriculture	do	4,923	7,319	3,879	5,983
Cement	do	2,550	2,093	2,724	2,334
Asphalt	do	W	W	30	128
Other [2]	do	2,961	4,510	2,663	4,103
Total [3]	do	46,152	60,824	48,452	66,644
Grand total	do	46,157	60,953	48,457	66,754

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Average weight of 170 pounds per cubic foot used to convert cubic feet to short tons.
[2] Includes limestone for asphalt filler (1966), filter beds (1967), chemical uses, dust for coal mines, fertilizer, lime, metallurgical uses, mineral food, poultry grit, stone sand, whiting or whiting substitute, and other uses.
[3] Data may not add to totals shown because of independent rounding.

Production of crushed and broken limestone was reported from 60 counties, 11 of which had production exceeding 1 million tons. Those 11 counties, Cook, Du Page, Hardin, Kankakee, La Salle, Lee, Livingston, Randolph, Rock Island, St. Clair, and Will, produced two-thirds of the State total crushed and broken stone; Cook County alone contributed nearly one-third of the total. Dimension stone was produced in Kane, McHenry, and Union Counties.

Sulfur.—Shipments of elemental sulfur remained about the same in quantity as in 1966, but increased 22 percent in value.

The Anlin Company of Illinois recovered sulfur by the Amine-Gas-Purification and Modified-Clause processes at its Hartford plant in Madison County. The Pure Oil Co., a Division of Union Oil Co. of California, recovered sulfur by the Modified-Claus process at its Lemont plant in Will County.

Tripoli (Amorphous Silica).—Crude material was recovered from underground mines in Alexander County by Illinois Minerals Co. near Elco and Tamms Industries Co. near Tamms. The production of crude material increased nearly 13 percent in quantity and over 10 percent in value. Output of prepared material increased 2 percent in quantity and 20 percent in value. Prepared material was used for abrasives, filler, and other purposes.

Vermiculite.—Crude vermiculite mined outside the State was processed at plants operated by three companies in Cook, DeKalb, and Macoupin Counties. The output of exfoliated vermiculite, used for insulation, concrete and plaster aggregate, masonry fill, and agricultural purposes, declined about 14 percent in quantity and 15 percent in value.

METALS

Lead and Zinc.—While production of recoverable lead metal increased 4 percent, that of zinc metal increased 34 percent. The substantial gain in zinc production chiefly resulted from the increase in fluorspar production and the first full year of operation for the Eagle-Picher Industries, Inc., Rehm-Bauer mine. The total value of lead produced declined 3 percent, while the value of zinc increased 28 percent. Average weighted yearly prices of lead and zinc were 14.00 cents per pound for lead and 13.84 cents per pound for zinc. The 1966 averages were 15.12 cents per pound for lead and 14.50 cents per pound for zinc. The principal producer in northern Illinois was Eagle-Picher Industries, Inc., and those in southern Illinois, were Aluminum Company of America, Minerva Oil Co., and Ozark-Mahoning Co. Southern Illinois producers recovered lead and zinc as byproducts from their fluorspar operations.

Pig Iron and Steel.—About 6.2 million tons of pig iron, valued at $348.6 million, was shipped from Illinois blast furnaces or was consumed by the producing companies. This quantity represented a decrease of nearly 5 percent from 1966 production. Pig iron was produced at blast furnaces in Granite City and South Chicago. The dismantling of the three blast furnaces of Youngstown Sheet & Tube Co. was completed.

About 4.0 million short tons of domestic iron and manganiferous ores (excluding agglomerates), 2.2 million short tons of sinter, and 2.8 million tons of pellets were consumed in Illinois blast furnaces; pellet consumption increased by one-sixth.

Table 12.—Mine production of lead and zinc

Year	Mines producing	Crude ore sold or treated			Lead (recoverable metal)		Zinc (recoverable metal)		Total value (thousands)
		Fluorspar-lead-zinc	Lead and/or zinc	Total	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	13	400,283	350,647	750,930	2,901	$627	20,337	$4,678	$5,304
1964	14	359,247	177,894	537,141	2,180	571	13,800	3,754	4,325
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

The iron and steel industry consumed over 2.3 million short tons of limestone and dolomite—about 59 percent in blast furnaces, 21 percent in agglomerating plants, and 20 percent in steel furnaces. Nearly 4.3 million short tons of coke was consumed by blast furnaces. Illinois agglomerating plants consumed 2.8 million short tons of iron ore. Over 27 percent of the iron ore consumed by agglomerating plants and 81 percent of the 515,000 tons of ore consumed in steel furnaces was of foreign origin. Data for nonintegrated steel plants are not included.

According to the American Iron and Steel Institute, steel production in Illinois was 10.6 million tons, a decrease of 3 percent from the 1966 quantity.

Other Metals.—American Zinc Co. recovered byproduct cadmium at its Monsanto plant and byproduct cadmium and germanium from domestic zinc ores at its Fairmont City plant; both plants are in St. Clair County. 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 containing thorium, rare-earth elements, and yttrium at its West Chicago plant. The company raised its yttrium oxide capacity to 150,000 pounds per year.

Table 13.—Principal producers and processors of metals, minerals, and mineral fuels

Commodity and company	Location of operation		Remarks
	Nearest town	County	
Ground barite:			
Chas. Pfizer & Co. Inc., Minerals, Pigments & Metals Division.	East St. Louis	St. Clair	
Cement:			
Alpha Portland Cement Co	La Salle	La Salle	Portland and masonry, dry process.
Marquette Cement Manufacturing Co	Oglesby	----do	Do.
Medusa Portland Cement Co	Dixon	Lee	Do.
Missouri Portland Cement Co	Joppa	Massac	Do.
Clays and shale: [1]			
American Brick Co	Dolton	Cook	Brick.
Hydraulic Press Brick Co	Utica	La Salle	Do.
Do	Streator	Livingston	Pit only, processed at Utica. Brick.
Do	Sparland	Marshall	Underground mine. Brick.
Do	Aledo	Mercer	Brick.
Do	East St. Louis	St. Clair	Lightweight aggregate.
Illinois Brick Co	Blue Island	Cook	Brick.
Illinois Clay Products Co., Division A.P. Green Refractories Co.	Coal City	Grundy	Firebrick, foundries.
Marquette Cement Manufacturing Co	Oglesby	La Salle	Cement.
Material Service Division, General Dynamics Corp	Ottawa	----do	Lightweight aggregate.
Medusa Portland Cement Co	Dixon	Lee	Cement.
Richards Brick Co	New Douglas	Bond	Pit only, processed at company plant in Madison County. Brick.
Western Brick Co	Danville	Vermilion	Brick, lightweight aggregate.
Coal (bituminous):			
Ajax Coal Co., Inc	Elkville	Jackson	Strip mine.
Ayrshire Collieries Corp:			
Delta	Marion	Williamson	Strip mine and cleaning plant.
Harmattan	Danville	Vermilion	Do.
Sun Spot	Vermont	Fulton	Do.
Barbara Kay Coal, Inc	Marion	Williamson	Underground mine and cleaning plant.
Bell & Zoller Coal Co	Johnston City	----do	Do.
Belle Valley Coal Co., Inc	Belleville	St. Clair	Do.
Blue Bird Coal Co	Harrisburg	Williamson	Underground mine.
Florida Coal Co	Gillespie	Macoupin	Underground mine and cleaning plant.
Forsyth-Energy Co	Herrin	Williamson	Strip mine and cleaning plant.
Freeman Coal Mining Corp.:			
Crown	Farmersville	Montgomery	Underground mine and cleaning plant.
Orient No. 3	Waltonville	Jefferson	Do.
Orient No. 4	Pittsburg	Williamson	Do.
Orient No. 5	Benton	Franklin	Do.
Main Line Coal Corp:			
No. 1	Cambria	Williamson	Strip mine. Abandoned in August.
No. 2	Elkville	Jackson	Strip mine.
No. 3	Dowell	----do	Do.
Midland Electric Coal Corp:			
Mecco	Victoria	Knox	Strip mine and cleaning plant.
Middle Grove	Farmington	Fulton and Knox	Strip mine. Cleaning plant in Fulton County.

Table 13.—Principal producers and processors of metals, minerals, and mineral fuels—Continued

Commodity and company	Location of operation		Remarks
	Nearest town	County	
Coal—Continued			
Moffat Coal Co	Murdock	Douglas	Underground mine and cleaning plant.
Old Ben Coal Corp:			
Old Ben No. 9	West Frankfort	Franklin	Do.
Old Ben No. 21	Sesser	----do	Do.
Old Ben No. 24	Benton	----do	Underground mine.
Peabody Coal Co.:			
No. 10	Pawnee	Christian	Underground mine and cleaning plant.
Eagle	Shawneetown	Gallatin	Strip and underground mine.
Bright Star	Fairview	Fulton	Strip mine and cleaning plant.
Edwards	Edwards	Peoria	Do.
Midwest	Millstadt	St. Clair	Strip and underground mine and cleaning plant.
Northern Illinois	Essex	Grundy and Will	Strip mine. Cleaning plant in Kankakee County.
River King	Freeburg	St. Clair	Strip mine and cleaning plant.
Utility	Marion	Williamson	Underground mine and cleaning plant.
Sahara Coal Co., Inc.:			
No. 5	Harrisburg	Saline	Underground mine.
No. 6	----do	----do	Strip mine and cleaning plant.
No. 16	----do	----do	Underground mine.
Sherwood-Templeton Coal Co., Inc	Laura	Peoria	Strip mine and cleaning plant.
Southwestern Illinois Coal Corp:			
Captain	Cutler	Perry	Do.
Streamline	Percy	----do	Strip mine. Cleaning plant in Randolph County.
Stonefort Coal Mining Co., Inc.:			
Allendale	Wyoming	Stark	Strip mine and cleaning plant.
Will Scarlet	Stonefort	Saline and Williamson	Strip mine. Cleaning plant in Williamson County.
Tab Mining Co., Inc	Carbondale	Jackson	Strip mine.
Truax-Traer Coal Division, Consolidation Coal Co., Inc.:			
Burning Star No. 2	Du Quoin	Perry	Strip mine and cleaning plant.
Burning Star No. 3	Sparta	Randolph	Do.
Hillsboro	Coffeen	Montgomery	Underground mine.
Little Sister	St. David	Fulton	Strip mine and cleaning plant. Closed in November.
Red Ember	Fiatt	----do	Strip mine and cleaning plant.
The United Electric Coal Cos.:			
Cuba No. 9	Cuba	Fulton	Do.
Fidelity No. 11	Du Quoin	Perry	Do.
Buckheart No. 17	Canton	Fulton	Do.
Banner No. 27	Glasford	Peoria	Do.
Zeigler Coal & Coke Co	Sparta	Randolph	Underground mine and cleaning plant.
Coke:			
General Motors Corp	Waukegan	Lake	
Granite City Steel Co	Granite City	Madison	
Interlake Steel Corp	South Chicago	Cook	
International Harvester Co	----do	----do	
Republic Steel Corp	----do	----do	

Ground feldspar:			
Briggs Manufacturing Co	Abingdon	Knox	
Fluorspar:			
Aluminum Company of America	Rosiclare	Hardin	Processed stockpiled crude ore.
Minerva Oil Co.:			
Crystal Group	Elizabethtown	----do	Underground mine and mill.
Minerva No. 1	Cave-in-Rock	----do	Do.
Ozark-Mahoning Co	Rosiclare	Hardin and Pope	Underground mines. Mill in Hardin County.
Gypsum:			
National Gypsum Co	Waukegan	Lake	Calcining, fabricating.
Iron and steel:			
Granite City Steel Co	Granite City	Madison	
Interlake Steel Corp	South Chicago	Cook	
Republic Steel Corp	----do	----do	
United States Steel Corp	----do	----do	
Wisconsin Steel Division, International Harvester Co.	----do	----do	
Iron oxide pigments:			
Chas. Pfizer & Co., Inc., Minerals, Pigments & Metals Division.	East St. Louis	St. Clair	
Geo. B. Smith Chemical Works, Inc	Maple Park	Kane	
Tamms Industries Co	Springfield	Sangamon	
Lead and zinc:			
Aluminum Company of America	Rosiclare	Hardin	Processed stockpiled crude ore.
Eagle-Picher Industries, Inc.:			
Blackjack and Rehm-Bauer	Galena	Jo Daviess	Underground mines, ore processed at Graham mill.
Graham mill	----do	----do	
Minerva Oil Co.:			
Crystal Group	Elizabethtown	Hardin	Underground mine and mill.
Minerva No. 1	Cave-in-Rock	----do	Do.
Ozark-Mahoning Co	Rosiclare	Hardin and Pope	Underground mines. Mill in Hardin County.
Lime:			
Marblehead Lime Co	Marblehead	Adams	Quicklime and hydrated lime, 3 shaft kilns.
Do	Quincy	----do	Quicklime, 1 calcimatic kiln.
Do	South Chicago and Thornton.	Cook	Quicklime and hydrated lime, 4 rotary kilns at each plant.
Menke Stone & Lime Co	Quincy	Adams	Quicklime and hydrated lime, 2 shaft kilns.
Standard Lime & Refractories Co., Division Martin Marietta Corp.	McCook	Cook	Quicklime, 3 rotary kilns.
Magnesium compounds:			
Johns-Manville Product Corp	Waukegan	Lake	
Ground mica:			
U.S. Mica Co., Inc	Forest Park	Cook	
Natural Gas Processing:			
U.S. Industrial Chemical Co., Division of National Distillers & Chemical Corp.	Tuscola	Douglas	
Peat:			
Anderson Peat Co	Morrison	Whiteside	Moss peat.
Markman Peat Co	----do	----do	Reed-sedge peat.
Expanded perlite:			
Filter Materials Corp	Lake Zurich	Lake	
Johns-Manville Perlite Corp	Rockdale	Will	
Mica Pellets, Inc	De Kalb	De Kalb	
National Gypsum Co	Waukegan	Lake	
Ryolex Corp	Champaign	Champaign	
Silbrico Corp	Chicago	Cook	

Table 13.—Principal producers and processors of metals, minerals, and mineral fuels—Continued

Commodity and company	Location of operation		Remarks
	Nearest town	County	
Petroleum refineries:			
American Oil Co	Wood River	Madison	
Clark Oil & Refining Co	Blue Island	Cook	
Do	Hartford	Madison	
Marathon Oil Co	Robinson	Crawford	
Mobil Oil Corp	East St. Louis	St. Clair	
Shell Oil Co	Wood River	Madison	
Texaco, Inc	Lawrenceville	Lawrence	
Do	Lockport	Will	
Union Oil Co. of California	Lemont	Cook	
Sand and gravel: [2]			
Bellrose Silica Co	Ottawa	La Salle	Stationary plant, industrial sands.
Chicago Gravel Co	Elgin	Cook	Stationary plant.
Do	Joliet and Plainfield	Will	Stationary plants.
Concrete Materials Division, Martin Marietta Corp	Forreston	Ogle	Dredge.
Do	Chillicothe, Oak Hill, and Pottstown.	Peoria	Dredge at Chillicothe.
Do	Mackinaw and Pekin	Tazewell	Dredges.
Crystal Lake Trucking & Excavating Co	Algonquin and Cary	McHenry	Dredge at Algonquin.
Elmhurst-Chicago Stone Co	Bartlett, Warrenville, and West Chicago	DuPage	Stationary plants.
Do	Lisle	Will	Stationary plant.
Illinois-Wisconsin Sand & Gravel Co	South Beloit	Winnebago	Stationary plant and dredge.
Kenny & Palumbo	Bureau Junction	Bureau	Pit run material.
Larson Bros. Sand & Gravel	Rockford	Winnebago	Stationary plant.
McHenry Sand & Gravel Co., Inc	McHenry	McHenry	
Manley Sand Division, Martin Marietta Corp	Oregon	Ogle	Stationary plant, industrial sands.
Material Service Division, General Dynamics Corp	Spaulding and Wheeling.	Cook	Stationary plants.
Do	Morris	Grundy	Stationary plant.
Do	East Dundee	Kane	Do.
Do	Algonquin	McHenry	Do.
Do	Channahon and Lockport	Will	Stationary plants.

Moline Consumers Co	Bureau	Bureau	Stationary plant.
Do	Sheridan	La Salle	Do.
Do	Cordova and Milan	Rock Island	Stationary plants.
Ottawa Silica Co	Ottawa	La Salle	Stationary plant, industrial sands.
C. A. Powley Co	East Peoria	Tazewell	Stationary plant.
Road Materials Corp., E. M. Melahn Const. Co., Inc	East Dundee	Kane	Do.
Do	Island Lake	McHenry	Do.
Rowe Construction Co., R. A. Cullinan & Son	Strawn	Livingston	
Do	Arrowsmith, Bloomington, Danvers, Downs, Heyworth, Lexington, and Saybrook.	McLean	Stationary plant at Heyworth.
Strunk Brothers Co	Tiskilwa	Bureau	
Urban Sand & Gravel Co	Champaign and Mahomet.	Champaign	Dredge at Champaign.
Do	Greenup	Cumberland	Dredge.
Vulcan Materials Co., Midwest Division	Algonquin	Kane	Stationary plant.
Do	Wadsworth	Lake	Do.
Do	Crystal Lake	McHenry	Do.
Wedron Silica Co	Wedron	La Salle	Stationary plant, industrial sands.
Smelters and refineries:			
American Smelting & Refining Co	Beckemeyer	Clinton	Zinc secondary plant.
American Zinc Co	Fairmont City	St. Clair	Zinc primary plant (roasting only).
Do	Hillsboro	Montgomery	Zinc secondary plant.
Do	Monsanto	St. Clair	Zinc primary plant.
Apex Smelting Co	Chicago	Cook	Zinc secondary plant.
Continental Smelting & Refining Co	McCook	----do	Lead secondary plant.
Goldsmith Bros. Division of National Lead Co	Chicago	----do	Do.
Imperial Type Metals Co	----do	----do	Do.
National Lead Co	----do	----do	Do.
Do	Granite City	Madison	Do.
The New Jersey Zinc Co	Depue	Bureau	Zinc primary plant.
Sandoval Zinc Co	Sandoval	Marion	Zinc secondary plant.
Stone: [3]			
Columbia Quarry Co	Karnak	Massac	Stationary plant.
Do	Valmeyer	Monroe	Stationary plant, underground mine.
Do	Ullin	Pulaski	Stationary plant.
Do	Columbia and Dupo	St. Clair	Stationary plants.
Dolese & Shepard Co	Hodgkins	Cook	Stationary plant.
East St. Louis Stone Co	Dupo	St. Clair	Do.
Elmhurst-Chicago Stone Co	Elmhurst	DuPage	Do.
Industrial Chemicals Division, Allied Chemicals Corp	Prairie du Rocher	Randolph	Stationary plant, underground mine.
Lehigh Stone Corp	Kankakee	Kankakee	Stationary plant.
Lincoln Stone Quarry, Inc	Joliet	Will	Do.
Marquette Cement Manufacturing Co	Oglesby	La Salle	Do.
Material Service Division General Dynamics Corp	Chicago, McCook, and Thornton.	Cook	Stationary plants.
Do	Tuscola	Douglas	Stationary plant.
Do	Fairmount	Vermilion	Do.
Do	Lockport	Will	Do.
Medusa Portland Cement Co	Dixon	Lee	Do.
Midwest Stone Co	Anna	Union	
Mississippi Lime Co	Alton	Madison	Stationary plant, underground mine.

See footnotes at end of table.

Table 13.—Principal producers and processors of metals, minerals, and mineral fuels—Continued

Commodity and company	Location of operation		Remarks
	Nearest town	County	
Stone—Continued			
Moline Consumers Co	Loraine, Marcellene, Payson, Quincy, and Richfield.	Adams	
Do	Mt. Sterling	Brown	
Do	Cleveland	Henry	Stationary plant.
Do	Florence and Kinderhook.	Pike	
Do	Hillsdale and Milan	Rock Island	Stationary plants.
Do	St. Augustine	Warren	Stationary plant.
National Stone Co. Division of Dolese & Shepard Co	Joliet	Will	Do.
Pontiac Stone Co	Pontiac	Livingston	Do.
Rein, Schultz & Dahl, Inc	Mt. Carroll, Savanna	Carroll	
Do	Derinda, East Dubuque, Galena.	Jo Daviess	
Do	Kent, Lena, and Ridott	Stephenson	
Do	Rock Falls, and Woosung.	Whiteside	
Do	Freeport	Winnebago	
River Sand & Stone Co	Rosiclare	Hardin	Stationary plant, underground and open quarry.
Southern Illinois Stone Co	Buncombe	Johnson	Stationary plant.
Vulcan Materials Co Midwest Division	Hillside, Hodgkins Lemont, and McCook	Cook	Stationary plants.
Do	Joliet	Will	Stationary plant.
Recovered Sulfur:			
The Anlin Company of Illinois	Hartford	Madison	Amine-Gas-Purification and Modified-Claus processes.
The Pure Oil Co. Division of Union Oil Co. of California.	Lemont	Will	Modified-Claus process.
Tripoli (amorphous silica):			
Illinois Minerals Co	Elco	Alexander	Underground mine.
Tamms Industries Co	Tamms	----do	Do.
Exfoliated vermiculite:			
International Vermiculite Co	Girard	Macoupin	
Mica Pellets, Inc	De Kalb	De Kalb	
Zonolite Division W. R. Grace & Co	Franklin Park	Cook	

[1] All companies listed under "Clays and Shale" operated pits and processing plants; products manufactured are shown under "Remarks" column.
[2] Portable plants were operated at the listed locations unless otherwise specified.
[3] All companies produced crushed limestone, and operated portable crushing plants at the listed locations unless otherwise stated.

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. Kiyce [1] and Mary B. Fox [2]

In 1967, the value of mineral production in Indiana reached a record high of $245 million. Portland cement, coal, sand and gravel, and stone registered substantial gains over the previous year. Production of construction materials—cement, clays, gypsum, lime, sand and gravel, and stone —was nearly 7 percent larger than in 1966. The output of mineral fuels increased at a lower rate because of a decline in the production of natural gas and petroleum. Nonmetals accounted for nearly 58 percent of the value of State mineral production. The remainder represented the value of mineral fuels, since no metallic ores were mined in the State.

Mineral production was reported from 87 of the 92 counties in Indiana. Nearly half the value of State mineral production came from six counties: Clark, Lake, Lawrence, Putnam, Sullivan, and Warrick. In these counties most of the cement, nearly two-thirds of the coal, and substantial quantities of building and crushed stone, sand and gravel, and clay were produced. Twenty-eight counties had mineral production valued at $1 million or more. No mineral production was reported in Benton, Brown, Ohio, Tipton, and Vanderburgh Counties.

Legislation and Government programs.— The 1967 Indiana Legislature enacted a revised strip-mining law (House enrolled act 1789) to become effective January 1, 1968. This law which applies to all coal, clay, and shale surface-mining operations on land owned or leased by the operator, is administered by the Indiana Natural Resources Commission. It requires operators to submit a complete plan of land reclamation before a mining permit is issued. A permit must be obtained each year and bond posted.

Grading guidelines specified by the commission require that land good only for trees be graded to a rolling terrain of no more than 33⅓ percent, land for row crops must have a slope of no more than 8 percent, and pasture land of high quality is to be graded to a slope of no more than 25 percent. Peaks and ridges will not be permitted. A soil test will help determine land capability.

[1] Industry economist, Bureau of Mines, Minneapolis, Minn.
[2] Mineral statistician, Geological Survey, Indiana Department of Natural Resources, Bloomington, Ind.

Table 1.—Mineral production in Indiana [1]

Mineral		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Abrasives (whetstones)	short tons	5	$15	5	$16
Cement, portland	thousand 376-pound barrels	15,305	49,826	15,924	53,123
Clays	thousand short tons	1,491	2,196	1,489	2,126
Coal (bituminous)	do	17,326	67,857	18,772	73,419
Natural gas	million cubic feet	215	51	198	46
Peat	short tons	38,111	456	42,962	441
Petroleum (crude)	thousand 42-gallon barrels	10,617	31,850	10,081	30,041
Sand and gravel	thousand short tons	24,992	23,542	26,265	25,588
Stone	do	24,323	42,474	26,977	46,725
Value of items that cannot be disclosed: Masonry cement, gypsum, and lime		XX	11,743	XX	13,396
Total		XX	230,010	XX	244,921
Total 1957–59 constant dollars		XX	230,890	XX	p 242,760

p Preliminary. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

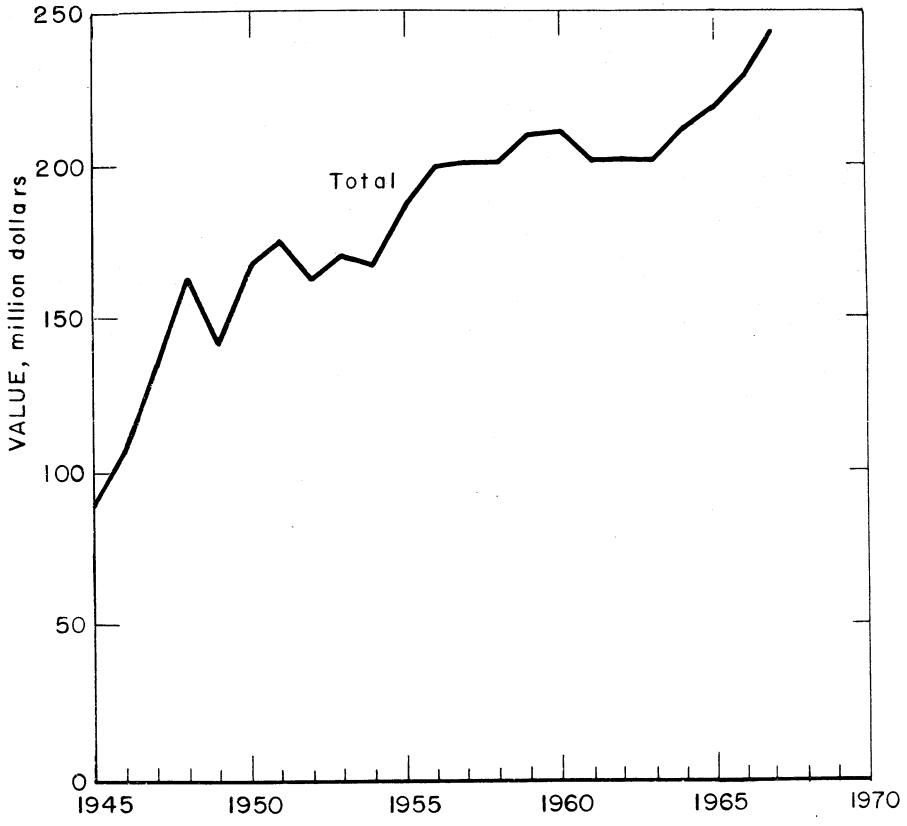

Figure 1.—Total value of mineral production in Indiana.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Adams	$719	$794	Stone, sand and gravel, clays.
Allen	2,614	2,855	Stone, sand and gravel.
Bartholomew	W	W	Stone.
Blackford	W	W	Stone, sand and gravel, clays.
Boone	138	137	Sand and gravel.
Carroll	W	W	Stone, sand and gravel.
Cass	W	W	Cement, stone, sand and gravel, clays.
Clark	W	W	Do.
Clay	5,097	W	Coal, clays.
Clinton	46	W	Sand and gravel.
Crawford	W	W	Stone.
Daviess	210	W	Sand and gravel, coal.
Dearborn	W	236	Sand and gravel.
Decatur	W	390	Stone.
De Kalb	385	368	Sand and gravel.
Delaware	1,400	1,361	Stone, sand and gravel.
Dubois	2	1	Clays.
Elkhart	619	496	Sand and gravel, stone.
Fayette	W	287	Sand and gravel.
Floyd	W	W	Stone.
Fountain	653	621	Sand and gravel, clays, coal.
Franklin	33	W	Sand and gravel, clays.
Fulton	231	198	Sand and gravel, stone.
Gibson	W	W	Coal, sand and gravel.
Grant	W	W	Stone, sand and gravel, peat.
Greene	9,605	8,633	Coal, sand and gravel, clays.
Hamilton	1,627	2,487	Sand and gravel, stone.
Hancock	W	55	Sand and gravel.
Harrison	814	1,380	Sand and gravel, stone.
Hendricks	W	W	Sand and gravel.
Henry	W	W	Do.
Howard	W	W	Stone, sand and gravel.
Huntington	W	1,636	Stone, sand and gravel, clays.
Jackson	316	385	Sand and gravel, clays.
Jasper	676	W	Stone, sand and gravel.
Jay	W	W	Do.
Jefferson	W	W	Stone.
Jennings	323	328	Do.
Johnson	W	W	Sand and gravel.
Knox	719	739	Sand and gravel, coal.
Kosciusko	577	614	Sand and gravel, stone.
Lagrange	W	294	Do.
Lake	W	W	Cement, lime, sand and gravel, clays.
La Porte	W	W	Sand and gravel, stone.
Lawrence	14,199	16,417	Cement, stone.
Madison	1,726	2,105	Stone, sand and gravel.
Marion	W	W	Sand and gravel, peat.
Marshall	320	176	Sand and gravel, stone, peat.
Martin	W	W	Gypsum, stone.
Miami	W	414	Sand and gravel.
Monroe	8,262	8,293	Stone.
Montgomery	73	109	Clays, sand and gravel.
Morgan	950	970	Clays, sand and gravel, stone.
Newton	W	W	Sand and gravel, stone.
Noble	225	220	Do.
Orange	750	719	Stone, abrasives.
Owen	899	1,128	Stone, sand and gravel, clays, coal.
Parke	406	323	Sand and gravel, coal, clays.
Perry	W	W	Stone.
Pike	8,992	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	11,079	12,299	Cement, stone, sand and gravel, clays.
Randolph	W	341	Stone, sand and gravel.
Ripley	484	425	Stone.
Rush	332	315	Stone, sand and gravel.
St. Joseph	629	718	Sand and gravel, stone.
Scott	258	305	Stone.
Shelby	1,222	1,262	Stone, sand and gravel.
Spencer	498	W	Coal, stone.
Starke	W	37	Sand and gravel.
Steuben	W	W	Sand and gravel, stone.
Sullivan	11,986	15,314	Coal, sand and gravel, stone.
Switzerland	W	W	Sand and gravel, stone.
Tippecanoe	W	W	Sand and gravel.
Union	13	18	Do.
Vanderburgh	21	----------	
Vermillion	576	369	Sand and gravel, clays, coal.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Vigo	$3,362	$3,210	Coal, sand and gravel.
Wabash	441	498	Stone, sand and gravel.
Warren	W	W	Sand and gravel, peat.
Warrick	28,299	W	Coal, sand and gravel, stone.
Washington	W	W	Stone, sand and gravel.
Wayne	712	W	Sand and gravel, stone.
Wells	W	W	Stone, sand and gravel, peat.
White	349	384	Stone.
Whitley	W	W	Sand and gravel.
Undistributed [2]	106,142	154,256	
Total [3]	230,010	244,921	

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, values for these commodities are included with "Undistributed." Benton, Brown, Ohio, and Tipton Counties are not listed because no production was reported.

[2] Includes value for petroleum, natural gas, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

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

Table 3.—Indicators of Indiana business activity

		1966	1967	Change (percent)
Personal income:				
Total	millions	$15,230	p $16,205	+6.4
Per capita		$3,076	p $3,241	+5.4
Construction activity:				
Building permits:				
Valuation of authorized residential and nonresidential private construction	millions	$427.9	$458.1	+7.1
Number of private and public residential building permits issued		18,236	19,755	+8.3
Contract construction work performed:				
Total	millions	$1,282	$1,370	+6.9
Nonresidential building	do	$560	$590	+5.4
Residential building	do	$366	$442	+20.8
Nonbuilding	do	$356	$338	−5.1
State highway commission contracts awarded	do	$163.5	$134.3	−17.9
Portland cement shipments to and within Indiana	thousand 376-pound barrels	9,812	10,699	+9.0
Cash receipts from farm marketings	millions	$1,460.7	$1,350.1	−7.6
Mineral production	do	$230.0	$244.9	+6.5
Raw steel production	thousand tons	18,044.0	17,613.6	−2.4
Manufacturing payrolls	millions	$5,002.9	$5,083.9	+1.6
Annual average labor force and employment: [1]				
Total labor force	thousands	2,033.6	2,073.5	+2.0
Agricultural employment	do	71.8	62.4	−13.1
Nonagricultural employment [2]	do	1,907.4	1,939.1	+1.7
Construction	do	78.2	84.2	+7.7
Manufacturing	do	719.7	714.4	−.7
Mining and quarrying	do	7.5	7.2	−4.0
Primary metal industries	do	111.8	110.7	−1.0
Steel mills	do	68.0	67.0	−1.5
Stone, clay, and glass products	do	26.1	26.2	+.4
Transportation	do	58.7	58.1	−1.0

p Preliminary.

[1] Adjusted to March 1967 benchmark levels.

[2] Includes nonagricultural, self-employed, and unpaid family workers, and domestic workers in private households.

Sources: Survey of Current Business, Construction Review, Statistical Abstract of the United States, Indiana State Highway Commission, Farm Income Situation, American Iron and Steel Institute, Indiana Employment Security Division in cooperation with the United States Department of Labor.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	2,047	261	534	4,113	2	136	33.55	3,886
Peat	30	260	8	70	-------	4	57.31	1,118
Nonmetal	834	256	213	1,689	-------	28	16.58	2,432
Sand and gravel	1,145	242	277	2,402	3	38	17.07	7,873
Stone	3,106	292	907	7,478	2	158	21.40	3,704
Total [1]	7,162	271	1,938	15,752	7	364	23.55	4,239
1967: [p]								
Coal	2,150	248	534	4,232	7	138	34.26	10,870
Peat	25	228	6	46	-------	2	43.94	857
Nonmetal	885	257	228	1,798	-------	24	13.35	280
Sand and gravel	1,110	232	257	2,227	1	44	20.20	4,994
Stone	3,160	279	883	7,277	-------	127	17.45	646
Total [1]	7,335	260	1,908	15,580	8	335	22.02	4,003

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Materials.—For more than 150 years, sandstone has been quarried in Orange County for fabrication of whetstones at a mill near Orleans. This is one of the oldest quarrying and mineral-processing operations in the State.

Cement.—Shipments of portland cement continued to increase, exceeding the record high established in 1966 by more than 4 percent. The output of masonry cement was slightly lower than in 1966. Portland cement was produced at five plants, four of which also produced masonry cement. The average mill value of portland cement was $3.34 per barrel compared with $3.26 in 1966. The price of masonry cement remained unchanged at $3.09 per barrel. Yearend stocks of portland cement were nearly 1.9 million barrels compared with 2.5 million (adjusted) in 1966. About 39 percent of the portland cement shipped was used within the State. Out-of-State shipments were principally to Illinois, Kentucky, and Wisconsin; shipments were also made to 13 other States. Over 4.5 million barrels of portland cement were shipped into Indiana from plants located in other States, principally Illinois, Kentucky, Michigan, New York, and Ohio.

Nearly 3.5 million tons of limestone and more than 1 million tons of slag, clays and shale, gypsum, sand, air-entraining compounds, and grinding aids were used in manufacturing portland cement. Approximately 329 million kilowatt-hours of electrical energy was used at the plants. The dry process of manufacture was used at three plants and the wet process at two plants.

Annual finished portland cement capacity of Indiana plants was 18.4 million barrels.

Lone Star Cement Corp. continued development of its new plant near Greencastle, scheduled to go onstream early in 1969. The plant will have a single 580-foot kiln and a direct digital control computer process system. Planned capacity is 4 million barrels per year. The Lehigh Portland Cement Co. plant at Mitchell was renamed the Virgil J. Grissom plant after astronaut Lt. Col. Grissom, a native of Mitchell, who was killed at Cape Kennedy, Florida, in January.

Clays.—Clay production was reported from 34 clay and shale pits operated by 27 companies in 20 counties.

Although clay output stayed at approximately the same level as in 1966, the demand for clay for various uses shifted during 1967. Clay for use in manufacturing heavy clay products, notably building brick and tile, decreased substantially. Most of this loss was made up by an increased demand for clay for use in lightweight aggregate and cement.

Figures compiled by the Indiana Geological Survey indicated that the value of products manufactured from clay and shale, excluding cement, was $41.3 million.

Table 5.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Fire clay		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	448	$724	1,098	$1,623	1,546	$2,347
1964	376	644	1,169	1,620	1,545	2,264
1965	329	526	1,130	1,634	1,459	2,160
1966	314	511	1,177	1,685	1,491	2,196
1967	247	420	1,242	1,706	1,489	2,126

Gypsum.—Crude gypsum was produced at two underground mines in Martin County. Production remained at approximately the same level as in 1966. Lath, plaster, and wallboard were manufactured at plants adjacent to the mines. A board plant was also operated in Lake County.

Lime.—The new (1966) plant of the Marblehead Lime Co. at Buffington had its first year of full production. The entire output of the plant was used in steelmaking, principally in Indiana, but some was shipped to Illinois. Limestone used at the plant was brought in by lake transport from Michigan quarries.

Perlite.—Crude perlite, mined in Western States, was expanded at plants in Lake, Martin, and Scott Counties. The expanded product was used chiefly for building plaster, insulation, and concrete aggregate.

Sand and Gravel.—Increased demand for building and paving materials and fill was chiefly responsible for a 5-percent increase in output of sand and gravel. Demand for industrial sand was lower than in 1966, but because of a higher average price per ton, value was greater in 1967 by more than 26 percent. Production was reported in 69 counties from 216 commercial and 38 Government-and-contractor operations. Production was from 109 stationary plants, 60 portable plants, 29 dredges, and one pit-run operation.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,654	$4,005	4,679	$4,130
Paving	4,127	3,454	4,057	3,485
Fill	2,099	1,446	2,052	1,157
Railroad ballast	W	W	14	14
Industrial [1]	672	1,689	639	2,134
Other	81	52	68	52
Total	11,633	10,646	11,509	10,972
Gravel:				
Building	2,947	3,480	3,263	3,983
Paving	7,091	7,191	8,154	8,597
Railroad ballast	W	W	19	18
Fill	1,910	1,201	2,388	1,469
Other	584	548	7	10
Total	12,532	12,420	13,831	14,077
Total sand and gravel	24,165	23,066	25,340	25,049
Government-and-contractor operations:				
Sand:				
Paving	23	10	45	25
Other	16	9	--------	--------
Total	39	19	45	25
Gravel:				
Paving	785	456	873	510
Other	3	1	7	4
Total	788	457	880	514
Total sand and gravel	827	476	925	539
All operations:				
Sand	11,672	10,665	11,554	10,997
Gravel	13,320	12,877	14,711	14,591
Total	24,992	23,542	26,265	25,588

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

[1] Includes abrasives (1966), pottery, porcelain, and tile (1967), blast, engine, fire or furnace, glass, molding, and other industrial sand.

Table 7.—Production of sand and gravel in 1967, by counties [1]

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Adams	111	$124	Marion	4,407	W
Allen	988	W	Marshall	196	$169
Blackford	W	W	Miami	398	414
Boone	134	137	Montgomery	64	W
Carroll	63	36	Morgan	387	304
Cass	W	W	Newton	W	W
Clark	685	W	Noble	287	216
Clinton	43	W	Owen	W	W
Daviess	63	58	Parke	288	241
Dearborn	211	236	Porter	W	W
De Kalb	411	368	Posey	W	W
Delaware	344	345	Pulaski	W	W
Elkhart	614	493	Putnam	W	W
Fayette	264	287	Randolph	57	42
Fountain	508	W	Rush	33	W
Franklin	88	62	St. Joseph	800	717
Fulton	209	198	Shelby	325	346
Gibson	117	W	Starke	48	37
Grant	320	W	Steuben	416	W
Greene	194	W	Sullivan	186	W
Hamilton	W	W	Switzerland	W	W
Hancock	75	55	Tippecanoe	W	W
Harrison	W	W	Union	33	18
Hendricks	W	W	Vermillion	180	W
Henry	W	W	Vigo	884	W
Howard	W	W	Wabash	151	W
Huntington	460	W	Warren	579	606
Jackson	299	232	Warrick	W	W
Jasper	85	85	Washington	W	W
Jay	72	48	Wayne	447	W
Johnson	W	W	Wells	W	W
Knox	640	W	Whitley	133	W
Kosciusko	677	612	Undistributed [2]	6,976	18,818
Lagrange	317	284			
Lake	W	W	Total	26,265	25,588
La Porte	W	W			
Madison	998	W			

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

[1] No sand and gravel production reported from the following counties: Bartholomew, Benton, Brown, Clay, Crawford, Decatur, Dubois, Floyd, Jefferson, Jennings, Lawrence, Martin, Monroe, Ohio, Orange, Perry, Pike, Ripley, Scott, Spencer, Tipton, Vanderburgh, and White.

[2] Includes production for which no county breakdown is available, and data indicated by symbol W.

Over 49 percent of the output came from 10 counties, with Marion County again ranking first.

About 92 percent of the sand and gravel was transported by truck, and most of the remainder by rail.

Slag (Iron-Blast Furnace).—Slag, a by-product of pig iron production in Lake County blast furnaces, was used in manufacturing cement, mineral wool, and roofing granules. Crushed slag was used as an aggregate and expanded for lightweight aggregate.

At the Bethlehem Steel Corp. complex at Burns Harbor, large quantities of blast furnace slag aggregate were used in the first phase of construction. As the 5-year construction plan is developed, additional large quantities of slag will be used as aggregate and for soil stabilization, roadways, and railroad ballast.

Stone.—Total stone output reached a record high of nearly 27 million tons valued at $46.7 million. Larger demand for crushed and broken limestone for use in concrete aggregate, riprap, roadstone, and cement more than offset decreases in demand for agricultural limestone and dimension limestone used in building construction.

Salem limestone, which was the main source of Indiana building stone, was quarried in Lawrence and Monroe Counties in the vicinity of Bedford and Bloomington. Several of the building limestone quarries shipped about one-half million tons of large rough blocks of stone for use as a breakwater for a Lake Michigan port at Burns Harbor. This material is included in riprap mentioned previously.

Crushed stone was produced from dolomites and limestones. The most important

Table 8.—Limestone sold or used by producers, by uses

Use	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rubble—thousand short tons	51	$173	----------	----------
Rough architectural—thousand cubic feet	2,648	3,266	2,424	$3,202
Sawed—do	1,234	3,230	1,050	2,881
House stone veneer—do	844	1,491	705	1,402
Cut—do	523	3,547	464	3,254
Flagging—do	123	30	172	32
Total approximate thousand short tons [1]	440	11,737	349	[2] 10,772
Crushed and broken:				
Riprap—thousand short tons	159	205	592	1,810
Concrete aggregate and roadstone—do	17,784	23,055	20,597	27,266
Railroad ballast—do	382	484	425	551
Agriculture—do	2,567	3,697	1,888	2,781
Cement—do	2,646	2,187	2,800	2,486
Other [3]—do	260	699	257	729
Total [2]—do	23,799	30,327	26,558	35,623
Grand total [2]—do	24,239	42,064	26,907	46,396

[1] Average weight of 145 pounds per cubic foot used to convert cubic feet to short tons.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes limestone used for miscellaneous filler (1967), asphalt filler, dust for coal mines, fertilizer, filter beds, mineral food, metallurgical uses, and stone sand.

Table 9.—Production of limestone in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	Type of stone
Adams	W	W	Crushed and dimension.
Allen	W	W	Crushed.
Bartholomew	W	W	Do.
Blackford	W	W	Do.
Carroll	W	W	Do.
Cass	788	$880	Do.
Clark	2,470	2,762	Do.
Crawford	W	W	Do.
Decatur	280	390	Do.
Delaware	715	1,016	Do.
Floyd	W	W	Do.
Grant	W	W	Crushed and dimension.
Hamilton	658	W	Crushed.
Harrison	219	W	Do.
Howard	W	W	Do.
Huntington	W	W	Do.
Jasper	W	W	Do.
Jay	W	W	Do.
Jefferson	W	W	Do.
Jennings	234	328	Do.
Lawrence	2,449	W	Crushed and dimension.
Madison	W	W	Crushed.
Monroe	1,245	W	Crushed and dimension.
Morgan	W	W	Crushed.
Newton	W	W	Do.
Orange	568	702	Do.
Owen	W	W	Do.
Perry	W	W	Do.
Pulaski	W	W	Do.
Putnam	3,250	W	Do.
Randolph	207	299	Do.
Ripley	295	425	Do.
Rush	W	W	Crushed and dimension.
Scott	210	305	Crushed.
Shelby	633	916	Crushed and dimension.
Sullivan	W	W	Crushed.
Switzerland	62	87	Do.
Wabash	W	W	Do.
Warrick	W	W	Do.
Washington	W	W	Do.
Wayne	164	236	Do.
Wells	W	W	Do.
White	267	384	Do.
Total	26,907	46,396	

W Withheld to avoid disclosing individual company confidential data; included in "Total."

sources were the Ste. Genevieve limestone and Silurian and Devonian limestones and dolomites. Although crushed and broken limestone was produced in several areas of the State, half the production came from seven counties: Allen, Clark, Crawford, Huntington, Lawrence, Monroe, and Putnam. Four new quarries, for the production of crushed limestone, were opened in Allen, Huntington, Putnam, and White Counties.

Calcareous marl, used for soil enrichment, was produced in nine counties with the largest production reported from Lagrange, Marshall, and Noble Counties.

Sandstone was quarried for building use in Lawrence, Martin, Monroe, and Spencer Counties, and for rubble in Morgan County. In Pike County, sandstone was removed from old coal mine spoilbanks and crushed for road use. General Refractories Co. did not operate its quartz conglomerate quarry in Martin County in 1967.

Table 10.—Calcareous marl production

Year	Number of producers	Short tons	Value
1963	17	59,265	$36,635
1964	29	86,493	52,335
1965	21	64,493	40,260
1966	21	61,532	38,778
1967	18	51,890	33,553

Sulfur.—Byproduct sulfur was recovered from crude petroleum at the Whiting refinery of American Oil Co. using the Mathieson-Fluor process.

MINERAL FUELS

Coal (Bituminous).—Coal was produced from 48 mines (11 underground and 37 strip mines) in 14 counties. Most of the production (93 percent) came from mines in five counties. Warrick County ranked first in output.

About 15.1 million tons of coal was mechanically cleaned at 11 plants. About 64 percent of the coal was moved by rail, 13 percent by truck, 10 percent by water, and the remaining 13 percent by conveyor, tram, and other methods. Nearly 65 percent of the coal mined was used for power generation by electric utilities. More than 40 million tons of coal was consumed in Indiana, of which nearly two-fifths came from Indiana mines.

The Peabody Coal Co. opened a new mine near Dugger that was designed to produce about 3 million tons of coal annually. A preparation plant is under construction and is scheduled for completion by January 1968. A walking dragline with a bucket capacity of 145 cubic yards is being erected at the mine site. Under a long-term contract, the mine, which produces coal from the Indiana No. 6 and No. 7 seams, will supply fuel to the Wabash River Generating Station of the Public Service Co. of Indiana, near Terre Haute.

Table 11.—Coal (bituminous) production in 1967, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (short tons)			Value
	Underground	Strip	Underground	Strip	Total	
Clay	---	5	---	1,194,735	1,194,735	$4,906,525
Daviess	---	1	---	W	W	W
Fountain	---	1	---	W	W	W
Gibson	2	1	343,915	204,035	547,950	W
Greene	---	5	---	2,123,292	2,123,292	8,334,257
Knox	1	---	60,429	---	60,429	W
Owen	---	1	---	W	W	W
Parke	---	1	---	9,695	9,695	57,844
Pike	2	3	27,000	1,957,386	1,984,386	W
Spencer	---	5	---	95,880	95,880	388,046
Sullivan	2	3	1,099,810	2,707,808	3,807,618	15,146,897
Vermillion	1	---	1,624	---	1,624	W
Vigo	1	1	81,341	475,436	556,777	W
Warrick	2	10	26,672	8,331,764	8,358,436	31,295,145
Total	11	37	1,640,791	17,130,905	18,771,696	73,419,369

W Withheld to avoid disclosing individual company confidential data; included in "Total."

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
	1	2	3 and 6	4	7 and 8	9	10	11	
1963:									
Electric utilities	-----	-----	1	-----	616	4,576	1,351	8,815	15,359
Coke and gas plants	-----	-----	-----	-----	10,242	-----	455	-----	10,697
Retail dealers	1	-----	29	-----	1,011	24	18	656	1,739
All others	-----	-----	-----	6	384	511	935	3,493	5,329
Total	1	-----	30	6	12,253	5,111	2,759	12,964	33,124
1964:									
Electric utilities	-----	-----	-----	-----	543	5,915	1,787	8,774	17,019
Coke and gas plants	-----	-----	84	-----	11,381	-----	391	-----	11,856
Retail dealers	-----	-----	13	-----	833	21	13	481	1,361
All others	-----	-----	15	3	314	405	1,283	3,629	5,649
Total	-----	-----	112	3	13,071	6,341	3,474	12,884	35,885
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

[1] States or portion of States represented by each district are as follows: District 1—Eastern Pennsylvania; 2—Western Pennsylvania; 3 and 6—Northern West Virginia; 4—Ohio; 7 and 8—Eastern Kentucky, Southwestern Virginia, Southern West Virginia, and North Central Tennessee; 9—Western Kentucky; 10—Illinois; 11—Indiana.

Coke.—Coke was produced at five plants, with output of 8.3 million tons, compared with 8.4 million tons in 1966. About 11.9 million tons of coal was carbonized at Indiana coke plants. Most of this coal came from Kentucky, Virginia, and West Virginia; none was mined in Indiana. Most of the coke produced in Indiana was used in northern Indiana blast furnaces.

Peat.—Humus, moss, and reed-sedge peat were dug from bogs in seven counties, principally in the northern part of the State. Peat was used chiefly for soil improvement. None was sold for use as fuel.

Petroleum and Natural Gas.—During 1967, five new fields, five extensions to known fields, and 24 new pools were discovered but added little to the proven oil and gas reserves. Two of the new fields, 20 of the new pools, and all five extensions produce from Mississippian formations; three new fields and one new pool produce from Ordovician formations; and three new pools are in Pennsylvanian formations.

The development wells shown in table 14 resulted in 91 oil wells, three gas wells, and 82 dry holes, and the listed exploratory tests resulted in 32 oil wells, two gas wells, and 236 dry holes.

Oil produced by secondary recovery methods increased by an estimated 243,000 barrels from the previous year. Wells drilled for secondary recovery purposes totaled 188 and resulted in 44 oil wells, 128 input, supply, and disposal wells, and 16 dry holes.

Table 13.—Crude petroleum production in 1967, 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	1	121,878
Caborn Consolidated	1940	1,850	Posey	NA	6	143,979
Coe South	1961	440	Pike	17	0	142,545
College Consolidated	1941	770	Posey	NA	2	299,054
Evansville	1947	400	Vanderburgh	NA	0	145,787
Fleener	1940	140	Gibson	10	0	131,896
Griffin Consolidated	1938	7,350	Gibson and Posey	NA	8	2,302,340
Heusler Consolidated	1938	2,150	Posey and Vanderburgh	71	3	434,928
Mount Carmel Consolidated	1941	2,010	Gibson and Knox	NA	16	143,967
Mount Vernon Consolidated	1941	2,300	Posey	145	1	441,067
Newtonville Consolidated	1943	520	Spencer	NA	0	168,011
Oliver South	1950	190	Posey	13	1	112,860
Owensville Consolidated	1940	1,830	Gibson	67	0	141,304
Owensville North Consolidated	1943	1,970	Gibson	NA	1	124,784
Plainville	1950	350	Daviess	NA	0	107,593
Princeton North Consolidated	1943	1,020	Gibson	34	4	157,634
Spencer Consolidated	1948	540	Posey	33	1	106,351
Springfield Consolidated	1946	2,550	Posey	135	4	789,663
Union-Bowman (New) Consolidated	1941	15,150	Gibson, Knox, and Pike	312	21	607,441
Welborn Consolidated	1941	1,770	Posey	103	4	277,713
Welborn North Consolidated	1953	380	Posey	25	0	128,821
Wheatonville Consolidated	1949	1,600	Gibson	97	7	205,755
Undistributed	XX	XX		NA	87	2,845,781
Total	XX	XX		e 4,956	167	10,081,152

e Estimate. NA Not available. XX Not applicable.

Source: Petroleum Section, Indiana Geological Survey.

Development drilling increased appreciably the proved area of a Renault sand reservoir in the St. James Field, Gibson County. Several good wells were completed in Pennsylvanian, Chesterian, and Ste. Genevieve beds in the Knox County part of the Mount Carmel Consolidated field.

Information from a number of test holes drilled in east-central Indiana has permitted reconstruction of the geologic setting in middle Ordovician time, indicating the probability of a substantial number of erosional remnants of the Knox dolomite (Cambrian and Ordovician) protruding upward through overlying rocks equivalent to the Glenwood shale into the Black River limestone. Drilling near Redkey, in Jay County, encountered oil saturation in the Knox, but tests showed depleted reservoir conditions. This indication of oil accumulation in older beds raises hope for new sources of oil production in the future.

The proved oil reserve at the end of 1967 was 47,158,000 barrels; the total liquid hydrocarbon reserve was 47,217,000 barrels.[3]

Eleven petroleum refineries had a total operating capacity of 534,700 barrels per stream day.[4]

METALS

Aluminum.—Aluminum Company of America operated a smelter at Newburgh, that produced aluminum ingots and thin-gage aluminum sheet. Annual plant capacity is 175,000 tons.

Pig Iron and Steel.—In Lake County, pig iron and steel were produced at three plants. Pig iron output increased slightly to about 12.2 million tons, compared with 12 million tons in 1966.

The American Iron & Steel Institute reported that steel production in Indiana decreased to 17.6 million tons from 18.0 million tons in 1966.

Other Metals.—The United States Smelting Lead Refinery, Inc., recovered antimonial lead, bismuth, gold, lead, silver, and tellurium at its East Chicago plant in Lake County.

[3] 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 as of December 31, 1967. V. 22, May 1968.

[4] Oil and Gas Journal. U.S. Refineries: Where, Capacities, Types of Processing. V. 66, No. 14, Apr. 1, 1968, pp. 137–138.

Table 14.—Oil and gas wells drilled in 1967

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Adams	----	------	------	1	------	------	1
Allen	----	------	1	------	------	1	2
Cass	----	------	------	------	------	1	1
Clay	----	------	------	------	------	1	1
Crawford	----	------	------	------	------	1	1
Daviess	----	------	2	1	------	4	7
Decatur	----	------	------	------	------	1	1
De Kalb	----	------	------	------	------	3	3
Dubois	2	------	1	1	------	11	15
Elkhart	----	------	------	------	------	13	13
Fayette	----	------	------	------	------	1	1
Floyd	----	------	------	------	------	1	1
Gibson	35	------	19	8	------	25	87
Grant	----	------	1	------	------	2	3
Hamilton	----	------	------	------	------	1	1
Harrison	----	------	1	------	------	------	1
Huntington	1	------	------	------	------	------	1
Jasper	----	------	------	------	------	4	4
Jay	1	1	------	------	------	1	3
Jennings	----	------	------	------	------	1	1
Knox	14	------	4	5	------	8	31
Kosciusko	----	------	------	------	------	2	2
La Porte	2	1	1	------	------	12	16
Lawrence	----	------	------	------	------	1	1
Miami	1	------	3	------	------	6	10
Noble	----	------	------	------	------	7	7
Perry	1	------	2	1	------	5	9
Pike	12	------	13	4	------	6	35
Posey	35	------	17	5	------	28	85
Randolph	----	------	------	------	1	1	2
Ripley	----	------	------	------	------	1	1
Rush	----	1	------	------	------	------	1
Scott	----	------	------	------	------	1	1
Spencer	17	------	23	4	------	28	72
Sullivan	1	------	4	------	------	2	7
Switzerland	----	------	------	------	1	------	1
Vanderburgh	4	------	------	------	------	4	8
Vermillion	----	------	------	1	------	1	2
Vigo	----	------	------	------	------	4	4
Wabash	9	------	4	1	------	37	51
Warrick	----	------	1	------	------	10	11
Wells	----	------	1	------	------	------	1
Total	[1] 135	3	[2] 98	32	2	236	506

[1] Includes oil wells completed in secondary recovery projects.
[2] Includes dry holes completed in secondary recovery projects.

Source: Petroleum Section, Indiana Geological Survey.

Table 15.—Principal producers and processors of metals, minerals, and mineral fuels

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Abrasive stone:			
Hindostan Whetstone Co.	Orleans	Orange	Whetstones.
Cement:			
Lehigh Portland Cement Co.	Mitchell	Lawrence	Portland and masonry, dry process.
Lone Star Cement Co.	Limedale	Putnam	Portland and masonry, wet process.
Louisville Cement Co.	Logansport	Cass	Portland, wet process.
Do.	Speed	Clark	Portland and masonry, dry process.
Universal Atlas Cement Division, United States Steel Corp.	Buffington	Lake	Do.
Clays and shale: [1]			
American Brick Co.	Munster	Lake	Brick.
American Vitrified Products Co.	Crawfordsville	Montgomery	Vitrified sewer pipe.
Arketex Ceramic Corp.	Hillsdale	Vermillion	Structural clay tile.
Bloomfield Shale, Inc.	Bloomfield	Greene	Brick.
Colonial Brick Corp.	Cayuga	Vermillion	Do.
Comet Coal & Clay Co., Inc.	Switz City	Greene	Pit only. Material sold for brick manufacture.
Hydraulic-Press Brick Co.	Veedersburg	Fountain	Brick.
Do.	Crawfordsville	Montgomery	Do.
Do.	Brooklyn	Morgan	Lightweight aggregate.
The Krick-Tyndall Co.	Decatur	Adams	Vitrified sewer pipe.
Lehigh Portland Cement	Mitchell	Jackson	Cement.
Log Cabin Coal Co.	Ashboro, Cardonia, and Brazil.	Clay	Pits only. Material sold for use in art pottery, floor and wall tile, architectural terra cotta, brick, vitrified sewer pipe, flue liners, and cement.
Louisville Cement Co.	Logansport	Cass	Cement.
Medora Brick Co.	Medora	Jackson	Brick.
Peabody Coal Co.	Coal City	Owen	Pit only. Material sold for use in floor and wall tile, and mortar.
Coal:			
Ayrshire Collieries Corp.:			
Chinook	Staunton	Clay	Strip mine and cleaning plant.
Minnehaha	Dugger	Sullivan	Do.
Thunderbird	Shelburn	----do	Underground mine and cleaning plant.
Wright	Boonville	Warrick	Strip mine.
Cornell Excavating, Inc.		Spencer	Do.
Do.	Lynnville	Warrick	Do.
Enos Coal Corp., Old Ben Coal Corp.:			
Enos	Spurgeon	Gibson, Pike, and Warrick.	Strip mine. Cleaning plant in Pike County.
Blackfoot No. 5	Winslow	Pike	Strip mine and cleaning plant.
J. R. Coal Corp.	Millersburg	Warrick	Strip mine.
Kings Station Coal Corp.	Princeton	Gibson	Underground mine and cleaning plant.
Lemmons & Co., Inc.	Boonville	Warrick	Strip mine.
Mt. Pleasant Mining Corp.	Terre Haute	Vigo	Underground mine and cleaning plant.
Mulzer Brothers	Tell City	Spencer	Strip mine.
Parke Coal Co.	Petersburg	Pike	Do.
Peabody Coal Co.:			
Chieftain	Riley	Vigo	Strip mine and cleaning plant.
Hawthorn	Carlisle	Greene and Sullivan.	Strip mine. Cleaning plant in Greene County.
Lynnville	Lynnville	Warrick	Strip mine and cleaning plant.
Old Glory	Coal City	Greene	Strip mine.
Victoria	Boonville	Warrick	Do.
R. S. & K. Coal Corp.	Shelburn	Sullivan	Underground mine.
Squaw Creek Coal Co.	Boonville	Warrick	Strip mine and cleaning plant.
Sunshine Coal Corp.	Wheatland	Knox	Underground mine.
Coke:			
Citizens Gas & Coke Utility	Indianapolis	Marion.	
Indiana Gas & Chemical Corp.	Terre Haute	Vigo.	
Inland Steel Co.	East Chicago	Lake	Two plants.
United States Steel Corp.	Gary	----do	
Youngstown Sheet & Tube Co.	East Chicago	----do	

See footnotes at end of table.

Table 15.—Principal producers and processors of metals, minerals, and mineral fuels —Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Gypsum:			
National Gypsum Co	Shoals	Martin	Mining, calcining, and fabricating.
United States Gypsum Co.	Shoals	do	Do.
Do	East Chicago	Lake	Calcining and fabricating.
Iron and steel:			
Bethlehem Steel Corp	Chesterton and Portage	Porter.	
Inland Steel Co	East Chicago	do	
Midwest Steel Division, National Steel Corp.	Portage	do	
Republic Steel Corp., Union Drawn Division.	Gary	Lake.	
United States Steel Corp	Gary	Lake.	
Youngstown Sheet & Tube Co.	East Chicago	do	
Lime: Marblehead Lime Co	Buffington	do	Quicklime; 2 rotary kilns.
Peat:			
Glacier Peat Moss Corp	Jonesboro	Grant	Moss.
Millburn Peat Co., Inc	Otterbein	Warren	Moss and humus.
Peat Moss Co	Indianapolis	Marion	Reed-sedge.
Expanded perlite:			
Airlite Processing Corp	Scottsburg	Scott.	
Federal Cement Products, Inc.	Hammond	Lake.	
National Gypsum Co	Shoals	Martin.	
United States Gypsum Co.	East Chicago	Lake.	
Do	Shoals	Martin.	
Petroleum refineries:			
American Oil Co	Whiting	Lake.	
Cities Service Oil Co	East Chicago	do	
Mobil Oil Corp	do	do	
Sinclair Refining Co	do	do	
Roofing granules: H. B. Reed Co., Inc.	Gary	do	Two plants; produced from slag.
Sand and gravel:			
American AggregatesCorp.	Carmel and Indianapolis	Hamilton	Stationary plants.
Do	Indianapolis	Marion	Do.
Do	Richmond	Wayne	Stationary plant.
Paul C. Brudi Stone & Gravel Co., Inc.	Fort Wayne	Allen	Two pits, portable plants.
Do	Garrett	De Kalb	Portable plant.
Crisman Sand Co., Inc	Portage	Porter	Stationary plant, industrial sands.
Eagle Sand & Gravel Corp.	Lowell	Lake	Stationary plant.
Hilltop Concrete Corp	Patriot	Switzerland	Do.
Holloway Sand & Gravel Co., Inc.	Various locations	Huntington	Portable plant.
Indiana Glass Sand Corp	Elizabeth	Harrison	Stationary plant, industrial sands.
Interstate Sand & Gravel Co., Inc.	Covington	Warren	Stationary plant.
Irving Bros. Gravel Co., Inc.	Marion	Grant	Do.
Irving Materials, Inc., No. 2.	Fortville	Hamilton	Do.
Do	New Castle	Henry	Do.
Do	Spiceland	do	
Kickapoo Sand & Gravel Corp., J. C. O'Connor & Sons, Inc.	Peru	Miami	Do.
Knox County Sand Co., Ralph Rogers & Co., Inc.	Vincennes	Knox	Stationary plant, industrial sands.
Manley Sand Division, Martin Marietta Corp.	Michigan City	La Porte	Do.
May Stone & Sand, Inc	Fort Wayne and Woodburn.	Allen	Stationary plants.
Myers Sand & Gravel Corp.	Anderson	Madison	Stationary plant.
Neal Gravel Co., Inc., Interstate Sand & Gravel Co., Inc.	Attica	Fountain	Do.

See footnotes at end of table.

Table 15.—Principal producers and processors of metals, minerals, and mineral fuels —Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Sand and gravel—Continued			
Rieth-Riley Construction Co., Inc.	Benton, Bristol, Elkhart, Middlebury, and New Paris.	Elkhart	Nine pits, portable plants.
Do	Lagrange and Wolcottville	Lagrange	Three pits, portable plants.
Do	La Porte	La Porte	Portable plant.
Do	Albion, Rome City, and Wolf Lake.	Noble	Four pits, portable plants.
Do	South Bend	St. Joseph	Portable plant.
River Sand & Stone Co., Inc., Ryan Contracting Co., Inc.	Newburgh	Warrick	Dredge.
S & L Gravel Corp	Various locations	Various	Portable plants.
Standard Materials Corp., Martin Marietta Corp.	Utica	Clark	Stationary plant.
Do	Plainfield	Hendricks	Do.
Do	Indianapolis	Marion	Four pits, stationary plants.
Do	Clinton	Vermillion	Stationary plant.
Stone-Street Gravel, Inc	Terre Haute	Vigo	Two pits, stationary plants.
Strum & Dillard Gravel Co., Inc.	Angola	Steuben	Stationary plant.
Western Indiana Aggregates, Inc.:	Syracuse	Kosciusko	Stationary plant, industrial sands.
Leesburg Gravel Division.	Leesburg	Kosciusko	Stationary plant.
Hanna Sand & Gravel Co., Inc.	Hanna	La Porte	Do.
Anderson Gravel Division.	Anderson	Madison	Do.
Montezuma Gravel Division.	Montezuma	Parke	Do.
South Bend Gravel Division.	South Bend	St. Joseph	Do.
Lafayette No. 1 Gravel Division.	Lafayette	Tippecanoe	Do.
Lafayette Portable Gravel Division.	----do	----do	Portable plant.
Nonferrous Smelters and Refineries:			
Aluminum Company of America.	Newburgh	Warrick	Aluminum smelter.
American Smelting & Refining Co.	Whiting	Lake	Lead secondary plant.
National Lead Co	Indianapolis	Marion	Do.
United States Smelting Lead Refinery, Inc.	East Chicago	Lake	Lead primary and secondary plant.
Stone:			
Limestone:			
American Aggregates Corp.	Indianapolis	Hamilton	Stationary plant.
Bloomington Crushed Stone Co., Inc.	Spencer	Owen	Do.
Bloomington Limestone Corp.	Springville	Lawrence	Do.
Empire Stone Co	Bloomington	Monroe	Do.
Do	----do	----do	Dimension.
		----do	Do.
		Lawrence	Do.
	Smithville	Monroe	Smithville monroe Stationary plant, crushed and broken dimension
Erie Stone, Inc., Irving Bros. Gravel Co., Inc.	Huntington	Huntington	Stationary plant.
	Bluffton	Wells	Do.
B. G. Hoadley Quarries, Inc.	Bloomington	Monroe	Dimension.
Independent Limestone Co.	----do	----do	Do.
J & K Stone Corp., Old Fort Industries, Inc.	Montpelier	Blackford	Stationary plant.
	Muncie	Delaware	Do.
Lehigh Portland Cement Co.	Mitchell	Lawrence	Do.
Lone Star Cement Corp.	Limedale	Putnam	Do.
Louisville Cement Co	Logansport	Cass	Do.
Do	Speed	Clark	Do.
May Stone & Sand, Inc.	Fort Wayne and Woodburn.	Allen	Stationary plants.

See footnotes at end of table.

Table 15.—Principal producers and processors of metals, minerals, and mineral fuels Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Stone—Continued			
Limestone—Continued			
Mitchell Crushed Stone Co., Inc., Ralph Rogers & Co., Inc.	Georgia	Lawrence	Stationary plant.
Newton County Stone Co., Inc.	Kentland	Newton	Do.
Northern Indiana Stone, Inc.	Pleasant Ridge	Jasper	Do.
Ohio & Indiana Stone Corp.	Greencastle	Putnam	Do.
Victor Oolitic Stone Co.	Bloomington	Monroe	Dimension.
S. & S. Materials Corp.	Cloverdale	Putnam	Stationary plant.
Standard Materials Corp., Martin Marietta Corp.	Greenville	Floyd	Do.
	Hanover	Jefferson	Do.
	Lapel	Madison	Do.
Do	Cloverdale, Manhattan, and Stilesville.	Putnam	Stationary plants.
Do	Waldron	Shelby	Stationary plant.
Utica Limestone Quarry, Louisville Sand & Gravel Co.	Utica	Clark	Do.
Western Indiana Aggregates, Inc. Francesville Stone Division.	Francesville	Pulaski	Do.
Yeoman Stone Co	Kokomo	Howard	Do.
Woolery Stone Co., Inc.	Bloomington	Monroe	Stationary plant, crushed and broken and dimension.
Marl:			
Vernon M. Kaufman	Topeka	Noble.	
Miller Marl	Middlebury	Lagrange.	
Willis Speicher	Shipshewana	do	
E. M. Ulmer & Son	Elkhart	Elkhart.	
Do	Walkerton	La Porte.	
Do	Atwood	Kosciusko.	
Allen Weaver	Culver	Marshall.	
Sandstone:			
High Bluff Quarry	Mooresville	Morgan	Dimension.
Hinkle Sandstone Co	Bloomington	Monroe	Do.
Indiana Sandstone Co., Inc.	Huron	Lawrence	Do.
St. Meinrad Sandstone.	St. Meinrad	Spencer	Dimension; plant in Dubois County.
Springs Valley Sandstone Co.		Martin	Dimension.
Do	Williams	Lawrence	Dimension; plant in Martin County.
Recovered sulfur:			
American Oil Co	Whiting	Lake	Mathieson-Fluor process.

[1] Except as noted, all companies listed under "Clays and Shale" operated pits and processing plants; products manufactured are shown under "Remarks" column.

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 Ronald W. Michelson [1]

Iowa mineral production was valued at $113.2 million in 1967, a decrease of more than 5 percent from the record high established in 1966. Decreases in portland cement, sand and gravel, and stone production accounted for nearly 85 percent of the decline. Other decreases were recorded for masonry cement, bituminous coal, gypsum, and lime. Gains in total value of production were reported for clays and peat. Nonmetals, the major commodity group, accounted for nearly 97 percent of the State total production. The remaining 3 percent was supplied by mineral fuels.

Oil and gas exploration activities consisted of one shallow test hole drilled in Washington County; no production was reported. No production of, nor exploration for, metallic minerals was recorded during the year.

Mineral production was reported from 97 of the 99 counties in Iowa. Value of mineral output increased in 43 counties and decreased in 54. The three leading counties in State output values were Cerro Gordo with 23 percent, Polk with 15 percent, and Scott with 12 percent.

[1] Geologist, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Iowa [1]

Mineral		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Portland	thousand 376-pound barrels	14,058	$46,736	13,712	$45,394
Masonry	thousand 280-pound barrels	633	1,890	612	1,853
Clays	thousand short tons	1,130	1,438	1,208	1,643
Coal (bituminous)	do	1,025	3,783	883	3,227
Gypsum	do	1,285	5,577	1,219	5,186
Sand and gravel	do	19,644	18,213	17,734	16,564
Stone	do	27,729	40,081	26,133	37,912
Value of items that cannot be disclosed:					
Other nonmetals and peat		XX	1,595	XX	1,443
Total		XX	119,313	XX	113,222
Total 1957–59 constant dollars		XX	116,014	XX	p 110,561

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 Iowa, by counties [1]

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Adair	W	W	Stone.
Adams	W	W	Do.
Allamakee	W	W	Stone, sand and gravel.
Appanoose	$651	$663	Stone, clays, coal, sand and gravel.
Audubon	152	147	Sand and gravel.
Benton	W	W	Sand and gravel, stone, clays.
Black Hawk	1,702	1,520	Stone, sand and gravel.
Boone	W	W	Sand and gravel, clays.
Bremer	W	W	Stone, sand and gravel.
Buchanan	347	277	Stone.
Buena Vista	308	217	Sand and gravel.
Butler	426	429	Stone, sand and gravel.
Calhoun	32	42	Sand and gravel.
Carroll	201	184	Do.
Cass	W	W	Stone.
Cedar	W	W	Do.
Cerro Gordo	26,201	25,631	Cement, stone, clays, sand and gravel, lime.
Cherokee	324	383	Sand and gravel.
Chickasaw	132	W	Stone, sand and gravel.
Clarke	W	W	Stone.
Clay	135	198	Sand and gravel.
Clayton	723	689	Stone, sand and gravel.
Clinton	W	W	Do.
Crawford	W	195	Sand and gravel.
Dallas	1,770	650	Sand and gravel, clays, stone.
Decatur	680	647	Stone.
Delaware	327	300	Stone, sand and gravel.
Des Moines	2,135	2,185	Stone, gypsum, sand and gravel.
Dickinson	166	W	Sand and gravel.
Dubuque	683	802	Stone, sand and gravel.
Emmet	269	331	Sand and gravel.
Fayette	717	642	Stone, sand and gravel.
Floyd	364	338	Stone, sand and gravel, clays.
Franklin	317	W	Sand and gravel, stone, clays.
Fremont	2	W	Stone.
Greene	W	227	Sand and gravel.
Grundy	135	W	Stone, sand and gravel.
Guthrie	W	78	Sand and gravel.
Hamilton	W	369	Stone, sand and gravel.
Hancock	407	399	Do.
Hardin	1,482	1,638	Do.
Harrison	1,292	1,012	Do.
Henry	W	W	Do.
Howard	219	311	Do.
Humboldt	1,311	1,130	Do.
Ida	20	W	Sand and gravel.
Iowa	W	W	Do.
Jackson	406	330	Stone, sand and gravel.
Jasper	W	W	Sand and gravel, stone.
Jefferson	W	W	Stone, sand and gravel.
Johnson	1,457	1,326	Do.
Jones	539	547	Do.
Keokuk	W	W	Stone, clays.
Kossuth	365	328	Sand and gravel.
Lee	W	W	Stone, sand and gravel.
Linn	2,754	2,523	Do.
Louisa	W	W	Do.
Lucas	347	362	Coal.
Lyon	224	W	Sand and gravel.
Madison	3,615	3,367	Stone, clays.
Mahaska	1,601	1,518	Coal, stone, sand and gravel, clays.
Marion	2,741	1,871	Coal, stone, sand and gravel.
Marshall	W	W	Stone, sand and gravel.
Mills	W	W	Do.
Mitchell	W	429	Do.
Monona	W	W	Sand and gravel.
Monroe	552	650	Coal.
Montgomery	W	W	Stone.
Muscatine	1,111	978	Sand and gravel, stone.
O'Brien	132	115	Sand and gravel.
Osceola	251	128	Do.
Page	W	W	Stone, sand and gravel.
Palo Alto	W	132	Sand and gravel.
Plymouth	574	W	Do.
Pocahontas	W	W	Stone.
Polk	17,264	17,302	Cement, sand and gravel, clays.

See footnotes at end of table.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Pottawattamie	W	W	Stone, sand and gravel.
Poweshiek	W	W	Stone.
Sac	$665	$537	Sand and gravel.
Scott	14,992	13,789	Cement, stone, lime, sand and gravel, clays.
Shelby	565	237	Sand and gravel.
Sioux	603	607	Do.
Story	1,121	1,718	Sand and gravel, stone, clays.
Tama	W	W	Stone, sand and gravel.
Taylor	W	W	Stone.
Union	W	W	Do.
Van Buren	802	592	Stone, sand and gravel, coal.
Wapello	523	494	Stone, sand and gravel, clays.
Warren	83	82	Sand and gravel, clays.
Washington	W	W	Stone.
Wayne	-------	W	Do.
Webster	5,474	5,223	Gypsum, stone, clays, sand and gravel.
Winnebago	W	W	Peat, sand and gravel.
Winneshiek	440	505	Stone, sand and gravel.
Woodbury	225	W	Sand and gravel, clays.
Worth	W	365	Stone, peat, sand and gravel.
Wright	171	144	Sand and gravel.
Undistributed [2]	16,085	15,389	
Total [3]	119,313	113,222	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Davis and Ringgold Counties are not listed because no production was reported.
[2] Includes some sand and gravel and stone that cannot be assigned to specific counties and values indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Iowa business activity

		1966	1967	Change (percent)
Personal income:				
Total	millions	$8,258.0	p $8,516.0	+3.1
Per capita		$2,992.0	p $3,093.0	+3.4
Construction activity:				
Building permits:				
Valuation of authorized residential and non-residential private construction	millions	$199.6	$231.3	+15.9
Number of private and public residential building permits issued		7,477	9,012	+20.5
Contract construction work performed:				
Total	millions	$737	$635	−13.8
Nonresidential building	do	$325	$245	−24.5
Residential building	do	$199	$225	+13.1
Nonbuilding	do	$212	$165	−22.2
State highway commission contracts awarded [1]	do	$120.8	$126.3	+4.6
Portland cement shipments to and within Iowa	thousand 376-pound barrels	8,779.4	9,034.9	+2.9
Cash receipts from farm marketings	millions	$3,460.4	$3,356.7	−3.0
Mineral production	do	$119.3	$113.2	−5.1
Manufacturing payrolls	do	$1,386.8	p $1,484.2	+7.0
Annual average labor force and employment:[2]				
Total labor force	thousands	1,186.2	1,205.2	+1.6
Agricultural employment	do	216.7	196.6	−9.3
Nonagricultural employment [3]	do	945.1	978.0	+3.5
Manufacturing	do	211.5	218.5	+3.3
Construction	do	40.7	41.6	+2.2
Transportation and utilities	do	50.2	50.6	+.8
Mining	do	3.3	3.3	-------
Stone, clay and glass products	do	6.8	6.6	−2.9
Primary metal industries	do	8.7	8.7	-------

p Preliminary.
[1] Fiscal year ending June 30.
[2] Adjusted to March 1967 benchmark levels.
[3] Includes nonagricultural, self-employed, and unpaid family workers, and domestic workers in private households.

Sources: Survey of Current Business, Construction Review, Statistical Abstract of the United States, Iowa State Highway Commission, Farm Income Situation, Iowa Employment Security Commission in cooperation with the U.S. Department of Labor.

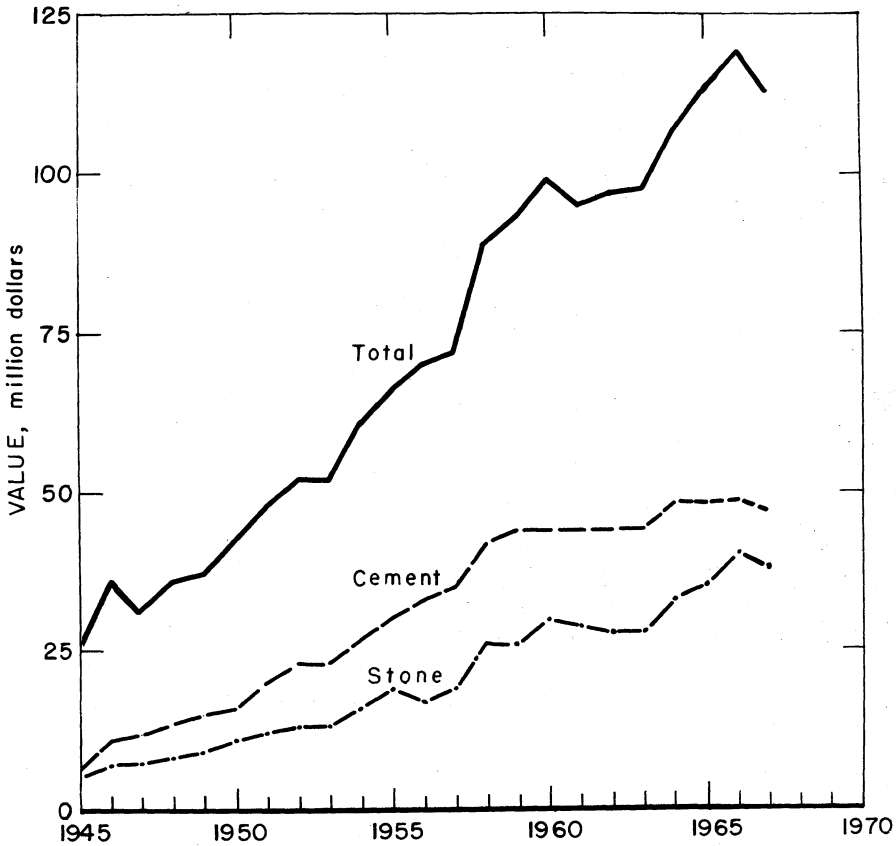

Figure 1.—Value of cement, stone, and total value of mineral production in Iowa.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal and peat	250	214	54	442	1	7	18.11	13,874
Nonmetal	1,108	272	301	2,422	-----	53	21.89	1,571
Sand and gravel	1,319	220	290	2,596	3	46	18.87	7,486
Stone	2,431	278	677	5,847	1	97	16.76	1,588
Total [1]	5,108	259	1,321	11,307	5	203	18.40	3.418
1967:[p]								
Coal and peat	260	207	54	448	-----	7	15.63	281
Nonmetal	1,045	269	281	2,263	-----	52	22.98	573
Sand and gravel	1,075	214	229	2,080	1	40	19.71	3.572
Stone	2,490	265	661	5,704	3	85	15.43	3,712
Total [1]	4,865	252	1,225	10,495	4	184	17.91	2,861

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of portland cement decreased over 2 percent in quantity and nearly 3 percent in value from 1966 levels. Overall unit value, f.o.b. mill, dropped slightly from $3.32 to $3.31 per barrel. The five cement plants in the State operated a total of 19 kilns and produced types I, II, and III cement. The 13.7 million barrels of portland cement produced represented nearly 89 percent of their combined capacity.

Types I and II (general use and moderate heat) cements accounted for 95 percent of the total portland cement production, of which about 11 percent was air-entrained and 89 percent non-air-entrained. Type III (high-early-strength) cement accounted for 5 percent of total production; 40 percent was air-entrained and 60 percent non-air-entrained. The wet process was used in manufacturing cement at three plants and the dry process at the other two. Electrical energy consumed in all plants totaled 320.1 million kilowatt-hours, a decrease of nearly 5 percent from that of 1966; 83 percent was purchased and 17 percent home generated. Nearly 86 percent of the total portland cement shipped from Iowa plants was to consumers in Iowa and Minnesota. Other States, listed in order of destination of shipments, were Wisconsin, Illinois, North Dakota, South Dakota, Nebraska, Missouri, Kansas, and Colorado. Approximately 54 percent of the portland cement shipments were by truck and 46 percent by rail. Of the total shipments, 93 percent were in bulk form and the remaining 7 percent in packaged containers. Approximately 62 percent of the State shipments were to ready-mixed concrete companies, 16 percent to concrete product manufacturers, 12 percent to highway contractors, 6 percent to building material dealers, and 4 percent to other users. Nearly 2.8 million barrels of portland cement were shipped into Iowa from plants located in other States, principally Missouri, Nebraska, Kansas, Illinois, and Indiana.

Raw materials consumed in manufacturing portland cement included over 3.7 million tons of cement rock and limestone, 584,000 tons of clay and shale, 127,000 tons of gypsum, and small quantities of iron ore, mill scale, sand, blast-furnace slag, air-entraining compounds, and grinding aids.

Masonry cement was produced at all of the State cement plants except the Penn-Dixie Cement Corp. plant in Polk County. Shipments decreased over 3 percent in quantity and nearly 2 percent in value. The average value per 280-pound barrel, f.o.b. mill, rose to $3.03 from $2.99 in 1966. About 76 percent of the masonry cement marketed went to Iowa and Minnesota. Other States, in order of receipts, were Illinois, Wisconsin, North Dakota, South Dakota, Nebraska, and Missouri. Approximately 40,000 barrels of masonry cement was shipped into Iowa from plants in other States.

Clays.—Production of clay and shale increased 7 percent in quantity and 14 percent in value over 1966 levels. The gain in output was attributed chiefly to the 2-percent increase in production for manufacturing cement and a 14-percent increase for use in manufacturing heavy clay products. Total output for lightweight aggregate, mortar mix, and floor and wall tile recorded a 12-percent decrease.

Twenty-seven deposits of clay or shale were operated by 25 companies in 17 counties. Approximately 47 percent of the production was used for the manufacture of cement, 45 percent for making heavy clay products (including building brick, vitrified sewer pipe, and other miscellaneous heavy clay products), and the remainder for lightweight aggregate, mortar mix, and floor and wall tile.

All producing companies used their entire output in their own plants.

Sheffield Brick & Tile Co. began construction on a new drainage tile and manufacturing facility at its Sheffield plant, which was expected to be completed early in 1968. Anticipated capacity of the new facility, which will include a top-fired tunnel kiln and tunnel dryer, is 100 tons of tile per day.

Gypsum.—Production of crude gypsum in Iowa decreased 5 percent in quantity and 7 percent in value from 1966 levels.

The State continued as one of the Nation's major producers of gypsum and gypsum products, ranking third in the United States in the quantity of crude gypsum produced.

Gypsum was produced from an underground mine, operated by United States Gypsum Co. in Des Moines County, and from four open-pit mines, operated in Webster County by Bestwall Gypsum Division, Georgia-Pacific Corp.; The Celotex Corp.; National Gypsum Co.; and United States Gypsum Co. All companies produced a wide variety of gypsum products. Uncalcined gypsum was sold for portland cement retarder, agricultural use, brewer's fixe, fillers, and other uses. Calcined gypsum was used primarily for building purposes including base-coat plaster, veneer plaster, mill-mixed basecoats, gaging and molding plasters, prepared finishes, roof deck plasters, lath, wall board, sheathing, laminated board, and formboard. Others uses of calcined-gypsum products included plate glass and terra cotta works, dental and orthopedic plaster, industrial molding, art, and casting plasters.

Natural gas was used as the sole or primary fuel at all of the five calcining plants in the State. Calcining equipment utilized included 22 kettles and four Hydrocal cylinders.

The Iowa State University Center for Industrial Research & Service conducted exploration drilling for gypsum near Albia. Results indicated a deposit consisting mostly of anhydrite at a depth of about 350 to 400 feet. The drilling was financed by grants from the Federal Economic Development Administration and the Albia Chamber of Commerce.

Lime.—Total production of quicklime and hydrated lime decreased 10 percent in tonnage and 12 percent in value from that of 1966.

American Crystal Sugar Co. produced quicklime for internal use in sugar refining at its Mason City plant in Cerro Gordo County. Purchased high-calcium limestone was burned in the company's shaft kiln, utilizing coke as fuel.

Linwood Stone Products Co., Inc., was the sole commercial producer of quicklime and hydrated lime. At its plant near Buffalo in Scott County three rotary kilns were used for burning the high-calcium limestone obtained locally from company-owned sources. Coal and natural gas were used as fuel.

Consumption of lime in Iowa exceeded the State's production by 14 percent, with Missouri being the principal source of shipments into the State.

Sales of Iowa-produced lime were principally to Iowa markets, which received 47 percent of the shipments, and to Illinois and Indiana.

Of Iowa's lime production, 41 percent was used primarily for water purification, 38 percent for steelmaking, and the remainder for construction, sugar refining, sewage treatment, and paper and pulp manufacture.

Perlite.—Crude perlite, mined outside the State, was expanded at plants operated by the gypsum producers in Webster County. The expanded product was used principally in manufacturing lightweight building plaster.

Sand and Gravel.—Sand and gravel production decreased 10 percent in quantity and 9 percent in value, from 1966 levels. Production for paving use decreased over 12 percent. Since paving required 67 percent of the State total sand and gravel production, the decrease in interstate highway construction represented most of the decline in total production from the previous year. Production for building, the other major use of sand and gravel (representing 25 percent of the State total), increased 1 percent.

Sand and gravel production was reported in 78 counties, from 259 commercial and 50 Government-and-contractor operations. Polk, Story, Lyon, Sioux, and Sac Counties ranked in that order as the five leading sand and gravel producers, accounting for over 30 percent of the State total.

Overall average unit value for sand and gravel was $0.93 per ton, approximately the same as for 1966.

Approximately 97 percent of the total commercial sand and gravel shipments were transported by truck, with the remainder by rail and water.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,054	$2,899	3,030	$2,966
Paving	2,715	2,659	2,828	2,852
Railroad ballast	4	2	W	W
Fill	1,112	721	1,147	736
Other [1]	204	532	114	320
Total	7,089	6,813	7,119	6,874
Gravel:				
Building	1,278	2,213	1,361	2,289
Paving	7,032	6,524	6,699	5,778
Railroad ballast	69	46	44	36
Fill	336	198	164	103
Other	32	41	18	15
Total	8,747	9,022	8,286	8,221
Total sand and gravel	15,836	15,835	15,405	15,095
Government-and-contractor operations:				
Sand:				
Building	------	--------	3	1
Paving	98	51	72	40
Fill	15	5	3	1
Other	2	1	2	1
Total	115	57	80	43
Gravel:				
Paving	3,680	2,317	2,249	1,426
Other	13	4	--------	--------
Total	3,693	2,321	2,249	1,426
Total sand and gravel	3,808	2,378	2,329	1,469
All operations:				
Sand	7,204	6,870	7,199	6,917
Gravel	12,440	11,343	10,535	9,647
Total	19,644	18,213	17,734	16,564

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes filtration and railroad ballast (1967), blast, molding, and other construction sand.

Table 6.—Limestome sold or used by producers, by uses

Use	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:				
Rubble—thousand short tons	3	$28	3	$25
Sawed stone—thousand cubic feet	2	10	6	22
House stone veneer—do	24	61	26	68
Cut stone—do	73	116	68	128
Flagging—do	4	5	5	6
Total—approximate thousand short tons [1]	12	220	12	249
Crushed and broken:				
Riprap—thousand short tons	991	1,436	387	450
Concrete aggregate and roadstone—do	19,746	27,899	19,119	27,024
Agriculture—do	2,857	4,831	2,488	4,421
Railroad ballast—do	164	156	169	173
Cement—do	3,628	4,232	3,664	4,295
Other [2]—do	331	1,308	295	1,299
Total [3]—do	27,717	39,861	26,120	37,663
Grand total [3]—do	27,729	40,081	26,133	37,912

[1] Average weight of 170 pounds per cubic foot used to convert cubic feet to short tons.
[2] Includes limestone for asphalt filler, fertilizer, flux, lime, mineral food, other uses, and dust for coal mines (1967).
[3] Data may not add to totals shown because of independent rounding.

Table 7.—Production of sand and gravel and stone in 1967, by counties

(Thousand short tons and thousand dollars)

County	Sand and gravel		Stone		County	Sand and gravel		Stone	
	Quantity	Value	Quantity	Value		Quantity	Value	Quantity	Value
Adair	---	---	W	W	Johnson	W	W	707	W
Adams	---	---	W	W	Jones	41	$53	294	$494
Allamakee	W	W	192	$231	Keokuk	---	---	W	W
Appanoose	1	W	W	W	Kossuth	508	328	---	---
Audubon	90	$147	---	---	Lee	W	W	W	W
Benton	W	W	W	W	Linn	390	441	1,677	2,082
Blackhawk	484	W	W	W	Louisa	W	W	W	W
Boone	W	W	---	---	Lyon	W	W	---	---
Bremer	W	W	133	180	Madison	---	---	2,067	W
Buchanan	---	---	235	277	Mahaska	W	W	W	W
Buena Vista	320	217	---	---	Marion	237	219	500	749
Butler	112	110	278	319	Marshall	W	W	W	W
Calhoun	67	42	---	---	Mills	75	100	W	W
Carroll	231	184	---	---	Mitchell	112	85	256	344
Cass	---	---	W	W	Monona	416	W	---	---
Cedar	---	---	W	W	Montgomery	---	---	W	W
Cerro Gordo	173	158	1,818	1,719	Muscatine	516	W	W	W
Cherokee	428	383	---	---	O'Brien	180	115	---	---
Chickasaw	20	15	W	W	Osceola	127	128	---	---
Clarke	---	---	W	W	Page	W	W	W	W
Clay	276	198	---	---	Palo Alto	192	132	---	---
Clayton	W	W	324	W	Plymouth	247	W	---	---
Clinton	258	192	W	W	Pocahontas	---	---	W	W
Crawford	279	195	---	---	Polk	2,395	2,662	---	---
Dallas	456	499	W	W	Pottawattamie	23	25	W	W
Decatur	---	---	380	647	Poweshiek	---	---	343	W
Delaware	W	W	W	W	Sac	553	537	---	---
Des Moines	174	W	W	W	Scott	129	136	1,970	2,816
Dickinson	110	W	---	---	Shelby	151	237	---	---
Dubuque	91	W	419	W	Sioux	689	607	---	---
Emmet	368	331	---	---	Story	W	W	352	564
Fayette	78	94	496	548	Tama	45	44	W	W
Floyd	W	W	W	W	Taylor	---	---	W	W
Franklin	182	142	64	95	Union	---	---	W	W
Fremont	---	---	W	W	Van Buren	W	W	360	W
Greene	248	227	---	---	Wapello	W	W	W	W
Grundy	W	W	63	W	Warren	47	54	---	---
Guthrie	104	78	---	---	Washington	---	---	323	W
Hamilton	198	W	W	W	Wayne	---	---	W	W
Hancock	264	190	150	209	Webster	285	147	353	W
Hardin	471	W	W	W	Winnebago	W	W	---	---
Harrison	161	W	W	W	Winneshiek	76	W	361	W
Henry	W	W	120	130	Woodbury	290	177	---	---
Howard	W	W	237	W	Worth	59	50	W	W
Humboldt	147	100	865	1,030	Wright	199	144	---	---
Ida	71	W	---	---	Undistributed [1]	3,890	6,641	10,616	25,479
Iowa	W	W	---	---					
Jackson	W	W	180	W	Total [2]	17,734	16,564	26,133	37,912
Jasper	W	W	W	W					
Jefferson	W	W	W	W					

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.—Production of stone, consisting entirely of limestone, decreased nearly 6 percent in quantity and over 5 percent in value from that of 1966. The marked drop was attributed to substantial decreases in output for concrete aggregate and roadstone, agricultural limestone, and riprap.

Limestone was produced from about 250 operations in 66 of Iowa's 99 counties. Of these, six were underground operations. The five leading limestone-producing counties listed in descending order of production quantities were Madison, Scott, Cerro Gordo, Linn, and Humboldt.

Principal uses for crushed and broken limestone were for concrete aggregate and roadstone, which accounted for 73 percent of the total. Cement manufacture accounted for 14 percent, agricultural purposes 10 percent, and the remainder was for other purposes.

Overall unit value of crushed and broken stone in 1967 was $1.44 per ton, the same as in 1966.

Dimension limestone was produced from three quarries located in Dubuque, Harrison, and Jones Counties. Production increased slightly in quantity and 13 percent in value over that of 1966.

Iowa became the first State to enact into law evaluation of agricultural lime on an ECCE (Effective Calcium Carbonate Equivalent) basis. The method of evaluation was initiated in 1965 by the Iowa State University in cooperation with the Iowa Limestone Producers Association. The ECCE is a measure of the effectiveness of a given quantity of lime generally expressed as "Certified____pounds ECCE, per ton." Under Iowa's new law, the certification must be affixed to every scale ticket or delivery receipt. The law was to become effective January 1, 1968.

MINERAL FUELS

Coal (Bituminous).—Production of coal decreased 14 percent in quantity and 15 percent in total value. Average value per ton decreased to $3.66 from $3.69.

One new mine was opened during the year, a strip mine operated by the Mich Coal Co. in Mahaska County. Two mines closed in 1967; both were underground operations, operated by the No. 4 Coal Co. and the Walter Coal Co. in Appanoose and Marion Counties, respectively.

Approximately 78 percent of the coal output from the State's five underground and 12 strip mine operations was used in electric powerplants. Of the total State production, over 70 percent was shipped to consumers by rail and the remainder by truck. Approximately 64 percent of the 5.5 million tons of coal consumed in Iowa in 1967 was supplied from Illinois mines; 16 percent was furnished from mines within the State.

Coal seams mined in underground operations during the year ranged in thickness from 32 to 70 inches. Thickness of coal seams mined in strip operations ranged from 36 to 66 inches, with overburden ranging from 25 to 70 feet. No mechanical cleaning plants were operated in the State in 1967.

Peat.—Production of peat increased approximately 4 percent in quantity and 5 percent in value from that of 1966.

The Eli Colby Co. mined moss peat in Winnebago County near Lake Mills and processed it at its plant in Hanlontown. The Colby Pioneer Peat Co. mined reed-sedge and humus peat from a deposit near Fertile in Worth County and processed the material at its plant, also located in Hanlontown. The peat was sold for general soil improvement, in bulk and packaged form.

Petroleum, Natural Gas.—No production of petroleum or natural gas was reported. Exploration drilling reported by the American Association of Petroleum Geologists consisted of one wildcat well, drilled in Washington County to a depth of only 100 feet. It was a dry hole.

Table 8.—Coal (bituminous) production in 1967, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operated		Production (short tons)			Value
	Underground	Strip	Underground	Strip	Total	
Appanoose	2	------	7,465	---------	7,465	$52,412
Lucas	1	------	100,901	---------	100,901	361,516
Mahaska	---	7	---------	327,072	327,072	1,201,353
Marion	1	4	1,359	248,775	250,134	903,047
Monroe	1	------	185,093	---------	185,093	650,000
Van Buren	---	1	---------	12,176	12,176	59,058
Total	5	12	294,818	588,023	882,841	3,227,386

Table 9.—Shipments of bituminous coal for consumption in Iowa, by district of origin and consumer use

(Thousand short tons)

Use	District of origin [1]											Total
	3 and 6	4	7 and 8	9	10	11	12	13	15	17	20	
1963:												
Electric utilities	-------	-------	-------	5	1,326	6	916	-------	282	-------	-------	2,535
Retail dealers	4	2	235	150	205	13	41	13	41	9	1	714
All others	-------	-------	47	51	1,377	134	389	-------	24	-------	-------	2,022
Total	4	2	282	206	2,908	153	1,346	13	347	9	1	5,271
1964:												
Electric utilities	-------	-------	-------	-------	1,397	1	747	-------	174	-------	-------	2,319
Retail dealers	-------	-------	193	162	132	9	4	-------	40	7	1	548
All others	-------	-------	59	32	1,510	93	261	-------	27	-------	-------	1,982
Total	-------	-------	252	194	3,039	103	1,012	-------	241	7	1	4,849
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

[1] States or portion of States represented by each district are as follows: District 3 and 6—Northern West Virginia; 4—Ohio; 7 and 8—Eastern Kentucky, Southwestern Virginia, Southern West Virginia, and North Central Tennessee; 9—Western Kentucky; 10—Illinois; 11—Indiana; 12—Iowa; 13—Alabama, Georgia, and Southcentral Tennessee; 15—Kansas, Missouri, and Northeastern Oklahoma; 17—Western Colorado, and Northeastern New Mexico; 20—Utah.

METALS

Ferroalloys.—Keokuk Electro-Metals Co. (Kemco), Division of Vanadium Corp. of America, produced ferrosilicon and silvery iron at its Keokuk plant, utilizing electric furnaces. The company was the sole producer of ferroalloys in the State.

Table 10.—Principal producers and processors of minerals and mineral fuels

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Cement:			
Dewey Portland Cement Co., Division of Martin-Marietta Corp.	Davenport	Scott	Portland and masonry, wet process.
Lehigh Portland Cement Co.	Mason City	Cerro Gordo	Portland and masonry, dry process.
Marquette Cement Mfg. Co.	Des Moines	Polk	Portland and masonry, wet process.
Northwestern States Portland Cement Co.	Mason City	Cerro Gordo	Portland and masonry, dry process.
Penn-Dixie Cement Corp.	West Des Moines	Polk	Portland, wet process.
Clays and shale: [1]			
Adel Clay Products Co.	Centerville	Appanoose	Brick and other heavy clay products.
Do.	Redfield	Dallas	Do.
Ballou Brick Co.	Sergeant Bluff	Woodbury	Brick.
Carter-Waters Corp.	Centerville	Appanoose	Lightweight aggregate.
Des Moines Clay Co.	Des Moines	Polk	Brick.
Dewey Portland Cement Co., Division of Martin Marietta Corp.	Davenport	Scott	Cement.
W. S. Dickey Clay Mfg. Co.	Lehigh	Webster	Vitrified sewer pipe.
Iowa Clay Pipe Co.	Des Moines	Polk	Do.
Kalo Brick & Tile Co.	Coalville	Webster	Brick and other heavy clay products.
Lehigh Portland Cement Co.	Mason City	Cerro Gordo	Cement.
Mason City Brick & Tile Co.	----do	----do	Brick and other heavy clay products.
Northwestern States Portland Cement Co.	----do	----do	Cement.
Redfield Brick & Tile Co.	Redfield	Dallas	Brick and other heavy clay products.
Rockford Brick & Tile Co.	Rockford	Floyd	Other heavy clay products.
Sheffield Brick & Tile Co.	Sheffield	Franklin	Do.
United Brick & Tile Co.	Adel	Dallas	Brick.
Coal (bituminous):			
Beard Coal Co.	Knoxville	Marion	Strip mine.
Big Ben Coal Co.	Chariton	Lucas	Underground mine.
Jude Coal Co. Inc.	Bussey	Mahaska	Strip mine.
Lost Creek Coal Co.	Oskaloosa	----do	Do.
Lovilia Coal Co.	Melrose	Monroe	Underground mine.
Mich Coal Co.	Oskaloosa	Mahaska	Three strip mines.
Weldon Coal Co.	Hamilton and Harvey	Marion	Strip mines.
Ferroalloys:			
Keokuk Electro-Metals Co., Division of Vanadium Corp of America.	Keokuk	Lee	Ferrosilicon and silvery iron.
Gypsum:			
Bestwall Gypsum Division, Georgia-Pacific Corp.	Fort Dodge	Webster	Mining, calcining, and fabricating.
The Celotex Corp.	----do	----do	Do.
National Gypsum Co.	----do	----do	Do.
United States Gypsum Co.	Sperry	Des Moines	Do.
Do.	Fort Dodge	Webster	Do.
Lime:			
American Crystal Sugar Co.	Mason City	Cerro Gordo	Quicklime; shaft kiln.
Linwood Stone Products Co., Inc.	Buffalo	Scott	Quicklime and hydrated lime, three rotary kilns.
Peat:			
Eli Colby Co.	Lake Mills	Winnebago	Bog.
Do.	Hanlontown	Worth	Processing plant.
Colby Pioneer Peat Co.	Fertile	----do	Bog.
Do.	Hanlontown	----do	Processing plant.
Expanded Perlite:			
Bestwall Gypsum Divison, Georgia-Pacific Corp.	Fort Dodge	Webster.	
The Celotex Corp.	----do	----do	
National Gypsum Co.	----do	----do	
United States Gypsum Co.	----do	----do	

See footnotes at end of table.

Table 10.—Principal producers and processors of minerals and mineral fuels—Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Sand and Gravel:[2]			
K. H. Buttler	Lake City	Calhoun	
Do	Lanesboro	Carroll	
Do	Bayard	Guthrie	
Do	Auburn, Early, Lake View, Sac City.	Sac	
Do	Barnum	Webster	
Concrete Materials Division, Martin Marietta Corp.	Waterloo	Black Hawk	Stationary plant.
Do	Clayton	Clayton	Stationary plant at underground mine.
Do	Cedar Rapids	Linn	Stationary plant.
Do	Eddyville	Mahaska	Do.
Do	Marshalltown	Marshall	Do.
Do	West Des Moines	Polk	Do.
Do	Ottumwa	Wapello	
Do	Fertile	Worth	
Do	Various locations	Various counties	
G A. Finley	Brayton and Fiscus	Audubon	Stationary plant at Brayton.
Do	Adel	Dallas	
Do	Avoca	Pottawattamie	
Do	Corley	Shelby	Stationary plant.
Hallett Construction Co	Boone and Madrid	Boone	Stationary plant at Boone.
Do	Cherokee	Cherokee	Stationary plant.
Do	Geneva	Franklin	Do.
Do	Marengo	Iowa	Stationary plant.
Do	Clemons	Marshall	Stationary plant.
Do	Ashton	Osceola	Do.
Do	Essex	Page	
Do	Lake View	Sac	Stationary plant.
Do	Ames and Peterson	Story	Stationary plant at Ames.
Hogan Construction Co	Rock Rapids	Lyon	
Keefner-White Materials Corp.	Des Moines	Polk	Stationary plant and dredge.
LaHarv Construction Co	Crystal Lake, Forest City, Hutchins.	Hancock	Pit run at Forest City.
Do	Forest City and Leland	Winnebago	
Maudlin Construction Co	Boone and Luther	Boone	
Do	Newell	Buena Vista	
Do	Quimby	Cherokee	
Do	Denison	Crawford	
Do	Adel, Perry, Redfield	Dallas	
Do	Wallingford	Emmet	
Do	Dows, Geneva, Hampton.	Franklin	
Do	Blairsburg, Dows, Stratford, Webster City.	Hamilton	
Do	Alden, Gifford, Hubbard, Iowa Falls, New Providence.	Hardin	
Do	Pisgah	Harrison	
Do	Armstrong, Cylinder, Irvington, Plum Creek.	Kossuth	
Do	Hawarden	Lyon	
Do	Clemons	Marshall	
Do	Turin	Monona	
Do	Ashton and Sheldon	O'Brien	
Do	Merrill	Plymouth	
Do	Lake View	Sac	
Do	Alton and Chatsworth	Sioux	
Do	Ames, Maxwell, Zearing.	Story	
Do	Fort Dodge, Moorland	Webster	
Do	Correctionville, Logan	Woodbury	
Peters Construction Co	Rodney	Monona	
Do	Des Moines	Polk	
Pound Construction Co., Inc.	Carroll	Carroll	
Do	Cooper, Grand Junction, Jefferson, Scranton.	Greene	
Do	Dayton	Webster	
Stevens Sand & Gravel Co., Inc.	Iowa City	Johnson	Dredge.

See footnotes at end of table.

Table 10.—Principal producers and processors of minerals and mineral fuels—Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Sand and gravel—Continued			
Welp & McCarten, Inc.	Swaledale	Cerro Gordo	
Do.	Goodell, Hutchins, Klemme.	Hancock	
Do.	Lourdes	Howard	
Do.	Bradgate	Humboldt	
Do.	Cylinder	Palo Alto	
Do.	Auburn	Sac	
Do.	Barnum, Coalville, Dayton, Duncombe, Fort Dodge.	Webster	
Stone: Limestone: [2 3]			
B. L. Anderson	Robins	Linn	
Concrete Materials Division, Martin Marietta Corp.	Jamesville, LaPorte City, Waterloo.	Black Hawk	Stationary plant at LaPorte City.
Do.	Frederika	Bremer	
Do.	Nashua	Chickasaw	
Do.	Garner	Hancock	
Do.	Fairfax, Iowa City	Johnson	
Do.	Cedar Rapids	Linn	Stationary plant.
Do.	Earlham	Madison	Do.
Do.	Ferguson	Marshall	Do.
Do.	Gladbrook	Tama	
Do.	Fertile	Worth	
Do.	Various locations	Various counties	
DeWees-Potthoff Stone Co.	Jesup and Raymond	Black Hawk	
Do.	Mechanicsville, Tipton.	Cedar	
Do.	Zwingle	Jackson	
Do.	Marion, Monticello, Scotch Grove, Olin.	Jones	
Do.	Center Point, Central City, Coggon, Springville.	Linn	
Dewey Portland Cement Co., Division of Martin Marietta Corp.	Buffalo	Scott	Stationary plant.
Gendler Stone Products Co.	Dexter	Dallas	
Do.	Earlham, Winterset	Madison	
Do.	Braddyville	Page	
Do.	Redford	Taylor	
Kaser Construction Co.	Mediapolis	Des Moines	Stationary plant.
Do.	Thurman	Fremont	
Do.	Sully	Jasper	
Do.	Harper, Keswick, Ollie.	Keokuk	
Do.	Oskaloosa, Fremont	Mahaska	
Do.	Glenwood, Tabor	Mills	
Do.	Grant, Stennett	Montgomery	
Do.	New Sharon	Poweshiek	
Do.	Selma	Van Buren	
Do.	West Chester, Coppock.	Washington	
Lehigh Portland Cement Co.	Mason City	Cerro Gordo	Stationary plant.
Linwood Stone Products Co., Inc.	Davenport	Scott	Stationary plant at combined open quarry and underground mine.
Lowe & Eschman Construction Co.	Charlotte, Clinton, DeWitt, Elwood, Goose Lake, Grand Mound, Lost Nation, Teeds Grove, Toronto.	Clinton	
Marquette Cement Mfg. Co.	Earlham	Madison	Stationary plant.
Paul Niemann Construction Co.	Denver	Bremer	
Do.	Brandon, Fairbank, Independence, Jesup, Troy Mills.	Buchanan	
Do.	Shell Rock	Butler	
Do.	Elgin	Clayton	
Do.	Fairbank, Fayette, Hawkeye, Marysville, St. Lucas Waucoma, West Union.	Fayette	
Northwestern States Portland Cement Co.	Mason City	Cerro Gordo	Stationary plant.

See footnotes at end of table.

Table 10.—Principal producers and processors of minerals and mineral fuels—Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Stone, limestone—Continued			
Penn-Dixie Cement Corp.	Winterset	Madison	Stationary plant.
Raid Quarries, Inc.	Burlington, Danville, Mediapolis.	Des Moines	
Do.	Argyle, Denmark, St. Francisville, West Point.	Lee	Stationary plant.
The River Products Co.	Coralville	Johnson	Do.
Do.	Columbus Junction	Louisa	Underground mine.
Do.	Keota, Washington	Washington	Young America quarry at Washington is underground.
E. I. Sargent Quarries, Inc.	Osceola	Clarke	Stationary plant.
Do.	Davis City, Decatur, Grand River.	Decatur	
Do.	Peru, Winterset	Madison	Stationary plant at Winterset.
Schildberg Construction Co., Inc.	Greenfield	Adair	
Do.	Corning, Mount Etna	Adams	
Do.	Atlantic	Cass	
Do.	Greenfield	Madison	
Do.	Council Bluffs, Macedonia, Treynor.	Pottawattamie	
Do.	Thayer	Union	
Weaver Construction Co.	Lowden	Cedar	
Do.	Mason City, Sheffield	Cerro Gordo	
Do.	Geneva	Franklin	
Do.	Webster City	Hamilton	
Do.	Alden, Iowa Falls	Hardin	Stationary plant at Alden.
Do.	Maquoketa	Jackson	
Do.	McCausland	Scott	
Do.	Roland	Story	

[1] All companies listed under "Clays and Shale" operated pits and processing plants; products manufactured are shown under "Remarks" column.
[2] Portable plants were operated at the listed locations unless otherwise specified.
[3] Crushed limestone was produced at all listed locations.

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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 George T. McIntyre,[1] A. L. Hornbaker,[2] and R. G. Hardy[2]

Mineral production value in Kansas reached a record high in 1967. Principal mineral commodities produced, in order of value, were petroleum, natural gas, natural gas liquids, helium, cement, and stone. Mineral fuels and related products comprised 87.1 percent of the total mineral value, nonmetals 12.6 percent, and metals 0.3 percent. Kansas ranked seventh among the States in the production of oil, sixth in the marketed production of natural gas, and sixth in the production of natural gas liquids.

Trends and Developments.—The Kansas Power and Light Co. will install the Nation's largest air pollution control system in its new 430,000 kilowatt addition to the Lawrence generating station. The control system will eliminate 83 percent of sulfur dioxide, 99 percent of fly ash, and all sulfur trioxide from the flue gases. Installation has already begun on its existing 125,000-kilowatt unit at the same station at a cost of $3 million. Both gener-

[1] Petroleum engineer, Bureau of Mines, Bartlesville, Okla.
[2] Geologist, State Geological Survey of Kansas, University of Kansas, Lawrence, Kans.

Table 1.—Mineral production in Kansas [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Portland cement—thousand 376-pound barrels	8,979	$27,246	8,833	$25,545
Masonry cement—thousand 280-pound barrels	395	1,151	350	1,000
Clays—thousand short tons	847	1,006	935	1,339
Coal—do	1,122	5,355	1,136	5,294
Hellium:				
Grade A—thousand cubic feet	75,500	1,885	225,000	5,364
Crude—do	2,624,200	30,951	2,719,700	32,554
Lead (recoverable content of ores, etc.)—short tons	1,109	335	1,031	289
Natural gas—million cubic feet	847,495	114,412	871,971	116,844
Natural gas liquids:				
Natural gasoline—thousand gallons	175,053	9,399	194,173	10,703
LP gases—do	664,164	25,902	665,057	31,923
Petroleum (crude)—thousand 42-gallon barrels	103,738	306,027	99,200	297,600
Salt [2]—thousand short tons	969	13,388	1,069	14,686
Sand and gravel—do	11,627	8,374	12,066	8,650
Stone—do	14,027	18,789	13,551	17,806
Zinc (recoverable content of ores, etc.)—short tons	4,769	1,383	4,765	1,319
Value of items that cannot be disclosed: Natural cement, gypsum, pumice, salt (brine)	XX	2,789	XX	3,152
Total	XX	568,392	XX	574,068
Total 1957–59 constant dollars	XX	552,897	XX	p 552,532

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

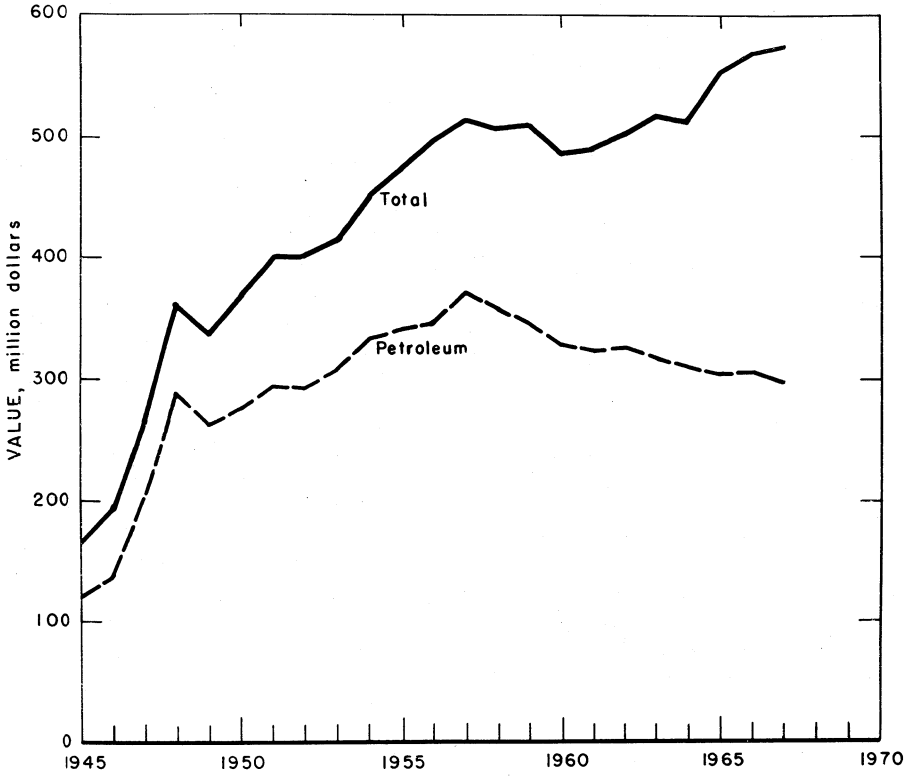

Figure 1.—Value of petroleum, and total value of mineral production in Kansas.

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

County	1966 r	1967	Minerals produced in 1967 in order of value
Allen	$13,107,364	$12,434,351	Cement, petroleum, stone, clays, natural gas.
Anderson	1,176,255	873,962	Petroleum, stone, natural gas.
Atchison	W	513,634	Stone.
Barber	9,508,980	9,398,595	Natural gas, petroleum, gypsum, natural gas liquids, sand and gravel.
Barton	24,004,754	19,088,290	Petroleum, natural gas, salt, sand and gravel, clays.
Bourbon	833,024	777,656	Stone, petroleum, cement, sand and gravel.
Brown	16,553	3,000	Sand and gravel.
Butler	15,352,614	14,226,168	Petroleum, stone, sand and gravel, natural gas.
Chase	388,547	223,399	Stone, natural gas, petroleum, sand and gravel.
Chautauqua	2,352,003	2,143,596	Petroleum, stone, natural gas.
Cherokee	5,931,127	5,936,695	Coal, zinc, lead, clays, stone.
Cheyenne	W	W	Sand and gravel.
Clark	2,946,790	2,670,196	Natural gas, petroleum, sand and gravel.
Clay	266,606	224,397	Sand and gravel, stone, petroleum.
Cloud	280,004	212,950	Clays, sand and gravel, stone.
Coffey	448,066	170,860	Stone, petroleum, sand and gravel, natural gas.
Comanche	1,298,774	1,078,370	Natural gas, petroleum, sand and gravel.
Cowley	9,463,599	9,100,550	Petroleum, stone, sand and gravel, natural gas.
Crawford	1,663,554	1,609,321	Coal, petroleum, clays, natural gas.
Decatur	1,580,558	1,960,000	Petroleum, sand and gravel.
Dickinson	932,882	409,913	Stone, petroleum, sand and gravel, natural gas.
Doniphan	731,620	W	Stone, sand and gravel.
Douglas	315,333	516,773	Sand and gravel, petroleum, stone, natural gas.
Edwards	1,114,171	988,278	Petroleum, natural gas, sand and gravel.
Elk	1,250,566	1,168,828	Stone, petroleum, natural gas, sand and gravel.
Ellis	25,733,972	26,314,949	Petroleum, sand and gravel, stone.
Ellsworth	22,389,953	25,440,616	Natural gas liquids, helium, petroleum, salt, clays, sand and gravel, natural gas.
Finney	10,604,175	7,597,464	Natural gas, petroleum, natural gas liquids, sand and gravel.
Ford	401,527	555,327	Petroleum, natural gas liquids, sand and gravel, natural gas.
Franklin	1,003,241	437,211	Stone, clays, natural gas, petroleum.
Geary	734,267	365,668	Stone, sand and gravel, petroleum.
Gove	881,870	864,000	Petroleum, sand and gravel.
Graham	14,848,082	14,180,000	Petroleum, stone, sand and gravel.
Grant	37,570,028	35,202,576	Natural gas, helium, natural gas liquids, petroleum, sand and gravel.
Gray	W	W	Sand and gravel.
Greeley	18,000	4,000	Do.
Greenwood	9,545,402	9,034,052	Petroleum, stone, sand and gravel, natural gas.
Hamilton	2,160,137	2,326,209	Natural gas, sand and gravel, petroleum.
Harper	4,975,475	3,728,797	Petroleum, natural gas liquids, natural gas, sand and gravel.
Harvey	3,205,089	2,803,408	Petroleum, natural gas, sand and gravel, natural gas liquids.
Haskell	11,488,685	14,328,372	Petroleum, natural gas, sand and gravel.
Hodgeman	5,225,945	4,655,000	Petroleum, sand and gravel.
Jackson	289,185	206,739	Petroleum, stone, sand and gravel.
Jefferson	W	W	Stone.
Jewell	883,880	W	Stone, sand and gravel.
Johnson	2,312,252	1,470,598	Stone, sand and gravel, petroleum, natural gas.
Kearny	12,775,509	13,972,359	Natural gas, petroleum, natural gas liquids, sand and gravel.
Kingman	14,613,186	19,974,898	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	4,572,779	5,113,622	Natural gas, petroleum, sand and gravel.
Labette	399,837	309,813	Stone, petroleum, natural gas.
Lane	721,394	216,000	Petroleum.
Leavenworth	444,027	473,895	Stone, sand and gravel, natural gas, petroleum.
Lincoln	W	1,026,275	Stone, pumice.
Linn	306,539	330,166	Petroleum, stone, natural gas, sand and gravel.
Logan	1,000	1,000	Sand and gravel.
Lyon	761,153	1,199,963	Petroleum, stone, sand and gravel.
McPherson	6,457,350	7,406,202	Petroleum, natural gas, clays, stone, sand and gravel.
Marion	4,199,572	4,046,251	Petroleum, stone, natural gas, natural gas liquids, sand and gravel.
Marshall	970,423	959,561	Gypsum, sand and gravel, stone.
Meade	4,020,729	4,312,897	Natural gas, petroleum, sand and gravel.
Miami	685,449	978,856	Petroleum, stone, natural gas.
Mitchell	W	W	Sand and gravel.
Montgomery	7,033,866	6,779,660	Cement, petroleum, stone, clays, natural gas.
Morris	1,160,599	1,081,649	Petroleum, stone, sand and gravel, natural gas.
Morton	19,594,438	22,364,399	Natural gas, petroleum, helium, natural gas liquids.
Nemaha	84,060	67,000	Petroleum, sand and gravel, stone.
Neosho	8,801,699	9,032,121	Cement, petroleum, stone, sand and gravel, clays, natural gas.
Ness	6,761,270	7,559,224	Petroleum, sand and gravel, stone.
Norton	1,622,557	1,421,357	Petroleum, stone, pumice, sand and gravel.
Osage	W	W	Stone, sand and gravel.
Osborne	248,249	291,000	Sand and gravel, petroleum.

See footnotes at end of table.

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

County	1966 r	1967	Minerals produced in 1967 in order of value
Ottawa	$7,000	----------	
Pawnee	2,993,939	$2,943,565	Petroleum, natural gas, sand and gravel.
Phillips	6,359,163	6,287,170	Petroleum, sand and gravel, stone.
Pottawatomie	130,297	116,405	Stone, sand and gravel.
Pratt	4,819,891	5,033,571	Petroleum, natural gas, sand and gravel.
Rawlins	1,318,090	1,155,034	Petroleum, sand and gravel, stone.
Reno	18,240,897	20,529,583	Salt, natural gas liquids, petroleum, natural gas, sand and gravel.
Republic	W	11,000	Sand and gravel.
Rice	20,394,729	21,562,991	Petroleum, salt, sand and gravel, natural gas, stone.
Riley	644,329	726,913	Petroleum, stone, sand and gravel.
Rooks	15,161,240	16,485,000	Petroleum, sand and gravel.
Rush	4,839,036	9,335,349	Helium, natural gas liquids, petroleum, natural gas, sand and gravel.
Russell	25,164,185	25,945,486	Petroleum, sand and gravel, natural gas.
Saline	2,228,940	1,538,000	Petroleum, sand and gravel.
Scott	234,597	758,051	Natural gas liquids, petroleum, sand and gravel, natural gas.
Sedgwick	10,606,067	10,352,996	Petroleum, natural gas liquids, salt, sand and gravel, stone, natural gas.
Seward	27,335,033	29,336,311	Helium, natural gas liquids, natural gas, petroleum, sand and gravel.
Shawnee	1,413,881	1,325,228	Stone, sand and gravel.
Sheridan	961,542	1,287,000	Petroleum, sand and gravel.
Sherman	79,431	112,000	Sand and gravel, petroleum.
Smith	15,648	388	Stone.
Stafford	14,781,144	13,652,617	Petroleum, natural gas, sand and gravel.
Stanton	4,256,736	4,229,149	Natural gas, petroleum.
Stevens	27,667,145	27,111,869	Natural gas, petroleum, stone.
Sumner	8,497,503	7,321,286	Petroleum, sand and gravel, natural gas.
Thomas	W	W	Sand and gravel.
Trego	4,679,191	3,595,000	Petroleum, sand and gravel.
Wabaunsee	917,804	900,000	Do.
Wallace	W	82,877	Stone, sand and gravel.
Washington	159,000	192,676	Sand and gravel, stone.
Wichita	18,944	17,000	Sand and gravel.
Wilson	4,811,004	4,384,893	Cement, petroleum, stone, clays, natural gas.
Woodson	2,800,406	2,506,643	Petroleum, stone, natural gas.
Wyandotte	7,903,149	7,280,930	Cement, sand and gravel, stone.
Undistributed	3,481,445	3,788,083	
Total	568,392,000	574,068,000	

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

Table 3.—Indicators of Kansas business activity

	1966	p 1967	Percent change
Personal income:			
Total—millions	$6,511.0	$6,846.0	+5.1
Per capita	$2,862.0	$3,009.0	+5.1
Construction activity:			
Building permits—millions	$183.3	$197.9	+8.0
State highway commission:			
Value of contracts awarded—do	$65.4	$79.0	+20.8
Value of contract work performed—do	$66.2	$57.4	−13.3
Authorized miles of State highways	9,882	9,800	−.8
Authorized number of bridges	4,000	4,061	+1.5
Authorized miles of county secondary roads	20,943	20,994	+.2
Authorized miles of road resurfacing	1,280	1,099	−14.1
Miles of interstate highways opened during the year	58	4	−93.1
Miles of interstate highways completed to date	623	627	+.6
Money allocated for interstate since enactment of the Federal Highway Act in 1956—millions	$272.7	$300.4	+10.2
Money allocated for Interstate (not obligated at yearend) millions	$29.1	$25.5	−12.4
Cement shipments to and within Kansas thousand 376-pound barrels	5,129	4,755	−7.3
Cash receipts from farm marketings—millions	$1,533.0	$1,398.7	−8.8
Mineral production—do	$568.4	$574.1	+1.0
Annual average labor force and employment:			
Total labor force—thousands	844.3	858.6	+1.7
Unemployment—do	22.6	23.7	+4.9
Employment:			
Construction—do	32.2	30.5	−5.3
Food products—do	19.7	19.5	−1.0
All manufacturing—do	139.4	145.2	+4.2
All industries—do	637.0	655.3	+2.9

p Preliminary.

Sources: Survey of Current Business, Construction Review, Kansas Highway Commission, The Farm Income Situation, and Kansas Employment Security Division.

ating units are coal and gas fired. The air control system on the existing unit is expected to be in operation in autumn of 1968, With its completion in 1971, the $37 million, 430,000-kilowatt system will be the largest single generating unit in Kansas. When using coal as its main fuel source, it will burn as much as 4,000 tons of southeastern Kansas coal daily.

Owing to the gap between crude oil production and demand in Kansas, the Skelly Oil Co. will build a 135-mile, 8-inch pipeline from Cushing, Okla., to its refinery in El Dorado, Kans. The line will deliver 20,000 barrels of Texas and Oklahoma crude oil to the refinery daily.

Employment and Injuries.—According to the Employment Security Division of the Kansas Department of Labor, average annual employment in the crude-petroleum and natural gas production industries in 1967 was 10,200, compared with 11,000 in 1966. According to the Workmen's Compensation Commission, State of Kansas, 740 on-the-job injuries occured in the mining industry in 1967. Of the 11 fatalities, 10 occurred in the crude petroleum and natural gas industries and one in nonmetallic mining and quarrying.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	219	230	50	406	----	13	32.03	658
Metal	103	295	30	243	----	10	41.11	1,040
Nonmetal	1,090	271	295	2,356	2	64	28.01	5,817
Sand and gravel	807	224	181	1,564	----	41	26.22	785
Stone	1,785	238	425	3,519	3	35	10.80	5,507
Total [1]	4,004	245	982	8,088	5	163	20.77	4,306
1967: [p]								
Coal	210	243	51	403	----	13	32.26	677
Metal	85	254	21	173	----	12	69.49	1,813
Nonmetal	1,225	238	291	2,318	1	50	22.00	2,932
Sand and gravel	785	251	198	1,700	1	23	14.12	3,820
Stone	1,625	257	417	3,442	----	41	11.91	452
Total [1]	3,930	249	978	8,036	2	139	17.55	1,920

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

Legislation and Government Programs.—The Kansas Legislature passed a oil field unitization law which empowers the Kansas Corporation Commission to approve a unit that has the agreement of at least 75 percent of both working and royalty interests. The law should be particularly helpful in establishing workable secondary recovery projects.

Also passed by the Kansas Legislature were laws pertaining to underground mining and open-pit coal mining. House Bill No. 1212, pertaining to underground mining, provides for maintenance of the ground surface contour, subsurface support of public streets, roads, highways, and other public properties, and notice of mining activity to future purchasers of surface ground. House Bill No. 2003, pertaining to open-pit coal mining, sets forth requirements for reclaiming mined areas, and creates a conservation and reclamation board for the purpose of enforcing this act.

The Kansas Corporation Commission rejected a proposal for computing Hugoton allowables on the basis of field reserves rather than on potential production, but directed that a committee be named to study the allowable setup and other field problems. The panel will be composed of firms with a major interest in Hugoton development and a consultant to represent the Kansas Corporation Commission.

Drilling and Exploration.—During 1967, operators drilled 1,271 exploratory wells to discover 202 new oilfields and 67 gasfields. Some of the more productive oil-

fields were Northeast Hampton field in Rush County, producing from the Arbuckle at 3,800 feet; West Donelson field in Cowley County producing from the Marmaton at 2,600 feet; High Hill field in Graham County, producing from the Lansing-Kansas City at 4,000 feet; and Northeast Stark field in Pratt County, producing from the Viola dolomite at 4,100 feet.

Much of the drilling activity in 1967 was again in the central Kansas Uplift area but the search for oil appeared to be moving to the southwest, west, and northwest flanks of the central Kansas Uplift.

Geophysical activity dropped 50 percent in Kansas during 1967.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Carbon Black.—One firm, Columbian Carbon Co. produced carbon black in Kansas. In the last 6 years carbon black production has varied from 48.1 million pounds to 102.3 million pounds. A strike in the rubber industry had an adverse effect on carbon black production, since most of it is used as additive in rubber manufacturing.

Coal (Bituminous).—Five strip mines in Cherokee and Crawford Counties reported an output of 1,000 tons or more each; production of less than 1,000 tons each was credited to three strip mines in Linn and Osage Counties. Over 99 percent of total coal mined was mechanically cleaned at three cleaning plants. Of total shipments, 89 percent was by rail and 11 percent by truck.

Table 5.—Coal (bituminous) production [1]

Year	Number of mines			Short tons (thousands)	Value (thousands)
	Underground	Strip	Total		
1963	1	9	10	1,169	$5,311
1964	--	7	7	1,263	5,749
1965	--	6	6	1,310	6,072
1966	--	5	5	1,122	5,355
1967	--	5	5	1,136	5,294

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

Helium.—Two privately owned and operated helium plants—the Kansas Refined Helium Co. plant near Otis and the Alamo Chemical Co.-Gardner Cryogenics, Inc., plant at Elkhart—produced grade A helium for sale to commercial (non-Federal) customers. Neither plant is associated with the Federal helium program in any way. Combined production from the two plants, both of which began operations in 1966, was estimated at 225 million cubic feet, or almost triple the 75.5 million cubic feet produced in 1966. The 1967 production was valued at $5.4 million. Both plants can produce large volumes of liquid helium.

As part of the Federal long-range helium conservation program crude helium (50- to 80-percent purity) was produced at four plants in the State. These plants—Northern Helex Co. plant near Bushton; Cities Service Helex, Inc., plant near Ulysses; National Helium Corp. plant near Liberal; and Federal Bureau of Mines plant at Otis—produced a combined total of 2,719.7 million cubic feet of crude helium valued at $32.6 million. This was a slight increase over the 2,624.2 million cubic feet produced by these plants in 1966. About 43.5 million cubic feet of this production was in excess of contract requirements and was sold by the companies to private producers of Grade A helium for purification and sale.[3] The remainder was purchased by the Bureau of Mines under long-term contracts, and most of it was stored in a partially depleted, underground natural gas reservoir in the Cliffside gasfield near Amarillo, Tex. When needed the helium will be withdrawn, purified, and sold.

The Cities Service Cryogenics, Inc., plant near Scott City was still under construction at yearend. This plant, when operational in 1968, will produce Grade A helium and will be owned and operated independently of the Federal helium program.

Natural Gas.—With a record output of 871,971 million cubic feet, Kansas ranked sixth in the Nation in the marketed pro-

[3] An additional 57.4 million cubic feet of crude helium was produced at two conservation plants. This helium was stored in the Cliffside field for the credit of the producing companies. As it was not sold, it is not included in these data.

duction of natural gas. In 1967, the Kansas Corporation Commission listed 61 gas-purchasing firms in the State. Four of these purchasers have underground storage facilities in Kansas for 103.4 billion cubic feet of natural gas, to be used during peak consumption periods. Natural gas reserves declined 4 percent, to 15,283,657 million cubic feet, comprising 5.2 percent of the Nation's gas reserve. At yearend there were 8,603 producing gas wells located in 311 pools and fields.

To meet the increasing demand for natural gas due to continuing population and industrial growth, Cities Service Gas Co. planned to increase its pipeline capacity from the Kansas portion of the Hugoton gasfield by another 100 million cubic feet per day. This will increase the annual production of 628.7 billion cubic feet by 36.5 billion cubic feet, or about 6 percent. The added capacity will permit an additional $5.5 million annual purchase of gas at the wellhead, for delivery to the Wichita, Topeka, and Kansas City areas.

Natural Gas Liquids.—With 25 plants operating in the State in 1967, Kansas ranked sixth in the Nation as a producer of natural gas liquids, supplying 4.0 percent of domestic output. Proved recoverable reserves of natural gas liquids amounted to 272 million barrels as of December 31, 1967, according to the Committee on Natural Gas Reserves of the American Gas Association.

Table 6.—Marketed production of natural gas

Year	Million cubic feet	Value (thousands)
1963	732,946	$97,482
1964	764,073	96,031
1965	793,379	105,519
1966	847,495	114,412
1967	871,971	116,844

Table 7.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	165,370	$9,811	395,877	$15,481	561,247	$25,292
1964	162,725	8,713	512,747	18,121	675,472	26,834
1965	153,485	7,791	587,416	22,322	740,901	30,113
1966	175,053	9,399	664,164	25,902	839,217	35,301
1967	194,173	10,703	665,057	31,923	859,230	42,626

A major expansion was scheduled for the Bushton, Kans., plant of Northern Gas Products Co., a subsidiary of Northern Natural Gas Co. Because the expansion will facilitate the extraction of ethane from the natural gas stream, the Federal Power Commission has authorized Northern Natural Gas Co. to transport an additional 62.4 million cubic feet of natural gas daily.

Cities Service Oil Co. was increasing production at its Hutchinson fractionation plant in Kansas. The work includes the expansion of the fractionation system, improved product handling and storage, and the extension of the product-gathering systems. The expansion will increase feedstream capacity to 40,000 barrels per day. The company also completed a 69,000-gallon-per-day gasoline plant near Cheney.

Anadarko Production Co. added a depropanizer to its Interstate plant in Morton County, and its propane capacity was increased 10,000 gallons per day.

Kansas, with 13.6 percent of the Nation's underground storage for LP gases, can store 19.2 million barrels underground.

Petroleum.—Increased allowables have not checked the downward trend of crude oil production in Kansas. Since it appears that this trend will continue, predictions on future crude oil production in the State (table 9) are based on the following assumptions and calculations:

1. Known oil reserves in Kansas as of January 1, 1967, included 905 million barrels of primary reserves, 745 million barrels of water injection reserves, and 445 million barrels of reserves recoverable by other methods, for a total of 2,095 million barrels of recoverable oil.

2. In the interval between January 1, 1967, and January 1, 2,020 discoveries in Kansas will reach a minimum of 2,431

Table 8.—Natural gasoline and LP gases produced in 1967

(42-gallon barrels)

Company	Location		Natural gasoline	Butane	Propane	LP gases	Isobutane	Total
	Nearest town	County						
Alamo Chemical Co	Elkhart	Morton				315,209		315,209
Anadarko Production Co	Liberal	Seward	62,103		24,130			86,233
Do	Elkhart	Morton	123,364		62,894			186,258
Cities Service Helex, Inc	Ulysses	Grant				36,687		36,687
Cities Service Oil Co	Cheney	Kingman				442,714		442,714
Do	Midway	do				181,286		181,286
Do	Hutchinson	Reno	270,069	711,544	3,198,605			4,180,218
Do	Wichita	Sedgwick	296,357	471,571	327,500			1,095,428
Do	Wilburton	Morton				58,833		58,833
Colorado Interstate Gas Co	Lakin	Kearney	104,348					104,348
Hugoton Production Co	Ulysses	Grant	189,606	217,797	208,972			616,375
Kansas-Nebraska Natural Gas Co., Inc	Scott City	Scott		6,100		292,980		299,080
Kansas Refined Helium Co	Otis	Rush				1,659,520		1,659,520
Mobil Oil Corp	Spivey	Harper	289,351	146,016	311,522			746,889
Do	Hickok	Grant	158,424	78,704	124,169	341,902		703,199
National Helium Corp	Liberal	Seward	1,022,154	1,086,148	2,130,393			4,238,695
Northern Gas Products Co	Bushton	Ellsworth	969,386	2,267,408	5,654,588			8,891,382
Northern Natural Gas Co	Holcomb	Finney	146,642					146,642
Do	Sublette	Seward	392,609					392,609
Pan American Petr. Corp	Ulysses	Grant	693,213	719,021	659,116		233,562	2,304,912
Do	do	do				353,633		353,633
Plateau Natural Gas Co	Burrton	Harvey	8,154					8,154
Rounds & Stewart Natural Gasoline Co., Inc	Marion	Marion	55,218	54,678	101,605			211,501
Skelly Oil Co	Medicine Lodge	Barber	56,240		48,837			105,077
Do	Minneola	Ford	57,674		50,374			108,048

Source: Kansas State Corporation Commission.

million barrels and maximum of 2,902 million barrels of original oil in place. A recovery factor of 0.515 percent gives the State a minimum of 1,253 million barrels and a maximum of 1,495 million barrels of additional recoverable oil reserves.

3. Oil production, in the period 1967–2019, will be 1,679 million to 1,872 million barrels of primary oil, 971 million to 1,067 million barrels of secondary oil recovered by water injection, and 17 million to 175 million barrels of oil recovered by thermal means.

4. By January 1, 2020, primary reserves will be between 82 million and 105 million barrels of recoverable oil, water injection reserves will be between 124 million and 148 million barrels of recoverable oil, and thermal reserves will be between 271 million and 429 million barrels of recoverable oil.

Table 9.—Projected future crude oil production

(Million 42-gallon barrels)

Period	Minimum	Maximum
1967–1969	280.0	295.0
1970–1979	747.0	870.0
1980–1989	570.0	644.0
1990–1999	440.0	525.0
2000–2009	345.0	450.0
2010–2019	285.0	330.0
Total	2,667.0	3,114.0

Table 10.—Crude petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1963	109,107	$317,501
1964	106,252	310,256
1965	104,733	305,820
1966	103,738	306,027
1967	99,200	297,600

Table 11.—Crude petroleum production, indicated demand, and stocks in 1967, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Kansas (end of month)
January	8,598	7,970	6,370
February	7,784	7,520	6,634
March	8,678	9,350	5,962
April	8,140	7,385	6,717
May	8,560	8,040	7,237
June	8,221	8,515	6,943
July	8,286	9,097	6,132
August	8,466	8,723	5,875
September	8,064	7,872	6,067
October	8,291	8,388	5,970
November	8,085	7,306	6,749
December	8,027	8,348	6,428
Total:			
1967	99,200	98,514	XX
1966	103,738	104,376	XX

XX Not applicable.

Table 12.—Crude petroleum production, by fields [1]

(Thousand 42-gallon barrels)

Field [2]	1964	1965	1966	1967	Cumulative Dec. 31, 1967
Bemis-Shutts	3,594	3,371	3,267	3,101	200,903
Chase-Silica	2,799	2,690	2,579	2,297	239,939
El Dorado	3,329	2,899	2,534	2,294	269,199
Geneseo-Edwards	1,299	1,212	1,187	1,138	75,210
Gorham	1,375	1,328	1,275	1,191	72,838
Hall-Gurney	3,396	3,345	3,290	3,156	110,651
Kraft-Prusa	1,988	1,942	1,992	1,834	103,295
Ray	1,214	1,147	1,132	1,140	33,667
Spivey-Grabs	3,457	3,168	2,796	2,540	35,248
Trapp	2,758	2,772	3,055	2,467	191,149
Other fields [3]	81,043	80,859	80,631	78,042	NA
Total	106,252	104,733	103,738	99,200	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 13.—Oil and gas well drilling in 1967, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Allen	35	-----	26	-----	-----	-------	61
Anderson	9	-----	8	-----	-----	7	24
Atchison	-----	-----	1	-----	-----	-------	1
Barber	13	10	14	5	14	30	86
Barton	52	1	68	14	-----	54	189
Bourbon	1	-----	11	1	-----	33	46
Brown	-----	-----	-----	-----	-----	1	1
Butler	41	-----	31	6	-----	22	100
Chase	2	-----	-----	-----	-----	-------	2
Chatauqua	28	4	16	1	1	11	61
Clark	2	-----	2	-----	-----	5	9
Cloud	-----	-----	-----	-----	-----	1	1
Coffey	5	-----	4	-----	-----	1	10
Comanche	2	-----	3	-----	5	15	25
Cowley	48	1	20	5	-----	21	95
Crawford	4	-----	4	-----	-----	1	9
Decatur	11	-----	4	6	-----	14	35
Dickinson	8	-----	2	-----	-----	5	15
Doniphan	-----	-----	-----	-----	-----	1	1
Douglas	1	-----	2	-----	-----	1	4
Edwards	1	5	3	2	5	11	27
Elk	12	-----	3	-----	-----	4	19
Ellis	61	1	63	15	-----	77	217
Ellsworth	5	-----	7	1	-----	9	22
Finney	-----	1	-----	1	-----	4	6
Ford	2	-----	-----	-----	-----	6	8
Franklin	4	-----	8	-----	-----	1	13
Geary	-----	-----	1	-----	-----	-------	1
Gove	4	-----	3	2	-----	10	19
Graham	29	-----	30	9	-----	52	120
Grant	-----	3	-----	-----	-----	1	4
Gray	-----	-----	-----	-----	-----	1	1
Greeley	-----	-----	-----	-----	-----	1	1
Greenwood	111	1	61	-----	-----	17	190
Hamilton	-----	2	-----	-----	-----	-------	2
Harper	17	3	6	2	2	18	48
Harvey	15	1	10	2	-----	8	36
Haskell	2	-----	1	-----	-----	-------	3
Hodgeman	4	-----	6	5	1	20	36
Jackson	-----	-----	-----	-----	-----	3	3
Jefferson	-----	-----	-----	-----	1	1	2
Johnson	-----	1	2	-----	1	1	5
Kearny	-----	-----	3	-----	-----	1	4
Kingman	5	10	8	2	1	32	58
Kiowa	13	8	5	6	16	35	83
Labette	5	2	4	-----	-----	1	12
Lane	-----	-----	-----	-----	-----	1	1
Leavenworth	-----	-----	-----	-----	-----	2	2
Linn	4	4	8	2	-----	1	19
Lyon	10	-----	4	1	-----	3	18
McPherson	23	-----	6	-----	-----	10	39
Marion	18	-----	5	-----	-----	9	32
Meade	2	1	2	1	4	7	17
Miami	16	1	7	-----	1	-------	25
Montgomery	24	1	17	-----	-----	-------	42
Morris	-----	-----	-----	-----	-----	5	5
Morton	2	2	4	-----	3	5	16
Nemaha	1	-----	-----	-----	-----	-------	1
Neosho	10	1	23	-----	-----	4	38
Ness	28	-----	19	15	-----	42	104
Norton	-----	-----	1	-----	-----	12	13
Osage	-----	-----	-----	-----	-----	1	1
Osborne	-----	-----	1	1	-----	-------	2
Pawnee	9	2	6	7	-----	13	37
Phillips	11	-----	2	1	-----	11	25
Pottowatomie	-----	-----	-----	-----	-----	1	1
Pratt	19	2	8	7	-----	29	65
Rawlins	2	-----	1	1	-----	12	16
Reno	24	-----	7	3	-----	16	50
Rice	46	-----	28	5	-----	23	102
Riley	-----	-----	2	-----	-----	-------	2
Rooks	33	1	19	11	-----	23	87
Rush	24	18	20	8	4	28	102
Russell	61	1	41	12	-----	31	146
Saline	4	-----	3	2	-----	7	16
Scott	-----	-----	1	-----	-----	3	4
Sedgwick	2	-----	3	1	-----	12	18

See footnotes at end of table.

Table 13.—Oil and gas well drilling in 1967, by counties—Continued

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Seward	2	3	4	1	5	3	18
Sheridan	9	-----	11	6	-----	35	61
Stafford	30	1	29	17	1	38	116
Stanton	-----	-----	1	-----	-----	1	2
Stevens	1	4	2	1	1	3	12
Sumner	9	1	19	3	-----	38	70
Trego	13	1	14	9	-----	23	60
Wabaunsee	-----	-----	-----	-----	-----	4	4
Wichita	-----	-----	-----	1	-----	4	5
Wilson	23	-----	8	-----	-----	1	32
Woodson	19	3	16	1	-----	4	43
Wyandotte	-----	-----	-----	-----	1	-------	1
Total	1,031	101	782	202	67	1,002	3,185

Source: American Association of Petroleum Geologists.

Table 14.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

Product	Proved reserves Dec. 31, 1966	Changes in proved reserves, due to extensions, revisions, and new discoveries, in 1967	Proved reserves Dec. 31, 1967 (production was deducted)	Changes from 1966 (percent)
Crude oil—thousand barrels	726,429	−2,928	625,121	−14
Natural gas liquids [1]—do	256,848	33,310	271,952	+6
Natural gas—million cubic feet	15,923,275	252,422	15,283,657	−4

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

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association· Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. Tulsa Daily World, 63d year, No. 208 Apr. 8, 1968, p. 22.

The figure for total known reserves in Kansas reservoirs as of January 1, 1967, was obtained by modifying and updating statistics originally prepared by Paul D. Torrey.[4] Estimates of oil reserves from discoveries in the interval between January 1, 1967, and December 31, 2019, are based on existing data projected by using a mathematical formula developed by C. L. Moore.[5]

Kansas ranked seventh in the Nation in volume and value of petroleum production. Petroleum producing wells at the end of 1967 totaled 47,597, compared with 46,016 wells in 1966.

Refineries.—At yearend, 12 refineries were operating in Kansas. Crude capacity continued to increase and was up to 399,500 barrels per stream day from 376,860 barrels in 1966.[6] The 6.0-percent increase in refinery capacity was about in line with the national increase of 6.4 percent. During 1967, Kansas produced only 76.7 percent of the crude oil run to its stills; although future Kansas production will tend to decrease, future refinery demands will tend to increase.

New additions and expansions to the State's refining facilities included the CRA, Inc., increase in crude capacity at its Phillipsburg refinery to 17,500 barrels per stream day; the National Cooperative Refinery Association addition of a butane isomerization unit with a capacity of 3,500 barrels per day to its McPherson refinery; and the Skelly Oil Co. addition of an 8000-barrel-per-day hydrodesulfur-

[4] Torrey, Paul D. Evaluation of United States Oil Resources as of January 1, 1966. Pres. at Ann. Meeting of Interstate Oil Compact Commission, Phoenix, Ariz., Dec. 12–14, 1966 p. 3.

[5] Moore C. L. Method for Evaluation of U.S. Crude Oil Resources and Projecting Domestic Crude Oil Availability. U.S. Dept. of Interior, Office of Oil and Gas, May 1962, p. 42.

[6] Oil and Gas Journal. V. 66, No. 14, Apr. 1, 1968, p. 130.

Table 15.—Petroleum thermal recovery projects

Operator	County	Field	Type of flood	Year of project	Remarks
Midland Trailers Co.	Franklin	Lane	Steam	1966 or 1967	Near Lane, Project 1.
Do	do	do	do	1966 or 1967	Near Lane, Project 2.
Sohio Oil Co	Allen	Carlyle	Combustion	1963	North of Iola.
Sun Oil Co	do	West Moran	do	1964	Near Iola.
Tenneco Oil Co	do	La Harpe	Steam	1966 or 1967	South of La Harpe.
Do	Labette	Chetopa	do	1966 or 1967	West of Chetopa.
Do	do	Chetopa Townsite.	do	1966 or 1967	South of Chetopa.

ization unit to its El Dorado refinery.

Petrochemicals.—The State's petrochemical industry expanded existing facilities and made additions during 1967. M. W. Kellogg Co., a division of Pullman, Inc., was given a contract to design and construct a 600-ton-per-day ammonia plant near Dodge City, Kans., for Farmland Industries, Inc. The ammonia will be used primarily for production of nitrogen-based fertilizers. This is part of a $14 million fertilizer complex. Cooperative Farm Chemicals Association of Lawrence, Kans., was building a 350-ton-per-day nitric acid plant which will be completed in mid-1968.

Using natural gas as feedstock, Cooperative Farm Chemicals Association produced ammonia, ammonium nitrate, ammonium phosphate, nitric acid, urea nitrate solutions and fertilizers at its plant near Lawrence.

Gulf Oil Corp. used natural gas as feedstock to produce ammonia, nitric acid, fertilizers, dry ice, and methanol at its plant near Pittsburg.

Mobil Chemical Co. used petroleum fractions as feedstock in the production of carbon black oils and sodium cresylate solutions at its Augusta Plant.

Phillips Petroleum Co. produced rubber extender and process oils from petroleum fractions at its Kansas City plant.

Racon Inc., used carbon tetrachloride and chloroform from natural gas and hydrofluoric acid as feedstock to produce refrigerants and other petrochemicals at its Wichita plant.

Reichhold Chemicals, Inc., produced formaldehyde, phenolformaldehyde resins, and polyvinyl acetate emulsions at its Kansas City plant.

Skelly Oil Co. produced acetone, benzene, cumene, phenol, toluene, xylene, and a variety of high-solvency naphtha compounds at its El Dorado plant.

Vickers Petroleum Co., Inc., produced benzene, higher aromatics, insecticide components, paint solvents, specialty solvents, and toluene from catalytic reformate at its plant in Potwin.

Vulcan Materials Co. produced ammonia from hydrogen and natural gas feedstock at its Wichita plant.

Pipelines.—Mobil Pipe Line Co. will increase the capacity of its 6-inch products pipeline from Augusta, Kans., to South Dakota by 20 percent. The new capacity will be 26,000 barrels per day from Augusta to Topeka, and 16,000 barrels per day from Topeka to South Dakota. The project is scheduled for completion in 1968. The control center for the fully automated system is at the Mobil Oil Corp. Augusta refinery.

Williams Bros. Pipeline Co. planned a 118-mile, 8-inch products line from Humboldt, Kans., to Carthage and Springfield, Mo.

NONMETALS

Cement.—The Kansas portland cement industry, after setting new production records for 5 consecutive years, failed to reach the 1966 peak. The lack in demand for Kansas cement was due to a shortage of money in the construction industry and an overcapacity in the cement industry of Kansas and Missouri.

The output of the six plants was 9.0 million barrels of portland cement, utilizing an average of 70 percent of total capacity. Almost 59 percent of the cement was produced by the wet process and 41 percent by the dry process. Based on reports of five of the six portland cement plants, 75 percent of the shipments were by rail and 25 percent by truck. Six plants reported 92 percent of the shipments in bulk and 8 percent in paper bags. The distribution of shipments by type of customer was as follows: Ready-mixed concrete companies, 56.1 percent; highway contractors, 13 percent; other contractors,

5 percent; building material dealers, 7 percent; concrete product manufacturers, 10.5 percent; and miscellaneous customers, 8 percent.

Masonry cement was produced at all portland cement plants and at a natural cement plant in Bourbon County.

The Ash Grove Lime and Portland Cement Co. completed a research laboratory and office building in Kansas City, Kans.

Clay.—Activity in the sewer pipe and lightweight aggregate industries accounted for the gain in clay output.

Table 16.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1963	8,248	8,201	$25,372
1964	8,335	8,483	25,959
1965	8,877	8,801	26,972
1966	9,174	8,979	27,246
1967	9,023	8,833	25,545

Table 17.—Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	893	$1,104
1964	785	935
1965	789	953
1966	847	1,006
1967	935	1,339

Thirteen firms produced clay from 24 pits in Kansas. Uses of Kansas clay and shale included 41 percent for cement, 27 percent for building brick, and 32 percent for sewer pipe, lightweight aggregate, heavy clay products, and stoneware and pottery.

The Excelsior Brick Co., one of the oldest continuously operated industries in Fredonia, was sold to Lusco Brick Co. of Wichita, Kans. The company name was changed to Excelsior Clay Products, Inc.

Gypsum.—Production of crude gypsum increased 3 percent, but that of calcined gypsum decreased 10 percent from the 1966 output. The decrease was due to the decline in the building industry, since the principal uses of calcined gypsum are for wallboard and wall plaster. Kansas crude gypsum was used as a retarder in portland cement, as a soil conditioner, and as a filler in paper and paint.

Perlite.—Crude perlite mined outside the State was processed by Lite Weight Products, Inc., at its plant in Kansas City, Kans. Expanded perlite was used as a carrying agent for fertilizer, soil conditioning, building plaster aggregate, concrete aggregate, filler material, and loose fill insulation.

Pumice.—Output was considerably less in 1967 than in 1966. Volcanic ash was used in cleansing and scouring compounds, hand soaps, and dusting powders, and as an aggregate in asphalt concrete.

Salt.—Evaporated and rock salt were produced by six companies in Barton, Ellsworth, Reno, and Rice Counties. Three companies produced rock salt, five produced evaporated salt, and two produced both rock and evaporated salt. Another producer pumped brine in Sedgwick County for use in making chlorine and caustic soda.

Meatpackers, livestock raisers, leather tanners, and feed dealers were large consumers of salt. Large amounts were also used for road stabilization and snow and ice removal. Most of the increased production was consumed in ice removal and for feeding stock.

Table 18.—Evaporated and rock salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt	
	Quantity	Value	Quantity	Value
1963	435	$9,669	489	$2,324
1964	438	9,485	492	2,314
1965	453	9,828	600	2,548
1966	452	10,836	517	2,552
1967	521	12,085	548	2,601

Sand and Gravel.—Sand and gravel was produced in 86 counties at 134 commercial and 83 Government-and-contractor operations. Commercial operators produced 71 percent of total sand and gravel. The annual output of 46 percent of the commercial operators was less than 25,000 tons; 47 percent produced 25,000 to

200,000 tons; and 7 percent produced over 200,000 tons. Twenty-five commercial operators (19 percent) produced 62 percent of the commercial sand and gravel. Over 88 percent of the total production was used for building and highway construction, and 87 percent of the total production was washed and screened.

Table 19.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	9,763	$7,603	2,299	$1,073	12,062	$8,676
1964	10,227	7,788	2,741	1,320	12,968	9,108
1965	9,960	7,494	2,584	979	12,544	8,473
1966	9,316	7,193	2,311	1,181	11,627	8,374
1967	8,510	6,727	3,556	1,922	12,066	[1] 8,650

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

Table 20.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,026	$3,186	3,450	$2,822
Paving	2,636	1,980	2,207	1,677
Fill	869	398	1,049	546
Other [1]	220	236	227	222
Total	7,751	5,800	6,933	5,267
Gravel:				
Building	219	229	309	337
Paving	1,184	995	1,180	1,014
Fill	66	43	28	31
Other [2]	96	126	60	78
Total	1,565	1,393	1,577	1,460
Total sand and gravel	9,316	7,193	8,510	6,727
Government-and-contractor operations:				
Sand:				
Building	108	108	165	165
Paving	1,096	510	1,432	726
Fill	4	2	5	3
Total	1,208	620	1,602	894
Gravel:				
Paving	1,006	521	1,954	1,029
Fill	97	40	--------	--------
Total	1,103	561	1,954	1,029
Total sand and gravel	2,311	1,181	3,556	[3] 1,922
Grand total	11,627	8,374	12,066	[3] 8,650

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

Table 21.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Barton	172	$94	Meade	3	$1
Bourbon	3	3	Morris	18	9
Brown	6	3	Ness	59	25
Butler	7	11	Norton	3	1
Chase	7	3	Osage	1	1
Clark	28	14	Osborne	262	174
Clay	182	W	Pawnee	73	56
Coffey	19	8	Phillips	30	W
Comanche	15	7	Pratt	174	87
Cowley	333	233	Rawlins	13	7
Decatur	26	19	Reno	354	207
Doniphan	6	6	Republic	21	11
Elk	17	7	Rice	184	145
Ellis	218	151	Rush	6	3
Finney	94	100	Russell	77	46
Ford	219	129	Scott	167	W
Gove	51	27	Sedgwick	1,794	1,172
Graham	17	7	Seward	111	103
Greeley	9	4	Sheridan	66	27
Greenwood	60	94	Sherman	68	58
Hamilton	632	316	Stevens	12	6
Haskell	55	27	Sumner	210	114
Hodgeman	75	38	Trego	87	W
Jackson	43	21	Wabaunsee	5	3
Jewell	8	4	Wallace	53	W
Johnson	370	W	Washington	169	185
Kearny	51	25	Wichita	44	17
Kiowa	121	73	Wyandotte	1,736	1,533
Leavenworth	19	24	Other counties [1]	3,233	3,080
Linn	2	1			
Logan	1	1	Total	12,066	8,650
Lyon	135	116			
McPherson	32	13			

W Withheld to avoid disclosing individual company confidential data; included with other counties.
[1] Includes Barber, Cheyenne, Cloud, Dickinson, Douglas, Edwards, Ellsworth, Geary, Grant, Gray, Harper, Harvey, Kingman, Marion, Marshall, Mitchell, Nemaha, Neosho, Pottawatomie, Riley, Rooks, Saline, Shawnee, Stafford, and Thomas Counties. Undistributed amounts from various counties are also included.

Stone.—Owing to the cyclic trend of highway construction, output of stone in Kansas decreased for the second year.

Limestone, sandstone, and chat were quarried in 54 counties. Crushed limestone was produced in 50 counties at 144 commercial and 35 Government-and-contractor operations. Dimension limestone was quarried and prepared at eight operations in five counties.

Table 22.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Limestone [1]		Other stone		Total stone	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	12,904	$17,600	654	$883	13,558	$18,483
1964	13,412	17,747	726	1,165	14,138	18,912
1965	14,673	19,566	597	972	15,270	20,538
1966	13,503	17,886	524	903	14,027	18,789
1967	12,776	16,594	775	1,212	13,551	17,806

[1] Includes limestone for cement.

Table 23.—Stone sold or used by producers, by kinds and uses

Uses	1966		1967	
	Short tons	Value	Short tons	Value
Limestone:				
Riprap	1,202,347	$1,175,814	W	W
Concrete aggregate and roadstone	8,826,102	11,618,915	8,434,686	$11,208,321
Agriculture	581,979	949,974	546,384	885,078
Cement	2,515,582	2,672,949	2,686,043	2,848,122
Dimension	21,085	647,802	6,906	507,610
Other [1]	355,703	821,046	1,101,515	1,144,508
Total	13,502,798	17,886,500	12,775,534	16,593,639
Sandstone: Dimension	305	5,823	141	3,800
Grand total [2]	14,027,004	18,789,408	13,551,000	17,805,841

W Withheld to avoid disclosing individual company confidential data; included in total.
[1] Includes riprap (1967), flux (1967), railroad ballast, cement rock, whiting, and other uses.
[2] Includes crushed sandstone, and miscellaneous stone.

The principal uses for crushed stone included concrete aggregate, roadstone, cement, riprap, and soil conditioner. Dimension stone was used for building stone, curbing, and flagging. Commercial producers supplied 93 percent of total stone output.

Vermiculite.—The Dodson Manufacturing Co., Inc., plant for exfoliating vermiculite at Wichita was shut down during 1967.

Water.—The State of Kansas published a report entitled "Kansas Water Law." [7] The publication contains: (1) The Republican River Interstate Compact Between Kansas, Colorado, and Nebraska, the Arkansas River Compact Between Kansas and Colorado, and the Arkansas River Basin Compact Between Kansas and Oklahoma; (2) the Basic Water Law Doctrine in Kansas; (3) the Important Court Decisions Concerning Water Rights; (4) the Present Kansas Water Appropriation Statutes; (5) the Opinions of the Attorneys General of Kansas on Riparian Rights, Littoral Rights, Ground Water Rights and Powers, Rural Water Districts, and Watershed Districts; (6) the Organization and Responsibility of the Kansas Water Resources Board; and (7) information on other State agencies and commissions interested in water use and supply.

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. Further details on Tri-State activity are in the Oklahoma Chapter.

Lead and Zinc.—Eleven small lead-zinc mines operated in the Kansas portion of the Tri-State District. Five of the mines produced 96 percent of the crude ore.

The Eagle-Picher Industries, Inc., are reopening the Swalley-Paxson area 2 miles west of Baxter Springs, Kans. An incline tunnel will be driven and the ore transported by conveyor from the underground crusher to the unit train loading station on the surface. Production is expected to reach 3,000 rock tons per day.

[7] Shurtz, Earl B. Kansas Water Law. Water Resources Board, Kansas P–43 Rept. 16(f), September 1967, 104 pp.

Table 24.—Mine production of lead and zinc, in terms of concentrate and recoverable metals [1]

Year	Mines producing	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content [2]			
						Lead		Zinc	
		Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1963	8	1,402	$172	6,433	$514	1,027	$222	3,508	$807
1964	10	1,603	228	8,636	768	1,185	310	4,665	1,269
1965	9	2,304	380	12,003	1,157	1,644	513	6,508	1,900
1966	9	1,574	242	8,911	849	1,109	335	4,769	1,383
1967	10	1,486	209	8,832	817	1,031	289	4,765	1,319

[1] Based on Kansas ore and old tailing treated at mills during calendar year indicated.
[2] In calculating metal content of the ores from assays, allowance made for smelting losses of both lead and zinc. In comparing values of concentrate (ore) and metal, value given for concentrate is that actually received by producer, whereas value of lead and zinc is calculated from average price for all grades.

Table 25.—Principal producers of metals, minerals, and fuels

Commodity and company	Type of activity	County	Address	Remarks
Cement:				
Ash Grove Lime & Portland Cement Co	Quarry and plant	Neosho	Kansas City, Mo	Limestone and clay.[1]
General Portland Cement Co	do	Wilson	Fredonia, Kans	Do.[1]
Lehigh Portland Cement Co	do	Allen	Allentown, Pa	Do.[1]
Lone Star Cement Corp	do	Wyandotte	Indianapolis, Ind	Limestone.
The Monarch Cement Co	do	Allen	Humboldt, Kans	Limestone and clay.[1]
Universal Atlas Cement Co	do	Montgomery	Pittsburgh, Pa	Do.[1]
Clay:				
Acme Brick Co	Mine and plant	Cherokee, Ellsworth, Wilson	Fort Worth, Tex	
Buildex, Inc	do	Franklin and McPherson	Pittsburg, Kans	
Cloud Ceramics	do	Cloud	Concordia, Kans	
W. S. Dickey Clay Manufacturing Co	do	Cherokee and Crawford	Kansas City, Mo	
Excelsior Clay Products, Inc	do	Wilson	Wichita, Kans	
Humboldt Shale Mining Co	do	Allen	Humboldt, Kans	
Kansas Brick & Tile Co., Inc	do	Barton and Ellsworth	Hoisington, Kans	
Wilkinsons, Inc	Mine	Cherokee	Weir, Kans	
Coal:				
The Clemens Coal Co	Strip mine	Crawford	Pittsburg, Kans	
Pittsburg & Midway Coal Mining Co	do	Cherokee	Kansas City, Mo	
Wilkinsons, Inc	do	do	Weir, Kans	
Cliff Carr Coal Co	do	Crawford	Mulberry, Kans	
Gypsum:				
Georgia-Pacific Corp. Bestwall Gypsum Co. Division	Quarry and plant	Marshall	Portland, Oreg	
National Gypsum Co	do	Barber	Buffalo, N.Y	
Lead and zinc:				
Eagle-Picher Industries, Inc	Underground mine	Cherokee	Miami, Okla	
Mid-Continent Lead & Zinc Co	do	do	Baxter Springs, Kans	
Pumice:				
Ernest Hanzlicek	Mine	Lincoln	Wilson, Kans	
Wyandotte Chemical Corp	Mine and plant	Norton	Wyandotte, Mich	
Salt:				
American Salt Corp	Brine wells and underground mine.	Rice	Kansas City, Mo	
The Barton Salt Co	Brine wells	Reno	Hutchinson, Kans	
The Carey Salt Co	Brine wells and underground mine.	do	do	
Cargill, Inc	Brine wells	Barton	Minneapolis, Minn	
Independent Salt Co	Underground mine	Ellsworth	Kanopolis, Kans	
Morton Salt Co	Brine wells	Reno	Chicago, Ill	
Vulcan Materials Co	do	Sedgwick	Wichita, Kans	
Sand and gravel:				
American Sand Co	Dredge	Wyandotte	Kansas City, Kans	
Builders Sand Co	Pit	do	do	
Holliday Sand & Gravel Co	Dredge and stationary	Johnsor, Douglas, Wyandotte.	Overland Park, Kans	
Miles Sand, Inc	Stationary	Sedgwick	Wichita, Kans	
Peck-Woolf Sand & Material Co	Dredge	Wyandotte	Kansas City, Kans	
Salina Sand Co., Inc	Stationary	Saline	Mentor, Kans	
San Ore Construction Co., Inc	Portable and mine	Thomas, Mitchell, Geary, Rooks.	McPherson, Kans	Volcanic ash (Lincoln County).
Siebert Sand Co., Inc	Portable and stationary	Thomas, Trego, Ellis, Scott, Phillips, Ness, Wallace.	Ness City, Kans	
Stewart Sand & Material Co	Stationary	Wyandotte	Kansas City, Mo	
Superior Sand Co	Dredge	Sedgwick	Wichita, Kans	

Stone:			
Anderson-Oxandale Co	Quarry	Chase, Clay, Coffey Dickinson, Geary, Jackson, Jewell, Marion, Morris, Ness, Pottawatomie, Rawlins, Riley, Smith.	Herington, Kans.
Hallett Construction Co	Quarry	Chase, Clay, Dickinson, McPherson, Marion, Morris, Rice.	Crosby, Minn.
Martin Marietta Corp. Concrete Materials Div.	do	Atchison, Elk, Franklin, Leavenworth, Lyon, Riley, Shawnee, and various.	Cedar Rapids, Iowa.
Nelson Bros. Quarries	do	Allen, Coffey, Montgomery, Woodson, and various.	La Harpe, Kans.
Reno Construction Co	do	Johnson	Overland Park, Kans.
John J. Stark, Contractor	do	Various	Girard, Kans.
Thompson-Strauss Quarries	do	Wyandotte	Kansas City, Kans.
Union Quarries, Inc.	do	Johnson	Overland Park, Kans.
West Lake Quarry & Material Co	do	Doniphan	Bridgeton, Mo.
Quartzite Stone Co., Inc.	do	Lincoln	Lincoln, Kans.
Helium:			
Alamo Chemical Co-Gardner Cryogenics, Inc.	Plant	Morton	Elkhart, Kans.
Cities Service Helex, Inc.	do	Grant	Ulysses, Kans.
Kansas Refined Helium Co	do	Rush	Otis, Kans.
National Helium Corp.	do	Seward	Liberal, Kans.
Northern Helex Co.	do	Ellsworth	Bushton, Kans.
Petroleum operators:			
Cities Service Oil Co.		Various	Tulsa, Okla.
Continental Oil Co.		do	Houston, Tex.
National Cooperative Refinery Association		do	McPherson, Kans.
Pan American Petroleum Corp.		do	Tulsa, Okla.
Skelly Oil Co.		do	do
Sunray DX Oil Co.		do	do
Texaco, Inc.		do	New York, N.Y.
Petroleum refineries:			
American Oil Co.	Refinery	Wilson	Neodesha, Kans.
American Petrofina Co. of Texas	do	Butler	Eldorado, Kans.
Apco Oil Corp.	do	Cowley	Arkansas City, Kans.
Century Refining Co., Inc.	do	Scott	Scott City, Kans.
Cra, Inc.	do	Montgomery	Coffeyville, Kans.
Do.	do	Phillips	Phillipsburg, Kans.
Derby Refining Co.	do	Sedgwick	Wichita, Kans.
Mid-American Refining Co., Inc.	do	Neosho	Chanute, Kans.
Mobil Oil Corp.	do	Butler	Augusta, Kans.
National Cooperative Refinery Association	do	McPherson	McPherson, Kans.
Phillips Petroleum Co.	do	Wyandotte	Kansas City, Kans.
Skelly Oil Co.	do	Butler	Eldorado, Kans.
Natural gas purchasers:			
Cities Service Gas Co.		Various	Oklahoma City, Okla.
Colorado Interstate Gas Co.		do	Colorado Springs, Colo.
Kansas Nebraska Natural Gas Co.		do	Hastings, Nebr.
Northern Natural Gas Co.		do	Omaha, Nebr.
Panhandle Eastern Pipeline Co.		do	Houston, Tex.

[1] Multiple commodities produced at a single location.

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 Geological Survey of Kentucky, for collecting information on all minerals except fuels.

By H. L. Riley [1] and Preston McGrain [2]

Mineral production value in Kentucky increased 7 percent in 1967 for a new record. Kentucky ranked second in the United States in production of bituminous coal, with 18 percent of the national total, and second in the production of both ball clay and fluorspar.

Coal mining was dominant in the State's mineral industry and comprised 74 percent of the total value, compared with 73 percent in 1966. Leading companies, in order of value of production, were Peabody Coal Co., Island Creek Coal Co., and The Pittsburgh and Midway Coal Mining Co.

Legislation and Government Programs.—The U.S. Geological Survey and the Kentucky Geological Survey continued the cooperative program of mapping the geology of the State on 7.5-minute quadrangles. At yearend, 280 maps involving all or parts of 297 quadrangles had been published. The Kentucky Geological Survey, in cooperation with the Kentucky Department of Mines and Minerals, published an oil and gas map of Letcher County. The Kentucky Geological Survey published three reports relating to mineral resources [3]

Economic Indicators.—The only economic indicators not showing an increase were total mining employment and sale of power to large industries, manufacturers, and mines. The reduction in sale of power to large industries reflects a decrease in the Atomic Energy Commission's operations. Bituminous coal mining employment increased. Total private construction value, including residential and nonresidential, increased 40 percent over 1966 levels and was 7 percent above 1965 levels.

[1] Mining engineer, Bureau of Mines, Knoxville, Tenn.

[2] Assistant State geologist, Kentucky Geological Survey, Lexington, Ky.

[3] McGrain, Preston and G. R. Dever, Jr., Limestone Resources in the Appalachian Region of Kentucky, Kentucky Geological Survey, Ser. X, Bull. 4, 1967.

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Hollenbeck, R. P., J. S. Browning and T. L. McVay. Industrial Sand in Pike County, Kentucky. Kentucky Geological Survey in cooperation with BuMines, Ser. X, Rep. Inv. 7, 1967.

Table 1.—Mineral production in Kentucky [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	1,152	$2,277	1,195	$2,066
Coal (bituminous) do	93,156	363,440	100,294	396,883
Fluorspar short tons	28,725	1,361	32,952	1,686
Lead (recoverable content of ores) do	484	146	845	237
Natural gas million cubic feet	76,536	18,139	89,168	21,400
Petroleum (crude) thousand 42-gallon barrels	18,066	51,488	15,535	45,052
Sand and gravel thousand short tons	8,064	7,524	7,981	7,859
Silver (recoverable content of ores) troy ounces	1,086	1	568	1
Stone thousand short tons	22,667	31,179	24,812	35,481
Zinc (recoverable content of ores) short tons	6,586	1,910	6,317	1,749
Value of items that cannot be disclosed:				
Asphalt, cement, ball clay, and natural gas liquids	XX	20,899	XX	23,291
Total	XX	498,364	XX	535,705
Total 1957–59 constant dollars	XX	r 525,351	XX	p 544,258

p Preliminary. r Revised. XX Not applicable.

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

[2] Excludes ball clay, included with "Value of items that cannot be disclosed."

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

County	1966	1967	Minerals produced in 1967 in order of value [2]
Adair	W	W	Limestone, petroleum.
Allen	W	W	Petroleum, limestone.
Anderson	W	W	Limestone.
Ballard	$19,000	$20,000	Sand and gravel.
Barren	W	W	Limestone, petroleum.
Bath	11,879	11,168	Petroleum.
Bell	8,491,703	9,685,546	Coal, petroleum.
Boone	1,922,000	1,707,000	Sand and gravel.
Bourbon	W	W	Limestone.
Boyd	120,263	W	Coal, miscellaneous clay, petroleum.
Boyle	324,634	W	Limestone.
Breathitt	2,372,985	6,825,337	Coal, petroleum.
Breckinridge	W	W	Limestone, petroleum, sand and gravel.
Bullitt	W	W	Miscellaneous clay, limestone.
Butler	W	W	Coal, petroleum, limestone.
Caldwell	W	W	Limestone.
Calloway	W	W	Limestone, sand and gravel.
Carlisle	16,000	16,000	Sand and gravel.
Carter	1,288,200	1,541,435	Limestone, fire clay, coal.
Casey	228,428	W	Limestone, petroleum.
Christian	2,011,347	W	Limestone, petroleum, miscellaneous clay.
Clay	5,151,925	2,957,207	Coal, petroleum.
Clinton	W	W	Petroleum, limestone, coal.
Crittenden	W	W	Fluorspar, limestone, zinc, petroleum.
Cumberland	W	W	Limestone, petroleum.
Daviess	W	W	Coal, petroleum, sand and gravel, miscellaneous clay.
Edmonson	W	W	Limestone, native asphalt, petroleum.
Elliott	160,582	140,788	Petroleum, coal.
Estill	W	W	Petroleum, limestone.
Fayette	1,483,610	W	Limestone.
Fleming	W	W	Do.
Floyd	W	W	Coal, petroleum, sand and gravel.
Franklin	801,000	W	Limestone.
Fulton	W	16,000	Sand and gravel.
Gallatin	W	W	Do.
Garrard	82,548	W	Limestone.
Graves	W	W	Ball clay, sand and gravel.
Grayson	W	W	Limestone.
Green	W	W	Petroleum, limestone.
Greenup	W	W	Fire clay, limestone, petroleum.
Hancock	733,173	615,950	Petroleum, miscellaneous clay.
Hardin	1,629,000	1,169,900	Limestone.
Harlan	W	W	Coal, limestone.
Harrison	W	W	Limestone.
Hart	318,064	W	Limestone, petroleum.
Henderson	W	W	Petroleum, sand and gravel, coal.
Henry	W	W	Limestone.
Hickman	14,000	16,000	Sand and gravel.
Hopkins	37,942,336	46,385,184	Coal, petroleum.
Jackson	263,036	W	Limestone, coal, petroleum.
Jefferson	W	W	Cement, sand and gravel, limestone, miscellaneous clay.
Jessamine	W	W	Limestone.
Johnson	3,530,988	2,866,995	Petroleum, coal.
Kenton	2,598	----------	
Knott	8,933,753	7,162,787	Coal, petroleum.
Knox	W	W	Coal, miscellaneous clay, petroleum.
Laurel	W	W	Limestone, coal, petroleum.
Lawrence	1,452,280	1,279,549	Petroleum, coal.
Lee	W	W	Petroleum, limestone, coal.
Leslie	5,755,526	6,800,044	Coal, petroleum.
Letcher	W	W	Coal, limestone, petroleum.
Lincoln	5,902	3,402	Petroleum.
Livingston	W	W	Limestone, zinc, fluorspar, lead, sand and gravel, silver.
Logan	W	W	Limestone, petroleum.
Lyon	11,000	12,000	Sand and gravel.
Madison	W	W	Limestone.
Magoffin	2,257,238	W	Petroleum, coal.
Marion	W	W	Limestone.
Marshall	38,000	42,000	Sand and gravel.
Martin	1,922,147	1,960,940	Coal, petroleum, sand and gravel.
Mason	116,000	W	Sand and gravel.
McCracken	W	W	Do.
McCreary	2,131,353	2,134,221	Coal, petroleum.
McLean	3,478,659	2,939,272	Petroleum.
Meade	1,336,500	W	Limestone.

See footnotes at end of table.

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

County	1966	1967	Minerals produced in 1967 in order of value [2]
Menifee	$138,662	W	Limestone, petroleum.
Mercer	170,800	W	Limestone.
Metcalfe	W	W	Petroleum, limestone.
Monroe	943,547	$340,364	Do.
Montgomery	83,258	W	Limestone.
Morgan	875,610	W	Limestone, coal, fire clay, petroleum.
Muhlenberg	W	W	Coal, petroleum, limestone.
Nelson	W	W	Limestone.
Nicholas	126,000	79,000	Do.
Ohio	W	W	Coal, petroleum, limestone.
Oldham	1,172,000	W	Limestone.
Owsley	2,784	1,694	Petroleum.
Pendleton	W	W	Limestone.
Perry	19,757,911	21,943,242	Coal, petroleum.
Pike	W	W	Coal, petroleum, limestone.
Powell	W	W	Limestone, petroleum, miscellaneous clay.
Pulaski	W	1,870,670	Coal, limestone, petroleum.
Rockcastle	W	W	Limestone.
Rowan	W	W	Limestone, fire clay, miscellaneous clay.
Russell	2,750	3,996	Petroleum.
Scott	W	W	Limestone.
Simpson	W	W	Limestone, petroleum.
Taylor	W	W	Do.
Todd	W	W	Do.
Trigg	215,000	W	Limestone.
Trimble	W	W	Sand and gravel.
Union	28,176,152	W	Coal, petroleum, sand and gravel.
Warren	1,609,039	908,929	Limestone, petroleum.
Washington	W	----------	
Wayne	W	W	Limestone, petroleum, coal.
Webster	6,340,940	7,927,948	Coal, petroleum.
Whitley	1,726,789	1,167,371	Do.
Wolfe	W	W	Petroleum, limestone.
Undistributed [3]	340,665,101	405,153,061	
Total	498,364,000	535,705,000	

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

[1] The following counties are not listed because no production was reported: Bracken, Campbell, Carroll, Clark, Grant, Larue, Lewis, Owen, Robertson, Shelby, Spencer, 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.

Table 3.—Indicators of Kentucky business activity

		1966	1967 [p]	Change (percent)
Personal income:				
Total	millions	$7,143	$7,612	+6.6
Per capita		$2,246	$2,387	+6.3
Total sales of electric energy:				
To ultimate consumers	million kilowatt-hours	28,444	28,691	+.9
To large industries, manufacturers, and mines	do	21,052	20,647	−1.9
Construction activity:				
Value (residential and nonresidential)	millions	$170.2	$238.0	+40.1
Mineral production	do	$498	$536	+7.0
Nonagricultural employment:				
Total	thousands	803.8	835.0	+3.9
Manufacturing	do	226.5	230.2	+1.6
Nondurable goods	do	105.1	109.0	+3.7
Chemicals and allied products	do	14.1	14.2	+.1
Nonmanufacturing	do	577.4	604.8	+4.7
Mining	do	28.1	27.9	−.1
Bituminous coal mining	do	21.6	22.1	+2.3
Contract construction	do	47.1	48.1	+2.1
Wholesale and retail trade	do	161.1	169.8	+5.4
Finance, insurance, and real estate	do	30.8	32.0	+3.9
Service and miscellaneous	do	108.2	113.0	+4.4
Total government	do	145.2	155.4	+7.0

[p] Preliminary.

Sources: U.S. Department of Commerce, Kentucky Department of Economic Security in cooperation with U.S. Department of Labor, Bureau of Labor Statistics, and Edison Electric Institute.

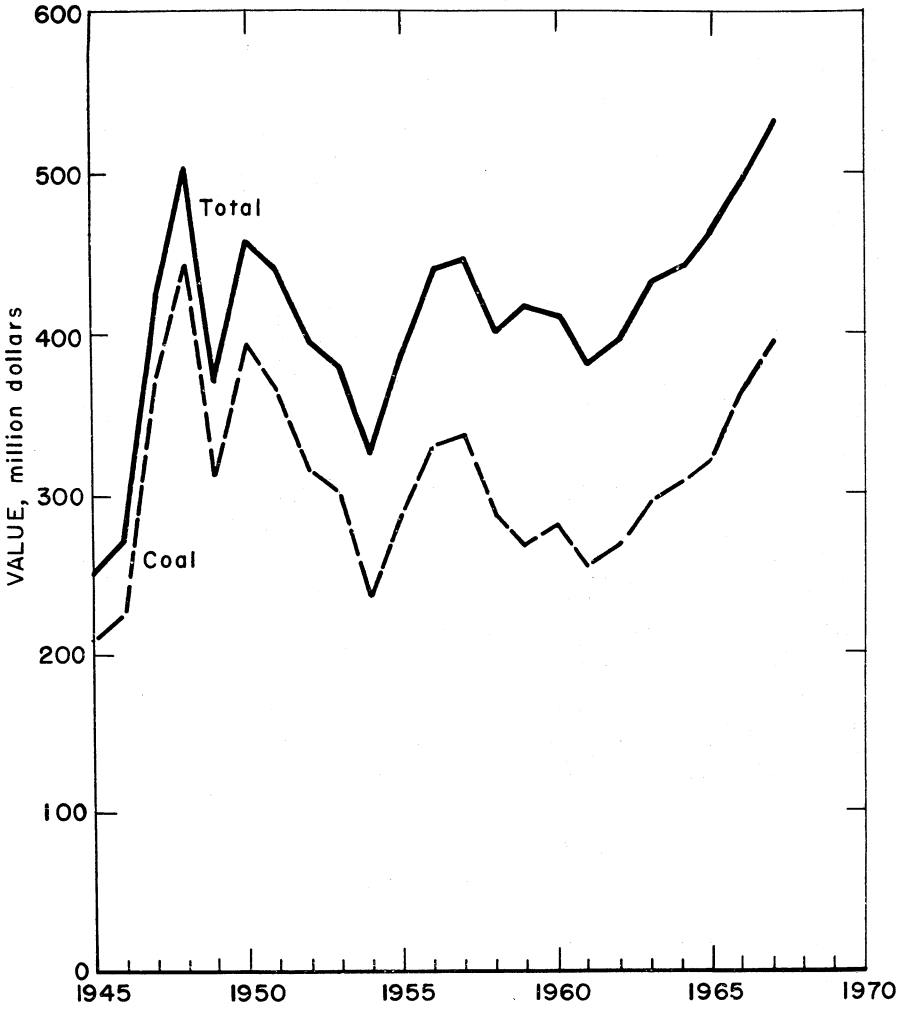

Figure 1.—Value of coal and total value of mineral production in Kentucky.

Trends and Developments.—The Evans-Elkhorn Division, Island Creek Coal Co., dedicated its new Gund mine in Pike County. After full development, the planned annual mine production capacity will be 2 million tons; unit-train loading facilities have been provided.

The West Kentucky Division of Island Creek Coal Co. opened the Hamilton mine in Union County. Planned annual production capacity for 1971 will be 5 million tons. Coal will be transported by belt conveyor to a 4,000-ton-per-hour barge loading facility for water shipment.

United States Steel Corp. announced plans to open a new mine at Lynch in Harlan County. Pikeville Coal Co. began production at the Chisholm mine in Pike County. Beth-Elkhorn Corp., a subsidiary of Bethlehem Steel Corp., began preparation and shipment of metallurgical coal from the new Pike No. 26 mine.

Kentucky Power Co. is constructing an 800,000-kilowatt steam-electric generating

unit at its Big Sandy Plant at Louisa. Company officials estimated this unit would use over 2 million tons of coal annually.

Tennessee Valley Authority is constructing a 1,150,000-kilowatt steam-electric generating unit at the Paradise plant in Muhlenberg County.

Kentucky Utilities Co. plans a 420,000-kilowatt steam-electric unit at the E. W. Brown plant on Herrington Lake near Harrodsburg.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1966:								
Coal	24,225	187	4,519	36,001	42	1,588	45.28	9,576
Metal	41	308	13	101	----	12	118.68	7,922
Nonmetal	435	227	99	788	1	36	46.97	9,001
Sand and gravel	384	273	105	993	----	24	24.17	351
Stone	2,001	234	469	3,841	4	103	27.86	7,208
Total	27,086	192	5,205	41,724	47	1,763	43.38	9,124
1967 p								
Coal	24,000	196	4,698	36,800	51	1,620	45.41	10,868
Metal	40	282	11	90	----	15	166.25	2,383
Nonmetal	365	237	86	688	----	37	53.77	1,543
Sand and gravel	420	245	103	1,001	----	23	22.99	817
Stone	2,050	247	507	4,205	3	112	27.35	5,296
Total [1]	26,875	201	5,406	42,784	54	1,807	43.50	9,918

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

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of bituminous coal, natural gas, and crude petroleum production was $463 million, 86 percent of the total mineral production value of the State.

Coal (Bituminous).—Output of coal increased 8 percent above that of 1966, the record year, and surpassed the million ton mark for the first time. The value of production was $397 million, 11 percent below that of 1948, the record year.

Bituminous coal was produced at 1,532 mines in 37 counties, compared with 1,704 mines in 37 counties in 1966. Leading producing counties on basis of tonnage mined were Muhlenberg, Pike, Hopkins, Ohio, and Letcher.

In the Eastern Kentucky coalfield, 1,454 mines in 27 counties produced 54 million tons, compared with 1,623 mines in 27 counties and a production of 51 million tons in 1966. Average production per mine increased from 31,400 tons to 37,100 tons. Underground mines produced 79 percent of the total, auger mines 11 percent, and strip mines 10 percent. Shipments were 95 percent by rail or water, and 5 percent by truck. Captive tonnage was 11 percent of the total.

Equipment used at 1,248 underground mines included 938 cutting machines, which cut 71 percent of the coal mined underground; 1,422 power drills, which drilled 78 percent of the tonnage; 533 mobile loading machines, loading 59 percent of the tonnage; 90 continuous mining machines, with six mobile loaders used in conjunction, mined 21 percent of the tonnage. Other equipment included 528 locomotives, 662 shuttle cars, 512 shuttle buggies, and 190 gathering conveyors.

At the 66 strip mines, equipment used included 103 power shovels, 86 bulldozers, 48 power drills, and 172 trucks. Equipment used at 140 auger mines included 142 coal recovery augers, five power shovels, 103 bulldozers, nine power drills, and 83 trucks.

Of the total coal production from the Eastern Kentucky field, 22 percent was crushed, 37 percent was cleaned at 34 preparation plants, and 11 percent was treated with oil or other materials.

In the Western Kentucky coalfield, 78 mines in 10 counties produced 46 million tons of coal, compared with 81 mines in 10 counties and 42 million tons in 1966.

Table 5.—Coal (bituminous) production [1] in 1967, by counties

(Thousand short tons and thousand dollars)

County	Number of mines operation			Production [2]				
							Total	
	Underground	Strip	Auger	Underground	Strip	Auger	Quantity	Value
Bell	40	11	10	943	1,383	354	2,681	$9,685
Boyd	1	1	------	1	12	------	13	70
Breathitt	7	7	4	103	1,559	606	2,267	6,725
Butler	2	4	1	55	105	8	167	573
Carter	2	------	------	20	------	------	20	108
Clay	41	2	4	598	58	84	740	2,917
Clinton	3	------	------	12	------	------	12	50
Daviess	------	2	------	------	W	------	W	W
Elliott	1	------	------	3	------	------	3	11
Floyd	162	1	1	5,111	25	W	[3] 5,136	[3] 29,449
Harlan	92	7	13	5,694	313	411	6,418	32,742
Henderson	4	------	------	216	------	------	216	680
Hopkins	13	12	2	7,301	4,809	17	12,127	43,584
Jackson	2	------	------	7	------	------	7	35
Johnson	38	2	1	253	224	2	480	1,213
Knott	74	3	11	1,481	248	407	2,136	7,127
Knox	39	------	3	134	------	117	251	807
Laurel	2	------	------	13	------	------	13	58
Lawrence	1	1	------	3	1	------	4	15
Lee	1	------	------	20	------	------	20	102
Leslie	25	------	2	1,561	------	25	1,587	6,791
Letcher	185	6	12	5,785	409	347	6,541	32,816
Magoffin	2	------	2	52	------	W	[3] 52	[3] 129
Martin	9	------	1	677	------	2	679	1,902
McCreary	9	1	------	537	18	------	555	2,127
Morgan	1	5	------	4	19	------	23	123
Muhlenberg	6	8	------	1,427	18,352	------	19,779	65,110
Ohio	2	9	1	1,117	5,768	7	6,892	22,837
Perry	73	13	20	2,770	898	1,610	5,278	21,887
Pike	391	3	53	16,037	218	1,842	18,097	78,396
Pulaski	12	1	1	262	100	26	388	1,486
Union	4	------	------	W	------	------	W	W
Wayne	------	1	------	------	11	------	11	29
Webster	5	3	------	1,517	W	------	[4] 1,517	[4] 4,550
Whitley	35	1	2	363	6	3	372	1,121
Undistributed [5]	------	------	------	4,444	1,248	121	5,813	21,624
Total [2]	1,284	104	144	58,518	35,785	5,990	100,294	396,883

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] Excludes auger mines; included with "Undistributed."
[4] Excludes strip mines; included with "Undistributed."
[5] Includes auger and strip mines indicated by footnotes 2 and 3, and counties indicated by symbol W.

Average production per mine increased from 521,000 tons to 595,000 tons. Strip mines produced 65 percent of the total coal, and underground mines 35 percent. Shipments were 86 percent by rail or water, and 14 percent by truck. All coal was sold on the open market.

In the 36 underground mines, equipment used included 95 cutting machines and two continuous miners, 94 power drills, and 92 mobile loading machines. Equipment used at 38 strip mines included 75 power shovels, 40 draglines, 114 bulldozers, one carry-all scraper, 53 power drills, and 211 trucks. Four recovery augers and one bulldozer were used at the four auger mines in operation.

In the Western Kentucky coalfield, 23 preparation plants cleaned 65 percent of the coal, 84 percent of the total coal was crushed, and 8 percent was treated with oil or calcium chloride.

Natural Gas.—Marketed production of natural gas increased by 16 percent, but was 8 percent below the 1947 record. Most of the gas production came from the eastern portion of the State. At yearend, 6,295 wells were estimated to be in production.

Natural Gas Liquids.—Production of natural gasoline decreased 11 percent, and output of liquefied petroleum gases (LPG) decreased 1 percent. Natural gasoline output was 47 percent below its 1958

record, and LPG production was 17 percent below its 1956 record.

Petroleum.—Crude oil production of 15.6 million barrels was 2.5 million barrels below 1966 production, partly because secondary recovery projects did not offset declining output from producing wells for the first time in several years.

Crude petroleum was produced in 62 of the State's 120 counties. Henderson County in western Kentucky continued to be the leading oil producer in the State, with

Table 6.—Crude petroleum by counties

County	1966		1967	
	Barrels	Value	Barrels	Value
Adair	1,155	$3,292	414	$1,201
Allen	59,993	170,980	62,299	180,667
Barren	16,907	48,185	15,232	44,173
Bath	4,168	11,879	3,851	11,168
Bell	82	234	63	183
Boyd	39	111	4,149	12,032
Breathitt	44,541	126,942	34,700	100,630
Breckinridge	24,659	70,278	25,376	73,590
Butler	94,789	270,149	75,400	218,660
Casey	8,366	23,843	7,403	21,469
Christian	296,415	844,783	240,047	696,136
Clay	32,355	92,212	13,913	40,348
Clinton	58,182	165,819	56,048	162,539
Crittenden	232	661	81	235
Cumberland	43,270	123,319	38,071	110,406
Daviess	1,325,548	3,777,812	1,257,941	3,648,029
Edmonson	965	2,750	1,039	3,013
Elliott	54,155	154,342	44,724	129,700
Estill	174,713	497,932	256,175	742,908
Floyd	28,070	79,999	27,278	79,106
Green	138,338	394,263	192,288	557,635
Greenup	2,063	5,880	1,342	3,892
Hancock	139,780	398,373	111,362	322,950
Hart	40,839	116,391	32,271	93,586
Henderson	3,134,702	8,905,304	2,678,457	7,768,024
Hopkins	1,233,665	3,515,945	965,830	2,800,907
Jackson	253	721	172	499
Johnson	635,467	1,811,081	570,171	1,653,496
Knott	10,337	29,460	12,392	35,937
Knox	2,636	7,513	1,704	4,942
Laurel	2,727	7,772	3,937	11,417
Lawrence	509,572	1,452,280	436,012	1,264,435
Lee	2,193,978	6,252,837	1,793,157	5,200,155
Leslie	2,596	7,399	3,139	9,103
Letcher	16,606	47,327	32,614	94,581
Lincoln	2,071	5,902	1,173	3,402
Logan	819	2,334	390	1,131
Magoffin	603,948	1,721,252	491,920	1,426,568
Marion	123	351	----------	----------
Martin	13,331	37,993	13,743	39,855
McCreary	2,690	7,666	2,420	7,018
McLean	1,220,582	3,478,659	1,013,542	2,939,272
Menifee	878	2,502	1,003	2,909
Metcalfe	172,764	492,377	139,097	403,381
Monroe	221,709	631,871	63,560	184,324
Morgan	1,466	4,178	1,228	3,561
Muhlenberg	677,877	1,931,949	543,717	1,576,779
Ohio	620,390	1,796,611	583,914	1,693,350
Owsley	977	2,784	584	1,694
Perry	25,400	72,390	19,225	55,752
Pike	33,118	94,386	29,510	85,579
Powell	108,329	308,738	74,725	216,702
Pulaski	----------	----------	1,151	3,338
Russell	965	2,750	1,378	3,996
Simpson	5,391	15,364	5,582	16,188
Taylor	1,393	3,970	868	2,517
Todd	1,007	2,870	183	531
Union	2,766,633	7,884,904	2,443,307	7,085,590
Warren	31,475	89,704	27,329	79,254
Wayne	18,299	52,152	26,081	75,635
Webster	1,173,616	3,344,806	1,020,880	2,960,552
Whitley	14,768	42,088	16,045	46,530
Wolfe	13,818	39,381	13,393	38,840
Total	18,066,000	51,488,000	15,535,000	45,052,000
Earliest record to date	528,899,000	1,261,872,000	544,434,000	1,306,924,000

Source: Kentucky Geological Survey.

Table 7.—Gas and oil well drilling in 1967

County	Development wells				Exploratory wells			
	Gas	Oil	Dry	Footage	Gas	Oil	Dry	Footage
Adair	---	2	2	1,265	-----	-----	11	2,664
Allen	1	18	19	14,576	3	1	14	8,845
Barren	---	2	6	3,458	-----	1	16	9,324
Bath	---	1	-----	208	-----	-----	2	3,740
Bell	---	-----	-----	----------	-----	-----	4	10,776
Boyd	3	-----	-----	9,794	-----	2	-----	9,766
Breathitt	2	-----	-----	3,276	5	-----	-----	9,536
Breckinridge	---	-----	3	1,469	1	-----	4	4,777
Butler	---	5	5	4,696	-----	-----	3	2,909
Campbell	---	-----	-----	----------	-----	-----	1	1,089
Carlisle	---	-----	-----	----------	-----	-----	1	3,048
Casey	---	3	10	8,706	-----	3	5	8,414
Christian	---	-----	11	7,075	-----	1	11	9,908
Clark	---	-----	-----	----------	-----	-----	2	5,087
Clay	31	-----	12	40,381	8	1	12	29,512
Clinton	---	5	4	9,018	-----	2	1	3,841
Crittenden	---	-----	-----	----------	-----	-----	1	2,500
Cumberland	---	9	16	10,488	-----	4	21	19,378
Daviess	3	67	68	175,705	-----	2	13	25,611
Elliott	---	5	-----	5,521	-----	-----	3	3,829
Estill	---	6	1	3,931	1	1	2	5,913
Floyd	3	2	2	10,629	-----	-----	-----	----------
Garrard	---	1	3	366	-----	-----	-----	----------
Grayson	1	-----	-----	1,321	-----	-----	2	1,715
Green	---	52	7	28,762	-----	-----	11	7,127
Greenup	1	1	1	3,350	1	1	1	6,875
Hancock	---	12	7	10,813	-----	-----	6	6,740
Harlan	---	-----	-----	----------	-----	-----	1	4,285
Hart	---	2	1	1,959	-----	1	4	3,654
Henderson	---	15	22	59,614	-----	1	9	22,805
Hopkins	19	21	31	180,030	2	3	25	71,448
Johnson	6	3	6	29,409	1	1	1	6,543
Knott	6	-----	-----	13,491	-----	-----	-----	----------
Knox	---	-----	-----	----------	1	-----	1	3,430
Laurel	---	-----	-----	----------	-----	-----	1	3,440
Lawrence	9	14	1	35,310	2	-----	1	6,970
Lee	---	26	-----	23,278	-----	1	-----	1,201
Leslie	2	-----	-----	7,006	-----	-----	-----	----------
Letcher	14	-----	2	56,874	3	1	-----	11,569
Lincoln	---	-----	-----	----------	-----	-----	2	540
Magoffin	---	22	2	24,842	-----	-----	-----	----------
Marion	---	-----	-----	----------	-----	-----	1	1,513
Martin	9	-----	1	22,733	-----	-----	-----	----------
McCreary	---	1	-----	675	-----	-----	1	538
McLean	---	26	45	124,000	-----	5	20	54,018
Meade	---	-----	-----	----------	-----	-----	2	6,007
Menifee	---	-----	-----	----------	-----	-----	2	7,077
Metcalfe	---	18	33	18,123	-----	3	35	14,763
Monroe	---	23	18	16,253	-----	3	35	23,984
Morgan	---	1	-----	718	-----	-----	-----	----------
Muhlenberg	6	8	9	25,050	-----	1	8	12,086
Nelson	---	-----	-----	----------	-----	-----	1	1,650
Nicholas	---	-----	-----	----------	-----	-----	2	1,967
Ohio	2	25	31	43,141	-----	3	13	16,186
Owsley	---	-----	-----	----------	-----	-----	1	1,424
Pendleton	---	-----	-----	----------	-----	-----	1	550
Perry	27	1	3	102,775	3	-----	-----	9,857
Pike	19	-----	2	60,736	3	-----	5	26,882
Powell	---	3	-----	2,847	-----	1	-----	895
Pulaski	---	1	-----	1,810	-----	-----	2	3,755
Rowan	---	1	-----	365	-----	-----	-----	----------
Russell	---	2	2	869	-----	-----	1	525
Shelby	---	-----	-----	----------	-----	-----	1	1,074
Simpson	---	-----	-----	----------	-----	-----	6	4,025
Spencer	---	-----	-----	----------	-----	-----	2	3,030
Taylor	---	2	-----	965	-----	-----	-----	----------
Todd	---	-----	-----	----------	-----	-----	1	1,605
Union	---	32	23	89,984	-----	1	5	16,996
Warren	---	1	-----	600	-----	1	2	1,273
Wayne	---	5	7	10,993	-----	1	23	27,853
Webster	---	17	18	84,082	-----	1	9	28,419
Whitley	7	1	2	11,244	2	-----	5	8,704
Wolfe	3	7	-----	13,063	-----	1	2	7,605
Total	174	469	436	1,417,647	36	48	378	623,070

Source: American Association of Petroleum Geologists.

2.7 million barrels. Lee County led eastern Kentucky counties with 1.8 million barrels.

The Kentucky Geological Survey reported a total of 1,685 wells completed in 1967, including injection wells for gas storage, water injection wells for secondary oil recovery, and wells for water supply, and salt water disposal.

The most significant oil discovery during the year was Inland Gas Co.'s well in Boyd County. Initial production was 32 barrels of oil per day from a sandstone formation of Cambrian age at a depts of 7,598 feet. This well was producing from a record depth for Kentucky.

Basement test wells were drilled during the year in Clark and Menifee Counties; both were dry holes.

NONMETALS

Production of nonmetals accounted for 11 percent of the total value of mineral production in the State.

Cement.—Kosmos Portland Cement Co. operated the Kosmosdale plant throughout the year. Shipments of portland cement increased 20 percent above those of 1966, and were 6 percent below the 1965 record. Masonry cement shipments decreased 1 percent and were 6 percent below the 1965 record. Raw materials used in portland cement included limestone (75 percent), miscellaneous clay (21 percent), gypsum (3 percent), and iron ore (less than 1 percent).

Clays.—Kentucky ranked second in the United States in ball clay production. Kentucky-Tennessee Clay Co. and Old Hickory Clay Co. mined clay at three mines in Graves County.

Total fire clay production was 144,000 tons valued at $900,000, or 19 percent less tonnage than in 1966. Nine companies mined fire clay at 19 mines in four counties for firebrick, mortar, and other uses. Leading producers were General Refractories Co., Harbison-Walker Refractories Co., and North American Refractories Co.

Miscellaneous clay was mined by 13 companies at 15 mines in nine counties for heavy clay products, lightweight aggregate, and cement. Leading producers were Ohio River Sand Co., Inc., Kosmos Portland Cement Co., and Harsco Corp. Production increased 8 percent over that of 1966, the previous record year, and totaled 1.1 million tons valued at $1.1 million.

Fluorspar.—Fluorspar was mined in Livingston and Crittenden Counties for use in manufacturing hydrofluoric acid, glass, ceramics, steel, ferroalloys, and in iron foundries. Shipments were 33,000 tons

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

(Thousand short tons and thousand dollars)

County	1966			1967		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Ballard	1	32	$19	1	35	$20
Boone	4	2,027	1,922	4	1,819	1,707
Calloway	3	W	W	2	138	120
Carlisle	1	27	16	1	29	16
Fulton	2	W	W	1	31	16
Gallatin	1	299	W	1	W	W
Graves	1	57	29	1	63	32
Henderson	1	550	W	2	W	W
Hickman	1	29	14	1	32	16
Jefferson	4	2,161	1,848	4	2,191	2,361
Livingston	1	28	14	1	30	15
Lyon	1	21	11	1	24	12
Marshall	1	77	38	1	85	42
Martin	1	20	20	1	19	19
Mason	1	81	116	2	W	W
McCracken	1	319	W	2	W	W
Trimble	1	895	W	1	W	W
Union	3	349	377	2	W	W
Other counties [1]	4	1,092	3,100	4	3,485	3,483
Total	33	8,064	7,524	33	7,981	7,859

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Breckinridge, Daviess, and Floyd Counties, 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	1966			1967		
		Value			Value	
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Sand:						
Structural	2,809	$2,945	$1.05	2,496	$2,553	$1.02
Paving	1,352	1,296	.96	2,218	2,098	.95
Fill	1,007	489	.49	741	415	.56
Gravel:						
Structural	1,302	1,355	1.04	817	1,007	1.23
Paving	1,205	1,097	.91	1,494	1,602	1.07
Fill	153	82	.54	W	W	W
Total sand and gravel [1]	8,064	7,524	.93	7,981	7,859	.98

W Withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."

[1] Includes molding (1966), engine and other sands; railroad ballast, other gravel, and uses indicated by symbol W.

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

County	1966			1967		
	Number of quarries	Short tons	Value	Number of quarries	Short tons	Value
Allen	1	114,098	W	1	W	W
Barren	1	213,000	W	1	210,000	W
Bourbon	1	153,351	W	1	W	W
Boyle	2	209,625	$324,634	2	321,045	W
Butler	1	81,611	W	1	83,000	W
Calloway	1	W	W	1	120,576	W
Carter	4	504,414	667,016	4	706,985	$944,903
Casey	1	115,210	204,585	1	W	W
Christian	3	949,244	1,076,514	3	1,118,478	1,329,292
Fayette	4	1,191,833	1,483,610	4	W	W
Fleming	1	218,261	W	1	W	W
Franklin	3	593,474	801,000	1	W	W
Garrard	1	63,499	82,548	1	W	W
Grayson	2	189,374	W	2	175,736	W
Greenup	1	53,476	80,200	1	W	W
Hardin	5	1,271,428	1,629,000	5	778,899	1,169,900
Harrison	1	185,304	W	1	139,098	W
Hart	1	134,449	201,673	1	W	W
Jackson	2	73,600	110,000	2	W	W
Jefferson	4	1,561,450	2,255,147	4	1,624,531	2,344,852
Kenton	1	1,732	2,598			
Meade	3	991,155	1,336,500	3	W	W
Menifee	1	88,434	136,160	1	115,075	W
Mercer	2	108,000	170,800	2	W	W
Monroe	1	156,073	311,676	1	100,000	156,040
Montgomery	1	71,144	83,258	1	65,534	W
Morgan	4	445,408	712,232	4	463,464	724,977
Muhlenberg	2	W	W	1	550,732	W
Nelson	1	197,600	W	1	W	W
Nicholas	1	63,000	126,000	1	40,000	79,000
Oldham	3	853,877	1,172,000	3	W	W
Powell	2	209,564	309,938	2	608,742	W
Pulaski	2	W	W	3	282,533	381,039
Simpson	1	81,250	W	1	W	W
Trigg	1	172,000	215,000	1	W	W
Warren	4	1,231,331	1,519,335	3	611,195	829,675
Wayne	1	90,311	W	1	126,878	W
Other counties [1]	42	10,029,264	16,167,331	49	16,569,275	27,521,610
Total	113	22,666,844	31,178,755	116	24,811,776	35,481,288

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

[1] Includes Adair, Anderson, Breckinridge, Bullitt (1967), Caldwell, Clinton, Crittenden, Cumberland, Edmonson, Estill, Green, Harlan, Henry, Jessamine, Laurel, Lee, Letcher, Livingston, Logan, Madison, Metcalfe, Ohio, Pendleton, Pike (1966), Rockcastle, Rowan (1967), Scott, Taylor, Todd, Washington (1966), and Wolfe Counties, and counties indicated by symbol W.

valued at $1.7 million, an increase of 15 percent over the previous year's total.

Lime.—National Carbide Co. regenerated lime by calcining sludge at plants in Marshall and Jefferson Counties.

Perlite.—Grefco, Inc. expanded perlite from Western States at its Florence plant in Boone County. W. R. Grace & Co. expanded perlite at the Wilder plant near Newport.

Sand and Gravel.—Sand and gravel was mined by 22 producers, including the State and two county highway departments, at 33 operations in 21 counties, led by Jefferson, Boone, and Trimble. Production decreased 1 percent below the 1966 record. Of the commercial production, 92 percent was processed, 70 percent transported by truck, 20 percent by water, and 10 percent by rail.

Stone.—Eighty producers crushed limestone at 116 operations in 67 counties. Leading counties were Livingston, Jefferson, and Meade.

Vermiculite.—W. R. Grace & Co. exfoliated vermiculite from Southeastern States at the Wilder plant, near Newport.

METALS

The value of metallic ores accounted for less than 1 percent of the total mineral production value in Kentucky.

Ferroalloys.—Shipments of ferroalloys, including ferromanganese, silicomanganese, silvery pig iron, ferrosilicon, ferrochromium, and ferrochromium-silicon decreased 10 percent below 1966 levels.

Lead.—Lead concentrate was recovered as a byproduct of fluorspar milling and the tonnage increased 75 percent.

Pig Iron and Steel.—Armco Steel Corp. produced foundry and basic pig iron at Ashland; output increased 6 percent. Steel was produced by the following: Armco Steel Corp., at Ashland; Interlake Steel Corp., at Newport; Green River Steel Co., at Owensboro; and Kentucky Electric Steel Co., near Princess.

Silver.—About 568 troy ounces of silver was produced as a byproduct in milling fluorspar ore.

Zinc.—Production of zinc concentrates decreased 4 percent below 1966 output; most of the zinc was produced by Eagle-Picher Co. at the Hutson mine. Some zinc concentrates were recovered as a byproduct of fluorspar milling.

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

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	17,964,878	$24,424,998	$1.36	19,689,862	$28,050,527	$1.42
Agstone	1,923,659	2,929,806	1.52	2,109,868	3,364,858	1.59
Railroad ballast	341,078	407,400	1.19	W	W	W
Other uses [1]	2,437,229	3,416,551	1.40	3,012,046	4,065,903	1.35
Total	22,666,844	31,178,755	1.38	24,811,776	35,481,288	1.43

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes riprap, cement, coal mine dusting (1967), fertilizer filler, stone sand, flux (1967), and other uses, and uses indicated by symbol W.

Table 12.—Principal producers

Commodity and company	Name of operation	County	Address	Remarks
Asphalt, native:				
Gripstop Corp	Indian Creek quarry	Edmonson	Box 66, Brownsville, Ky. 42210	Bituminous sandstone.
Cement:				
Portland and masonry:				
Kosmos Portland Cement Co	Kosmosdale mill	Jefferson	1529 Starks Bldg. Louisville, Ky. 40202	
Clay:				
Ball:				
Kentucky-Tennessee Clay Co	Kentucky mine	Graves	Box 77 Mayfield, Ky. 42066	
Old Hickory Clay Co	Hickory mine	do	Box 271 Paducah, Ky. 42001	
Do	Lamkin mine	do	Do.	
Fire:				
Davis Fire Brick Co	Eaton-Jones mine	Carter	Oak Hill, Ohio 45656	
Do	Work-Inn mine	do	Do.	
Ford Burchett Clay Co	No. 2 mine	do	Olive Hill, Ky. 41164	
General Refractories Co	Carrol mine	Carter	1520 Locust Street Philadelphia, Pa. 19102	
Do	Cooper mine	do	Do.	
Do	Grefco Bennett mine	do	Do.	
Do	S. M. Hilger mine	do	Do.	
Do	Licking River mine	Morgan	Do.	
Do	Cogswell-Fultz mine	Rowan	Do.	
Do	Clay Heirs mine	do	Do.	
Harbison-Walker Refractories Co	Brinegar mine	Carter	1800 Farmer's Bank Bldg. Pittsburgh, Pa. 15222	
Do	Riggs mine	Greenup	Do.	
North American Refractories Co	Armstrong-Brickles mine	Carter	National City East 6th Bldg. Cleveland, Ohio 44114	
Do	Eaton mine	do	Do.	
Miscellaneous:				
General Shale Products Corp	Coral Ridge mine	Jefferson	Johnson City, Tenn. 37601	
Harsco Corp	Lewisport mine	Hancock	Cannelton, Ind. 47520	
Do	No. 1 mine	do	Do.	
Kenlite Division, Ohio River Sand Co	Shepherdsville mine	Bullitt	129 River Road Louisville, Ky. 40202	Lightweight aggregate (expanded shale).
Kosmos Portland Cement Co	Kosmosdale mine	Jefferson	1529 Starks Bldg. Louisville, Ky. 40202	
Owensboro Brick & Tile Co	Lewisport No. 1 mine	Hancock	Ewing Road Owensboro, Ky. 42302	
Coal:				
Beth-Elkhorn Corp	No. 20 mine	Letcher	701 East Third Street Bethlehem, Pa. 18016	All underground mines.
Do	No. 21 mine	do	Do.	
Do	No. 22 mine	do	Do.	
Do	No. 27 mine	do	Do.	
Do	No. 28 mine	do	Do.	
Do	Pike No. 26 mine	Pike	Do.	
Island Creek Coal Co	Buckingham mine	Floyd	Wayland, Ky. 41666	Do.
Do	Price mines	do	Do.	
Do	Nos. 2 and 3	do	Do.	

Do	Wheelwright mines Nos. 1 and 2	----do	Do.	
Do	Atkinson mine	Hopkins	444 S. Main Street, Hopkinsville, Ky. 42431	
Do	East Diamond mine	----do	(same as above)	
Do	Fies mine	----do	Do.	
Do	Williams mine	----do	Do.	
Do	Crescent mine	Muhlenberg	Do.	
Do	Gund No. 44 mine	Pike	Wayland, Ky. 41666	
Do	Uniontown mine	Union	444 S. Main Street, Hopkinsville, Ky. 42431	
Peabody Coal Co	River Queen mines	Muhlenberg	301 North Memorial Drive, St. Louis, Mo. 63102	Strip and underground.
Do	Sinclair mine	----do	----do	Strip.
Do	Vogue mine	----do	----do	Do.
Do	Homestead mine	Ohio	----do	Do.
Do	Ken mines	----do	----do	Strip and underground.
Do	Riverview mine	----do	----do	Strip.
The Pittsburgh and Midway Coal Mining Co	Colonial mine	Hopkins	15 W. 10th Street, Kansas City, Mo. 64105	Strip.
Do	Drake mine	Muhlenberg	(same as above)	Underground.
Do	Paradise mine	----do	----do	Strip.
Do	Dekoven mines Nos. 6 & 9	Union	----do	Underground.
United States Steel Corp	No. 32 mine	Harlan	525 William Penn Place, Pittsburgh, Pa. 15219	Underground mines.
Do	No. 7 South Main mine	----do	Do.	
Coke:				
Semet-Solvay Division of Allied Chemical Corp	Ashland plant	Boyd	40 Rector Street, New York, N. Y. 10006	
Ferroalloys:				
Pittsburgh Metallurgical Co	Calvert City plant	Marshall	Highway 95, Calvert City, Ky. 42029	
Truecast Precision Casting Co	Louisville plant	Jefferson	1379 South 7th Street, Louisville, Ky. 40208	
Fluorspar:				
Calvert City Chemical Co	Clement mine	Livingston	Box 305, Calvert City, Ky. 42029	Also lead and zinc concentrates.
Do	Dyers Hill mine	----do	(same as above)	
Critten Industries, Inc	Watson mine	Crittenden	Salem, Ky. 42078	
Kenoise Mining Co	Hodge mine	----do	Route 4, Fredonia, Ky. 42411	
Minerva Oil Co	Tabb No. 1 mine	----do	Eldorado, Ill. 62930	Also zinc concentrates.
Nancy Hanks Mines, Inc	Nancy Hanks mine	Livingston	Marion, Ky. 42064	
Flurospar processor: Kentucky Fluorspar Co	Kentucky mill	Crittenden	Marion, Ky. 42064	
Graphite, artificial:				
Carborundum Co	Hickman plant	Fulton	Hickman, Ky. 42050	New 1967.
Iron, pig:				
Armco Steel Corp	Ashland plant	Boyd	Middleton, Ohio 45042	

Table 12.—Principal producers—Continued

Commodity and company	Name of operation	County	Address	Remarks
Lime, regenerated:				
National Carbide Co	Louisville limekiln	Jefferson	150 E. 42d Street	
Do	Calvert City limekiln	Marshall	New York, N.Y. 10017	
Natural gas:				
Plants:				
Columbia Hydrocarbon Corp	Siloam refinery	Greenup	South Shore, Ky. 41175	
Kentucky Hydrocarbon Corp	Maytown refinery	Floyd	Box 128 Langley, Ky. 41645	
Kentucky-West Virginia Gas Co	Dwale refinery	do	Allen, Ky. 41601	
Tennessee Gas Pipeline Co	Tenneco refinery	Green	Greensburg, Ky. 42743	
Producers:				
Cities Service Oil Co			Box 873 Charleston, W.Va. 25323	
Inland Gas Co			340 17th Street Ashland, Ky. 41101	
Kentucky-West Virginia Gas Co			Second National Bank Building Ashland, Ky. 41101	
Petroleum Exploration Co			Leeco Road Leeco, Ky. 41343	
United Fuel Gas Co			Box 1273 Charleston, W.Va. 25325	
Perlite, expanded:				
Grefco, Inc	Florence plant	Boone	Box 35 Florence, Ky. 41042	
W. R. Grace & Co	Wilder plant	Campbell	62 Whittemore Avenue Cambridge, Mass. 01109	Also exfoliated vermiculite.
Petroleum:				
Producers:				
Ashland Oil and Refining Co			1409 Winchester Avenue Catlettsburg, Ky. 41129	
Har-Ken Oil Co			Box 616 Owensboro, Ky. 42301	
Humble Oil and Refining Co			2010 W. Ohio Street Evansville, Ind. 47712	
Sinclair Oil and Gas Co			300 Fidelity National Bank Bldg. Oklahoma City, Okla. 73102	
Sun Oil Co			Box 5026 Lawndale Evansville, Ind. 47715	
Refineries:				
Ashland Oil and Refining Co		Boyd	1409 Winchester Avenue Catlettsburg, Ky. 41129	
Kentucky Oil and Refining Co		Floyd	Box 325 Betsy Layne, Ky. 41605	
Louisville Refining Co		Jefferson	1300 S. Western Parkway Louisville, Ky. 40211	
The Somerset Refinery, Inc		Pulaski	520 Monticello Street Somerset, Ky. 42501	

Sand and gravel:				
Evansville Material, Inc	Henderson dredge	Henderson	624 N.W. Riverside Drive Evansville, Ind. 47708	
R. W. Green, Jr. Sand & Gravel Co., Inc	Louisville dredge	Boone	1212 S. 13th Street Louisville, Ky. 40210	
Nugent Sand Co	----do	Jefferson	Box 6072 Louisville, Ky. 40206	
Ohio River Sand Co., Inc	----do	----do	129 River Road Louisville, Ky. 40202	
Standard Materials Corp	Burlington mine	Boone	11 N. Penn Street Indianapolis, Ind. 46204	Also limestone.
Do	Warsaw mine	Gallatin	Do.	
Do	Milton mine	Trimble	Do.	
Stone:				
Limestone, crushed:				
Cedar Bluff Stone Co., Inc	Cedar Bluff mine	Caldwell	Box 692 Princeton, Ky. 42445	
Do	Canton mine	Trigg		
Geoghegan & Mathis, Inc	Lockport quarry	Henry	Box 532 Bardstown, Ky. 40004	
Do	Nelson quarry	Nelson		
Do	Butler quarry	Pendleton	Do.	
Do	Falmouth quarry	----do	Do.	
Kentucky Stone Co	Tyrone mine	Anderson	400 Sherburn Lane Louisville, Ky. 40207	
Do	Irvington quarry	Breckinridge		
Do	Upton quarry	Hardin	Do.	
Do	High Bridge mine	Jessamine	Do.	
Do	Laurel quarry	Laurel	Do.	
Do	Yellow Rock mine	Lee	Do.	
Do	Russellville quarry	Logan	Do.	
Do	Mt. Vernon mine	Rockcastle	Do.	
Do	Mullins mine	----do	Do.	
Do	Sparks mine	----do	Do.	
Do	Franklin quarry	Simpson	Do.	
Do	Todd quarry	Todd	Do.	
Reed Crushed Stone Co, Inc	Grand Rivers quarry	Livingston	Box 35 Gilbertsville, Ky. 42044	
Vulcan Materials Co	Blue Grass quarry	Fayette	Box 7 Knoxville, Tenn. 37901	Also miscellaneous clay.
Do	Lexnigton quarry	----do		
Do	Okolona quarry	Jefferson	Do.	
Vermiculite, exfoliated:				
W. R. Grace & Co	Wilder plant	Campbell	62 Whittemore Avenue Cambridge, Mass. 01109	Also expanded perlite.
Zinc:				
Calvert City Chemical Co	Clement mine	Livingston	Box 305 Calvert City, Ky. 42029	Also fluorspar.
Do	Dyers Hill mine	----do	Do.	
Eagle-Picher Industries, Inc	Hutson mine	----do	Box 910 Miami, Okla. 74354	Do.
Minerva Oil Co	Tabb No. 1 mine	Crittenden	Eldorado, Ill. 60930	Do.

The Mineral Industry of Louisiana

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

By Owen W. Jones [1] and Leo W. Hough [2]

Louisiana mineral output in 1967 was valued at $4.0 billion, 15.5 percent more than the 1966 value. For the 10th consecutive year, Louisiana ranked second to Texas in value of mineral production. New records resulted from output of crude petroleum, natural gas, natural gas liquids, sulfur, salt, and sand and gravel.

Hydrocarbon fuels—crude petroleum, natural gas, and natural gas liquids—provided 93 percent of the total value of mineral output. Fewer new discoveries were made in 1967 as only 13 oilfields and 17 gasfields were recorded (24 onshore and six offshore). A net crude reserve increase of 47.5 million barrels established a new high for recoverable reserves in the State. Changes due to extensions, revisions, and new pools in old fields accounted for 724.2 million barrels of crude reserve; new field discoveries accounted for only 3.2 million barrels. In quantity of reserves added during 1967, Louisiana ranked first in the Nation in natural gas and natural gas liquids, and third in crude petroleum.

Trends and Developments.—Despite labor troubles during the year, investment in new or expanded manufacturing facilities in the State was at a record high. Since 1962, the State has experienced a rise in industrial spending. The Louisiana State Board of Commerce and Industry approved ad valorem tax exemption applications representing a total investment of $595.2 million.

[1] Petroleum and natural gas engineer, Bureau of Mines, Dallas, Tex.
[2] State Geologist, Louisiana Geological Survey, Baton Rouge, La.

Table 1.—Mineral production in Louisiana [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clay—thousand short tons	1,005	$983	995	$1,260
Lime—do	835	9,274	758	9,891
Natural gas—million cubic feet	5,081,435	929,902	5,716,857	1,057,619
Natural gas liquids:				
Natural gasoline and cycle products—thousand gallons	1,562,075	113,802	1,754,603	130,212
LP gases—do	1,469,716	72,016	1,844,689	92,234
Petroleum (crude)—thousand 42-gallon barrels	674,318	2,097,129	774,527	2,419,823
Salt—thousand short tons	8,736	44,189	9,585	48,483
Sand and gravel—do	18,216	22,504	20,312	27,442
Stone (shell)—do	8,091	11,253	7,599	11,174
Sulfur (Frasch process)—thousand long tons	4,018	104,472	4,233	139,739
Value of items that cannot be disclosed:				
Cement, gypsum, and miscellaneous stone	XX	24,616	XX	23,873
Total	XX	3,430,140	XX	3,961,750
Total 1957–59 constant dollars	XX	r 3,333,821	XX	p 3,803,146

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 Louisiana, by parishes [1]

Parish	1966 [r]	1967	Minerals produced in 1967 in order of value
Acadia	$122,796,002	$138,833,696	Natural gas, petroleum, natural gas liquids.
Allen	9,734,900	7,903,369	Petroleum, natural gas, natural gas liquids.
Ascension	5,475,033	33,288,024	Natural gas liquids, petroleum, salt, natural gas.
Assumption	22,762,679	32,752,186	Natural gas, petroleum.
Avoyelles	4,127,047	6,626,535	Petroleum, natural gas liquids, natural gas.
Beauregard	10,072,888	14,494,270	Petroleum, natural gas, natural gas liquids, sand and gravel.
Bienville	10,373,008	12,332,192	Natural gas, petroleum.
Bossier	37,126,888	20,137,341	Natural gas, petroleum, natural gas liquids.
Caddo	37,336,571	28,525,391	Petroleum, natural gas, natural gas liquids, clays.
Calcasieu	46,824,160	72,037,475	Petroleum, natural gas liquids, natural gas, cement, lime, salt, sulfur, clays.
Caldwell	2,929,286	2,502,270	Natural gas, petroleum.
Cameron	179,066,095	176,592,921	Petroleum, natural gas, natural gas liquids, salt, shell.
Catahoula	11,753,098	17,501,096	Petroleum, sand and gravel, natural gas.
Claiborne	28,088,793	34,783,822	Petroleum, natural gas, natural gas liquids.
Concordia	21,432,045	37,534,159	Petroleum, natural gas.
DeSoto	12,155,579	12,878,116	Natural gas, petroleum.
East Baton Rouge	17,978,682	18,916,791	Cement, petroleum, lime, sand and gravel, natural gas, clays.
East Feliciana	W	W	Sand and gravel.
Evangeline	11,892,566	13,607,637	Petroleum, natural gas, natural gas liquids, sand and gravel.
Franklin	2,253,333	4,119,262	Petroleum, natural gas.
Grant	517,810	462,048	Petroleum, sand and gravel.
Iberia	103,711,771	144,428,051	Petroleum, natural gas, salt, natural gas liquids, clays.
Iberville	49,390,479	64,781,481	Petroleum, salt, natural gas, natural gas liquids.
Jackson	377,517	4,250,721	Natural gas, petroleum.
Jefferson	161,369,546	144,308,861	Petroleum, sulfur, natural gas, salt, natural gas liquids, shell.
Jefferson Davis	58,629,255	80,786,129	Natural gas, petroleum, natural gas liquids, sand and gravel.
Lafayette	16,019,784	19,991,596	Natural gas, petroleum, natural gas liquids, clays.
Lafourche	351,941,758	315,272,276	Petroleum, natural gas, natural gas liquids, sulfur.
La Salle	21,091,574	29,924,927	Petroleum, natural gas, sand and gravel.
Lincoln	25,775,113	35,731,731	Natural gas, natural gas liquids, petroleum, clays.
Livingston	201,651	67,379	Petroleum.
Madison	1,795,567	1,955,278	Petroleum, natural gas.
Morehouse	2,224,874	1,891,371	Natural gas, natural gas liquids, petroleum.
Natchitoches	240,460	30,424,877	Petroleum, natural gas liquids, natural gas, clays.
Orleans	15,007,335	15,262,163	Cement, lime, shell, sand and gravel, natural gas, petroleum.
Ouachita	11,488,125	11,359,678	Natural gas, petroleum, sand and gravel, natural gas liquids.
Plaquemines	786,220,721	912,907,790	Petroleum, natural gas, sulfur, natural gas liquids, salt.
Pointe Coupee	12,751,845	22,667,504	Petroleum, natural gas, natural gas liquids, clays.
Rapides	5,597,360	10,499,027	Petroleum, sand and gravel, clays, natural gas.
Red River	1,458,360	1,581,277	Petroleum, sand and gravel, natural gas.
Richland	16,888,326	22,345,833	Petroleum, natural gas, natural gas liquids.
Sabine	23,288,190	14,226,210	Do.
St. Bernard	17,295,399	19,536,988	Natural gas liquids, petroleum, natural gas, clays.
St. Charles	48,674,020	88,874,539	Petroleum, natural gas, natural gas liquids.
St. Helena	592,000	W	Sand and gravel.
St. James	6,097,496	10,064,053	Petroleum, natural gas, natural gas liquids.
St. John the Baptist	4,978,012	6,482,333	Petroleum, natural gas, shell.
St. Landry	57,241,165	56,187,337	Petroleum, natural gas, natural gas liquids.
St. Martin	73,283,901	101,274,221	Petroleum, natural gas, salt, natural gas liquids.
St. Mary	268,956,782	328,346,403	Petroleum, natural gas, natural gas liquids, salt, shell, lime.
St. Tammany	2,951,039	3,165,048	Shell, sand and gravel, natural gas, petroleum, clays.
Tangipahoa	384,365	429,800	Sand and gravel, petroleum, clays.
Tensas	19,583,454	18,490,827	Petroleum, natural gas, natural gas liquids.
Terrebonne	422,729,363	535,504,338	Petroleum, natural gas, sulfur, natural gas liquids, salt.
Union	15,418,451	7,991,112	Natural gas, petroleum.
Vermilion	172,762,249	153,895,226	Natural gas, petroleum, natural gas liquids, sand and gravel.
Vernon	8,000	17,000	Sand and gravel.
Washington	790,000	621,000	Do.
Webster	33,420,647	36,959,362	Natural gas, petroleum, natural gas liquids, sand and gravel.
West Baton Rouge	707,023	844,807	Petroleum, clays, natural gas.
West Carroll	240,916	138,985	Natural gas.
West Feliciana	W	W	Sand and gravel.
Winn	3,611,346	2,438,813	Petroleum, gypsum, stone, sand and gravel, natural gas.
Undistributed	20,248,298	19,995,047	
Total	3,430,140,000	3,961,750,000	

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

[1] East Carroll not listed because no production was reported.

Table 3.—Indicators of Louisiana business activity

		1966	1967 p	Change (percent)
Personal income:				
Total	millions	$8,235	$8,954	+8.7
Per capita		$2,277	$2,445	+7.4
Construction activity:				
Building permits	millions	$366.2	$346.5	−5.4
Construction contracts awarded:				
Residential [1]	thousands	$374,650	$375,039	+0.1
Nonresidential [2]	do	$333,731	$415,908	+24.6
Nonbuilding	do	$401,824	$317,337	−21.0
Total	do	$1,110,205	$1,108,284	−.2
Cement shipments to and within Louisiana	thousand 376-pound barrels	11,619	11,773	+1.3
Cash receipts from farm marketings	millions	$549.9	$602.2	+9.5
Mineral production	do	$3,430.1	$3,961.8	+15.5
Annual average labor force and employment:				
Total labor force	thousands	1,301.9	1,348.8	+3.6
Unemployment	do	56.0	62.7	+12.0
Employment:				
Contract construction	do	88.5	89.1	+.7
Mining	do	51.0	51.2	+.4
Food products	do	31.0	32.6	+5.2
All manufacturing	do	164.9	173.4	+5.2
All industries	do	1,245.2	1,284.8	+3.2

p Preliminary.
[1] Includes apartments, hotels, dormitories, one and two-family dwellings, and other residential buildings.
[2] Includes commercial, manufacturing, educational, and other nonresidential buildings.

Sources: Survey of Current Business, Construction Review, The Farm Income Situation, Louisiana Labor Force Information, Bureau of Mines, and Dodge Statistical Research Service. Louisiana Business Review. V. 32, No. 2, February 1968, p. 14.

Chemical and petroleum industries accounted for $451.1 million, or approximately 63 percent of the total. Some of the largest investments in the chemicals and petroleum category during 1967 were Cos-Mar, Inc.'s new petrochemical plant at Carville to produce styrene monomer; Enjay Chemical Co.'s petrochemical expansion at Baton Rouge to produce polyethylene plastic; Pittsburgh Plate Glass Co.'s new plant at Lake Charles to produce mercury cell caustic and chlorine; Freeport Chemical Co.'s new plant at Convent to produce phosphoric and sulfuric acids; Commercial Solvents Corp.'s plant addition at Sterlington to produce ammonia; and Gulf Oil Corp.'s new plant at Donaldsonville to produce anhydrous ammonia, urea, and mixed fertilizer.

Three industrial bond issues were completed to build chemical plants: Iberville Parish, $25 million for an 80-million-gallon-per-year methanol plant by Hercules Corp.; West Baton Rouge Parish, $10 million for a new synthetic rubber plant by Copolymer Rubber and Chemical Corp.; and Calcasieu Parish, $20 million for a new polypropylene plant by Hercules Corp.

Other major investments of interest to the mineral industry, especially the mineral fuels segment, included paper and paper products, $93.7 million; metals, metal products, and machinery, $73.7 million (includes a $62.7 million bond issue for a new aluminum plant at Lake Charles); stone, clay, and glass products $14.9 million; and electric power $51.0 million.

The electric utility companies of Louisiana continued a large construction program. Louisiana Power and Light in late 1967 completed the remaining portion of the 500,000-volt transmission grid interconnecting the 11 companies comprising the South Central Electric Companies group. The company continued installation of a third generating unit at Little Gypsy generating station, 25 miles upriver from New Orleans in St. Charles Parish.

New Orleans Public Service, Inc., put its new 560,000-kilowatt generating unit at the Michoud steam-electric generating station into commercial operation.

The Federal Power Commission reported that eletric power generated in 1967 by Louisiana plants was 23,153 million kilowatt-hours. This was 6.7 percent higher than the 1966 total compared with a national increase of 5.1 percent. Louisiana's 1967 electricity output was about 1.9 percent of the national output.

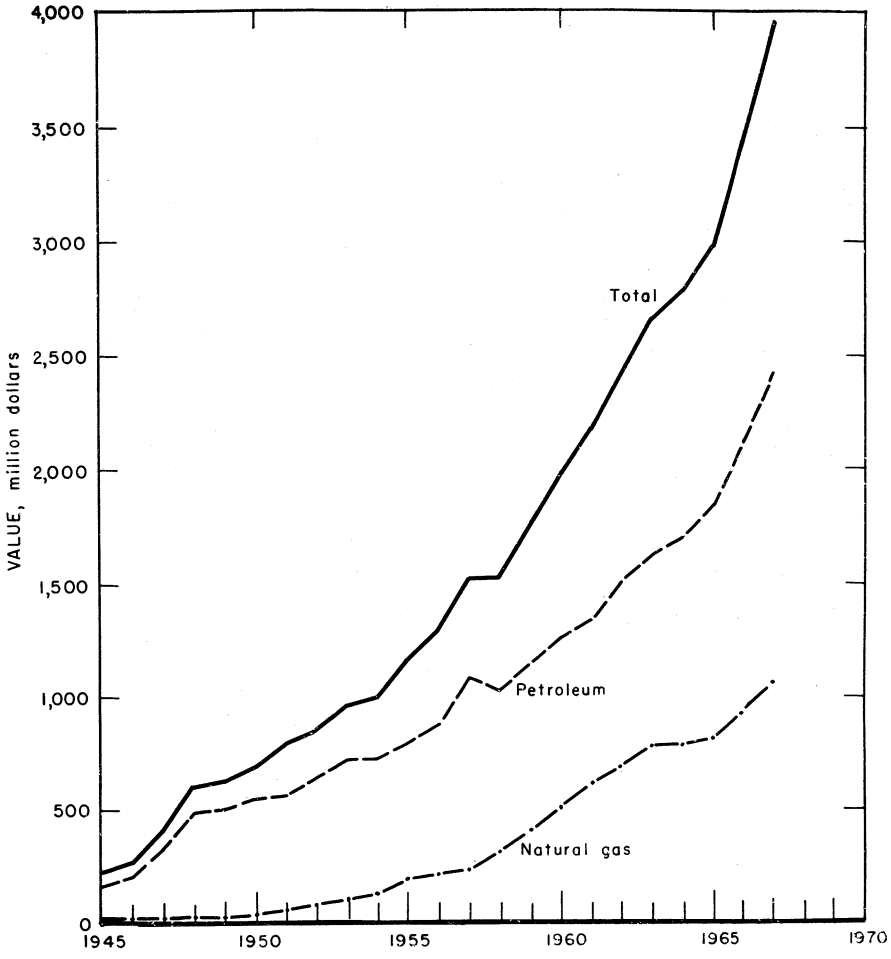

Figure 1.—Value of petroleum, natural gas, and total value of mineral production in Louisiana.

The State's system of rivers, canals, and ports greatly facilitates transportation of minerals and mineral products. New Orleans has long been the Nation's second largest port; Baton Rouge ranked seventh. The Port of Lake Charles was the State's third major port which handled heavy tonnages of oils and petrochemicals. All three ports experienced tonnage gains in 1967—New Orleans up 12 percent, Baton Rouge up 8 percent, and Lake Charles up 14 percent.

Louisiana and Texas continued at Toledo Bend the joint development of the Sabine River into a giant reservoir, with power generating facilities. Expected completion date was mid-1968. At the end of 1967, pool elevation was 143.9 feet (top of pool stage is 172 feet); the $68 million project was 95 percent complete. The reservoir will provide a dependable source of more than 1 billion gallons of water per day for industrial and commercial development. One of the major customers for this water will be the petrochemical complex in the Lake Charles area. Annual electric power-generating capacity of the completed project will be 80,750 kilowatts.

Capacity of Louisiana natural gas processing plants was increased 13 percent; product output increased 19 percent. Ten new plants were completed and four plants were closed. Storage space in salt dome caverns, to be used for recovered plant liquids, was increased 3.5 million barrels (23 percent).

Of $653 million total tax collections in Louisiana for the fiscal year 1966–67, $213 million was from the severance tax levied on minerals ($209 million from mineral fuels). Gasoline, lubricating oil, special fuel, and other minerals-related taxes accounted for an additional $94 million.

Legislation.—The Air Quality Act approved by the President on November 21, 1967, could affect segments of Louisiana's mineral industry. According to the Act, the U.S. Department of Health, Education, and Welfare will designate air quality control regions—either interstate or intrastate—where groups of communities have a common air pollution problem. The formula for implementation of the new air pollution law closely follows the mechanism established in the Water Quality Act of 1965—giving the States a chance to set adequate quality standards, subject to imposition of Federal standards if those of the States are not acceptable.

In May 1960, the U.S. Supreme Court decreed the Louisiana boundary to be 3 geographical miles seaward from the coast-

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Metal	1,063	365	388	3,255	-------	25	7.68	328
Nonmetal	1,853	299	555	4,827	-------	96	19.89	588
Sand and gravel	1,019	266	271	2,469	1	39	16.20	4,977
Stone	625	331	207	1,795	-------	31	17.27	485
Total [1]	4,560	312	1,421	12,345	1	191	15.55	1,382
1967: [p]								
Metal	820	365	299	2,394	-------	9	3.76	198
Nonmetal	1,925	302	581	4,719	4	90	19.92	5,771
Sand and gravel	1,230	237	291	2,600	-------	46	17.70	388
Stone	690	336	232	1,946	-------	38	19.53	5,118
Total [1]	4,665	301	1,404	11,659	4	183	16.04	3,317

[p] Preliminary.
[1] Data may not add to totals shown because of individual 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)	Gas utilities	Petroleum bulk tank stations	Retail filling stations	Chemicals and allied products [2]	Total
1963	40,400	11,400	1,000	6,200	4,000	9,400	16,500	88,900
1964	43,100	10,400	950	6,100	4,100	9,650	17,100	91,400
1965	46,500	10,400	850	6,050	4,300	10,000	17,100	95,200
1966	47,200	9,200	900	5,900	4,300	10,500	20,200	98,200
1967 [p]	47,300	9,800	950	5,850	4,400	11,300	21,500	101,100

[p] Preliminary.
[1] Employment in petroleum refineries and petrochemicals manufactured in petroleum refineries.
[2] Employment in petrochemical manufacturing facilities located outside petroleum refineries.

Source: Louisiana State Department of Labor, Division of Employment Security.

line. Since that time, the State and Federal courts have disputed the location of the coastline and the resulting line of demarcation between State and Federal ownership of offshore leases. The United States and Louisiana have approximately $1 billion in escrow, to be divided when the 3-mile line is finally drawn.

Employment and Injuries.—The petroleum production, refining, and related industries employed 101,100 workers in 1967, 2,900 more than in 1966. Employment in the mineral production industry decreased slightly (from 50,352 to 50,274). Oil and gas operations provided 92.4 percent of employment and 93.2 percent of wages derived from mineral industries in 1967.

Labor-management and inter-union jurisdictional disputes in 1967 severely curtailed petrochemical industry growth in the Baton Rouge-Geismar area. Construction companies halted all jobs in the troubled area for 6 weeks following a union jurisdictional dispute. The Governor called a special session of the Legislature to help solve the problem. The session passed an act establishing the Labor-Management Commission of Inquiry. On July 24, the Governor arranged a Memorandum of Understanding between the unions and the contractors' association, and work was resumed.

In February, fire swept an offshore platform located 40 miles southeast of Cameron, in the Gulf of Mexico, killing five men and injuring 10 others. On August 8, an explosion and fire occurred at the big Cities Service Lake Charles refinery. The casualty count was six killed and 14 injured.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

New records for production and value were established for all mineral fuels in 1967. At yearend, 1,281 oilfields and gasfields in the State had output from 39,706 wells (40,040 in 1966). North Louisiana had production from 13,803 oil wells and 4,599 natural gas wells; south Louisiana had production from 12,096 oil and 3,492 natural gas wells onshore, and 4,771 oil and 945 natural gas wells offshore.

Leasing Activity[3].—In the north Louisiana area, leasing of acreage blocks remained active in East Carroll, West Carroll, and Madison Parishes. Leasing in the Sligo (Lower Cretaceous) trend of Winn, Natchitoches, and Jackson Parishes was still very active. Terms of leases and lease bonuses remained stable, bonus prices generally ranging from $5 to $50 per acre.

In south Louisiana onshore, leasing activity decreased slightly. The State held five lease sales in 1967. At these sales, 127,215 acres sold for a total bonus of $15,110,803, or $118.78 per acre. The Federal Government held a sale of acreage in Zones III and IV on June 13, 1967, where more than 744,000 acres were sold for a record total bonus of $510,079,177, an average price of $685.17 per acre. Highest price for a single 5,000-acre tract was $6,500 per acre paid for Ship Shoal Block 207.

Exploration, Development, and Reserves.—According to the International Oil Scouts Association, 20 percent of the 1,061 exploratory holes drilled for oil and gas (statewise and offshore) were productive. Inland, 693 exploratory holes (16 percent productive) opened 24 new fields—four oil and nine gas discoveries in north Louisiana, and three oil and eight gas discoveries in south Louisiana. Offshore, 368 exploratory holes (26 percent productive) opened six new fields—all oil.

Of the 2,421 development (field) wells drilled, 68 percent were productive. Inland, 1,724 development wells were drilled—64 percent were successful; offshore, 697 were drilled—76 percent were successful.

The Louisiana Department of Conservation granted 4,639 permits to drill for hydrocarbons during the year (4,963 in 1966). There were 1,068 producing wells abandoned, compared with 1,195 in 1966.

In north Louisiana, activity declined to the lowest level in 20 years in exploratory and development drilling. Approximately one-half the total drilling was in Concordia, Catahoula, La Salle, Grant, Winn, and Caldwell Parishes. Nearly all these wells were drilled to test the Wilcox. Development drilling at Caddo-Pine Island field, one of most active areas of Upper

[3] Adapted from the American Association of Petroleum Geologists Bulletin, v. 52, No. 6, June 1968.

Table 6.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1967

Location	Drilling							Geophysical crew-weeks		
	Proved field wells			Exploratory wells			Total	Gravity meter method	Reflection seismograph method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
Parish:										
Acadia	-----	-----	-----	2	6	10	18	-----	16.0	16.0
Allen	-----	1	3	1	1	8	14	-----	59.0	59.0
Ascension	5	-----	6	-----	1	2	14	-----	17.0	17.0
Assumption	1	1	3	-----	1	5	11	-----	12.0	12.0
Avoyelles	-----	-----	1	-----	-----	10	11	-----	9.0	9.0
Beauregard	-----	2	6	-----	2	8	18	-----	79.0	79.0
Bienville	-----	3	4	-----	3	4	14	-----	2.0	2.0
Bossier	8	6	18	1	1	6	40	-----	11.5	11.5
Caddo	130	8	28	-----	2	1	169	-----	-----	-----
Calcasieu	9	8	10	2	-----	15	44	-----	52.0	52.0
Caldwell	-----	8	6	-----	3	26	43	-----	1.5	1.5
Cameron	12	13	13	1	5	21	65	-----	102.0	102.0
Catahoula	17	-----	36	4	-----	29	86	-----	-----	-----
Claiborne	9	-----	11	2	-----	3	25	-----	12.5	12.5
Concordia	45	2	52	1	-----	79	179	-----	-----	-----
DeSoto	4	20	24	1	-----	2	51	-----	1.0	1.0
East Baton Rouge	-----	-----	-----	-----	-----	-----	-----	-----	2.0	2.0
East Carroll	-----	-----	-----	-----	-----	1	1	-----	27.0	27.0
Evangeline	2	-----	4	-----	-----	7	13	-----	29.0	29.0
Franklin	-----	-----	2	1	-----	2	5	-----	6.0	6.0
Grant	8	-----	5	-----	-----	1	14	-----	12.0	12.0
Iberia	7	2	4	1	2	7	23	-----	95.0	95.0
Iberville	5	2	7	1	1	11	27	-----	52.0	52.0
Jackson	1	4	4	-----	1	9	19	-----	3.0	3.0
Jefferson	24	-----	6	2	-----	9	41	-----	16.0	16.0
Jefferson Davis	15	5	4	-----	7	13	44	-----	53.0	53.0
Lafayette	-----	3	3	-----	1	2	9	-----	31.0	31.0
Lafourche	35	4	24	2	5	30	100	-----	70.0	70.0
La Salle	89	4	99	-----	-----	13	205	-----	13.5	13.5
Lincoln	2	2	7	1	2	2	16	-----	2.5	2.5
Livingston	-----	-----	-----	-----	-----	1	1	-----	13.0	13.0
Madison	-----	-----	-----	-----	-----	4	4	-----	12.0	12.0
Morehouse	-----	36	2	-----	-----	1	39	-----	2.0	2.0
Natchitoches	2	-----	5	-----	-----	6	13	-----	3.5	3.5
Ouachita	-----	21	5	-----	-----	1	27	-----	3.0	3.0
Plaquemines	123	7	19	4	3	27	183	-----	51.0	51.0
Pointe Coupee	23	-----	12	3	-----	8	46	-----	14.0	14.0
Rapides	9	-----	11	-----	-----	3	23	-----	16.0	16.0
Red River	2	1	7	-----	-----	4	14	-----	1.5	1.5
Richland	2	38	19	-----	1	4	64	-----	10.0	10.0
Sabine	29	3	46	-----	-----	7	85	-----	11.5	11.5
St. Bernard	-----	-----	1	-----	-----	13	14	-----	84.0	84.0
St. Charles	10	4	1	1	-----	8	24	-----	6.0	6.0
St. James	3	1	1	-----	1	7	13	-----	5.0	5.0
St. John the Baptist	1	-----	-----	-----	-----	5	6	-----	-----	-----
St. Landry	5	5	4	-----	3	10	27	-----	28.0	28.0
St. Martin	7	8	4	2	-----	10	31	-----	97.0	97.0
St. Mary	27	11	14	-----	1	26	79	-----	90.0	90.0
Tangipahoa	-----	-----	-----	-----	-----	-----	-----	-----	11.0	11.0
Tensas	5	2	8	1	1	9	26	-----	-----	-----
Terrebonne	87	24	38	4	12	42	207	-----	164.0	164.0
Union	-----	25	1	-----	-----	-----	26	-----	20.5	20.5
Vermilion	3	12	14	1	4	21	55	-----	131.0	131.0
Vernon	-----	-----	-----	-----	-----	-----	-----	-----	13.0	13.0
Washington	-----	-----	1	-----	-----	-----	1	-----	-----	-----
Webster	8	2	4	-----	1	1	16	-----	4.5	4.5
West Baton Rouge	-----	-----	-----	1	-----	2	3	-----	5.0	5.0
West Carroll	-----	1	-----	-----	-----	2	3	-----	5.5	5.5
Winn	32	-----	12	1	1	22	68	-----	18.5	18.5
Total:										
1967	806	299	619	41	72	580	2,417	-----	1,607.0	1,607.0
1966	1,111	310	700	65	86	682	2,954	36.0	1,963.0	1,999.0
Offshore:										
Bay Marchand	20	-----	8	-----	2	-----	30	-----	-----	-----
Breton Sound	2	1	1	1	-----	15	20	-----	40.0	40.0
Cameron East	-----	12	9	-----	2	9	32	3.0	44.0	47.0
Cameron West	-----	12	2	-----	7	9	30	-----	72.0	72.0
Chandeleur Sound	6	2	4	1	1	10	24	-----	50.0	50.0
Delta West	27	13	22	9	2	15	88	9.0	35.0	44.0
Eugene Island	58	13	25	1	4	20	121	-----	61.0	61.0

See footnotes at end of table.

Table 6.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1967—Continued

Location	Drilling							Geophysical crew-weeks		
	Proved field wells			Exploratory wells			Total	Gravity meter method	Reflection seismograph method	Total
	Oil	Gas	Dry	Oil	Gas	Dry				
Offshore—Continued										
Grand Isle	58	8	9	8	3	13	99	-----	25.0	25.0
Main Pass	31	2	9	2	-----	57	101	4.0	85.0	89.0
Marsh Island, South	37	21	15	6	3	12	94	-----	30.0	30.0
Pelto, South	3	2	3	-----	-----	5	13	-----	8.0	8.0
Ship Shoal	34	17	12	10	3	40	116	7.0	64.0	71.0
South Pass	38	4	22	3	-----	28	95	7.0	25.0	32.0
Timbalier, South	76	14	13	8	11	29	151	-----	41.0	41.0
Vermilion	7	12	13	3	4	12	51	-----	41.0	41.0
Total:										
1967	397	133	167	52	42	274	1,065	30.0	621.0	651.0
1966	449	80	150	53	53	222	1,007	13.0	1,049.0	1,062.0
Grand total:										
1967	1,203	432	786	93	114	854	3,482	30.0	2,228.0	2,258.0
1966	1,560	390	850	118	139	904	3,961	49.0	3,012.0	3,061.0

Source: International Oil Scouts Association. International Oil and Gas Development. Austin, Tex., v. 38 (in 1967 Review).

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
1963	515	2	3,928	3,821	54	143
1964	550	74	4,153	3,711	62	101
1965	595	83	4,487	3,735	65	227
1966	674	163	5,081	873	72	114
1967	775	48	5,717	2,606	86	325
	Total proved reserves by Dec. 31, 1967					
1967	5,456		86,290		2,607	

Source: Reserves based on American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas. Tulsa Daily World, 63d year. No. 208, Apr. 8, 1968. p. 22.

Cretaceous production, decreased because of salt-water-disposal problems.

Probably the most significant discovery in north Louisiana was the Pan American Petroleum Corp. No. 1 Hodge Hunt Co. This well, completed in the Cadeville sand (Cotton Valley, Jurassic), is 6 miles southwest of present production and should expand the area of interest for Cadeville exploration.

In the Gulf Coast district, drilling activity decreased from 1966 except for offshore exploratory wells; a sharp increase in offshore exploratory drilling followed the Federal lease sale in June. The most significant new fields discovered included North Maurice field, Lafayette Parish; Manchac Point field, West Baton Rouge Parish; Block 207 field, Ship Shoal area; and Block 144 field, Main Pass area. The Main Pass Block 144 field discovery extends the limits of the producing Gulf Coast salt dome basin further eastward.

According to The Oil & Gas Journal, 25.8 million feet of hole (32.2 million in 1966) was drilled in the State during 1967.

The drop occurred in all three areas—north, south, and offshore. An average of 91 drilling rigs operated offshore in 1967 (98 in 1966); an average of 235 operated in the entire State in 1967 (256 in 1966).

According to the American Petroleum Institute, quantities of proved recoverable reserves of crude oil, natural gas, and natural gas liquids in Louisiana reached new highs in 1967. At yearend, the crude oil reserve (5,456 million barrels) comprised 17.4 percent of the U.S. reserve; the natural gas reserve (86,290 billion cubic feet) was 29.5 percent; the natural gas liquids reserve (2,607 million barrels) was 30.3 percent of the total. Of the gross additions to Louisiana's crude petroleum reserve in 1967, less than 1 percent was attributed to newly discovered fields; 16.4 percent to new reservoirs in old fields; and the remainder to extensions and revisions of previously discovered reservoirs.

Carbon Black.—The carbon black production in the State was 923 million pounds valued at $61 million in 1967, a 1-percent increase in value over 1966. This production represented 37 percent of the U.S. carbon black production. About 23.1 billion cubic feet of natural gas was consumed by the industry for an average yield of 12.64 pounds of carbon black per 1,000 cubic feet of gas; 129 million gallons of liquid hydrocarbons was consumed for an average yield of 4.87 pounds per gallon.

Nearly all the carbon black produced in Louisiana was from furnace plants. St. Mary Parish had production from three plants; Ouachita Parish from two plants plus a channel black plant; and Avoyelles, Calcasieu, and Evangeline Parishes each had one plant. The product was used mainly as an additive in rubber manufacturing. Nationwide, 94 percent was directed to the rubber industry; nearly 3 percent was used in ink; 1 percent in plastics; and the remainder was used in paint, paper, chemicals, foods, and miscellaneous uses.

Table 8.—Carbon black production

Year	Million pounds
1962	608
1963	649
1964	726
1965	821
1966	899
1967	923

Columbian Carbon Co. expanded its North Bend plant in St. Mary Parish by adding a 30-million-pound-per-year thermal plant.

Natural Gas.—Marketed production of natural gas increased 12.5 percent over that of 1966, representing the largest volume gain of any State and continuing a strong growth trend for the 22d consecutive year. Louisiana retained its position of second among the States as a producer of natural gas, supplying 31.5 percent of the total natural gas marketed.

Several pipeline companies purchased new gas supplies, mainly from offshore fields. Texas Eastern Transmission Corp. acquired 896 billion cubic feet of proved reserves in Block 6 field, Main Pass area. Southern Natural Gas Co. contracted with Pan American for unspecified reserves in West Delta Block 73 field, and acquired large reserves (estimated up to 500 billion cubic feet) in Lake Washington field, Plaquemines Parish, and Bay Ste. Elaine field, Terrebonne Parish. Michigan Wisconsin Pipe Line Co. acquired at least 400 billion cubic feet from Shell Oil Co. in four fields in Eugene Island and Marsh Island areas. Humble Oil & Refining Co. filed for a permit to sell gas from the same area—Eugene Island Block 188 field—to Michigan Wisconsin Pipe Line Co.

The Federal Power Commission (FPC) granted Florida Gas Transmission Co. a permit to build new facilities for transportation of an added 192 million cubic feet per day of south Louisiana gas, as sold by two producers, directly to a Florida utility. The FPC held that the 1.5-trillion-cubic-feet boiler-fuel sale was not subject to FPC jurisdiction. The New York Public Service Commission objected to the decision that the sale was not jurisdictional. With the prospect of years of litigation, the producers decided to seek other markets for the gas. In May, however, the New York Public Service Commission agreed to withdraw opposition, thus enabling Florida Gas Transmission Co. to proceed with pipeline plans.

The FPC approved an application by Tennessee Gas Pipeline Co. for a line to reach 80 miles into the Gulf of Mexico, farther than any other gas pipeline. It will deliver supplies to Tennessee's Muskrat line onshore.

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]
1963	3,540,100	710,000	4,250,100	3,928,427	$777,829	212,116	109,557
1964	3,682,200	808,400	4,490,600	4,152,731	793,328	221,280	116,589
1965	3,912,300	852,000	4,764,300	4,466,786	812,955	174,951	122,563
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

[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.

United Gas Pipeline Co. continued developing a gas storage reservoir to provide 104 billion cubic feet of storage in the old Bistineau gasfield of Bienville and Bossier Parishes in northwestern Louisiana. The company planned to store gas in the nearly depleted Pettet zone of the Sligo Formation. Gas from the Gulf Coast district will be transported and stored during seasons of low demand, and held ready for immediate distribution to meet winter's peak demands. The project should be completed before the 1969–70 heating season. South Louisiana Production Co. reported having 1.5 billion cubic feet of natural gas storage at Holly field, De Soto Parish.

Natural Gas Liquids.—The 1967 production of natural gas liquids again ranked second in the Nation, and was a new production record for Louisiana. New plants and expansions completed in 1967 raised the State's daily processing capacity from 14.3 to 16.1 billion cubic feet (23.8 percent of the Nation's total capacity).

Natural gasoline and cycle products were recovered in 35 parishes at 112 gasoline plants, 16 recycling plants, and five fractionators (107 gasoline, 16 recycling plants, and four fractionators in 1966).

Recovery of natural gas liquids gained 19 percent and amounted to 17 percent of the Nation's annual output. Production was 51 percent liquefied petroleum (LP) gases and 49 percent natural gasoline and cycle products.

Humble Oil & Refining Co. was expanding its Garden City processing plant to increase capacity by 350 million cubic feet per day (MMcfd). After completion, maximum daily throughput of the plant will total 1.25 billion cubic feet and recovery will be more than 20,000 barrels of liquid per day. Humble was also building a 300-MMcfd plant at Lirette field, Terrebonne Parish, to be completed about July 1968. Pan American Corp. constructed a refrigerated absorption unit, designed to process 120 MMcfd and recover 1,928 barrels of liquid per day, at South Pecan Lake field, Cameron Parish. The same company began expansion of its Forked Island plant in Vermilion Parish, and at yearend was processing about 85 MMcfd of gas from onshore and offshore fields. Upon completion of the expansion, the throughput can be increased to 300

Table 10.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	1,143,707	$81,332	1,113,670	$41,043	2,257,377	$122,375
1964	1,352,980	91,931	1,247,484	45,935	2,600,464	137,866
1965	1,431,836	102,731	1,300,038	46,101	2,731,874	148,832
1966	1,562,075	113,802	1,469,716	72,016	3,031,791	185,818
1967	1,754,603	130,212	1,844,689	92,234	3,599,292	222,446

MMcfd. Liquid production of demethanized mix should rise from 1,900 barrels per day to about 6,800. Expansion plans followed FPC approval of Florida Gas Transmission Co.'s line enlargements between Louisiana and Florida, allowing bigger deliveries.

Sun Oil Co. completed a 175-MMcfd plant in Belle Isle field, St. Mary Parish. Other plants completed during the year were: Coastal States Gas Producing Co. South Manchester plant, Calcasieu Parish; Humble Thibodaux plant La Fourche Parish; Sunray DX Bayou Sale plant, St. Mary Parish; Union Oil Co. of California Houma plant, Terrebonne Parish; Placid Patterson plant in St. Mary Parish; and Black Lake plant in Natchitoches Parish.

Capacity of underground storage facilities increased 22.8 percent. As reported by The Oil & Gas Journal's annual survey, capacity was 16.0 million barrels of natural gas liquids and 2.8 million barrels of ethylene at yearend, not including projects under construction or planned.

Petroleum.—The petroleum industry of Louisiana established a production record of 774.5 million barrels, 15 percent higher than the 1966 record production and second highest in the Nation. Petroleum was produced in all but seven of the 64 parishes in Louisiana. Daily allowable production at the end of 1966 was 36 percent of depth-bracket allowable. This rate continued in January and February of 1967, decreased to 35 percent for March and April, and to 34 percent for May and June. On June 5, hosilities between Israel and the Arab nations precipitated a worldwide petroleum supply crisis, and the domestic petroleum industry was requested to supply a part of the oil ordinarily provided by the Arab countries. As most of the reserve crude oil productive capacity in the United States is in Louisiana and Texas, these States supplied virtually all of the domestic crude oil production increase during the crisis; most of this extra production was shipped to European countries.

The Louisiana Department of Conservation took immediate action to adjust well and field allowables in accordance with indicated increase in demand. As a result of an emergency meeting with major crude oil producers on June 20, a special order was issued increasing the demand factor from 34 percent in June to 38 percent in July. The intermediate zone allowable was increased from 115 to 130 percent of the onshore allowable. The production and transportation of crude oil up to 150 percent of the June allowable was also authorized, overproduction to be compensated by underproduction in a later month. This allowed operators to achieve the major production increase from selected wells

Table 11.—Crude petroleum production

(Thousand barrels and thousand dollars)

Year	Quantity	Value
1963	515,057	$1,608,120
1964	549,698	1,709,622
1965	594,853	1,841,714
1966	674,318	2,097,129
1967	774,527	2,419,823
1902–67	9,527,654	25,422,984

Table 12.—Crude petroleum production, indicated demand, and stocks in 1967, by months

(Thousand barrels)

Month	Production	Indicated demand	Stocks (end of month)
January	62,429	58,972	30,206
February	57,393	58,030	29,569
March	61,759	63,177	28,151
April	59,658	60,728	27,081
May	60,626	61,013	26,694
June	61,212	59,832	28,074
July	70,508	68,077	30,505
August	73,085	70,939	32,651
September	65,897	68,567	29,981
October	67,445	69,352	28,074
November	66,279	65,956	28,397
December	68,236	70,079	26,554
Total:			
1967	774,527	774,722	XX
1966	674,318	672,648	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]
1963	27,638	r 51.1
1964	29,452	51.0
1965	30,179	54.0
1966	31,063	59.5
1967	30,670	69.2

r Revised.
[1] Based on number of wells producing Dec. 31, 1967.

Table 14.—Production of crude petroleum by districts and selected fields

(Thousand barrels)

District and field [1]	1966	1967
Gulf Coast:		
Onshore: [2]		
Bastian Bay	5,493	4,436
Bay St. Elaine	7,447	9,023
Bayou Sale	9,325	9,767
Caillou Island	26,521	33,040
Cote Blanche Bay West	6,953	5,409
Delta Farms	2,366	2,481
Erath	2,890	2,537
Garden Island Bay	8,772	13,541
Golden Meadow	4,064	4,088
Grand Bay	6,374	7,523
Hackberry West	4,085	4,387
Iowa	1,093	902
Jennings	405	382
La Fitte	7,642	10,203
Lake Barre	15,049	16,228
Lake Washington	10,203	12,371
Leeville	3,907	4,297
Paradis	3,630	4,449
Quarantine Bay	6,708	8,768
Venice	5,803	7,220
Vinton	1,789	1,870
Weeks Island	6,883	8,247
West Bay	10,692	12,587
Other	218,831	243,771
Total onshore	376,925	427,527
Offshore: [2]		
Bay Marchand Block 2	27,211	30,908
Eugene Island Block 126	5,145	6,232
Grand Isle Block 16	12,963	14,212
Grand Isle Block 47	4,069	4,193
Grand Isle Block 43	6,645	10,124
Main Pass Block 35	4,393	4,880
Main Pass Block 41	8,486	13,111
Main Pass Block 69	11,807	12,832
South Marsh Island Block 73	1,469	3,044
South Pass Block 24	22,163	23,568
South Pass Block 27	20,179	22,955
South Timbalier Block 135	9,310	13,114
Timbalier Bay	23,775	33,033
West Delta Block 30	20,556	23,744
West Delta Block 73	10,689	13,249
Other	54,316	62,896
Total offshore	243,176	292,095
Total Gulf Coast	620,101	719,622
Northern:		
Caddo-Pine Island	5,691	5,012
Cotton Valley	3,059	2,782
Delhi	4,634	4,523
Haynesville	2,033	2,155
Homer	546	527
Lake St. John	1,959	2,169
Pendleton-Many	2,261	1,297
Rodessa	694	1,031
Other	33,340	35,409
Total Northern	54,217	54,905
Total Louisiana	674,318	774,527

[1] Breakdown for individual fields from The Oil and Gas Journal.

[2] Some fields include onshore and offshore.

with best control of water and gas production. At a hearing on July 11, 1967, the previously assigned July market demand factor of 38 percent was revised to 45 percent, and the 150 percent production and transportation authorization was continued. On August 9, purchaser nominations indicated additional demand for Louisiana crude; the August demand factor was increased from 45 to 47 percent and the 150 percent production and transportation authorization remained in effect. On August 28, the State Department of Conservation called the producers' attention to a pending emergency because Louisiana crude oil stocks had increased to 32 million barrels, 2.5 million barrels over the previous week.

The demand factor was maintained at 47 percent for September, but a memorandum was issued requesting producers to underproduce in September to compensate for the 150 percent overproduction allowed for June, July, and August. A formal order from the Department of Conservation stated that all overproduction was to be compensated by underproduction to the extent that allowable and production be balanced by November 1. October demand factor was 47 percent, November 39 percent, and December 40 percent. To meet the demand resulting from the Middle East crisis, Louisiana oil production (including field separated condensate) increased from 1,955,000 barrels per day for May to 2,357,000 barrels per day during August. This 20 percent production rate increase was 99 percent from south Louisiana and offshore fields. Additional productive capacity at the wellhead remained in about one-fourth of the south Lousiana and offshore fields.

Secondary recovery projects (water, gas, or other injection) accounted for 153 million barrels, or 20 percent of the 1967 production.

Louisiana had 13,121 oil wells classified as stripper wells at the end of 1966. For 1966, stripper wells represented 42 percent of total oil wells but only 2 percent of the annual production. Thus, normal production decline from stripper wells was not expected to appreciably affect the State's productive capacity and reserves in the immediate future.

In October, Louisiana ordered the oil industry to dispose of all salt water into subsurface formations unless it goes into

Table 15.—Crude petroleum production and estimated reserves in Louisiana offshore area

(Thousand barrels)

Offshore area	Number of wells		Production			Estimated reserve Dec. 31, 1967
	1966	1967	1966	1967	Cumulative total	
Bay Marchand Block 2 [1] [2]	453	484	27,211	30,908	214,442	386,094
Belle Isle [2]	62	59	1,732	1,874	17,560	17,440
Caillou Island [1] [2]	741	801	26,521	33,040	322,856	177,144
East Cameron Block 64	39	42	1,347	1,274	3,721	8,379
Eugene Island:						
Block 18	55	55	2,814	3,100	25,385	14,615
Block 32	38	42	1,504	1,739	14,481	20,519
Block 45	11	---	625	---	5,185	5,815
Block 100	23	---	947	---	5,490	14,510
Block 126 [1]	137	122	5,145	6,232	52,032	72,968
Block 128	71	60	2,647	3,101	23,744	36,256
Block 188	47	61	2,166	3,170	12,388	22,612
Block 208	25	36	659	1,167	8,058	26,942
Block 238	20	20	837	1,364	2,442	8,101
Block 276	---	68	---	3,288	3,979	40,001
Grand Isle:						
Block 41	9	---	596	---	727	5,967
Block 16 [1]	214	243	12,963	14,212	80,136	94,864
Block 18	43	42	1,791	2,133	25,925	14,075
Block 43 [1]	126	163	6,645	10,124	24,845	75,155
Block 47 [1]	81	70	4,069	4,193	39,829	60,595
Lake Washington [1] [2]	354	373	10,203	12,371	139,187	162,576
Main Pass:						
Block 6	18	---	1,012	---	1,337	10,120
Block 41 [1]	197	221	8,486	13,111	27,237	72,763
Block 69 [1]	247	239	11,807	12,832	115,794	184,206
Rabbit Island	10	39	691	2,899	6,025	30,000
Ship Shoal:						
Block 28	31	27	3,370	2,956	11,534	18,566
Block 107	55	54	3,853	4,038	20,961	39,039
Block 154	42	55	1,696	3,114	17,435	30,575
Block 176	18	34	1,283	1,861	11,229	13,919
Block 208	53	63	3,602	4,613	13,981	51,785
Block 113	30	38	692	1,365	3,005	11,365
South Marsh Island:						
Block 6	28	25	1,319	1,703	4,930	33,482
Block 23	42	39	2,002	2,198	8,117	45,865
Block 73	32	73	1,469	3,044	5,075	30,044
South Pass:						
Block 24 [1] [2]	682	668	22,163	23,568	279,593	470,407
Block 27 [1]	474	458	20,179	22,955	134,300	176,700
South Pelto:						
Block 23	12	---	517	---	1,629	6,123
Block 20	35	43	1,337	1,678	7,008	12,992
Tiger Shoal	23	40	1,027	2,209	7,648	22,000
Timbalier Bay [1] [2]	573	606	23,775	33,033	192,220	107,780
South Timbalier:						
Block 54	10	---	520	---	2,365	5,467
Block 131	62	60	3,067	2,856	14,937	35,063
Block 135 [1]	148	174	9,310	13,114	39,058	60,942
Block 176	21	41	480	2,019	2,947	20,017
Vermilion:						
Block 14	42	53	1,910	1,842	10,875	21,125
Block 16	4	---	606	---	1,353	5,398
Biock 245	---	39	---	2,853	4,572	29,250
West Cameron:						
Block 45	37	---	594	---	7,707	18,594
Block 192	34	---	460	---	3,435	16,565
West Delta:						
Block 105	---	53	---	2,906	4,683	15,906
Block 30 [1]	444	431	20,556	23,744	145,390	254,610
Block 53 [2]	27	---	492	---	8,752	13,248
Block 27	8	103	446	7,704	10,590	43,427
Block 41	55	67	3,519	5,069	10,636	50,110
Block 58	3	---	385	---	2,179	4,615
Block 73 [1]	206	214	10,689	13,249	31,829	68,171
Block 24	125	---	5,948	---	11,890	41,110
Total	[r] 6,377	6,698	[r] 279,684	345,823	2,204,668	3,335,977

[r] Revised.
[1] Estimated ultimate recovery of 100 million barrels or more.
[2] Combined onshore and offshore.

Source: The Oil and Gas Journal. V. 66, No. 6, Feb. 5, 1968, pp. 162–164.

waters already brackish. The prime purpose of the order was to halt the use of salt water pits. The order prohibits disposal of oilfield wastes into streams, lakes, and ditches which lead to other bodies of water.

"Capline," a 640-mile, 40-inch crude oil pipeline from Donaldsonville to the Wood River-Patoka, Ill., area, was under construction at yearend. The line initially will carry about 417,000 barrels per day and ultimately the capacity will be 1,080,000 barrels per day. This will be the largest crude-oil line built in the United States. Most of the crude will come from southern and offshore Louisiana. Several major companies have lines converging in the Donaldsonville area near the Capline originating station; others will be built. Efforts will be made to complete the line and begin operation as soon as possible, but near-torrential rains virtually stopped construction at yearend.

Refineries.—At yearend, 16 petroleum refineries were operating in Louisiana. Crude oil capacity (barrels per calendar day) totaled 1,111,070, a gain of approximately 186,920 barrels over that of 1966. Crude oil processed in State refineries totaled 364.3 million barrels (36.7 million barrels more than in 1966) and represented about 47 percent of the crude oil production in the State.

Gulf Oil Corp.'s new natural gas, gas liquids, and condensate processing plant near Venice started production in June. This refinery, the first in the United States designed only for natural gas liquids treatment, can process 20,000 barrels of crude condensate per day. Output is 85 percent gasoline, 50 percent higher than the industry average. Principal source of natural gas and condensate processed was West Delta area Block 27 field, southeast of the refinery, and 11 miles offshore in the Gulf of Mexico. The refinery section of the complex consists of a crude unit, two hydrocrackers, and two catalytic reformers. The product is stored underground. Six caverns were excavated by solution mining from the nearby Venice salt dome to store propane, normal butane, isobutane, natural gasoline, condensate, and raw gas liquids.

Texaco Inc. began production in July at its new 100,000-barrel-per-day refinery at Convent on the Mississippi River between Baton Rouge and New Orleans. The plant has advantages of water transportation, rail connections, and a location between the crude supply point and Colonial Pipelines products line. A new 18-inch line brings crude from Houma to the plant; a new 54-mile, 16-inch line connects storage at Baton Rouge to the Colonial Pipeline. Processing provided for high gasoline yields, along with middle distillates and residual fuels. No hydrocracker was included in this initial building program, however. All plant process and storm water was sent to a waste disposal plant. Quality of the effluent to the Mississippi River was better than that required by pollution-control agencies. Nearly 5 million barrels of storage capacity was provided by 44 atmospheric tanks. Three washed out salt dome caverns near Sorrento provided additional storage.

Good Hope Refinery, Inc., began reporting production in June. Average throughput was about 5,000 barrels per day.

Humble Oil & Refining Co. at Baton Rouge raised crude capacity to 424,000 barrels per stream day, expanded vacuum capacity, fluid cat cracking, sulfuric acid alkylation, and began expansion of the reformer section.

Tenneco Oil Co. at Chalmette was expanding crude capacity to 75,000 barrels per stream day and vacuum capacity to 20,000 barrels per stream day; a platformer, Isomax hydrocracker, coke facilities, and BTX unit will be added.

On August 8, an explosion and fire occurred at the Cities Service Oil Co. refinery at Lake Charles. Two alkylation units and a residual-fuel coking unit were severely damaged. Other facilities received only minor damage and there was no damage to any of the petrochemical or lube-oil facilities in the complex. Repairs were essentially completed by yearend and the refinery was processing a volume of crude equal to about 90 percent of the volume processed before the explosion.

Petrochemicals.—The fastest growing segment of the State's manufacturing economy was the petrochemical industry. The economic impact of these petroleum-derived chemicals affected every part of the State. The petrochemical industry continued to grow in 1967, although the growth rate was somewhat retarded by labor-management disputes, especially in the Baton Rouge area.

At Geismar, Allied Chemical Corp. completed a plant to produce 1,000 tons

per day each of ammonia and urea and 600 tons per day of nitric acid. Union Texas Petroleum Division completed a 500-million-pound-per-year ethylene plant. Borden Chemical Co. completed expansion of a vinyl acetate plant and neared completion of a methanol plant expansion, raising Borden's methanol capacity to 160 million gallons per year. Shell Chemical Co. completed plant facilities for ethylene oxide and derivatives for use in detergents, paints and antifreeze, and a plant to produce primary alcohols used in manufacturing soft detergents.

In the Baton Rouge area, Copolymer Rubber and Chemical Corp. completed a 25,000-long-ton-per-year solution polymer rubber facility. Enjay Chemical Co. completed a 50-million-gallon-per-year benzene plant, expanded an ethylene plant and a butadiene plant, and began constructing a 200-million-pound-per-year polypropylene plant. Allied Chemical Corp. announced plans to build a 500-million-pound-per-year vinyl chloride monomer plant at Baton Rouge to utilize feedstocks from the plant at Geismar. The new plant will be adjacent to Allied's industrial chemical plant and the plastic plant. At Carville, Cos-Mar, Inc., a joint venture of Cosden Oil & Chemical Co. and Marbon Chemical, approached completion of a 500-million-pound-per-year styrene monomer plant. Hercules, Inc., was building an 80-million-gallon-per-year-methanol plant in Iberville Parish, just south of Plaquemine.

In the New Orleans area, Shell Chemical Co. completed a 500-million-pound-per-year ethylene plant. American Cyanamid Co. completed a 48-million-pound-per-year methyl methacrylate monomer plant expansion at Avondale. Gulf Oil Corp. completed a 600-ton-per-day urea plant at Donaldsonville, continued work on a 1,000-ton-per-day ammonia plant, and began constructing an 80-million-gallon-per-year methanol plant. In the same area, Central Farmers Fertilizer Co. was building a 1,000-ton-per-day ammonia plant, as was Nitrogen, Inc. At its Taft complex, Union Carbide Corp. completed a caprolactam plant, peracetic acid plant, glyoxal plant, acrylic acid and esters plant, a 250-million-pound-per-year polyethylene plant (the first stage of a 500-million-pound-per-year plant) and a 100-million-gallon-per-year benzene plant. Tenneco Oil Co. was constructing a new aromatics and paraxylene plant at Chalmette and expanding its orthoxylene plant.

In the Lake Charles area, Pittsburgh Plate Glass Co. completed a 150-million-pound-per-year vinyl chloride plant. Calcasieu Chemical Corp. expanded ethylene glycol capacity to more than 20-million gallons per year. Continental Oil Co. completed a high-purity olefins plant with a 500-million-pound-per-year capacity and, in a joint venture with Stauffer Chemical Co., continued construction of a 600-million-pound-per-year vinyl chloride plant. Columbian Carbon Co. completed a 60- to 80-million-pound-per-year polyethylene plant. Petroleum Chemicals, Inc., a subsidiary of Columbian Carbon Co., completed a 25-million-pound-per-year cyclic chemicals plant, the first of its kind in the Western Hemisphere. Cities Service Petroleum Co. completed a paraxylene unit and a benzene plant. Hercules, Inc., was expanding polypropylene capacity by 30 million pounds per year.

In northeastern Louisiana, Commercial Solvents Corp. completed a 1,000-ton-per-day ammonia plant and planned to build a 100-million-gallon-per-day methanol plant.

NONMETALS

Value of nonmetals produced in 1967 was $262 million or 6.6 percent of total mineral value, and an increase of 20 percent over the 1966 total. Combined value of construction materials (clay, lime, cement, gypsum, sand and gravel, and stone or shell) gained 7.3 percent.

Barite.—Crude barite, principally from Arkansas, Georgia, Missouri, and various foreign countries, was crushed and ground in three plants at New Orleans and in one at Lake Charles. Output was used mainly as a weighting agent in oil well drilling fluids. Production was down 4 percent from 1966.

Cement.—Portland cement was produced at four Lousiana plants—one near Lake Charles, one at Baton Rouge, and two at New Orleans. Production was 2 percent higher than in 1966. Ready-mix concrete companies were the chief consumers, followed by highway contractors, concrete products manufacturers, and other contractors.

The Lone Star Cement Corp. in late 1967 announced the closing of four ce-

ment plants in early 1968 due to obsolescence and low profit margin. The plant at Lake Charles was one of the affected plants. Overall, the Lousiana cement industry operated at about 85 percent of capacity during the year. Dundee Cement Co.'s new distribution and service center was opened in May at New Orleans. The terminal is adjacent to the Michoud Canal, near the Gulf Intracoastal Waterway, and has six circular silos with barge and rail unloading, and truck loading facilities.

Clays.—Production was down slightly from 1966. Seven brick companies at eight plants, two lightweight aggregate companies, and four cement plants used clay in 13 parishes.

The Louisiana Geological Survey published a report[4] that compiles existing miscellaneous previously unpublished data on the occurrence and evaluation of clays in Louisiana. Data from tests made in past years by the Federal Bureau of Mines for the Louisiana Geological Survey represent a sizable portion of this report.

Table 16.—Miscellaneous clay sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	655	$655
1964	780	797
1965	909	936
1966	1,005	983
1967	995	1,260

The Louisiana Geological Survey continued a joint program with the Federal Bureau of Mines in making a statewide survey of Louisiana clay types and reserves.

Gypsum.—Winn Rock, Inc., Winn Parish, mined crude gypsum for use as retarder in portland cement. National Gypsum Co. at Westwego and United States Gypsum Co. at New Orleans calcined imported crude gypsum and manufactured plaster, lath, and wallboard. Georgia Pacific Corp. at New Orleans closed its calcining plant at the end of 1966.

Lime.—Lime production was down 9 percent from 1966 levels. Four companies produced lime—Olin Mathieson Chemical Corp. in Calcasieu Parish and Allied Chemical Corp. in East Baton Rouge Parish produced lime for their own use; United States Gypsum Co. in Orleans Parish and Pelican State Lime Co. in St. Mary Parish produced primary lime from oystershell for sale on the open market. The lime was used principally at chemical and industrial plants and for refractories. Regenerated lime for use in paper and pulp was produced by five companies at six plants as follows: Calcasieu Paper Co., Allen Parish; Olin Kraft, Inc., Ouachita Parish; Continental Can Co., Inc., Jackson Parish; Internationl Paper Co., Morehouse and Webster Parishes; and Crown Zellerbach Corp., Washington Parish. Regenerated lime production in 1967 was 457,000 short tons (451,000 in 1966).

Salt.—Louisiana was the Nation's leading salt-producing State. Demand for all types of salt—evaporated, rock, and brine—showed substantial increases, although increased consumption of rock salt accounted for 80 percent of the gain. Evaporated and/or rock salt was produced by six salt companies; brine was produced by seven chemical companies. Salt was used in tanning, food processing, manufacture of rubber, paper, chemicals, livestock feed, snow and ice removal, and numerous other industrial applications.

Sand and Gravel.—Production was 20.3 million tons (9 million tons of sand and 11.3 million tons of gravel), about 11 percent more than in 1966. Processed sand and gravel amounted to 19.9 million tons or 98 percent of the total. Sand use was as follows: Building sand, 57 percent; paving sand, 40 percent; industrial, other construction and fill sand, 3 percent. Gravel use was as follows: Building gravel, 54 percent; paving gravel, 44 percent; other construction and fill gravel, 2 percent. A total of 96 sand and gravel operations was reported in 21 parishes.

The Louisiana Geological Survey continued a study of Louisiana sands from the standpoint of suitability for industrial use—glass manufacture, foundry sand, etc. The study will be expanded to include detailed work on the Sparta Formation in north Louisiana. Results will be published when the study is complete.

[4] Louisiana Geological Survey. Clay Resources of Louisiana-Test Data and Evaluation of Miscellaneous Clays. Clay Resources Bull. 1, 1967.

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
1963	250	$5,988	2,294	$15,227	3,655	$9,235	6,199	$30,450
1964	252	6,080	2,516	16,537	3,633	13,439	6,401	36,056
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

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	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	12,125	$14,551	375	$150	12,500	$14,701
1964	13,228	14,959	366	294	13,594	15,253
1965	14,024	16,306	274	99	14,298	16,405
1966	18,171	22,459	45	45	18,216	22,504
1967	20,216	27,346	96	96	20,312	27,442

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	4,295	$4,632	5,097	$6,070
Paving	3,170	3,287	3,654	4,703
Other [1]	301	514	260	472
Total sand	7,766	8,433	9,011	11,245
Gravel:				
Building	5,307	7,099	6,174	8,799
Paving	4,765	6,499	4,848	7,073
Other [2]	333	428	183	229
Total gravel	10,405	14,026	11,205	16,101
Total sand and gravel	18,171	22,459	20,216	27,346
Government-and-contractor operations: Gravel: Paving	45	45	96	96
Grand total	18,216	22,504	20,312	27,442

[1] Includes fill, other construction, and industrial sand (ground and unground).
[2] Includes fill, other construction, and miscellaneous gravel (1966).

Stone.—Stone production consisted primarily of shell (clam and oyster) and some anhydrite produced in Winn Parish for use in road surfacing and concrete. Lacking an adequate supply of stone, Louisiana industries rely on shell as a substitute. Total output of shell was about 6 percent less than in 1966. About 75 percent of the shell was crushed for concrete aggregate and road construction; the remainder was used in the manufacture of cement and lime.

Sulfur.—As a result of demand and increased prices, shipments of Frasch sulfur were at a record level, exceeding the 1966 total by 5 percent. Louisiana was the leading sulfur-producing State, however, production remained essentially the same as in 1966. Most of the mines produced at or near capacity.

Freeport Sulpher Co's new Caminada development, (Grand Isle Block 16 field) offshore in the Gulf of Mexico, was virtually completed in 1967 and was expected to be operational in early 1968. Seven thousand tons of steel was used in the structure, which stands in 50 feet of water some 6 miles offshore and 6 miles southwest of the first development in the Gulf of Mexico at Grand Isle. As at Grand Isle Block 18 field, production will be brought ashore in liquid form through a 9-mile, heated, insulated pipeline trenched into the floor of the Gulf. The plant has the same hot water capacity as Grand Isle mine, 5 million gallons per day, but sulfur production is not expected to be as great as at Grand Isle because the sulfur-bearing formation is considerably thinner and will require more water per ton of sulfur produced.

Table 20.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1963	2,469	2,445	$48,905
1964	2,739	2,733	54,996
1965	3,582	3,577	81,372
1966	4,085	4,018	104,472
1967	4,059	4,233	139,739

Construction work progressed on facilities for mining of sulfur from the Bully Camp Dome by Texas Gulf Sulphur Co. and Lake Hermitage Dome by Jefferson Lake Sulphur Co. Water-heating capacity of each of these plants is 3 million gallons per day. The Lake Hermitage facility was scheduled to be in operation during the first quarter of 1968, and Bully Camp about the middle of the year. Frasch mining operations resumed in July at Chacahoula Dome by John W. Mecom, but did not contribute greatly to 1967 output. Water-heating capacity was being increased. Chacahoula previously was mined between February 1955 and September 1962.

A number of known salt domes in the area were unsuccessfully prospected for sulfur during 1967.

Continued heavy demand for sulfur led to further price increases, bringing about a reduction in the differential that had existed between overseas and domestic prices during recent years. U.S. Frasch producers increased domestic prices $4 per ton about the end of the first quarter, and $5.50 per ton on October 1, 1967. This brought the domestic price for dark sulfur to $38 per long ton f.o.b. Gulf ports. Bright sulfur was priced $1 to $2 per ton higher, depending on quality.

The outlook was for continued record-rate consumption and production in 1968. Production must increase at a faster rate than demand if consumers are to be fully supplied, because inventories are not large enough to make up any sizable shortage. Higher prices are stimulating exploration and development of new sources. Significant output from the new projects probably will not be achieved for 1 or 2 years, and supplies are expected to be short throughout 1968. The most critical factor in the outlook for demand was the rate of growth achieved in the production and consumption of phosphatic fertilizers. Fertilizer use accounted for 48 percent of the sulfur used, and chemicals for 18 percent. Freeport Chemical Co. was nearing completion of its phosphate chemical plant on the Mississippi River between New Orleans and Baton Rouge. The plant will produce phosphoric acid by acidulating phosphate rock with sulfuric acid.

METALS

Aluminum.—Kaiser Aluminum & Chemical Corp. produced alumina at its Gramercy and Baton Rouge plants, calcined coke at Norco and Chalmette, and produced aluminum at its reduction plant at Chalmette, the Nation's largest aluminum reduction plant. Louisiana plants produced all of Kaiser Aluminum's domestic alumina and about 39 percent of the company's domestic primary aluminum. The bauxite ore was imported from Jamaica. The aluminum industry, however, has been a very important part of the mineral activity of the State. Kaiser Aluminum Corp., along with Kaiser Chemical Corp., employed approximately 4,200 people with a payroll of $42 million per year. In 1967, it used 82 billion cubic feet of natural gas, 190,000 tons of oystershell, 100,000 tons of coke, 270,000 tons of salt, and 80,000 tons of sulfuric acid.

A modernization and expansion program was planned by Kaiser Aluminum &

Chemical Corp. for 1968. The company planned to spend $6 million at the Baton Rouge alumina plant and about $2 million to construct a coke calcining plant at Chalmette.

Ormet Corp., owned jointly by Olin Mathieson Chemical Corp. and Revere Copper & Brass, Inc., produced alumina at its Burnside plant.

A reduction plant to be built at Lake Charles was announced in late 1967. Gulf Coast Aluminum Co., a subsidiary of Swiss Aluminum Ltd. started preliminary work on the plant site. Construction is to start in early 1968, with completion scheduled for mid 1969. In addition to producing aluminum, the plant will include a unit for producing carbon electrodes from petroleum coke obtained from nearby refineries. Planned annual output of the plant was 35,000 tons of primary aluminum and 125,000 tons of carbon electrodes.

Table 21.—Principal producers and processors of minerals

Commodity and company	Type of activity	Parish	Address	Remarks
Barite:				
Dresser Minerals	Grinding plant	Orleans	Houston, Tex	
Do	do	Calcasieu	do	
Milchem, Inc	do	Orleans	do	
National Lead Co	do	do	do	
Cement:				
Ideal Cement Co., Portland Cement Division	Plant	East Baton Rouge	Denver, Colo	Also shell, various parishes, and clay, West Baton Rouge Parish.
Lone Star Cement Corp	Plant	Calcasieu	Dallas, Tex	Also clay.
Do	do	Orleans	do	
Louisiana Cement Co	do	do	New Orleans, La	Also clay, St. Bernard Parish.
Clay:				
Acme Brick Co	Mine and plant	East Baton Rouge	Fort Worth, Tex	
Athens Caddo Brick Co	do	Caddo	Athens, Tex	
Mike Baker Brick Co	do	Lafayette	Lafayette, La	
Do	do	Iberia	do	
Big River Industries, Inc	do	Pointe Coupee	Baton Rouge, La	For lightweight aggregate.
Dixie Brick, Inc	do	Natchitoches	Natchitoches, La	
Hammond-Baton Rouge Brick Co	do	Tangipahoa	Hammond, La	
Louisiana Lightweight Aggregate Co	do	Rapides	Alexandria, La	For lightweight aggregate.
Ruston Brick Works	do	Lincoln	Ruston, La	
St. Joe Brick Works, Inc	do	St. Tammany	Slidell, La	
Gypsum:				
National Gypsum Co	Calcining plant	Jefferson	Buffalo, N.Y	
United States Gypsum Co	do	Orleans	Chicago, Ill	
Winn Rock, Inc	Open pit	Winn	Winnfield, La	Also miscellaneous stone.
Lime:				
Allied Chemical Corp	Plant	East Baton Rouge	Morristown, N. J	
Olin Mathieson Chemical Corp	do	Calcasieu	New York, N. Y	Also salt, Cameron Parish.
Pelican State Lime Corp	do	St. Mary	Morgan City, La	
United States Gypsum Co	do	Orleans	Chicago, Ill	
Salt:				
Allied Chemical Corp	Brine wells	Iberville	Morristown, N. J	
The Carey Salt Co	Underground mine	St. Mary	Hutchinson, Kans	
Cargill, Inc	do	do	Minneapolis, Minn	

Diamond Crystal Salt Co	----do----	Iberia	St. Clair, Mich	
The Dow Chemical Co	Brine wells	Plaquemines	Midland, Mich	
Freeport Sulphur Co	----do----	Jefferson	New Orleans, La	
Do	----do----	Plaquemines	----do----	
Do	----do----	Terrebonne	----do----	
Gordy Salt Co., Inc	----do----	St. Martin	New Iberia, La	
International Salt Co	Underground mine	Iberia	Clarks Summit, Pa	
Kaiser Aluminum & Chemical Corp	Brine wells	Ascension	Washington, D. C	
Morton Salt Co	Underground mine	Iberia	Chicago, Ill	
Pittsburgh Plate Glass Co	Brine wells	Calcasieu	Lake Charles, La	
Wyandotte Chemicals Corp	----do----	Ascension	Wyandotte, Mich	
Sand and gravel:				
Braswell Sand & Gravel Co	Stationary	Webster	Minden, La	
Gifford-Hill & Co., Inc	----do----	----do----	Dallas, Tex	
Do	Dredge	Evangeline	----do----	
Do	----do----	Jefferson Davis	----do----	
Jahncke Service, Inc		St. Tammany	New Orleans, La	**Also shell; and shell St. John Parish.**
Louisiana Industries, Inc	Stationary	Rapides	----do----	
Do	Dredge	Orleans	----do----	
Do	----do----	Ouachita	----do----	
Louisiana Sand & Gravel Co	----do----	East Baton Rouge	Baton Rouge, La	
Monroe Sand & Gravel Co., Inc., & Red Stick Gravel Co	Stationary	Ouachita	----do----	
Do	----do----	East Baton Rouge	----do----	
Ouachita Gravel Co., Inc	----do----	Ouachita	Monroe, La	
Standard Gravel Co., Inc	----do----	Washington	Franklinton, La	
Mid-State Materials, Inc		Rapides	Alexandria, La	
Shell:				
Ayers Materials Co., Inc	Dredge	St. Tammany	Harvey, La	
W. T. Burton Industries, Inc	----do----	Cameron	Sulphur, La	
Laminar Corp	----do----	St. Mary	Berwick, La	
Louisiana Materials Co	----do----	Various	New Orleans, La	
Radcliff Materials, Inc	----do----	Orleans	Mobile, Ala	
Southern Shell Fish Co	----do----	Jefferson	Harvey, La	
Sulfur—Native:				
Freeport Sulphur Co	Frasch process	----do----	New York, N.Y	
Do	----do----	Plaquemines	----do----	
Do	----do----	Terrebonne	----do----	
John W. Mecom	----do----	Chacahoula	Houston, Tex	
Union Texas Petroleum	----do----	Calcasieu	----do----	
Vermiculite—Exfoliated:				
Zonolite Division, W. R. Grace & Co	Exfoliation plant	Orleans	Cambridge, Mass	

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]

The value of Maine mineral production totaled $14.9 million in 1967, 11 percent below the total for 1966. Gains resulting from greater sales of finished portland cement were not sufficient to offset the losses recorded for sand and gravel and stone, which were caused by the lower demand for aggregate used in highway construction. Output of clay and feldspar changed only slightly from the previous year. Domestic and foreign mining companies continued exploration for copper, lead, zinc, nickel, gold, and silver ore deposits.

IMC Chlor–Alkali, Inc., a joint venture in which International Minerals & Chemical Corp. is the principal partner, constructed a $9.5 million chlorine and caustic soda plant on a 15-acre site in Orrington. The plant was completed and placed in full production in December. High purity salt was imported to produce 60,000 tons of chlorine and 60,000 tons of sodium hydroxide annually.

[1] Statistical assistant, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Maine [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	45	$58	42	$54
Gem stones	NA	35	NA	35
Peat—short tons	1,600	60	W	W
Sand and gravel—thousand short tons	15,036	7,027	11,627	5,368
Stone—do	1,092	3,622	1,159	2,999
Value of items that cannot be disclosed: Cement (portland and masonry), feldspar, and values indicated by symbol W	XX	5,932	XX	6,426
Total	XX	16,734	XX	14,882
Total 1957–59 constant dollars	XX	16,210	XX	[p] 14,511

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

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

County	1966	1967	Minerals produced in 1967 in order of value
Androscoggin	$502,040	$425,308	Sand and gravel, clays, stone.
Aroostook	1,555,576	1,278,654	Sand and gravel, stone.
Cumberland	1,125,971	1,024,861	Stone, sand and gravel, clays.
Franklin	168,000	218,000	Sand and gravel.
Hancock	1,247,087	527,309	Sand and gravel, stone, clays.
Kennebec	400,000	376,047	Sand and gravel, stone.
Knox	W	W	Cement, stone, sand and gravel.
Lincoln	98,000	98,000	Sand and gravel.
Oxford	287,084	241,660	Sand and gravel, feldspar, stone.
Penobscot	1,110,000	680,371	Sand and gravel, stone.
Piscataquis	W	W	Stone, sand and gravel.
Sagadahoc	W	W	Sand and gravel, stone.
Somerset	315,000	342,586	Do.
Waldo	278,000	193,053	Do.
Washington	W	W	Sand and gravel, peat, stone.
York	W	W	Sand and gravel, stone.
Undistributed [1]	9,647,650	9,475,914	
Total	16,734,000	14,882,000	

W Withheld to avoid disclosing individual 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.

Table 3.—Indicators of Maine business activity

		1966	1967 [p]	Change (percent)
Personal income:[1]				
Total	millions	$2,422	$2,549	+5.2
Per capita		$2,477	$2,620	+5.8
Construction activity:				
Construction contracts [2]	thousands	$169,809	$160,162	−5.7
Nonresidential	do	$66,603	$76,822	+15.3
Residential	do	$60,476	$55,924	−7.5
Nonbuilding construction	do	$42,730	$27,416	−35.8
Cement shipments to and within Maine [3 4]	thousand 376-pound barrels	1,050	1,043	−.7
Mineral production	thousands	$16,734	$14,882	−11.1
Annual average employment:[5]				
Total labor force	do	382.7	388.1	+1.4
Unemployment	do	16.1	15.3	−5.0
Total manufacturing	do	115.0	116.6	+1.4
Lumber and wood products	do	14.6	14.6	----------
Food products	do	12.0	12.6	+5.0
Textile-mill products	do	13.1	12.4	−5.3
Paper and allied products	do	18.2	18.8	+3.3
Leather and leather products	do	29.7	29.7	----------
Total nonmanufacturing	do	194.2	200.2	+3.1
Contractor construction	do	14.8	14.5	−2.0
Total agricultural	do	16.4	16.2	−1.2
Total all other	do	41.0	39.8	−2.9

[p] Preliminary.
[1] Source: Bureau of Census, U.S. Department of Commerce.
[2] Source: F. W. Dodge Division, McGraw-Hill Information Systems Company.
[3] Source: Bureau of Mines, U.S. Department of Interior.
[4] Includes portland and masonry cement.
[5] Source: Bureau of Employment Security, S. S. Department of Labor.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Metal and peat	32	184	6	45	-----	-----	-----	-----
Nonmetal	111	182	20	163	1	7	49.01	38,328
Sand and gravel	1,446	231	335	2,700	-----	51	18.89	416
Stone	341	250	85	695	-----	23	33.09	793
Total [1]	1,930	231	446	3,604	1	81	22.76	2,201
1967:[p]								
Metal and peat	70	241	16	131	-----	1	7.63	229
Nonmetal	105	215	23	184	-----	5	27.12	602
Sand and gravel	1,490	163	243	2,087	-----	39	18.69	373
Stone	465	217	101	819	1	15	19.54	8,342
Total [1]	2,130	180	383	3,221	1	60	18.94	2,405

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Dragon Cement Co., Division of Martin Marietta Corp., produced both finished portland and masonry cements. Shipments of both types were greater than those of 1966. Cement rock, the principal raw material, was quarried locally by the company. Purchased sand, gypsum, and iron-bearing materials also were used as raw materials. The raw materials were fed into the two rotary kilns in a slurry of controlled consistency for use in manufacturing two types of portland cement: Type I–II (general use) and Type III (high-early-strength).

Portland cement was shipped chiefly by truck in both bulk and paper bags to consumers in Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. Total apparent consumption of portland cement in Maine during 1967 was 987,413 barrels. Consumers of portland cement, in decreasing order of quantity, were ready-mix concrete companies, concrete product manufacturers, and building material dealers.

Clay.—Production of miscellaneous clay was reported from two pits in Androscoggin County and three in Cumberland County, which again led in production. Miscellaneous clay, the predominant kind of clay produced, was used to manufacture building brick. A small quantity of stoneware clay recovered from property in Hancock County was used to manufacture dinnerware, art pottery, flowerpots, and glazed ware.

Feldspar.—Output of marketable crude feldspar continued downward and was at its lowest level since 1963. The loss of experienced miners, primarily through retirement, curtailed the production of feldspar and the industry had difficulty in finding replacements. Production was reported only from mines in Oxford County and the average value for crude material remained at $6 per long ton. Feldspar from mines in Oxford County, together with a substantial quantity of high potash feldspar from the Ruggles mine in Grafton, N.H., was processed at West Paris, Oxford County, by Bell Minerals Co. The ground feldspar was sold primarily for ceramic applications and was shipped chiefly to consumers in Pennsylvania, New Jersey, and Ohio. Lesser quantities were shipped to other States and some was exported to Africa and Canada.

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.

Lime.—Oxford Paper Co. at Rumford, Oxford County, produced high-calcium

quicklime for manufacturing paper. The lime was regenerated at the company's oil-fired rotary kiln and reused; losses were minimal and were supplemented with purchased material.

Nitrogen Compounds.—Northern Chemical Industries, Searsport, Waldo County, produced anhydrous ammonia for use as a fertilizer component.

Peat.—Peat production, confined to Washington County, was of the sphagnum variety and was used principally as a soil conditioner. Preliminary talks were underway to put all peat producers in Washington County under a single management. The new organization would be known as Northeast Peat Mine Co., Inc.

Sand and Gravel.—Output of sand and gravel continued to decline for the second consecutive year and was at its lowest level since 1963. The decline was attributed to a substantial decrease in consumption by the Maine State Highway Commision, the State's largest single user. Demand for sand and gravel fell sharply with the completion of the last 41 miles of Interstate 95 between Medway and Oakfield.

The Commission reported production of paving sand and gravel in all counties; output was obtained both by the Commission's own crews and by workers under contract. Aroostook and Penobscot Counties remained the principal producing areas; however, output of sand and

Table 5.—Sand and gravel sold by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	280	$166	252	$201
Paving	300	270	246	222
Fill	279	105	259	125
Engine	4	6	W	W
Other	72	47	[1] 122	[1] 77
Total	935	594	879	625
Gravel:				
Structural	199	184	211	215
Paving	680	726	672	807
Railroad ballast	26	9	([1])	([1])
Fill	199	79	126	69
Other [2]	126	52	188	142
Total	1,230	1,050	1,197	1,233
Total sand and gravel	2,165	1,644	2,076	1,858
Government-and-contractor operations:				
Sand:				
Paving	3,065	1,400	1,957	738
Other	238	183	268	109
Total	3,303	1,583	2,225	847
Gravel:				
Paving	9,566	3,799	7,320	2,661
Fill	2	1	3	1
Other	------	--------	3	1
Total	9,568	3,800	7,326	2,663
Total sand and gravel	12,871	5,383	9,551	3,510
All operations:				
Sand	4,238	2,177	3,104	1,472
Gravel	10,798	4,850	8,523	3,896
Total	15,036	7,027	11,627	5,368

W Withheld to avoid disclosing individual company confidential data.
[1] Includes railroad ballast, engine, and other sand.
[2] Includes miscellaneous, other, and railroad ballast (1967) gravel.

gravel from these two counties was nearly 2 million tons below the volume of the previous year. Five municipalities in Androscoggin County, and one each in Hancock and Penobscot Counties, recovered sand and gravel for local roads, ice control, and maintenance.

Additional Interstate construction for the northern half of the State was not anticipated before the middle of 1969. Two sections of I–95 were under construction, one near Augusta and the other near Brunswick. Completion of this portion was expected in 1970.

Commercial production, 18 percent of the total, was reported from all counties except Lincoln and Piscataquis. Production was centered mainly, in decreasing order, in Cumberland, York, Penobscot, Androscoggin, and Hancock Counties, which accounted for 74 percent of the commercial output. Almost all of the material was shipped by truck.

A total of 76 commercial operations was reported during the year having a combined output of over 2 million tons. Of these, 49 reported production of less than 25,000 tons; 15 ranged from 25,000 to 50,000 tons; nine ranged from 50,000 to 100,000 tons; and three produced between 100,000 to 200,000 tons. Eighty-five percent of the sand and gravel was washed, screened, or otherwise prepared; commercial producers processed 47 percent of their output, while Government-and-contractor operations processed 93 percent of their total output.

Stone.—Lack of new contracts and adverse summer weather conditions curtailed production of dimension granite in Hancock, Knox, and York Counties. Crushed granite was produced commercially in Cumberland, Knox, and York Counties. Output of dimension granite included rough and dressed construction stone, monumental and architectural stone, as well as rubble, curbing, and flagging. Knox County continued as the leading limestone-producing area; output was also reported in Aroostook and Kennebec Counties. Dragon Cement Co. and Lime Products Corp. announced plans to enlarge their quarry and plant facilities at Thomaston and Union, respectively. Miscellaneous stone quarried near Westbrook was used as concrete aggregate, roadstone, and riprap. Slate mined underground by Portland-Monson Slate Co., near Monson, was marketed as electrical slate, floor tile, and flagging.

Granite produced by The John Swenson Granite Co., Inc., from its Pink quarry near Wells and from its Green quarry near York was used for construction of break-water and dock facilities in a major harbor improvement project at Wells. The $2 million project which has been under construction since 1961 was nearing completion at yearend. The basin will have a capacity for 100 moorings of which about 30 will be of the heavy-duty type for larger crafts and the remainder for smaller boats. The company also announced plans to open a black granite quarry in southern Maine. Development of the quarry, near Wells, was expected to be completed in early 1968.

METALS

Callahan Mining Co. continued development of its open-pit copper-zinc mine in Hancock County. Construction of the concentrating mill was completed late in 1967 and initial processing of the ore was expected to start early in 1968. The copper and zinc minerals are extremely susceptible to oxidation changes from weathering which affect their metallurgical characteristics. The company planned to coordinate mining and milling so that the ore broken in the pit will be fed directly to the mill with stockpiling kept to a minimum. The present production schedule indicates the complex will be in operation for 6 years and may employ an estimated 75 persons when it attains full production. Northern Canada Mines Ltd., has made arrangements to start exploratory drilling on land owned by Scott Paper Company in Somerset County. In midyear, Humble Oil & Refining Company announced a letter of agreement with Spooner Mines and Oil Ltd., for the geophysical and geochemical exploration of 621 square miles of Spooner holdings in North central Maine.

Noranda Mines, Ltd., continued its diamond drilling program south of Jackman, in Somerset County. Black Hawk Mining Corp., a subsidiary of Dennison Mines, Ltd., Toronto, Ontario, suspended all work at Blue Hill. The operation will remain in a standby condition until economic and employment conditions become more favorable. Knox Mining

Corp. continued exploration and development drilling for nickel, copper, and cobalt at its Harriman-Crawford Pond prospect located about 1 mile southwest of East Union.

Table 6.—Principal producers

Commodity and company	Type of activity	County	Address
Cement:			
Dragon Cement Co., Division of Martin Marietta Corp.[1]	Plant	Knox	5A Joyce Kilmer Ave., New Brunswick, N.J.
Clays:			
Dennis Brick Co., Inc	Pit	Androscoggin	R.F.D. No. 1, 33 Old Washington Rd., Auburn, Maine
Lachance Bros. Brick Co	do	Cumberland	R.F.D. No. 2, Gorham, Maine
Fred S. Liberty & Son, Inc	do	do	R.F.D. No. 1, Gray, Maine
Morin Brick Co	do	Androscoggin	Danville, Maine
Rowantrees, Inc	do	Hancock	Bluehill, Maine
Royal River Brick Co., Inc	do	Cumberland	Box 191, Gray, Maine
Feldspar (crude):			
Bell Minerals Co	do	Oxford	West Paris, Maine
Carl Bonney	do	do	West Paris, Maine
Dave Buchanen	do	do	Ashville, N.C.
Norman Jack	do	do	Buckfield, Maine
Frank Perham	do	do	West Paris, Maine
James Ring	do	do	Bryant Pond, Maine
Harold Thorne	do	do	West Poland, Maine
Lime (regenerated):			
Oxford Paper Company	Plant	do	Rumford, Main
Peat:			
Eric W. Kelley Peat Moss Co., Inc.	Bog	Washington	Centerville, Maine
New England Peat Industries, Inc.	do	do	Mason's Bay Rd., Jonesport, Maine
Sand and Gravel:			
Blue Rock Sand & Gravel	Pit	Androscoggin	58 Main Street, Westbrook, Maine
Philip P. Boston, Inc	do	York	Elm St. No. Berwick, Maine
Cumberland Sand & Gravel Co., Inc.	do	Cumberland	Box 288, Portland, Maine
V. E. Dunn & Son	do	Kennebec	167 Sewell St., Augusta, Maine
I. H. Fenderson, Inc	do	York	North St., Saco, Maine
Lane Construction Co	do	Aroostook	965 E. Maine St., Meriden, Conn.
Lane Construction Co	do	Penobscot	Do.
Lewiston Crushed Stone Co., Inc	do	Androscoggin	South Ave, Lewiston, Maine
Harold MacQuinn, Inc	do	Hancock	Hull Cove, Bar Harbor, Maine
McKay Rock Products, Inc	do	Waldo	Box 656, Presque Isle, Maine
C. M. Page Co., Inc	do	Penobscot	234 Main St., Orono, Maine
Steelstone Corp	do	Somerset	Route 201, Fairfield, Maine
Wilton Red-E-Mix, Inc	do	Franklin	Wilton, Maine
Stone:			
Granite, dimension:			
Deer Island Granite Corp., Inc.	Quarry	Hancock	110 East 42nd St. New York, N.Y.
Hocking Granite Industries, Inc.[2]	do	Knox	Saint George, Maine
Joseph Musetti	do	Hancock	Mt. Desert, Maine
The John Swenson Granite Co., Inc.[2]	do	York	North State St., Concord, N.H.
Granite, crushed:			
Cook & Co., Inc	do	Cumberland	960 Ocean Ave., Portland, Maine
Limestone, crushed:			
Blue Rock Quarry	do	Kennebec	58 Main St., Cumberland Mills, Maine
Dragon Cement Co., Div. of Martin Marietta Corp.	do	Knox	5A Joyce Kilmer Ave., New Brunswick, N.J.
Lime Products Corp	do	do	P.O. Box 357, Union, Maine
McKay Rock Products, Inc	do	Aroostook	Box 656, Reach Rd. Presque Isle, Maine
Rockland-Rockport Lime Co	do	Knox	Rockland, Maine
Miscellaneous, crushed:			
Blue Rock Quarry	do	Cumberland	58 Main St. Cumberland Mills, Maine
Slate, dimension:			
Portland-Monson Slate Co	Underground	Piscataquis	Middle Granville, N.Y.

[1] Portland and masonry.
[2] Also crushed.

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]

Value of mineral production in Maryland declined 2 percent from that of 1966. Stone remained the leading commodity in value, accounting for 39 percent of the total value of all minerals produced, with sand and gravel accounting for 24 percent. Almost 20 percent of the value of all mineral production resulted from operations in Baltimore County. Carroll, Frederick, and Washington Counties also contributed heavily to the value of minerals produced. The only counties reporting no mineral production were Queen Annes and Somerset.

The Maryland Geological Survey published a new State Geologic Map with cross sections. This replaced the map issued in 1933. The Maryland Survey, in cooperation with the U.S. Geological Survey, also undertook a geologic mapping program in Baltimore, Cecil, and Frederick Counties.

The U.S. Geological Survey issued reprints of 16 topographic quadrangles within or including parts of Maryland. In addition, the Survey revised the Riley Quadrangle, published a Hydrologic Investigations Atlas on the water resources of the Patuxent River Basin, an aeromagnetic map of Baltimore County and Baltimore City, and a corresponding bouger gravity map.

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Maryland [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays—thousand short tons	[2] 856	[2] $1,084	998	$1,462
Coal (bituminous)—do	1,222	4,367	1,305	4,548
Gem stones	NA	3	NA	3
Lime—short tons	29,447	386	W	W
Natural gas—million cubic feet	696	181	621	159
Sand and gravel—thousand short tons	15,108	20,383	12,868	17,724
Stone—do	13,868	27,229	14,479	28,581
Value of items that cannot be disclosed: Ball clay 1966, cement (portland and masonry), greensand marl, peat, potassium salts, talc and soapstone	XX	20,528	XX	20,342
Total	XX	74,161	XX	72,819
Total 1957–59—constant dollars	XX	72,307	XX	71,232

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] Excludes ball clay; included with "Value of items that cannot be disclosed."

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Allegany	$2,663	$2,659	Coal, sand and gravel, stone, clays.
Anne Arundel	3,131	2,653	Sand and gravel.
Baltimore	13,628	14,035	Stone, sand and gravel, clays.
Calvert	W	W	Greensand marl, sand and gravel.
Caroline	W	W	Sand and gravel.
Carroll	W	W	Cement, stone, clays, soapstone.
Cecil	3,894	3,689	Stone, sand and gravel.
Charles	W	W	Sand and gravel.
Dorchester	W	W	Sand and gravel, stone.
Frederick	7,058	7,986	Cement, stone, lime, clays, sand and gravel.
Garrett	4,002	3,761	Coal, natural gas, stone, sand and gravel, peat.
Harford	1,763	1,670	Stone, sand and gravel, clays, talc.
Howard	W	W	Stone.
Kent	W	W	Peat, clays.
Montgomery	W	W	Stone.
Prince Georges	8,202	7,599	Sand and gravel, clays.
St. Marys	W	W	Sand and gravel.
Talbot	W	W	Do.
Washington	W	W	Cement, stone, clays, potassium salts.
Wicomico	W	W	Sand and gravel.
Worcester	W	W	Do.
Undistributed [2]	29,820	28,769	
Total [3]	74,161	72,819	

W Withheld to avoid disclosing individual company confidential data.
[1] Queen Annes and Somerset Counties are not listed because no production was reported.
[2] Includes some sand and gravel that cannot be assigned to specific counties (1967), gem stones, and values indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Maryland business activity

	1966	1967 p	Change, percent
Personal income:			
Total—millions	$11,537	$12,644	+9.6
Per capita	$3,204	$3,434	+7.2
Construction activity:			
Construction contracts—thousands	$1,163,756	$1,137,726	−2.2
Nonresidential buildings—do	$402,804	$407,513	+1.2
Residential buildings—do	$579,100	$435,846	−24.7
Nonbuilding construction—do	$181,852	$294,367	+61.9
Cement shipments to and within Maryland—thousand 376-pound barrels	6,885	6,720	−2.4
Mineral production—thousands	$74,161	$72,819	−1.8
Civilian work force—thousands	1,406.3	1,448.3	+3.0
Total civilian employment—do	1,365.9	1,410.1	+3.2
Unemployment—(percent of work force) seasonal adjusted	3.3	3.7	+12.1
Contract construction—employees, thousands	82.7	81.7	−1.2
Manufacturing:—do	282.2	280.3	−.7
Durable goods—do	157.6	156.0	−1.0
Nondurable goods—do	124.6	124.3	−.2
Nonmanufacturing—do	855.0	901.0	+5.4
Mining—do	2.5	2.5	-------

p Preliminary.
Source: Bureau of Mines; U.S. Department of Labor, Department of Employment Security; U.S. Department of Commerce; F.W. Dodge Division, McGraw-Hill Information Systems Company.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal and peat	372	212	79	638	----	11	17.25	365
Nonmetal	364	254	93	766	----	25	32.64	8,461
Sand and gravel	822	267	219	1,917	----	43	22.43	2,968
Stone	1,204	262	316	2,677	----	63	23.54	2,088
Total [1]	2,762	256	707	5,997	----	142	23.68	3,000
1967: [p]								
Coal and peat	420	211	88	726	1	9	13.78	8,615
Nonmetal	430	239	103	847	----	36	42.52	604
Sand and gravel	825	263	217	1,878	2	45	25.03	7,267
Stone	1,095	270	296	2,510	----	57	22.71	453
Total [1]	2,770	254	704	5,960	3	147	25.17	3,615

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—A slight decline in cement output from 1966 levels reflected lessening in construction activity. Carroll County was the State's leading cement producer, but plants in Frederick and Washington Counties also contributed significantly to the State's total output. Portland cement represented about 90 percent of the total production. A majority of the cement output was used for making ready-mixed concrete for road and building construction.

Clays.—Clays were produced in nine of the State's 23 counties. Nearly all of the clay was classified as miscellaneous clay, which was used chiefly for making building brick, lightweight aggregate, and portland cement. Small quantities of fire clay were produced in Allegany and Harford Counties, while ball clay production was reported from Baltimore County. Fire clay and stoneware clay were used in manufacturing refractories, building brick, and vitrified sewer pipe, while ball clay was sold for use in stoneware, refractories, and tile. The unit value of all clays remained nearly constant, but production increased by 17 percent.

Gem Stones.—Small quantities of semiprecious gem stones were collected by dealers and amateur collectors. The value was estimated to be only a few thousand dollars.

Lime.—Production of lime was limited to Frederick County, where three plants produced quicklime and hydrated lime. The total tonnage of both types of lime was slightly less than that of 1966.

Marl, Greensand.—Greensand marl was mined in Calvert County. The output was marketed for use in the manufacture of fertilizer, and as a soil conditioner.

Perlite.—Expanded perlite was produced in Baltimore and Prince Georges Counties by three companies each operating one plant. The product was sold for a wide variety of purposes, including use in building plaster, insulating material, concrete aggregate, as a filtering medium, and as a soil conditioner.

Potassium Salts.—A Washington County cement plant produced low-grade potassium sulfate as a byproduct and sold it for agricultural uses.

Sand and Gravel.—Total production (commercial and Government-and-contractor) of sand and gravel declined 15 percent from that of 1966; the average unit value of $1.38 per ton was slightly higher. Sixty-four companies conducted operations at 80 pits. There were 54 stationary plants, eight portable plants,

and one dredge in commercial operation. The remaining operations produced unprocessed sand and gravel. One stationary plant and one portable plant produced Government-and-contractor sand and gravel. The leading counties in sand and gravel production were Prince Georges, Anne Arundel, Baltimore, Charles, and Cecil; each produced over 1 million short tons. The chief uses of sand and gravel were for structural concrete, roadbuilding, and fill.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	3,874	$5,256	4,130	$5,306
Paving	1,860	2,758	1,900	2,711
Other [1]	2,303	2,239	453	976
Total	8,037	10,253	6,483	8,993
Gravel:				
Structural	2,907	5,438	2,724	4,971
Paving	2,524	3,311	2,267	2,931
Fill	549	327	823	509
Other [2]	822	966	340	202
Total	6,802	10,042	6,154	8,613
Total sand and gravel	14,839	20,295	12,637	17,606
Government-and-contractor operations:				
Sand	6	2	41	15
Gravel	263	86	190	103
Total sand and gravel	269	88	231	118
All operations:				
Sand	8,043	10,255	6,524	9,008
Gravel	7,065	10,128	6,344	8,716
Total	15,108	20,383	12,868	17,724

[1] Includes sand for glass, grinding and polishing (1967), fill, and other uses.
[2] Includes miscellaneous gravel, and other uses.

Stone.—Stone remained the leading commodity in value. Sales increased about 5 percent over those of 1966. The output was comprised of basalt, granite, limestone, marble, oystershell, sandstone, and miscellaneous stone. Production was reported from 12 counties. The two leading producing counties were Baltimore and Frederick, which together accounted for 43 percent of the State's total output. Thirty-eight quarries operated during the year. Of the total stone production, 68 percent was crushed limestone, which accounted for 63 percent of the value of all stone sold. About three-fourths of the crushed limestone produced was used in concrete and roadstone. Crushed sandstone, some of which was sold as ganister, was produced in Carroll and Cecil Counties. Dimension sandstone produced in Baltimore and Garrett Counties was sold for use as flagging, for rough construction, and as sawed stone. Basalt was quarried in several counties and was sold for use principally as roadstone and for concrete. Two operators in Cecil County reported production of crushed granite. Marble was quarried in Harford County, and was used for terrazzo chips.

Talc and Soapstone.—Talc was produced in Harford County and was used in ceramics, and in the manufacture of foundry facings and toilet preparations. Production of soapstone was reported from Carroll County. The commodity was ground and sold for use chiefly as roofing granules, as filler for asphalt, and in foundry facings.

Vermiculite (Exfoliated).—One operator in Prince Georges County processed crude vermiculite obtained from sources outside the State. The material was sold for use in insulation, concrete and plaster aggregate, and for agricultural purposes.

MINERAL FUELS

Coal (Bituminous).—Fifty-three mines, including 19 underground, 31 strip, and three auger, in Allegany and Garrett Counties produced about 7 percent more coal than in 1966. About two-thirds of all coal mined came from strip mines. Of the total production 46 percent was crushed before being sold. Coal mined underground brought an average price of $4.45 per ton, up 63 cents over the 1966 price. Coal from strip mines was sold at an average price of $3.12 compared with $3.44 during 1966. Auger-mined coal declined in price from $3.44 to $2.36 in 1967. The average price for all coal mined was $3.48, while in 1966 it was $3.57.

Coke and Chemicals.—Coke and coal chemicals were produced by Bethlehem Steel Corp., at its Sparrows Point plant. Coproducts and byproducts included coke breeze, coke oven gas, ammonium sulfate, soft tar pitch, crude tar, crude chemical oil, crude light oil and derivatives (benzene, toluene, and xylene), and naphthalene.

Natural Gas and Petroleum.—Natural gas was produced from 13 wells in the Mountain Lake Park field and the Negro Mountain field, both in Garrett County. The Accident field, formerly a producing field, was converted to a gas storage reservoir. Total production remained about the same as that of 1966. American Oil Co. and Chevron Oil Co. each refined crude petroleum at refineries located near Baltimore. Total throughput was 20,500 barrels per stream day, up 5.7 percent from that of the preceding year.

Peat.—Bogs in Garrett County and Kent County yielded reed-sedge and humus peat. The commodity was processed and sold for soil improvement in both bulk and packaged forms.

METALS

Copper.—One plant in Baltimore and one at Hawkins Point, Anne Arundel County refined copper from anodes shipped into the State. Some gold and silver were produced as byproducts.

Iron and Steel.—Basic and offgrade pig iron, steel ingot, and semifabricated products were produced by Bethlehem Steel Corp., at its Sparrows Point plant.

Lead.—Lead, lead alloys, and other alloys and products were produced at three plants in Baltimore. The plants consumed lead remelt, primary metals, and scrap.

Table 6.—Principal producers

Commodity and company	Type of activity	County	Address
Cement (portland):			
Alpha Portland Cement Co	Plant	Frederick	15 South Third St. Easton, Pa.
Lehigh Portland Cement Co.[1]	do	Carroll	718 Hamilton St. Allentown, Pa.
Marquette Cement Manufacturing Co.[2]	do	Washington	20 No. Wacker Dr. Chicago, Ill.
Cement (masonry):			
M. J. Grove Co., Division of the Flintkote Co.	Plant	Frederick	Lime Kiln, Md.
Clays:			
Ball:			
United Sierra Division Cyprus Mines Corp.	Pit	Baltimore	P. O. Box 1201 Trenton, N.J.
Fire:			
Kaiser Refractories, Division of Aluminum & Chemical Corp.	Mine	Allegany	P. O. Box 363 Frostburg, Md.
Maryland Clay and/or William D. Bowman	Pit	Harford	R.F.D. 2, Box 303 Aberdeen, Md.
Miscellaneous clay and shale:			
Baltimore Brick Co	do	Baltimore	3200 East Madison St. Baltimore, Md.
Do	do	Frederick	Do.
Do	do	Baltimore City	Do.
Champion Brick Co	do	Baltimore	7600 Pulaski Highway Baltimore, Md.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Clays—Continued:			
Miscellaneous clay and shale:			
Chestertown Brick Co	Pit	Kent	Chestertown, Md.
Victor Cushwa & Sons, Inc	do	Washington	201 W. Potamac St. Williamsport, Md.
Lehigh Portland Cement Co	do	Frederick	718 Hamilton St. Allentown, Pa.
United Brick Corp	do	Prince Georges	2801 New York Ave., N.E. Washington, D.C.
The Washington Brick Division Thos. Somerville Co.	do	do	6th and Decatur Sts., N.E. Washington, D.C.
West Brothers Brick Co	do	do	6600 Sheriff Rd., N.E. Washington, D.C.
Gypsum (calcined):			
National Gypsum Co.[3]	Plant	Baltimore	325 Delaware Ave. Buffalo, N.Y.
United States Gypsum Co	do	do	101 South Wacker Dr. Chicago, Ill.
Greensand marl:			
Kaylorite Corporation	Quarry	Calvert	Dunkirk, Md.
Finished iron oxide pigments (natural and manufactured):			
Mineral Pigments Corp	Plant	Prince Georges	Washington Blvd. Muirkirk, Md.
Lime:			
S. W. Barrick & Sons, Inc	do	Frederick	Woodsboro, Md.
Le Gore Lime Company	do	do	Le Gore, Md.
Everett V. Moser	do	do	R.D. #1 Middletown, Md.
Lime (regenerated):			
West Virginia Pulp & Paper Co	do	Allegany	Luke, Md.
Perlite (expanded):			
Atlantic Perlite Co	do	Prince Georges	1919 Kenilworth Ave. Washington, D.C.
Sand and gravel:			
Arundel Corp	Plant	Anne Arundel	501 St. Paul Place Baltimore, Md.
Arundel Supply Corp	Pit	Prince Georges	6900 Walker Mill Rd. Washington, D.C.
Harry T. Campbell Sons' Corp	Plant	Baltimore	Towson and Baltimore, Md.
Charles County Sand & Gravel Co., Inc.	Pit	Charles	P.O. Box 322 Waldorf, Md.
Contee Sand & Gravel Co., Inc	do	Prince Georges	Laurel, Md.
District Sand & Gravel Co	do	do	4800 Branch Avenue Silver Hill, Md.
Forestville Sand & Gravel Co., Inc	do	do	R.F.D. Box 4263 Upper Marlboro, Md.
Inland Materials, Inc	do	do	7401 Kirby Road Clinton, Md.
Manley Sand Division Martin Marietta Co.	do	Allegany	P.O. Box 1341 Cumberland, Md.
Nottingham Farms, Division of Harry T. Campbell Sons' Corp.	do	Baltimore	Regester Ave. & Overbrook Rd. Baltimore, Md.
Potomac Sand & Gravel Co	Dredge	Charles	3020 K St., N.W. Washington, D.C.
Silver Hill Sand & Gravel Co	Pit	Prince Charles	4600 St. Barnabas Rd., S.E. Washington, D.C.
A. H. Smith Co	do	do	Branchville, Md.
Stancills, Inc	do	Harford	P.O. Box 236 Aberdeen, Md.
York Building Products Co	do	Cecil	P.O. Box 1708 York, Pa.
Smelters:			
American Smelting and Refining Company.	Plant	Baltimore	120 Broadway, New York, N.Y.
Kennecott Refining Corp	Refinery	Anne Arundel	161 East 42d St. New York, N.Y.
Soapstone and talc:			
Harford Talc Co.[4]	Pit	Harford	Box 527 Bel Air, Md.
Liberty Talc Mines, Inc.[5]	do	Carroll	Box 85, Sykesville, Md.
Stone:			
Granite, crushed:			
Maryland Materials, Inc	Quarry	Cecil	P.O. Box 159 Elkton, Md.
Port Deposit Granite, Inc	do	do	Port Deposit, Md.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Stone—Continued:			
Limestone:			
Appalachian Stone Division Martin Marietta Co.	Quarry	Washington	Box 120 Mercersburg, Pa.
The Arundel Corp.[5]	do	Baltimore	501 St. Paul Place Baltimore, Md.
Harry T. Campbell Sons' Corp.	Underground mine and quarry.	do	Towson and Baltimore, Md.
M. J. Grove Lime Co	Quarry	Frederick	Lime Kiln, Md.
Howard-Montgomery Crushed Stone Co.	do	Howard	Brighton Dam Rd. Clarksville, Md.
LeGore Lime Co.[7]	do	Frederick	LeGore ,Md.
Superior Concrete, Inc	do	do	Frederick, Md.
Teeter Stone, Division Harry T. Campbell Sons' Corp.	do	Carroll	Towson and Baltimore, Md.
Marble:			
The Maryland Green Marble Corp.	Quarry	Harford	Box 1198 Roanoke, Va.
Miscellaneous (crushed):			
The Arundel Corp	do	Baltimore	501 St. Paul Place Baltimore, Md.
Miscellaneous (dimension):			
Stoneyhurst Quarries	Quarry	Montgomery	7501 Permisson Tree Lane, Bethesda, Md.
Sandstone (crushed):			
Harbison Walker Refractories	do	Cecil	Gateway 2 Pittsburgh, Pa.
Sandstone (dimension):			
B & B Stone Co	do	Garrett	Grantsville, Md.
M & S Stone Co	do	do	Do.
The Weaver Stone Co	do	Baltimore	Box 96 Reistertown, Md.
Vermiculite (exfoliated):			
Zonolite Division W. R. Grace & Co.[3]	Plant	Prince Georges	62 Whittemore Ave. Cambridge, Mass.
Oystershell:			
J. M. Clayton Company	Plant	Dorchester	Cambridge, Md.
Oyster Shell Corporation	do	Baltimore	1008 Keyser Bldg. Baltimore, Md.
Peat			
Garrett County Processing & Packaging Corp.	Bog	Garrett	R.F.D. 1 Accident, Md.
Maryland Peat & Humus Co	do	Kent	Box 68 Betterton, Md.
Petroleum refineries:			
American Oil Company	Refinery		Baltimore, Md.
Chevron Asphalt Co	do		Do.
Natural gas:			
Cumberland and Allegheny Gas Co.	Well	Mountain Lake Park Field, Garrett County	
Columbian Fuel Corp	do	do	
Eagle Gas Co	do	do	
Fox Trimble and others	do	do	
Orville Eberly, agent	do	do	
Orville Eberly, Robert E. Eberly, William E. Snee, and L. N. Murray.	do	do	
Melvin L. Smith	do	do	

[1] Also limestone, sandstone. [2] Also masonry cement, potassium salts, limestone. [3] Also expanded perlite. [4] Also talc. [5] Also soapstone [6] Also miscellaneous stone. [7] Also lime.

The Mineral Industry of Massachusetts

By Melvin E. Hinkle [1]

Massachusetts mineral production rose to a new high of $40.6 million, a 6-percent increase over the previous high set in 1966. The increase resulted mainly from the greater value of sand and gravel and stone, which combined represented 92 percent of the State total. The value of lime production increased 12 percent.

Middlesex County, with mineral output valued at $12 million or 30 percent of the State total, continued to retain its lead as the State's chief mineral-producing county; Berkshire County remained second with a mineral output value of $7.7 million.

[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Massachusetts [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	202	$260	W	W
Gem stones	NA	2	NA	$2
Lime—thousand short tons	182	2,712	195	3,044
Sand and gravel—do	17,321	17,846	17,881	19,504
Stone—do	6,424	17,624	6,203	17,724
Vaue of items that cannot be disclosed: Nonmetals	XX	29	XX	338
Total	XX	38,473	XX	40,612
Total 1957–59 constant dollars	XX	37,273	XX	p 39,606

p Preliminary. NA Not available. XX Not applicable. W Withheld to avoid disclosing individual company confidential data.

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

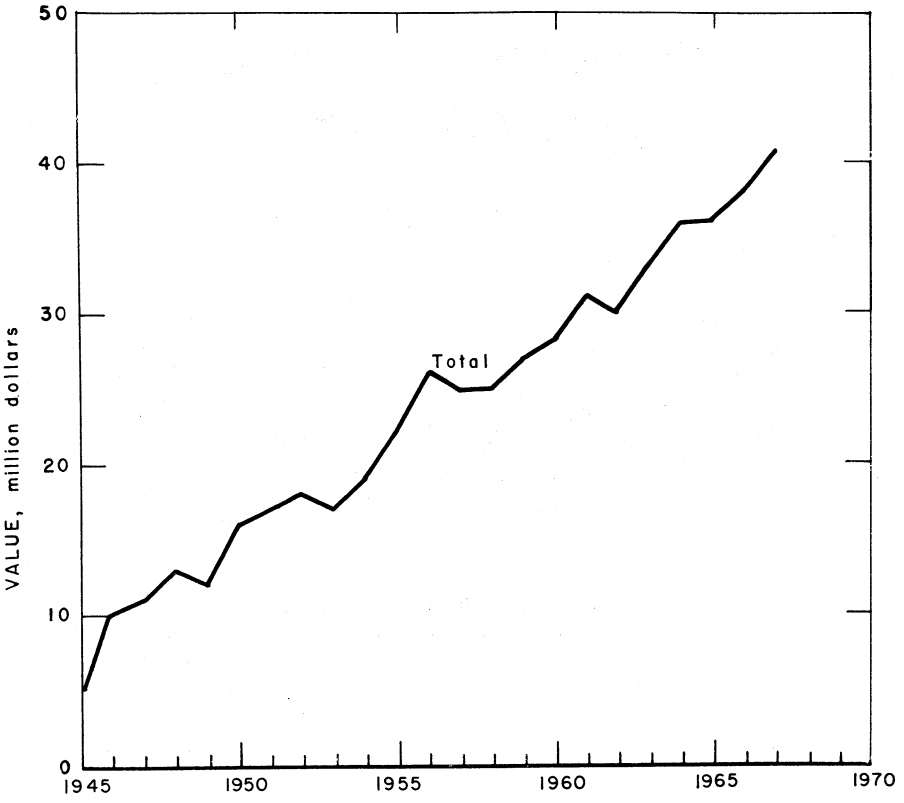

Figure 1.—Total value of mineral production in Massachusetts.

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

County	1966	1967	Minerals produced in 1967 in order of value
Barnstable	W	W	Sand and gravel.
Berkshire	$6,839,133	$7,666,594	Stone, lime, sand and gravel.
Bristol	3,100,229	3,016,056	Sand and gravel, stone.
Dukes	W	W	Sand and gravel.
Essex	2,820,970	3,283,181	Stone, sand and gravel, peat.
Franklin	1,241,691	881,782	Sand and gravel, stone.
Hampden	2,567,372	2,844,134	Stone, sand and gravel, clays.
Hampshire	942,420	708,050	Sand and gravel, stone.
Middlesex	11,268,960	12,084,044	Stone, sand and gravel.
Nantucket	W	10,000	Sand and gravel.
Norfolk	4,547,926	5,016,067	Sand and gravel, stone, clays.
Plymouth	750,215	614,686	Sand and gravel, clays, stone.
Suffolk	397,937	321,148	Stone, sand and gravel.
Worcester	2,895,279	2,863,789	Sand and gravel, stone, peat.
Undistributed [1]	1,101,000	1,302,000	
Total	38,473,000	40,612,000	

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.

Table 3.—Indicators of Massachusetts business activity

	1966	1967	Change (percent)
Personal income:			
Total ---millions--	$17,675	p $18,909	+7.0
Per capita	$3,271	p $3,488	+6.6
Construction activity:			
Cement shipments to and within Mass. thousand 376-pound barrels--	5,986	p 6,105	+2.0
Construction contracts [1] ---thousands--	$1,221,628	$1,412,303	+15.6
Nonresidential bldgs ---do----	$558,487	$666,561	+19.4
Residential bldgs ---do----	$435,804	$479,387	+10.0
Nonbuilding construction ---do----	$227,337	$266,355	+17.2
Mineral production ---do----	$38,473	$40,612	+5.6
Annual average labor force and employment:			
Civilian work force ---thousands--	2,407.9	2,430.1	+.9
Total employment ---do----	2,302.8	2,327.3	+1.1
Unemployment ---percent--	4.2	4.2	.0
Manufacturing employment: ---thousands--	694.3	696.7	+.3
Durable goods employment ---do----	344.2	353.9	+2.8
Primary metals ---do----	22.9	22.9	.0
Fabricated metal products ---do----	43.6	44.4	+1.8
Machinery ---do----	79.8	78.0	−2.3
Electrical equipment and supplies ---do----	97.6	101.8	+4.3
Transportation equipment ---do----	26.6	28.3	+6.4
Instruments, optical goods, watches, clocks ---thousands--	29.1	31.1	+6.9
Miscellaneous ---do----	44.6	47.4	+6.3
Nondurable goods employment ---do----	350.1	342.8	−2.1
Contract construction employment ---do----	88.1	87.4	−.8
Service, mining and miscellaneous ---do----	383.3	398.6	+4.0

p Preliminary.
[1] F. W. Dodge Division, McGraw-Hill Information Systems Company.

Sources: U.S. Bureau of Mines; U.S. Department of Labor; Commonwealth of Massachusetts, Division of Employment Security; U.S. Department of Commerce.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1966:								
Nonmetal and peat	77	293	23	181	----	3	16.57	978
Sand and gravel	991	219	217	1,821	1	39	21.97	3,854
Stone	1,080	241	260	2,103	----	44	20.92	714
Total [1]	2,148	233	500	4,104	1	86	21.20	2,118
1967: p								
Nonmetal and peat	65	286	18	147	----	10	68.26	1,406
Sand and gravel	1,005	229	230	1,882	----	38	20.19	587
Stone	955	267	255	2,059	1	51	25.26	3,625
Total [1]	2,030	248	504	4,087	1	99	24.47	2,146

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Production and value of clay increased over the 1966 figures. Norfolk County was the leading producer with one company that mined shale for use in manufacturing lightweight aggregate. Miscellaneous clay was mined by one company in Hampden County and one company in Plymouth County for use in building brick; another company in Hampden County permanently closed November 1966.

Gypsum.—A plant in Suffolk County manufactured calcined gypsum products from crude gypsum imported from Nova Scotia, Canada.

Lime.—Production and value of lime increased[1] 7 and 12 percent, respectively, over that for 1966. The chemical industry consumed 79 percent of the total output with the remainder used in agriculture and the building industries. Berkshire County was the only county in the State to produce lime; three companies produced quicklime and hydrated lime from local limestone.

Perlite (Expanded).—Crude perlite mined outside the State was expanded at two plants in Suffolk County that sold the product mainly for use as a lightweight aggregate, as a soil conditioner, and as cryogenic insulation.

Sand and Gravel.—Greater activity in highway and building construction resulted in a higher output and value of sand and gravel over that of 1966. The value of sand and gravel, output, $19.5 million, accounted for 48 percent of the total mineral value in the State, making it the leading mineral commodity produced. Gravel accounted for 61 percent of the 17.9 million tons of sand and gravel produced. Close to 82 percent of the total tonnage was mined at commercial operations; Government-and-contractor operations produced the balance.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Structural	3,485	$3,586	3,061	$3,400
Paving	2,197	2,070	2,461	2,509
Fill	604	213	678	276
Molding	W	W	118	578
Blast	4	45	7	68
Filtration	9	16	7	18
Undistributed [1]	575	1,069	595	511
Total	6,874	6,999	6,927	7,360
Gravel:				
Structural	3,170	4,534	2,973	4,461
Paving	2,968	2,904	3,098	3,416
Fill	1,126	680	1,093	699
Other	221	331	132	196
Miscellaneous	373	370	504	420
Total	7,858	8,819	7,800	9,192
Total sand and gravel	14,732	15,818	14,727	16,552
Government-and-contractor operations:				
Sand:				
Paving	178	176	23	20
Other	22	27	9	8
Total	200	203	32	28
Gravel:				
Paving	2,295	1,761	3,115	2,918
Fill	50	22	5	3
Other	44	42	2	3
Total	2,389	1,825	3,122	2,924
Total sand and gravel	2,589	2,028	3,154	[2] 2,950
All operations:				
Sand	7,074	7,202	6,959	7,388
Gravel	10,247	10,644	10,922	12,116
Total	17,321	17,846	17,881	19,504

W Withheld to avoid disclosing individual company confidential data.
[1] Includes sand for other uses and data indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

The Commonwealth of Massachusetts, Department of Public Works, mined sand and gravel in all counties except Nantucket, Suffolk, and Worcester. Both sand and gravel were used mainly for paving. The municipalities of North Adams, Dartmouth, Fall River, and Watertown produced small quantities of sand and gravel for their own street and road maintenance.

Commercial sand and gravel was produced in all counties in the State except Suffolk County. Building and paving markets consumed 65 percent of the sand and gravel output. Small quantities of sand were used for fill, molding, blast, filtration, and other uses. Gravel was also used as fill and for other uses.

A total of 285 pits operated by 133 producers was active in 1967. Middlesex County led all counties in the production of sand and gravel with 4.5 million tons. Other counties producing over 1 million tons were Berkshire, Bristol, Essex, Hampden, Norfolk, and Worcester.

Stone.—Production of stone declined 3 percent, while value increased less than 1 percent over that of 1966. The value of stone, amounting to $17.7 million, was second highest among the minerals produced, and contributed 44 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, sandstone, and miscellaneous stone. Basalt was the most important stone in both quantity and value, but output decreased from that of 1966. Output of limestone, sandstone, and miscellaneous stone also decreased while granite production increased. Crushed and broken stone accounted for 98 percent of the total stone output sold in 1967.

Basalt, sold as crushed stone, was produced by 13 commercial companies at quarries located in eight counties. Middlesex County led in output and value, followed by Essex County. The value of basalt accounted for 41 percent of total value of stone. The crushed stone was used mainly for concrete aggregate and roadstone; other uses were for railroad ballast, riprap, and mineral stabilizer.

The Commonwealth of Massachusetts, Department of Public Works, quarried basalt in Franklin and Hampden Counties for use as concrete and road metal and granite in Plymouth County for use mainly as riprap.

As a result of the National Safety Competition, jointly sponsored by the Federal Bureau of Mines and the American Mining Congress, Achievement in Safety awards were presented to a number of companies for their outstanding safety record of operating without a disabling work injury during 1967. Among companies receiving awards were Trimount Bituminous Products Co. (Saugus basalt quarry), George Brox, Inc. (Brox basalt quarry), and Bayer & Mingolia Construction Co., Inc. (Ashland basalt quarry).

Granite, sold as crushed and dimension stone, was quarried by 11 commercial companies located in four counties. Producers of granite in Worcester County were idle in 1967. Middlesex County led in value of granite produced, with Norfolk County second. Granite was the second most important stone produced in the State and contributed 33 percent of total stone value. Dimension granite accounted for 73 percent of the total value of output. The chief use for dimension stone was for curbing and flagging; other uses were for rough and dressed architectural and construction purposes, rubble, paving blocks, and dressed monumental stone. Crushed granite was used mainly for concrete aggregate and roadstone; smaller quantities were used for riprap and other uses.

Limestone, mined only in Berkshire County by four companies, accounted for 20 percent of total value of stone. The chief uses for crushed limestone were lime manufacture, rubber and asphalt filler, agriculture, concrete aggregate and roadstone, mineral food, and blast furnace flux.

Sandstone was produced only in Hampden County as dimension stone for construction.

Miscellaneous stone was quarried in Bristol, Norfolk, and Worcester Counties, and contributed 6 percent to the value of total stone produced. The crushed stone was used almost entirely for concrete aggregate and roadstone; minor uses were for riprap and roofing granules.

Roofing Granules.—Roofing granules were prepared from rhyolite quarried in

Norfolk County. For statistical purposes the rhyolite was classified as miscellaneous stone. Production increased 5 percent while value of the refined material increased 33 percent over that of 1966.

Table 6.—Stone sold or used by producers, by uses

Use	1966		1967	
	Short tons	Value	Short tons	Value
Riprap	40,509	$63,749	64,962	$77,124
Concrete aggregate and roadstone	5,148,856	8,855,099	4,904,825	8,960,517
Agricultural (limestone)	181,553	632,912	146,925	541,756
Undistributed [1]	1,053,407	8,072,119	1,086,202	8,144,571
Total	6,424,325	17,623,879	6,202,914	17,723,968

[1] Includes dimension stone, railroad ballast, furnace flux, and other uses.

Vermiculite.—Vermiculite, mined outside the State, was exfoliated at a plant in Hampshire County for use in agriculture, for insulation, and as lightweight aggregate for concrete and plaster. Sales decreased 7 percent in quantity and 11 percent in value below 1966 levels. Two other plants in the State, in Middlesex and Norfolk Counties have been abandoned.

MINERAL FUELS

Peat.—The value of peat declined 14 percent below that of 1966. One company recovered humus peat from a bog in Essex County for general soil improvement use, and another company recovered reed-sedge peat from a bog in Worcester County for use in packing flowers, plants, and shrubs.

Petroleum and Natural Gas.—The Tennessee Gas Pipeline Co. started up the liquefaction unit of its 12.5-million cubic-foot-per-day liquid natural gas (LNG) plant at Hopkinton, Middlesex County. Two large in-ground reservoirs provide storage for the LNG, equivalent to 3 billion cubic feet of natural gas. Liquefaction takes place in a three-stage refrigeration process which cools gas from 60° to −260° F.

The plant will provide gas storage and peaking service to 18 utility customers in New England.[2]

[2] Oil and Gas Journal. V. 65, No. 26, June 26, 1967.

Table 7.—Principal producers in Massachusetts

Commodity and company	Type of activity	County	Address
Clays:			
Masslite, Division of Blackstone industries, Inc.	Pit	Norfolk	Box 1747 Cross St. Plainville, Mass.
The Stiles & Hart Brick Co	do	Plymouth	Box J E. Bridgewater, Mass.
Westfield Clay Products Co	do	Hampden	Westfield, Mass.
Gypsum, calcined:			
United States Gypsum Co	Plant	Suffolk	101 S. Wacker Dr. Chicago, Ill.
Lime:			
Lee Lime Corporation	do	Berkshire	Marble St., Lee, Mass.
Minerals, Figments & Metals Division, Chas. Pfizer & Co., Inc.	do	do	260 Columbia St. Adams, Mass.
United States Gypsum Co	do	do	101 S. Wacker Dr. Chicago, Ill.
Peat:			
Andover Sand & Gravel, Inc	Bog	Essex	84 Beacon St. Lawrence, Mass.
Sterling Peat Co	do	Worcester	Sterling Junction, Mass.
Perlite, expanded:			
United States Gypsum Co	Plant	Suffolk	101 S. Wacker Dr. Chicago, Ill.
Whittemore Products, Inc	do	do	35 Harrison St. Roslindale, Mass.

See footnotes at end of table.

Table 7.—Principal producers in Massachusetts—Continued

Commodity and company	Type of activity	County	Address
Roofing granules:			
Bird & Son, Inc	Plant	Norfolk	East Walpole, Mass.
Sand and gravel:			
Assonet Sand & Gravel Co., Inc	Pit	Bristol	South Main St. Assonet, Mass.
Burlington Sand & Gravel Co., Inc	Pit	Middlesex	Blanchard Rd., Box 116 Burlington, Mass.
J. J. Cronin Co	----do	----do	P.O. Box 176 N. Reading, Mass.
E. L. Dauphinais, Inc	----do	Worcester	160 Worcester Rd. N. Crafton, Mass.
General Sand & Stone Corp	----do	Berkshire	444 Merrill Rd., Pittsfield, Mass.
Lexington Sand & Gravel Co	----do	Middlesex	Lawsbrook Rd., South Acton, Mass.
Merrimack Materials, Inc	----do	Essex	Yemma Road Groveland, Mass.
Morse Sand & Gravel Co	----do	Bristol	P.O. Box 175, Pawtucket, R.I.
New England Sand & Gravel Co., Inc	----do	Middlesex	Birch Road Framingham, Mass.
North Wilbraham Sand & Gravel & Concrete Co., Inc.	----do	Hampden	2420 Boston Rd. N. Wilbraham, Mass.
Pomerleau Bros., Inc	----do	Middlesex	P.O. Box 236 N. Chelmsford, Mass.
L. Romano Const. Co	----do	Norfolk	835 Taunton Ave. East Providence, R.I.
Rosenfeld Washed Sand & Stone Co	----do	Worcester	40 Cedar St. Milford, Mass.
San-Vel Contracting Co	----do	Middlesex	Route No. 2, Ayer Rd. Littleton, Mass.
A.A. Will Sand & Gravel Corp	----do	Norfolk	Turnpike St. Canton, Mass.
Worcester Sand & Gravel Co	----do	Worcester	182 Holden St. Shrewsbury, Mass.
Stone:			
Basalt, crushed:			
B. & M. Crushed Stone Division, Bayer & Mingolla Industries, Inc.	Quarry	Middlesex	Spring St. Ashland, Mass.
George Brox, Inc	----do	----do	1471 Methuen St. Dracut, Mass.
Essex Bituminous Concrete Corp	----do	Essex	Russell St. West Peabody, Mass.
Essex Bituminous Concrete Corp of Dracut.	----do	Middlesex	2140 Bridge St. Dracut, Mass.
Holden Trap Rock Co	----do	Worcester	N. Main St. Holden, Mass.
John S. Lane & Son, Inc [3]	----do	Hampden and Hampshire	Box 125, Westfield, Mass.
Lynn Sand & Stone Co	----do	Essex	30 Danvers Rd. Swampscott, Mass.
Massachusetts Broken Stone Co	----do	Middlesex	Boston Post Road Weston, Mass.
Mario Pandolf Co., Inc	----do	Worcester	106 Sachem Rd., Needham Heights, Mass.
Rowe Contracting Co	----do	Middlesex	1500 Salem St. Malden, Mass.
Simeone Stone Corp [3]	----do	Norfolk	Box 218 Wrentham, Mass.
Trimount Bituminous Products Co	----do	Essex	1840 Parkway St. Everett, Mass.
Warner Bros., Inc	----do	Franklin	Sunderland, Mass.
West Roxbury Crushed Stone Co	Quarry	Suffolk	10 Grove St., West Roxbury, Mass.
Granite, dimension:			
Bates Bros. Seam-Face Granite Co [4]	----do	Norfolk	1372 Hancock St. Quincy, Mass.
H. E. Fletcher Co. [4]	----do	Middlesex	W. Chelmsford, Mass.
Forrest Road Granite Co., Inc	----do	----do	20 Adams St. N. Chelmsford, Mass.
Guilmette Bros. Corp	----do	----do	57 Ledge Road N. Chelmsford, Mass.
Le Masurier Granite Quarry, Inc [4]	----do	----do	Box 71, Ledge Rd. N. Chelmsford, Mass.
Morris Bros. Granite Co., Inc	----do	----do	Box 277 N. Chelmsford, Mass.
Oak Hill Granit Co., Inc	----do	----do	Middlesex St., Lowell, Mass.

See footnotes at end of table.

Table 7.—Principal producers in Massachusetts—Continued

Commodity and company	Type of activity	County	Address
Stone—Continued			
Plymouth Quarries, Inc	Quarry	Plymouth	East Weymouth, Mass.
Rock port Quarries Co., Inc	do	Essex	210 Kingsley Ave. Providence, R.I.
Granite, crushed:			
Old Colony Crushed Stone Co	do	Norfolk	Box 230, Quincy, Mass.
Simeone Stone Corp [5]	do	do	Box 218 Wrentham, Mass.
Limestone, crushed:			
John S. Lane & Son, Inc	do	Berkshire	Box 125 Westfield, Mass.
Lee Lime Corp [6]	do	do	Marble St., Lee Mass.
Minerals, Pigments & Metals, Division Chas. Pfizer & Co., Inc.	do	do	260 Columbia St. Adams, Mass.
United States Gypsum Co	do	do	101 S Wacker Dr. Chicago, Ill.
Miscellaneous stone, crushed:			
Berlin Stone Co	Quarry	Worcester	Sawyer Hill Rd. Berlin, Mass.
S. M. Lorusso & Sons, Inc	do	Norfolk	331 West St. Walpole, Mass.
Warren Bros. Roads Co	do	Bristol	430 Howard St. Brockton, Mass.
Sandstone, dimension:			
McCormick Longmeadow Stone Co., Inc. [7]	do	Hampden	East Longmeadow, Mass.
Vermiculite, exfoliated:			
Zonolite Division, W. R. Grace & Co	Plant	Hampshire	62 Whittemore Ave. Cambridge, Mass.

[1] Also shale for lightweight aggregate.
[2] Westfield and Amherst quarries.
[3] Stoughton quarry.
[4] Also crushed granite.
[5] Wrentham quarry.
[6] Lee and Tobey quarries.
[7] Worcester and Redstone 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 Conservation, for collecting information on all minerals except fuels.

By Donald F. Klyce [1]

In 1967 a record high for the value of mineral production in Michigan was set despite reduced output of copper caused by a labor strike in the latter part of the year. The $610.2 million total was more than 1 percent larger than the previous high established in 1966.

The value of both construction materials and chemicals recovered from natural salines exceeded 1966 values by about 3 percent. These two nonmetallic mineral groups accounted for nearly 57 percent of the value of State mineral production. Metallic minerals (34 percent) and mineral fuels (9 percent) accounted for the remaining value.

[1] Industry economist, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Michigan [1]

Mineral		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Portland	thousand 376-pound barrels	28,171	$87,413	29,645	$94,515
Masonry	thousand 280-pound barrels	2,032	5,221	1,995	5,296
Clays	thousand short tons	2,450	2,620	2,466	2,636
Copper (recoverable content of ores, etc)	short tons	73,449	53,133	58,458	44,692
Gypsum	thousand short tons	1,522	5,489	1,422	5,085
Iron ore (usable)	thousand long tons, gross weight	14,377	157,377	14,130	162,610
Lime	thousand short tons	1,701	20,016	1,787	21,582
Magnesium compounds	short tons	342,482	28,105	309,446	26,388
Natural gas	million cubic feet	r 34,120	8,598	33,589	8,296
Natural gas liquids:					
Natural gasoline	thousand gallons	15,703	1,099	47,817	3,491
LP gases	do	79,719	4,385	59,390	3,444
Peat	short tons	235,842	2,175	237,107	2,292
Petroleum (crude)	thousand 42-gallon barrels	14,273	40,913	13,664	39,455
Salt	thousand short tons	4,465	38,611	4,789	42,389
Sand and gravel	do	55,123	49,521	52,310	49,616
Silver (recoverable content of ores, etc.)	thousand troy ounces	483	625	302	468
Stone	thousand short tons	37,864	40,380	36,432	39,910
Value of items that cannot be disclosed: Bromine, calcium chloride, calcium-magnesium chloride, gem stones, iodine, and potassium salts		XX	56,446	XX	58,039
Total		XX	602,127	XX	610,204
Total 1957–59 constant dollars		XX	556,249	XX	p 555,433

p Preliminary. r Revised. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

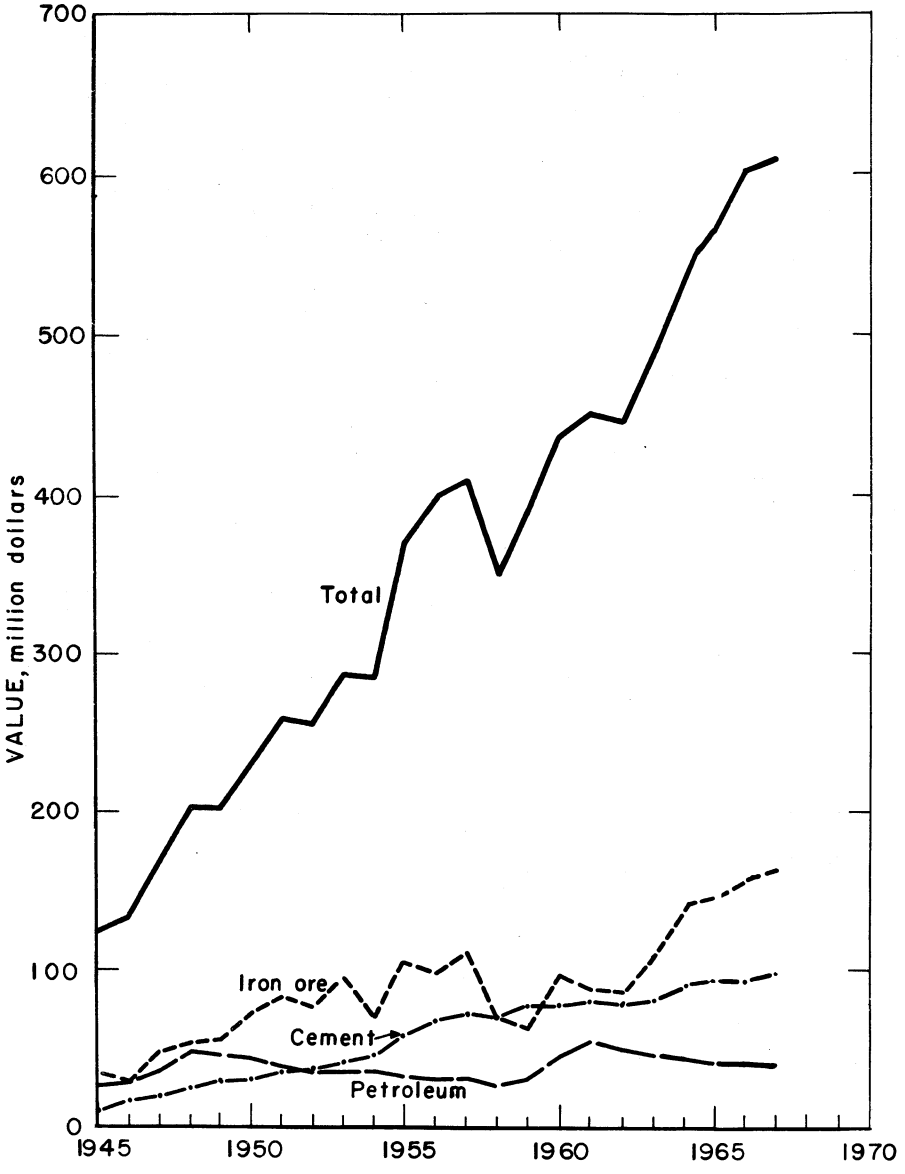

Figure 1.—Value of iron ore, petroleum, cement, and total value of all minerals produced in Michigan.

Legislation and Government Programs.—The 1967 Michigan Legislature enacted Bill 3008, "Mine Safety Act of 1967," to provide for the inspection of mines; the health and safety of persons employed in and about mines; mine inspectors; a mine safety board in the Department of Labor, and to prescribe its powers and duties; and penalties for violations.

The act covers mines extracting minerals in solid form, and includes milling, crushing, screening, washing, flotation, pelletizing, smelting, and other preparatory operations needed to render the minerals marketable. It also covers exploration and development of mineral properties.

The act will supersede legislation that provided for the inspection of metallic mines by county mine inspectors.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Alcona	$203	$133	Sand and gravel.
Alger	28	57	Do.
Allegan	1,184	[2] 992	Petroleum, sand and gravel, peat, stone, natural gas.
Alpena	W	W	Cement, stone, clays, sand and gravel.
Antrim	336	272	Clays, sand and gravel.
Arenac	1,155	1,081	Petroleum, stone, sand and gravel.
Baraga	W	72	Sand and gravel.
Barry	713	700	Sand and gravel, petroleum, stone.
Bay	10,355	9,637	Cement, petroleum, lime.
Benzie	57	--------	
Berrien	2,065	2,554	Sand and gravel, stone.
Branch	1,089	585	Do.
Calhoun	7,144	[2] 7,191	Petroleum, sand and gravel, stone, natural gas.
Cass	235	311	Sand and gravel, stone, petroleum.
Charlevoix	W	906	Cement, sand and gravel, stone, clays.
Cheboygan	127	69	Stone, sand and gravel.
Chippewa	4,382	W	Do.
Clare	1,761	[2] 1,795	Petroleum, sand and gravel, natural gas.
Clinton	399	315	Sand and gravel, clays.
Crawford	331	[2] 522	Petroleum, sand and gravel, natural gas.
Delta	354	260	Sand and gravel, stone.
Dickinson	19,631	19,749	Iron ore, sand and gravel, stone.
Eaton	547	603	Stone, sand and gravel, clays, peat.
Emmet	6,104	6,645	Cement, stone, sand and gravel.
Genesee	755	702	Sand and gravel, petroleum.
Gladwin	W	1,027	Petroleum, sand and gravel.
Gogebic	3,021	2,121	Iron ore, sand and gravel.
Grand Traverse	96	W	Sand and gravel.
Gratiot	W	W	Salines, salt, sand and gravel, petroleum, natural gas.
Hillsdale	13,657	[2] 12,161	Petroleum, sand and gravel, stone, natural gas.
Houghton	[3] 9,390	6,493	Copper, sand and gravel, stone.
Huron	1,256	897	Stone, sand and gravel, lime, petroleum.
Ingham	1,260	1,318	Sand and gravel, peat.
Ionia	354	W	Sand and gravel.
Iosco	4,720	4,401	Gypsum, sand and gravel.
Iron	20,102	14,998	Iron ore, sand and gravel.
Isabella	1,399	[2] 1,336	Petroleum, sand and gravel, natural gas.
Jackson	5,165	[2] 4,966	Petroleum, sand and gravel, stone, natural gas.
Kalamazoo	1,092	1,239	Sand and gravel, stone, peat.
Kalkaska	74	112	Petroleum, sand and gravel.
Kent	3,124	[2] 3,474	Sand and gravel, gypsum, petroleum, peat, natural gas.
Keweenaw	[4]	W	Copper, sand and gravel.
Lake	50	44	Sand and gravel, petroleum.
Lapeer	1,611	[2] 1,489	Peat, petroleum, sand and gravel, salines, natural gas.
Leelanau	113	56	Sand and gravel.
Lenawee	635	[2] 510	Sand and gravel, petroleum, clays, natural gas.
Livingston	3,561	[2] 2,804	Sand and gravel, petroleum, natural gas.
Luce	25	38	Sand and gravel.
Mackinac	W	W	Stone, sand and gravel.
Macomb	2,306	[2] 2,011	Sand and gravel, petroleum, natural gas.
Manistee	20,426	22,105	Salt, salines, sand and gravel.
Marquette	115,647	127,026	Iron ore, sand and gravel.
Mason	W	W	Salines, lime, sand and gravel, petroleum.
Mecosta	432	[2] 980	Petroleum, sand and gravel, peat, natural gas.
Menominee	890	633	Lime, sand and gravel.
Midland	W	W	Salines, salt, petroleum, sand and gravel.
Missaukee	1,296	[2] 1,302	Petroleum, sand and gravel, natural gas.
Monroe	W	W	Cement, stone, clays, peat, petroleum.
Montcalm	950	[2] 714	Petroleum, sand and gravel, natural gas.
Montmorency	19	--------	
Muskegon	2,272	2,244	Salt, sand and gravel, petroleum.
Newaygo	232	173	Sand and gravel, petroleum.
Oakland	8,595	9,939	Sand and gravel, peat, petroleum.
Oceana	523	425	Petroleum, sand and gravel.
Ogemaw	1,201	[2] 1,941	Sand and gravel, petroleum, natural gas.
Ontonagon	44,733	36,099	Copper, silver, sand and gravel.
Osceola	1,601	[2] 1,611	Petroleum, sand and gravel, natural gas.
Oscoda	125	76	Sand and gravel, petroleum.
Otsego	30	[2] 42	Sand and gravel, natural gas.
Ottawa	2,720	[2] 2,586	Sand and gravel, petroleum, stone, natural gas.
Presque Isle	W	W	Stone, sand and gravel.
Roscommon	698	[2] 616	Petroleum, sand and gravel, natural gas.
Saginaw	479	434	Clays, lime, petroleum, sand and gravel.

See footnotes at end of table.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
St. Clair	$16,498	[2] $14,679	Salt, cement, petroleum, peat, clays, sand and gravel, natural gas.
St. Joseph	262	279	Sand and gravel, peat, stone.
Sanilac	912	1,146	Peat, sand and gravel, lime.
Schoolcraft	W	W	Stone, sand and gravel.
Shiawassee	672	632	Sand and gravel, clays, peat, petroleum.
Tuscola	2,152	1,996	Sand and gravel, petroleum, lime, peat.
Van Buren	314	375	Sand and gravel, petroleum.
Washtenaw	1,279	[2] 1,974	Sand and gravel, petroleum, natural gas.
Wayne	50,556	[2] 55,288	Cement, lime, salt, sand and gravel, salines, stone, clays, petroleum, natural gas.
Wexford	147	[2] 84	Sand and gravel, natural gas.
Undistributed [5]	194,502	208,162	
Total [6]	602,127	610,204	

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 value of mineral production in Keweenaw County.

[4] Value of mineral production is included in that of Houghton County.

[5] Includes values for natural gas, natural gas liquids, gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

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

Table 3.—Indicators of Michigan business activity

		1966	1967	Percent change
Personal income:				
Total	millions	$27,685	[p] $29,125	+5.2
Per capita		$3,269	[p] $3,393	+3.8
Construction activity:				
Building permits:				
Valuation of authorized residential and nonresidential private construction	millions	$1,089.6	$1,248.3	+14.6
Number of private and public residential building permits issued		40,000	46,342	+15.9
Contract construction work performed:				
Total	millions	$2,098	$2,215	+5.6
Nonresidential building	do	$930	$947	+1.8
Residential building	do	$835	$929	+11.3
Nonbuilding	do	$333	$339	+1.8
State highway department:				
Contracts awarded	do	$131.7	$112.3	−14.7
Contract work performed	do	$149.3	$125.0	−16.3
Portland cement shipments to and within Michigan	thousand 376-pound barrels	16,900.1	16,386.4	−3.0
Cash receipts from farm marketings	millions	$886.4	$882.1	−.5
Mineral production	do	$602.1	$610.2	+1.3
Raw steel production	thousand tons	10,004.0	9,247.9	−7.6
Manufacturing payrolls	millions	$4,682.1	$4,590.6	−2.0
Annual average labor force and employment: [1]				
Total labor force	thousands	3,305.6	3,382.5	+2.3
Agricultural employment	do	71.7	67.5	−5.9
Nonagricultural employment [2]	do	3,111.9	3,141.3	+.9
Manufacturing	do	1,139.5	1,104.6	−3.1
Motor vehicles and equipment	do	374.9	352.7	−5.9
Construction	do	111.7	116.7	+4.5
Mining	do	13.5	12.6	−6.7
Primary metal products	do	99.7	93.0	−6.7
Stone, clay, and glass products	do	21.2	18.9	−10.9
Transportation	do	76.9	75.1	−2.3

[p] Preliminary.

[1] Adjusted to March 1967 benchmark levels.

[2] Includes nonagricultural, self-employed, and unpaid family workers, and domestic workers in private households.

Sources: Survey of Current Business, Construction Review, Statistical Abstract of the United States, State of Michigan Department of Highways, Farm Income Situation, American Iron & Steel Institute, and Michigan Employment Security Division in cooperation with the United States Department of Labor.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Peat	162	192	31	281	----	2	7.11	747
Metal	5,938	296	1,756	14,039	8	481	34.83	5,033
Nonmetal	1,697	274	466	3,727	----	34	9.12	864
Sand and gravel	2,470	232	572	4,872	2	85	17.86	3,542
Stone	3,427	295	1,010	8,115	1	87	10.84	1,454
Total	13,694	280	3,836	31,033	11	689	22.56	3,346
1967: p								
Peat	157	184	29	261	----	2	7.67	31
Metal	5,660	276	1,565	12,503	11	481	39.35	6,806
Nonmetal	1,670	283	472	3,777	2	54	14.83	3,524
Sand and gravel	2,475	212	526	4,619	----	93	20.14	705
Stone	3,390	295	1,000	8,025	----	62	7.73	373
Total [1]	13,350	269	3,591	29,184	13	692	24.16	3,586

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of portland cement reached a record high, more than 5 percent above 1966 shipments, while the output of masonry cement was slightly lower. Portland cement was produced at nine plants in seven counties, (Alpena, Bay, Charlevoix, Emmet, Monroe, St. Clair, and Wayne); masonry cement was produced at five of these plants. Total annual finished portland cement capacity increased to 39 million barrels. Yearend stocks of portland cement at mills were 3.8 million barrels, compared with 3.2 million barrels in 1966. More than 96 percent of the portland cement shipped was of types I and II (general use and moderate heat); the remainder was of type III (high-early-strength) and portland-pozzolan. About 47 percent of the cement was shipped to consumers within the State. Out-of-State distribution went mostly to Ohio, Illinois, Wisconsin, Indiana, Western New York, and Minnesota. Nearly 61 percent of the shipments were purchased by ready-mixed concrete companies with the remainder going principally to concrete product manufacturers (14 percent), highway contractors (13 percent), and building material dealers (8 percent). About 2.6 million barrels of cement, mostly portland, were shipped into Michigan. The bulk of the shipments originated in Ohio and Pennsylvania.

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	
1963	9	24,194	25,016	$76,944	2,532
1964	9	26,802	26,745	84,316	2,737
1965	8	27,018	27,565	86,996	2,110
1966	8	28,848	28,171	87,413	r 3,219
1967	9	29,862	29,645	94,515	3,825

r Revised.

Raw materials used in portland-cement manufacture included 6.9 million tons of limestone, and 2.2 million tons of clay or shale, as well as quantities of gypsum, iron

ore, sand, slag, mill scale, air-entraining compounds, and grinding aids. About 690 million kilowatt-hours of electrical energy was used. The wet process was used at eight plants and the dry process at one.

The Medusa Portland Cement Co. plant at Charleviox started producing clinker in August. The $25 million plant is located in a popular resort area on Lake Michigan; to avoid air pollution and shoreline defacement, the company consulted with local and State officials on all phases of the project during the planning stages. The plant's 580-foot rotary kiln has been designed for production of 4 million barrels of gray cement per year. An electrostatic precipitator removes dust from kiln exhaust gases. The plant is highly automated; two interconnected digital computers in a central control building will oversee operations from the quarry to the finished cement silos. An automatic X-ray spectrometer will analyze the quality of raw materials and the finished product. The plant site is on navigable water, and 12 silos and five interstice bins with a storage capacity of 250,000 barrels are located on an inshore slip. The docking facility was designed to meet objections against structures extending into Lake Michigan which might be unsightly or accumulate debris leading to pollution. Lakeborne shipments will be made on the new 67,000-barrel capacity cement carrier, the *S.S. Medusa Challenger.* Limestone is quarried on the site from a deposit with an estimated 100-year supply. Shale and sand are also available on the site. To help minimize blasting disturbance, a seismograph has been installed 1½ miles from the quarry.

In November, Martin Marietta Corp. announced it has discontinued development of a new cement plant at Milan, in southeastern Michigan. A severe water leakage in the quarry at the new site was instrumental in the decision to halt the project. Instead, it was announced, the company's plant at Essexville, near Bay City, will be modernized and expanded. The plant capacity at Essexville will be increased by 10 percent. One of the two kilns already delivered to Milan will be moved to Essexville to replace four older, smaller kilns. The second kiln and related equipment will be shipped to a new company plant under development in Colorado. Grinding mills will be moved from Milan to Essexville, a new raw mill will replace five mills, and a new finish mill will replace eight mills now in operation.

The Huron Cement Co. (Division of National Gypsum Co.) plant at Alpena marked its 60th anniversary in January. With an annual rated capacity of 18 million barrels, the plant is said to be the world's largest. Since the first cement shipment in 1908, plant production has totaled nearly 258 million barrels. Plant capacity is 30 times that of 1909, the first full year of production. Future plans call for expansion of the plant to a 24-million-barrel-per-year capacity.

Clays.—Miscellaneous clays and shale were mined in 11 counties from 13 pits. Total output was slightly larger than in 1966. Increases in production of material for manufacturing portland cement and lightweight aggregate offset decreases in output for stoneware and heavy clay products. About 90 percent of the production was used in cement manufacture. Of the remainder, 7 percent was used for lightweight aggregate, and the balance for vitrified tile, other heavy clay products, and stoneware. The largest production was reported from operations in Alpena, Antrim, Monroe, Saginaw, St. Clair, and Wayne Counties.

Gem Stones.—Agates, thomsonite, and other semiprecious stones, as well as specimens of native copper and hematite, were collected by hobbyists. Most of the gem stones were found along Lake Superior beaches in the Upper Peninsula.

Gypsum.—Smaller demand for building materials caused a decline in crude gypsum output of more than 6 percent. Crude gypsum was produced in Kent County from underground mines and processed at plants in Grand Rapids, principally for plaster, lath, and wallboard.

In Iosco County, gypsum was quarried at Whittemore for portland cement retarder. Quarries at Tawas City and Alabaster supplied crude gypsum for building material plants at National City, Detroit, and in Ohio and Wisconsin. Two deep water ports were maintained at National City and Alabaster for lake transport of gypsum materials.

Lime.—Increased demand for lime in basic oxygen converters and open-hearth furnaces in steel plants, as well as in chem-

ical manufacture, caused a 5-percent increase in State lime production. In addition to these major consumers, smaller quantities of lime were used in sugar refining, paper manufacture, water purification, and sewage treatment. Lime plants were operated in eight counties, but four-fifths of the State output was concentrated in Wayne County to meet requirements of steel mills and chemical plants in the Detroit area. About 55 percent of the production was used by the producers, and the remainder sold. Only 8 percent of the total production was shipped to consumers outside the State. About 262,000 tons of lime (more than three-quarters of it quicklime) were shipped into Michigan. Shipments originating in Ohio comprised most of the imports. Data for lime regenerated at papermills, water purification plants, and acetylene processors are excluded from 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. The total value of chemicals produced from natural salines, excluding salt which is discussed below, was about the same as in 1966. In June, Great Lakes Chemical Corp. closed its Filer City plant at which the company produced elemental bromine.

Perlite.—Crude perlite, mined in Western States, was expanded at plants in Iosco, Kent, and Wayne Counties. The material was used principally for building-plaster aggregate.

Salt.—Salt was produced from an underground mine in Detroit, and recovered from natural and artificial brines at plants in Gratiot, Manistee, Midland, Muskegon, St. Clair, and Wayne Counties. Increased demand for salt by major consumers in chemical manufacture, for road use, animal feed, and water softening resulted in a 7-percent increase in production. Michigan salt was distributed to 44 States and Canada. The largest out-of-State shipments were to Illinois, Indiana, Minnesota, Ohio, and Wisconsin.

Sand and Gravel.—Michigan continued to be a leading source of sand and gravel production, the second highest in the Nation (after California). Although tonnage was down about 5 percent, the increase in unit value from $0.90 to $0.95 per ton raised total value to a record high of $49.6 million. Demand for sand and gravel for building use increased about 3 percent; other major uses registered declines—for paving material and fill (7 percent), industrial sand (nearly 10 percent). Sand and gravel production was reported from all counties except Bay, Benzie, Monroe, and Montmorency. The Detroit area (Livingston, Macomb, Oakland, Washtenaw, and Wayne Counties) produced 19.5 million tons, or 37 percent of the State total. Production of more than 1 million tons was also reported from each of the following counties: Berrien, Ingham, Kalamazoo, Kent, Ogemaw, Ottawa, and Tuscola. Over 93 percent of the sand and gravel was processed. About 90 percent was moved by truck and the remainder by rail and water. Production was reported from 374 commercial and 108 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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	6,350	$5,093	6,508	$5,990
Paving	5,469	4,645	5,565	4,550
Fill	3,639	1,659	3,401	1,601
Molding	3,611	6,735	3,231	6,198
Other [1]	868	2,002	810	2,111
Total	19,937	20,134	19,515	20,450
Gravel:				
Building	6,385	8,329	6,585	9,198
Paving	17,533	14,849	16,604	14,514
Railroad ballast	201	212	W	W
Fill	353	205	419	300
Other	56	70	120	184
Total	24,528	23,665	23,728	24,196
Total sand and gravel	44,465	43,799	43,243	44,646
Government-and-contractor operations:				
Sand:				
Building	-------	-------	90	49
Paving	2,115	1,008	2,291	1,121
Fill	1,116	397	919	373
Other	114	42	102	44
Total	3,345	1,447	3,402	1,587
Gravel:				
Building	87	48	-------	-------
Paving	6,828	4,088	5,301	3,225
Fill	396	137	364	158
Other	2	2	-------	-------
Total	7,313	4,275	5,665	3,383
Total sand and gravel	10,658	5,722	9,067	4,970
All operations:				
Sand	23,282	21,581	22,917	22,037
Gravel	31,841	27,940	29,393	27,579
Total	55,123	49,521	52,310	49,616

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

[1] Includes fire or furnace and railroad ballast (1966), blast and foundry (1967), abrasives, enamel, engine, glass, pottery, porcelain, tile, and other construction and industrial uses.

Table 7.—Production of sand and gravel in 1967, by counties [1]

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Alcona	274	$133	Leelanau	105	$56
Alger	93	57	Lenawee	579	478
Allegan	401	278	Livingston	2,810	2,802
Alpena	187	W	Luce	35	38
Antrim	92	W	Mackinac	W	W
Arenac	W	W	Macomb	2,524	2,004
Baraga	152	72	Manistee	W	W
Barry	639	663	Marquette	877	741
Berrien	2,595	2,550	Mason	975	W
Branch	589	W	Mecosta	186	W
Calhoun	978	485	Menominee	417	W
Cass	326	285	Midland	W	242
Charlevoix	190	W	Missaukee	17	11
Cheboygan	17	21	Montcalm	411	215
Chippewa	W	W	Muskegon	477	W
Clare	203	W	Newaygo	184	113
Clinton	354	W	Oakland	9,707	9,889
Crawford	88	53	Oceana	329	210
Delta	334	W	Ogemaw	1,288	1,080
Dickinson	293	218	Ontonagon	230	W
Eaton	416	W	Oscelola	218	143
Emmet	364	W	Oscoda	136	71
Genesee	897	696	Otsego	66	42
Gladwin	24	10	Ottawa	2,462	2,275
Gogebic	151	W	Presque Isle	521	W
Grand Traverse	172	W	Roscommon	212	127
Gratiot	279	W	Saginaw	W	W
Hillsdale	399	476	St. Clair	W	W
Houghton	W	W	St. Joseph	336	269
Huron	133	101	Sanilac	395	W
Ingham	1,372	1,316	Schoolcraft	151	W
Ionia	435	W	Shiawassee	745	512
Iosco	77	31	Tuscola	1,475	1,714
Iron	94	W	Van Buren	414	345
Isabella	665	612	Washtenaw	1,912	1,903
Jackson	306	268	Wayne	2,511	4,349
Kalamazoo	1,120	1,182	Wexford	97	84
Kalkaska	W	W	Undistributed [2]	2,210	7,694
Kent	2,224	2,483			
Keweenaw	66	34	Total	52,310	49,616
Lake	34	30			
Lapeer	265	155			

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

[1] No sand and gravel production reported from the following counties: Bay, Benzie, Monroe, and Montmorency.

[2] Includes production for which no county breakdown is available, and data indicated by symbol W.

The new aggregate plant of Gil Brown Constructors, Inc., at West Branch employed a sink-float process for removal of chert and lightweight particles from gravel. According to company reports, approximately 7 percent of the 150-ton-per-hour feed to its heavy-media separation system is rejected in the form of chert and soft stone.

Stone.—Limestone was quarried in 17 counties by 24 commercial producers and four county highway departments. Limestone, which accounted for nearly all of the State stone output, came from large quarries in Alpena, Chippewa, Mackinac, Monroe, and Presque Isle Counties. Nearly 77 percent of the material was moved by water from company-operated ports on Lakes Huron and Michigan to cement and lime plants, steel mills, and other consumers.

Demand for limestone decreased, with smaller requirements of the steel industry for fluxstone, of roadbuilding for aggregates, and of cement plants for cement stone, being responsible for much of the loss. The only major increase was in limestone for manufacturing lime.

Small quantities of dimension limestone and sandstone were produced for building purposes. The limestone was quarried and processed in Eaton, Huron, and Presque Isle Counties. The sandstone was produced in Jackson County. A small quantity of granite was quarried and crushed in Dickinson County for use as facing aggregate in architectural concrete. In Houghton County, basalt was quarried and crushed

Table 8.—Dimension stone sold or used by producers, by kinds

Year	Basalt		Limestone		Sandstone		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1963	---	-----	4,938	$60,371	8,937	$62,348	13,875	$122,719
1964	150	$150	5,383	68,711	8,306	62,030	13,839	130,891
1965	---	-----	5,286	76,989	6,396	42,760	11,682	119,749
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

Table 9.—Crushed and broken stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Kind and use	1966		1967	
	Quantity	Value	Quantity	Value
Basalt: Concrete aggregate and roadstone	5	$6	27	$35
Granite: Exposed aggregate	------	--------	3	62
Limestone:				
Riprap	109	173	W	W
Flux	13,391	15,789	11,270	13,638
Concrete aggregate and roadstone	6,479	7,748	5,952	7,313
Railroad ballast	W	W	308	380
Agriculture	669	1,040	757	1,093
Cement	9,443	7,786	9,080	7,570
Lime	5,560	5,125	6,224	6,615
Other [1]	2,053	2,495	2,673	3,025
Total [2]	37,703	40,156	36,265	39,633
Marl: Agriculture	143	100	132	103
Grand total [2]	37,852	40,262	36,426	39,832

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes limestone used for asphalt and other miscellaneous filler, chemicals, dust for coal mines, mineral food, poultry grit, stone sand, whiting or whiting substitutes, other uses, and uses indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

for road use. Marl was produced in 11 counties and sold for agricultural use.

Sulfur.—Byproduct sulfur was recovered from crude petroleum at oil refineries in Alma, Detroit, and Trenton. Output increased over that of 1966.

Vermiculite.—Crude vermiculite, mined in Southern and Western States, was exfoliated at a plant in Dearborn and used for insulation, plaster, concrete aggregate, agricultural application, and other uses.

METALS

Copper.—Production of copper in terms of recoverable metal was 20 percent less than in 1966, due chiefly to a 4-month-long labor strike at the White Pine Copper Co. property in Ontonagon County, and a strike, lasting nearly 3 weeks, at the Calumet Division of Calumet & Hecla, Inc., at Calumet. The average weighted price for copper increased to 38.2 cents per pound.

On May 6, the Quincy Mining Co. closed its dredge and copper reclamation plant at Torch Lake. The Quincy smelter was closed down with the discontinuation of the reclamation plant, but the furnace is being rebuilt, connected to gas firing instead of coal, and will be used to smelt copper scrap.

Copper Range Co. closed its Champion mine in September and discontinued its tailings-reclamation program in November.

Calumet & Hecla, Inc., closed the Centennial No. 2 mine, but continued development of the Kingston and Centennial No. 6 mines during the year. Diamond drilling of the Hills Creek project was started in 1967 with holes located to intersect the lode substantially below and northerly from the old workings in the Calumet conglomerate lode. One drill hole from the surface was completed with satisfactory re-

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)
1963	10	3	7,211	2,226	75,262	$46,361
1964	9	3	6,718	2,174	69,040	45,014
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

sults, and the second was at a depth of 2,000 feet at yearend. Further drilling is planned.

According to company reports, exploration was designed to determine the degree of mineralization to the north as well as to give an indication of the grade and thickness of the vein. At the White Pine mine a new conveyor system is being installed capable of transporting ore, materials, or personnel horizontally, on an incline, or vertically without changing the mode of transportation.

The White Pine Copper Co. is carrying on research in cooperation with the Institute of Mineral Research at the Michigan Technological University that has resulted in a process for 90 percent recovery of residual copper lost in tailings. In the process, sand tailings are treated in three continuous stages of leaching, precipitation, and regeneration. The process was made economically feasible on a 7,000-ton-per-day basis by the exclusion of air from the process, thereby reducing reagent loss by oxidation. The White Pine Copper Co. has been undergoing a three-way expansion encompassing mining, milling, and refining operations. The new milling and smelting facilities were operational in April. A new selective mining method called "values only" is being tested in several development areas of the mine. Essentially, the method is a refinement of techniques that enables miners to take less of the surrounding rock, increasing the copper yield per ton of ore.

Two companies, Bear Creek Mining Co. and Copper Range Co., had geological teams searching for ore and performing analytical work at different sites of the Indiana copper tract in Ontonagon County.

Iron Ore.—Iron-ore shipments in 1967 reflected a larger proportion of pellets (73 percent) than in previous years. Consequently, although total shipments decreased by nearly 2 percent, value of shipments increased by more than 3 percent. Average weighted mine value for Michigan usable ore in 1967 was $11.51 per ton compared with $10.95 in 1966.

About 82 percent of the crude ore mined came from four open-pit mines, and the remainder from eight underground mines. Average iron content of usable ore produced was 60.25 percent natural, compared with 58.87 percent in 1966.

Michigan iron ore was shipped to producers of pig iron and steel, except for a small quantity used in manufacturing iron oxide pigments. About 98 percent of the ore was shipped by rail to ore docks in Escanaba and Marquette and then by water to lower Lake ports. The remainder was shipped by rail to consuming districts. The lake shipping season for Michigan iron ores opened at Escanaba on April 7, and closed at the same port on December 22.

For the first time since 1883, there was no production from the Gogebic Range, and the last shipment from remaining stocks left the Peterson mine at Bessemer in August. The Hanna Mining Co. began an expansion program at its Groveland plant that included increasing the output to 2.1 million tons of pellets per year from 1.6 million.

Table 11.—Crude iron ore data, in 1967, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production		Shipments		Stocks Dec. 31
		Underground	Open pit	Direct to consumers	To concentrators	
County:						
Dickinson	------	--------	3,686	--------	3,686	--------
Gogebic	190	[1] 49	--------	239	--------	--------
Iron	850	2,216	--------	2,065	--------	1,001
Marquette	692	2,917	19,770	707	22,006	665
Total [2]	1,731	5,182	23,456	3,011	25,692	1,666
Range:						
Gogebic	190	[1] 49	--------	239	--------	--------
Marquette	692	2,917	19,770	707	22,006	665
Menominee	850	2,216	3,686	2,065	3,686	1,001
Total [2]	1,731	5,182	23,456	3,011	25,692	1,666

[1] Stockpile overrun.
[2] 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 [2]
1854–1962	317,203	262,234	246,582	826,019
1963	5,706	3,729	902	10,336
1964	7,898	4,551	1,227	13,676
1965	8,973	4,595	753	14,322
1966	9,589	4,620	113	14,322
1967	10,231	3,750	[3] 49	14,030
Total [2]	359,601	[4] 283,478	[4] 249,626	892,705

[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] Stockpile overrun.
[4] Distribution by range partly estimated before 1906.

Table 13.—Usable iron ore shipped from mines, by ranges [1]

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total [2]
1963	5,809	4,168	813	10,789
1964	7,909	4,560	1,403	13,871
1965	8,303	4,451	773	13,527
1966	9,686	4,327	364	14,377
1967	10,260	3,631	239	14,130

[1] Exclusive of iron ore containing 5 percent or more manganese.
[2] Data may not add to totals shown because of independent rounding.

Table 14.—Production of usable iron ore

(Thousand long tons)

Year	Gross weight		Iron content (percent)
	Ore	Iron content	
1963	10,336	5,913	57.21
1964	13,676	7,923	57.93
1965	14,322	8,343	58.25
1966	14,322	8,432	58.87
1967	14,030	8,453	60.25

Table 15.—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]		
1963	4,852	4,364	1,574	5,938	10,789	55.03
1964	5,753	6,573	1,546	8,118	13,871	58.53
1965	4,969	7,554	1,004	8,558	13,527	63.26
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

[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.

According to the Michigan Department of Conservation [2], the average cost per ton for underground mines was $9.07 in 1967, compared with $9.15 in 1966. Labor costs decreased to $2.45 per ton, while taxes (excluding Federal income tax) decreased to $0.32 per ton. Deferred costs per ton were $0.47, and other costs were as follows: General overhead, $1.28; royalty, $0.42; and marketing, $0.05.

Pig Iron and Steel.—Pig iron and steel were manufactured at plants in Ecorse, Dearborn, and Trenton in the Detroit area. Pig iron shipments and value were nearly 5 percent smaller than in 1966. Basic and foundry grades were produced, and shipments included these grades as well as low phosphorus grade shipped from stocks.

About 2.3 million tons of iron and manganiferous ores, mostly domestic, were consumed in agglomerating plants and blast and steel furnaces.

The American Iron & Steel Institute reported Michigan steel production of 9.2 million tons, nearly 8 percent less than in 1966.

Silver.—Silver was recovered from copper ore mined and milled by the White Pine Copper Co. Concentrate from its silver-recovery circuit was smelted separately for delivery to electrolytic refineries where the silver was recovered. Silver contained in fire-refined copper was not recovered but was marketed as a constituent of Lake copper. Output in 1967 dropped substantially because of the labor strike at the White Pine operations.

MINERAL FUELS

Natural Gas and Natural Gas Products.—Natural gas was produced from both oil and gas wells in 25 counties. About 87 percent of the production came from five counties, with St. Clair County supplying 45 percent of the total State output.

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 gas delivered by interstate pipeline from out-of-State gasfields at a plant in Washtenaw County.

Peat.—Michigan led the Nation in peat production with 38 percent of the total. Peat was produced in 14 counties, with nearly one-half of the State output from

[2] Geological Survey Division, Michigan Department of Conservation. General Statistics Covering Cost and Production of Michigan Iron Mines. 1968, 5 pp.

Lapeer County; Oakland, St. Clair, and Sanilac Counties accounted for much of the remainder. Peat was marketed principally as a soil conditioner, and nearly three-quarters of the output was sold in packaged form. None was sold for fuel. About 80 percent of the peat mined was reed-sedge, and the remainder was moss and humus.

Petroleum.—Petroleum was produced in 44 counties, with the largest output reported from fields in the Albion-Pulaski-Scipio trend in Calhoun, Hillsdale, and Jackson Counties. According to the Geological Survey Division, Michigan Department of Conservation, the most active regions of new field exploration and field development drilling were in Macomb

Table 16.—Oil and gas wells drilled in 1967

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage [1]
Alcona	---	---	---	---	---	1	1	2,318
Allegan	3	---	1	---	---	8	12	25,897
Arenac	---	---	---	---	---	2	2	6,015
Bay	---	---	---	---	---	2	2	6,258
Branch	---	---	---	---	---	3	3	12,130
Calhoun	13	1	30	---	---	4	48	210,851
Clare	---	---	1	---	---	---	1	3,942
Crawford	---	---	---	---	---	1	1	4,592
Genesee	1	---	---	---	---	---	1	1,646
Gladwin	---	---	---	---	---	1	1	3,539
Gratiot	---	---	---	---	---	2	2	6,743
Hillsdale	5	---	6	---	---	9	20	81,283
Ionia	---	---	---	---	---	2	2	12,403
Isabella	---	---	1	1	---	---	2	8,160
Jackson	1	1	6	---	---	3	11	33,614
Kent	---	---	---	---	---	6	6	22,954
Lake	---	---	3	1	---	5	9	24,940
Lapeer	2	---	2	---	---	---	4	13,561
Lenawee	---	7	3	---	---	3	13	19,615
Livingston	---	---	---	1	---	1	2	10,118
Macomb	1	---	6	---	---	17	24	73,142
Mason	1	---	7	---	---	7	15	21,025
Mecosta	11	---	3	---	---	6	20	66,015
Midland	---	---	1	---	---	2	3	10,531
Missaukee	3	---	2	1	---	---	6	23,220
Monroe	---	---	---	---	---	1	1	2,146
Montcalm	2	---	4	---	---	6	12	35,464
Muskegon	4	---	8	---	---	4	16	29,294
Newaygo	1	---	2	---	---	7	10	36,047
Oakland	1	---	---	---	---	2	3	13,226
Oceana	---	---	1	---	---	9	10	19,011
Ogemaw	4	---	2	---	---	1	7	26,592
Osceola	2	---	5	1	---	4	12	34,457
Otsego	---	10	1	---	---	---	11	16,459
Ottawa	---	---	---	---	---	4	4	9,055
Roscommon	---	---	---	---	---	1	1	4,572
Saginaw	---	---	---	---	---	1	1	4,240
Shiawassee	2	---	---	1	---	1	4	6,314
St. Clair	3	18	22	1	2	40	86	254,302
Tuscola	1	---	1	---	---	---	2	5,232
Van Buren	---	---	---	---	---	1	1	1,205
Washtenaw	---	---	---	---	---	1	1	3,934
Total	61	37	118	7	2	168	393	1,206,062

[1] Includes only wells drilled and completed for oil and gas.

and St. Clair Counties and the area along the Albion-Pulaski-Scipio oilfield trend. Statewide, the discovery-to-dry hole ratio for new field wildcat wells was 1:20 compared with 1:17 in 1966. About 22 percent of the exploratory wells bottomed out in Traverse Group Limestones (Devonian), 10 percent for the Dundee Limestone (Devonian), 7 percent in the Reed City zone of Devonian age, 35 percent in Silurian age rocks of the Clinton and Niagaran Groups, and about 17 percent in Ordovician age (or older) rocks of the Black River and Trenton Groups. The remainder reached total depth in rocks younger than Devonian in age. No Precambrian or basement tests were drilled during the year. Nine new fields were discovered in 1967 and one new pool discovery was reported. Ten refineries had an operating capacity of 168,000 barrels per day.

Table 17.—Principal producers and processors of metals, minerals, and mineral fuels [1]

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Cement:			
Aetna Portland Cement Co., Division of Martin Marietta Corp.	Bay City	Bay	Portland and masonry, wet process.
Dundee Cement Co	Dundee	Monroe	Do.
Huron Cement Co., Division of National Gypsum Co.	Alpena	Alpena	Portland and masonry, dry process.
Medusa Portland Cement Co	Charlevoix	Charlevoix	Portland and masonry, wet process.
Peerless Cement Co., Division of American Cement Corp.:			
Port Huron plant	Port Huron	St. Clair	Portland, wet process.
Brennan Avenue plant	Detroit	Wayne	Do.
Jefferson Avenue plant	----do	----do	Portland and masonry, wet process.
Penn-Dixie Cement Corp	Petoskey	Emmet	Do.
Wyandotte Chemicals Corp	Wyandotte	Wayne	Do.
Clays and shale: [2]			
Aetna Portland Cement Co., Division of Martin Marietta Corp.	Saginaw	Saginaw	Cement.
Dundee Cement Co	Dundee	Monroe	Do.
Huron Cement Co., Division of National Gypsum Co.	Alpena	Alpena	Do.
Light Weight Aggregate Corp	Livonia	Wayne	Lightweight aggregate.
Peerless Cement Co., Division of American Cement Corp.	Smiths Creek	St. Clair	Cement.
Do	Allen Park	Wayne	Do.
Penn-Dixie Cement Corp	Petoskey	Antrim	Do.
Coke:			
Allied Chemical Corp	Detroit	Wayne	
Ford Motor Co	River Rouge	----do	
National Steel Corp., Great Lakes Steel Division	Ecorse	----do	
Copper:			
Calumet & Hecla, Inc.:			
Centennial Nos. 2, 3, and 6	Calumet	Houghton	On strike August 23–September 11.
Osceola No. 13	Osceola	----do	
Tamarack Reclamation	Hubbell	----do	Operation closed in December.
Ahmeek mill	Ahmeek	Keweenaw	
Allouez No. 3 and Kingston	----do	----do	
Ahmeek No. 3 and No. 4	----do	----do	"Poor rock" only.
Seneca No. 2	Mohawk	----do	Do.
Copper Range Co.:			
Atlantic Tailings	Freda	Houghton	Operation closed in November.
Champion	Painesdale	----do	Operation closed in September.
Freda mill	Freda	----do	Operation closed in November.
Quincy Mining Co.:			
Reclamation plant	Mason	----do	Operation closed in May.
White Pine Copper Co:			
White Pine	White Pine	Ontonagon	Mine and mill. On strike August 21 throughout balance of year.

See footnotes at end of table.

Table 17.—Principal producers and processors of metals, minerals, and mineral fuels [1]—Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Gypsum:			
Bestwall Gypsum Division, Georgia-Pacific Corp	Grand Rapids	Kent	Mining, calcining, and fabricating.
Grand Rapids Gypsum Co	do	do	Mining (underground), calcining, and fabricating.
Michigan Gypsum Co	Whittemore	Iosco	Mining.
National Gypsum Co	National City	do	Calcining and fabricating.
Do	Tawas City	do	Mining.
United States Gypsum Co	Alabaster	do	Do.
Do	Detroit	Wayne	Calcining and fabricating.
Iron ore:			
Cleveland-Cliffs Iron Co.:			
Bunker Hill and Maas	Negaunee	Marquette	Stockpile shipments only.
Cliffs shaft	Ishpeming	do	Ore treated at the Ore Improvement Plant. Underground mine closed in December.
Eagle Mills pellet plant	Negaunee	do	Pelletizes ore from the Republic mine.
Empire	Palmer	do	Open-pit mine, concentrator, and agglomerator.
Humboldt	Champion	do	Do.
Mather	Ishpeming	do	Underground mine. Ore treated at the Ore Improvement Plant and Pioneer Pellet Plant.
Ore improvement plant	Negaunee	do	
Pioneer pellet plant	do	do	Pelletizes ore from the Mather mine.
Republic	Republic	do	Open-pit mine, concentrator, and agglomerator. Part of the concentrates pelletized at the Eagle Mills Plant.
Tilden	Ishpeming	do	Stockpile shipments only.
The Hanna Mining Co.:			
Groveland	Iron Mountain	Dickinson	Open-pit mine, concentrator, and agglomerator.
Hiawatha	Stambaugh	Iron	Stockpile shipments only.
Homer	Mineral Hills	do	Underground mine.
Wauseca	Iron River	do	Do.
Inland Steel Co.:			
Bristol	Crystal Falls	do	Do.
Sherwood	Iron River	do	Do.
Jones & Laughlin Steel Corp.:			
Tracy	Negaunee	Marquette	Do.
North Range Mining Co.:			
Champion	Champion	do	Underground mine closed in August.
Pickands Mather & Co.:			
Peterson	Bessemer	Gogebic	Stockpile shipments only.
Iron and steel:			
Ford Motor Co	Dearborn	Wayne	Iron blast furnaces and open-hearth steel furnaces.
McLouth Steel Corp	Trenton	do	Do.
National Steel Corp., Great Lakes Steel Division	Ecorse	do	Do.
Lime:			
Detroit Lime Co	River Rouge	do	Quicklime, one shaft and one rotary kiln.
The Dow Chemical Co	Ludington	Mason	Quicklime, three rotary kilns, one continuous hydrator.
Industrial Chemicals Division., Allied Chemical Corp.	Detroit	Wayne	Quicklime, pot kiln.

Marblehead Lime Co	River Rouge	----do	Quicklime, two rotary kilns.
Wyandotte Chemicals Corp	Wyandotte	----do	Quicklime, nine shaft kilns.
Petroleum refineries:			
Bay Refining, Division Dow Chemical Co	Bay City	Bay	
Crystal Refining Co	Carson City	Montcalm	
Lakeside Refining Co	Kalamazoo	Kalamazoo	
Leonard Refineries, Inc.:			
Leonard Division	Alma	Gratiot	
Roosevelt Division	Mt. Pleasant	Isabella	
Marathon Oil Co	Detroit	Wayne	
Naph-Sol Refining Co	Muskegon	Muskegon	
Osceola Refining Co	West Branch	Ogemaw	
Petroleum Specialties, Inc	Flat Rock	Wayne	
Socony Mobil Oil Co	Trenton	----do	
Peat:			
Anderson Peat Co	Imlay City	Lapeer	Reed-sedge.
Fletcher & Rickard	New Hudson	Oakland	Humus.
Green Thumb Peat Co., Inc	Sandusky	Sanilac	Moss and reed-sedge.
J. M. Huber Corp	Imlay City	Lapeer	Reed-sedge.
Michigan Peat	----do	----do	Reed-sedge bog extends into St. Clair County.
Do	Capac	St. Clair	Reed-sedge, bog extends into Lapeer County.
Do	Minden City	Sanilac	Reed-sedge.
Expanded perlite:			
Bestwall Gypsum Division, Georgia-Pacific Corp	Grand Rapids	Kent	
National Gypsum Co	National City	Iosco	
United States Gypsum Co	Detroit	Wayne	
Salt and salines: [3]			
American Salt Corp	Midland	Midland	Salt.
Diamond Crystal Salt Co	St. Clair	St. Clair	Do.
The Dow Chemical Co	Ludington	Mason	Bromine, calcium compounds, and magnesium compounds.
Do	Midland	Midland	Bromine, calcium compounds, iodine, magnesium compounds, potash, and salt.
Great Lakes Chemical Corp	Filer City	Manistee	Bromine. Plant closed in June.
Harbison-Walker Refractories Co	Ludington	Mason	Magnesium compounds.
Hooker Chemical Corp	Montague	Muskegon	Salt.
International Salt Co., Inc	Detroit	Wayne	Underground salt mine.
Kaiser Aluminum & Chemical Corp	Midland	Midland	Magnesium compounds.
Manistee Salt Works, Division Hardy Salt Co	Manistee	Manistee	Salt.
Michigan Chemical Corp	East Lake	----do	Bromine.
Do	St. Louis	Gratiot	Bromine, calcium compounds, magnesium compounds, and salt.
Morton Chemical Co., Division Morton International, Inc.	Manistee	Manistee	Bromine, calcium compounds, and magnesium compounds.
Morton Salt Co., Division Morton International, Inc.	----do	----do	Salt.
Do	Port Huron	St. Clair	Do.
Pennsalt Chemicals Corp	Wyandotte	Wayne	Do.
Standard Lime & Refractories Co., Division of Martin Marietta Corp.	Manistee	Manistee	Magnesium compounds.
Wilkinson Chemical Corp	Mayville	Lapeer	Calcium compounds.
Wyandotte Chemicals Corp	Wyandotte	Wayne	Calcium compounds and salt.

See footnotes at end of table.

Table 17.—Principal producers and processors of metals, minerals, and mineral fuels [1]—Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Sand and gravel: [4]			
American Aggregates Corp	Kalamazoo	Kalamazoo	Stationary plant.
Do	Brighton	Livingston	Do.
Do	Romeo	Macomb	Do.
Do	Oxford	Oakland	Do.
Arrowhead Silica Corp., Manley Bros. Division	Bridgman	Berrien	Stationary plant, industrial sand.
J. V. Burkett	St. Joseph	do	
Construction Aggregates Corp	Ferrysburg	Ottawa	Do.
Grand Rapids Gravel Co	Grandville and Grand Rapids	Kent	Stationary plants.
Great Lakes Foundry Sand Co	Vassar	Tuscola	Stationary plant, industrial sand.
Holloway Sand & Gravel Co., Inc	Various locations	Calhoun	
Do		Genesee	
Do		Livingston	
Do		Oakland	
Do		Ogemaw	
Do		Washtenaw	
Holly Sand & Gravel Plant, J. P. Burroughs & Son, Inc.	Davisburg	Oakland	Stationary plant.
Manley Sand Division, Martin Marietta Corp	Bridgman	Berrien	Stationary plant, industrial sand.
Michigan Silica Division, Ottawa Silica Co	Rockwood	Wayne	Do.
Mickelson Corp	Oxford	Oakland	Stationary plant and dredge.
Natural Aggregates Corp	Brighton	Livingston	One stationary and one portable plant.
Do	Romeo	Macomb	Stationary plant.
New Hudson Sand & Gravel, Inc., Texas Industries, Inc.	New Hudson	Oakland	Do.
The Nugent Sand Co., Inc	Muskegon	Muskegon	Stationary plant, industrial sand.
Pickitt & Schreur, Inc	Various locations	Allegan	
Do		Berry	
Do		Branch	
Do		Calhoun	
Do		Kalamazoo	
Do		Kent	
Do		Ottawa	
Do		Roscommon	
Sand Products Corp	Manistee	Manistee	Stationary plant, industrial sand.
Do	Muskegon	Muskegon	Do.
Sargent Sand Co	Ludington	Mason	Do.
Do	Vassar	Tuscola	Do.
Standard Sand Co	Grand Haven	Ottawa	Do.
Do	South Haven	Van Buren	Do.
John G. Yerington	Otsego	Allegan	
Do	Dowling and Middleville	Barry	
Do	Berrien Springs, Buchanan, Eau Claire, and Watervliet	Berrien	
Do	Burlington	Calhoun	
Do	Dowagiac and Marcellus	Cass	
Do	Charlotte	Eaton	

Do	Kalamazoo	Kalamazoo	
Do	Sturgis	St. Joseph	
Do	Keeler and Lawrence	Van Buren	
Silver:			
White Pine Copper Co	White Pine	Ontonagon	
Smelters:			
Calumet & Hecla, Inc	Calumet	Houghton	Primary copper smelter.
Quincy Mining Co	Hancock	----do	Do.
White Pine Copper Co	White Pine	Ontonagon	Do.
Stone:			
Limestone: [5]			
Drummond Dolomite, Inc	De Tour Village	Chippewa	
Dundee Cement Co	Dundee	Monroe	
The France Stone Co	Monroe	----do	
Huron Cement Co., Division of National Gypsum Co.	Alpena	Alpena	
Inland Lime & Stone Co., Division of Inland Steel Co.	Manistique	Mackinac	
Do	----do	Schoolcraft	
The Michigan Stone Co	Maybee and Ottawa Lake	Monroe	
Penn-Dixie Cement Corp	Petoskey	Emmet	
Presque Isle Corp	Alpena	Presque Isle	
United States Steel Corp	Cedarville	Mackinac	
Do	Rogers City	Presque Isle	
Recovered sulfur:			
Leonard Refineries, Inc	Alma	Gratiot	Hydrofining process.
Marathon Oil Co	Detroit	Wayne	Parsons process.
Mobil Oil Co., Inc	Trenton	----do	Claus process.
Exfoliated vermiculite:			
Zonolite Division, W. R. Grace & Co	Dearborn	----do	

[1] Data regarding producers of natural gas, natural gas liquids, and petroleum are not available.
[2] All companies listed under "Clays and shale" operated pits and processing plants; products manufactured are shown under "Remarks" column.
[3] Except for International Salt Co., Inc., who operated an underground salt mine, all companies listed processed well brines and recovered the products shown under "Remark column."
[4] Portable plants were operated at the listed locations unless otherwise specified.
[5] All companies operated stationary plants at the listed locations and produced crushed limestone.

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]

Mineral production in Minnesota in 1967 was valued at $523.3 million, a 5-percent decrease from that of 1966. Chief reason for the decline was a 6-percent drop in value of iron ore shipments. Despite this decrease, Minnesota continued to lead the Nation in shipments of usable iron ore contributing 60 percent of the total shipped from mines in the United States. Iron-bearing ores (including manganiferous ores) accounted for 90 percent of the value of minerals produced in the State. Shipments of taconite concentrates were 23.9 million long tons, exceeding the previous record set in 1966 by 11 percent. Quantity and value increases were recorded for production of clays (including fire clay), peat, lime, and sand and gravel. Quantity and value decreases occurred in production of portland cement, iron ore, manganiferous ore, and stone. Production of abrasive stone and masonry cement decreased in quantity, but increased in value.

Mineral production was recorded from every county in the State. Because of its large-scale iron ore operations, St. Louis County accounted for 77 percent of the State total mineral value while Itasca County ranked second, contributing 13 percent.

[1] Industry economist, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Minnesota [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	224	$336	228	$342
Iron ore (usable) thousand long tons, gross weight	55,133	499,388	49,457	468,623
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight	275,581	W	236,753	W
Peat short tons	11,366	197	13,968	257
Sand and gravel thousand short tons	39,331	28,972	41,212	33,132
Stone do	4,901	11,688	4,160	11,442
Value of items that cannot be disclosed: Abrasive stone, cement, fire clay, gem stones, lime, and values indicated by symbol W	XX	9,696	XX	9,530
Total	XX	550,277	XX	523,326
Total 1957–59 constant dollars	XX	484,876	XX	p 449,917

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."

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Aitkin	$90	$318	Sand and gravel, peat.
Anoka	251	W	Sand and gravel.
Becker	W	512	Sand and gravel, peat.
Beltrami	370	103	Sand and gravel.
Benton	172	200	Do.
Big Stone	745	555	Stone, sand and gravel.
Blue Earth	1,655	1,717	Do.
Brown	206	211	Sand and gravel, clays.
Carlton	656	382	Sand and gravel, peat, clays.
Carver	506	510	Sand and gravel, lime.
Cass	94	204	Sand and gravel, stone.
Chippewa	227	329	Sand and gravel.
Chisago	W	257	Do.
Clay	1,764	2,167	Sand and gravel, lime.
Clearwater	64	138	Sand and gravel.
Cook	302	128	Do.
Cottonwood	155	W	Do.
Crow Wing	11,022	7,491	Iron ore, manganiferous ore, sand and gravel.
Dakota	2,941	2,878	Sand and gravel, stone.
Dodge	W	W	Stone, sand and gravel.
Douglas	551	468	Sand and gravel.
Faribault	205	101	Do.
Fillmore	W	2,558	Iron ore, stone, sand and gravel.
Freeborn	W	368	Sand and gravel.
Goodhue	476	437	Stone, sand and gravel, clays.
Grant	W	197	Sand and gravel.
Hennepin	3,707	3,828	Sand and gravel, clays.
Houston	W	220	Stone.
Hubbard	13	6	Sand and gravel.
Isanti	35	W	Do.
Itasca	72,243	65,703	Iron ore, sand and gravel, peat.
Jackson	60	47	Sand and gravel.
Kanabec	136	132	Do.
Kandiyohi	438	640	Do.
Kittson	31	53	Do.
Koochiching	74	141	Do.
Lac qui Parle	540	686	Stone, sand and gravel.
Lake	115	242	Sand and gravel.
Lake of the Woods	89	292	Do.
Le Sueur	1,704	2,161	Sand and gravel, stone.
Lincoln	118	173	Sand and gravel.
Lyon	273	202	Do.
McLeod	177	312	Do.
Mahnomen	W	W	Do.
Marshall	W	W	Do.
Martin	158	213	Do.
Meeker	146	205	Do.
Mille Lacs	306	252	Stone, sand and gravel.
Morrison	224	280	Sand and gravel.
Mower	511	527	Stone, sand and gravel.
Murray	82	W	Sand and gravel.
Nicollet	606	946	Sand and gravel, stone.
Nobles	173	203	Sand and gravel.
Norman	123	71	Do.
Olmsted	744	W	Stone, sand and gravel.
Otter Tail	480	366	Sand and gravel, peat.
Pennington	W	42	Sand and gravel.
Pine	282	228	Do.
Pipestone	212	193	Do.
Polk	874	1,009	Lime, sand and gravel.
Pope	119	249	Sand and gravel.
Ramsey	W	W	Sand and gravel, clays.
Red Lake	44	41	Sand and gravel.
Redwood	532	422	Sand and gravel, stone, clays.
Renville	524	666	Sand and gravel, stone.
Rice	407	387	Do.
Rock	452	912	Sand and gravel, abrasive stone, stone.
Roseau	85	123	Sand and gravel.
St. Louis	423,257	404,498	Iron ore, cement, sand and gravel, lime, stone, peat.
Scott	1,255	1,026	Stone, sand and gravel.
Sherburne	377	308	Sand and gravel.
Sibley	W	132	Do.
Stearns	2,690	4,238	Stone, sand and gravel.
Steele	494	463	Sand and gravel, stone.
Stevens	W	115	Sand and gravel.
Swift	139	115	Do.
Todd	W	98	Do.
Traverse	36	W	Do.

See footnotes at end of table.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Wabasha	$310	$231	Stone, sand and gravel.
Wadena	66	W	Sand and gravel, stone.
Waseca	49	W	Sand and gravel.
Washington	3,381	3,349	Sand and gravel, stone.
Watonwan	75	6	Sand and gravel.
Wilkin	29	150	Do.
Winona	1,104	943	Stone, sand and gravel.
Wright	207	290	Sand and gravel.
Yellow Medicine	315	340	Sand and gravel, stone.
Undistributed [1]	7,204	2,619	
Total [2]	550,277	523,326	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes some sand and gravel and stone that cannot be assigned to specific counties, and values indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Minnesota business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$10,323	p $11,144	+8.0
Per capita		$2,904	p $3,111	+7.1
Construction activity:				
Building permits:				
Valuation of authorized residential and nonresidential private construction	millions	$333.8	$457.3	+37.0
Number of private and public residential building permits issued		10,387	17,396	+67.5
Contract construction work performed:				
Total	millions	$894	$899	+0.6
Non-residential building	do	$322	$345	+7.1
Residential building	do	$277	$356	+28.5
Non-building	do	$295	$197	−33.2
State highway commission contracts awarded	do	$103.5	$114.1	+10.2
Portland cement shipments to and within Minnesota	thousand 376-pound barrels	8,173.9	8,366.4	+2.4
Cash receipts from farm marketings	millions	$1,814.6	$1,844.0	+1.6
Mineral production	do	$550.3	$523.3	−4.9
Manufacturing payrolls	do	$1,922.0	p $2,111.1	+9.8
Annual average labor force and employment: [1]				
Total labor force	thousands	1,561.5	1,600.7	+2.5
Agricultural employment	do	213.1	199.9	−6.2
Nonagricultural employment [2]	do	1,299.7	1,349.7	+3.8
Manufacturing	do	287.9	303.8	+5.5
Construction	do	61.7	61.9	+0.3
Transportation	do	55.3	56.5	+2.2
Mining and quarrying	do	14.9	14.4	−3.4
Metal mining	do	13.3	12.8	−3.8
Stone, clay, and glass products	do	7.4	7.5	+1.4
Primary metal industries	do	6.9	7.0	+1.4

p Preliminary.
[1] Adjusted to March 1967 benchmark levels.
[2] Includes nonagricultural, self-employed, and unpaid family workers, and domestic workers in private households.

Sources: Survey of Current Business, Construction Review, Statistical Abstract of the United States, Minnesota Department of Highways, Farm Income Situation, Minnesota Department of Employment Security in cooperation with the U.S. Department of Labor.

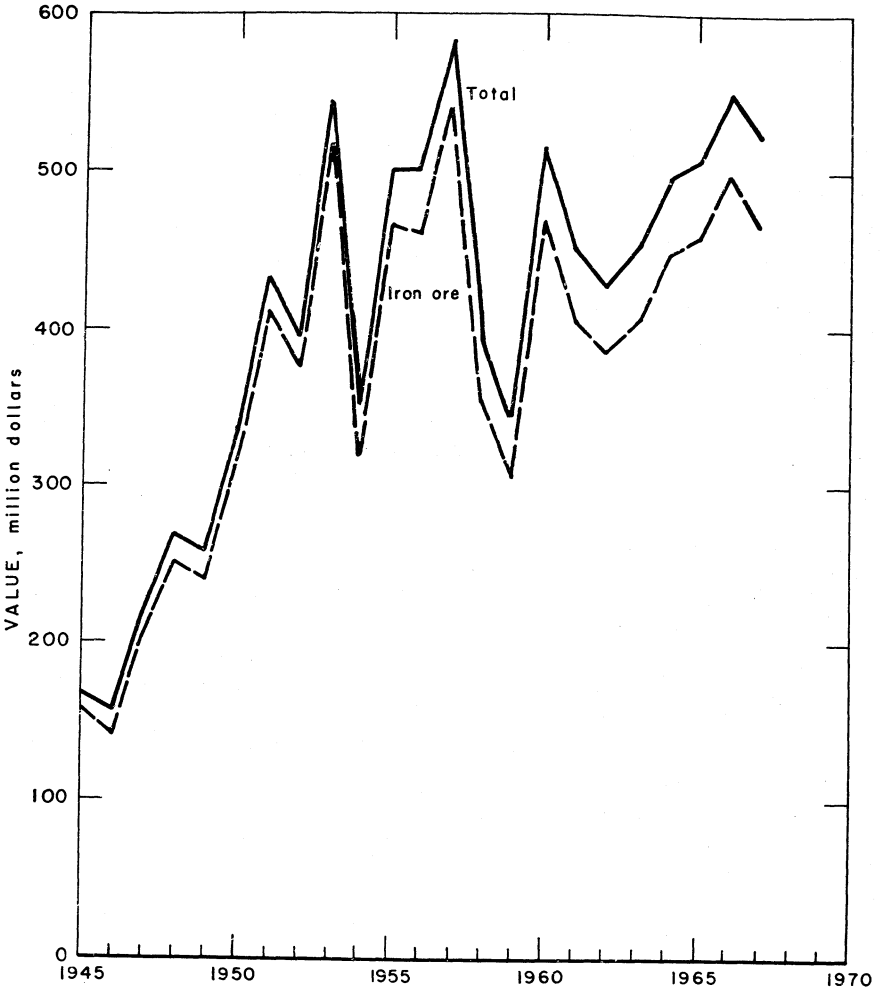

Figure 1.—Value of iron-ore shipments and total value of mineral production in Minnesota.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Peat	25	112	3	19	----	----	----	----
Metal	10,003	294	2,937	23,521	4	97	4.29	1,283
Nonmetal	219	271	59	478	1	29	62.74	14,940
Sand and gravel	2,265	181	409	3,553	2	62	18.01	3,844
Stone	1,452	259	376	3,116	----	47	15.08	391
Total [1]	13,964	271	3,784	30,688	7	235	7.89	1,701
1967: [p]								
Peat	30	115	3	25	----	1	39.70	397
Metal	9,340	295	2,752	22,026	6	71	3.50	2,102
Nonmetal	210	261	54	436	----	21	48.16	2,032
Sand and gravel	2,190	172	377	3,382	1	53	15.97	2,279
Stone	1,315	263	346	2,828	----	47	16.62	489
Total [1]	13,080	270	3,532	28,698	7	193	6.97	1,961

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

REVIEW BY MINERAL COMMODITIES

METALS

Copper-Nickel.—Copper-nickel exploration continued along the Duluth Gabbro in Cook, Lake, and St. Louis Counties. Major companies holding leases in the area and/or doing exploration work included: American Metal Climax, Inc., Bear Creek Mining Co. (exploration division of Kennecott Copper Corp.), Canadian Mining & Smelting Ltd., Cleveland-Cliffs Iron Co., Duval Corp., The Hanna Mining Co., Humble Oil & Refining Co., The International Nickel Co., Inc., Newmont Exploration Ltd., The New Jersey Zinc Co., United States Steel Corp., and Phelps Dodge Corp.

The International Nickel Co., Inc. (Inco), began sinking a 1,100-foot exploration shaft along the South Kawishiwi River, southeast of Ely. In 1968 the company planned to mine from lateral development a bulk sample for metallurgical testing at its Copper Cliff, Ontario, plant. Inco also conducted diamond drilling on its leases in the area. Legislation was enacted by the 1967 Minnesota Legislature establishing the State income tax as the basic method of taxation for copper-nickel mining. A production tax was also placed on the copper-nickel output in lieu of ad valorem property taxes.

The Minnesota Geological Survey conducted geological mapping, geophysical investigations, and other research on the Duluth Gabbro Complex and its copper-nickel deposits.

The University of Minnesota Mines Experiment Station studied flotation processes for the concentration of copper-nickel ores.

Iron Ore.—Shipments of usable iron ore (excluding ore containing 5 percent or more manganese, natural) from Minnesota mines were 49.5 million long tons, a decrease of 10 percent from that of 1966. Value of mine shipments was $468.6 million, 6 percent less than in 1966. The lesser decrease in value resulted from a combination of an 11-percent increase in shipments of higher value taconite concentrates and a 24-percent decrease in natural ore shipments. Concentrates constituted about 77 percent of the total iron ore shipped in 1967. Average iron content of usable ore was 57.3 percent, compared with 56.4 percent in 1966.

Lake Erie base prices for iron ore remained unchanged from 1966. As the result of taconite pellets representing a larger share of the total iron ore shipments, the 1967 average weighted mine value of Minnesota iron ore increased to $9.48 per ton compared with $9.06 per ton in 1966.

Nearly all iron ore produced in Minnesota was sold for pig iron and steel manufacturing. Small quantities were sold for cement manufacture and foundry purposes.

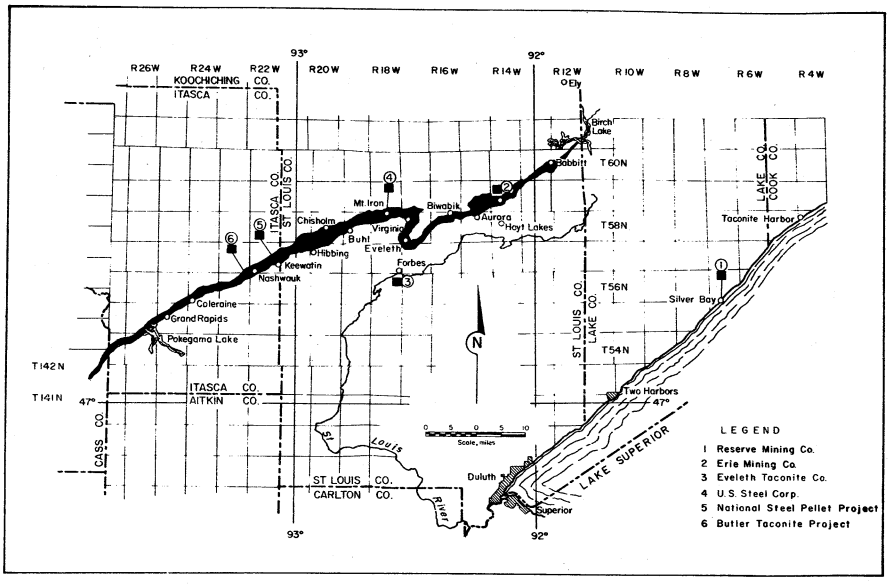

Figure 2.—Locations of Mesabi Range Taconite-processing plants.

Iron ore was produced by 13 companies operating mines on the Cuyuna Range in Crow Wing County, the Mesabi Range in Itasca and St. Louis Counties, the Spring Valley district in Fillmore County, and the Vermilion Range in St. Louis County. Shipments from the Mesabi Range accounted for 97 percent of all iron ore produced in Minnesota and for all of the taconite concentrates produced in the State.

Underground iron mining in Minnesota ceased in June when Inland Steel Co. closed its Armour No. 2 mine on the Cuyuna Range, Crow Wing County. Since its initial shipments in 1912, this mine shipped nearly 9 million tons of ore. Earlier in the year, United States Steel Corp. terminated mining at its Pioneer underground mine at Ely, the last remaining active mine on the Vermilion Range. The Pioneer began production in 1888 and produced about 41 million tons of ore during its operating life.

Completion of new plants and expansion of existing facilities increased shipments of taconite concentrates to 23.9 million long tons or 48 percent of the total Minnesota iron ore shipments, compared with 21 million tons, or 39 percent of the total, in 1966

At yearend, Minnesota's annual taconite capacity approached 32 million tons. The Hanna Mining Co. began production at the Butler Taconite Project in March. This operation is owned by The Hanna Mining Co., Inland Steel Co., and Wheeling Steel Corp. Oxide pellets are produced by the Allis-Chalmers grate-kiln process. The National Steel Pellet Plant, operated by The Hanna Mining Co. near Keewatin, began production in June. National Steel Corp. has an 85 percent interest in the venture and The Hanna Mining Co. a 15-percent interest. The plant produces pellets using a Midland-Ross twin-hearth rotary furnace. Both the National Steel and Butler plants were designed to employ autogenous grinding methods. Primary crushing for both plants is done in the pit areas with 60-inch gyratory crushers. A 200-car unit train transported pellets from these plants to the Great Northern Railway Co.'s ore docks at Superior, Wis. During the winter months, the pellets were stockpiled at the Great Northern's 2.2-million-ton capacity storage and handling facility at Superior.

United States Steel Corp.'s 4.5-million-ton-per-year Minntac taconite plant near Mountain Iron was in the startup stage at yearend. The first of three pellet production lines was placed in operation in October, using concentrates from the com-

pany's Pilotac plant. Crude ore for the Minntac operation was transported by rail from the nearby Minntac mine (formerly the Pilotac mine). The plant was expected to treat over 13 million tons of crude ore annually. Pellets were transported by the Duluth, Missabe & Iron Range Railroad (D.M.&I.R.) to its docks at Duluth and Two Harbors. Winter storage of taconite pellets is to be at the D.M. & I.R.'s Lakehead storage area at Duluth. During most of 1967, concentrates were shipped from the Pilotac operation to the company's Extaca plant near Virginia for agglomeration, but after the company ceased operations at the Extaca plant late in 1967, all concentrates produced at the Pilotac plant were agglomerated at the Minntac plant.

Erie Mining Co. (Pickands Mather & Co. operating agents) completed a $50 million expansion project designed to increase annual pellet capacity to 10.3 million tons at its Hoyt Lakes plant. Incorporated into this expansion was a method for effective 325-mesh separation of magnetite at high tonnage rates. The company mined approximately 30 million tons of crude taconite in 1967. Pellet production was about 9.9 million tons, exceeding the record set in 1966 by nearly 16 percent. From its Hoyt Lakes plant, pellets were transported 74 miles on the company-owned railroad to the company's shipping port at Taconite Harbor.

Reserve Mining Co. mined about 29.4 million tons of crude taconite from its Peter Mitchell mine near Babbitt. Ore was crushed to about 3-inch size at the mine and transported 47 miles on the company's railroad to its Silver Bay plant for further crushing, concentrating, pelletizing, and shipment.

Eveleth Taconite Co., owned jointly by Ford Motor Co. (85 percent) and Oglebay Norton Co. (15 percent), completed its second year of operation and exceeded its rated annual capacity, producing about 1.7 million tons of pellets. After primary crushing, about 5 million tons of crude ore produced at the Thunderbird mine was transported 10 miles by rail to the company's Fairlane plant near Forbes. Pellets were hauled about 61 miles by rail to Duluth for transshipment by lake vessel to lower Lake ports. Pellets were stored during the winter months in D.M. & I.R.'s Lakehead storage area at Duluth.

Natural ore mines producing more than 1 million tons, in decreasing order of production, were the Sherman group, Stephens mine, and the Rouchleau group, all operated by United States Steel Corp.; South Agnew and Pierce group, operated by The Hanna Mining Co.; the Plummer group, operated by United States Steel Corp.; and the Mahoning group, operated by Pickands Mather & Co. All except the Plummer group were located in St. Louis County.

At McKinley, Jones & Laughlin Steel Corp. constructed a 1.5-million-ton-per-year natural ore treatment plant and conducted development work at its McKinley mine. The mine and plant are to begin production in early 1968, producing beneficiated ore averaging 55 percent iron. Two sizes of material were to be produced —plus ⅜-inch for direct blast furnace consumption and minus ⅜-inch for sinter production. The property is leased from the United States Steel Corp., who last operated it in 1960. Shipments from this operation will be by rail to Superior, Wis., for transshipment by lake vessel to Jones & Laughlin Steel plants in Ohio and Pennsylvania. The company also expanded its Lind-Greenway and Hill-Annex mines near Grand Rapids and Calumet, respectively.

United States Steel Corp. announced plans to install additional ore washing facilities at its Sherman plant near Buhl to improve the competitive position of material produced. Construction began in September and was scheduled for completion in early 1968. The company also planned to begin development activities at its Twin City property at Chisholm preparatory to production from this property in 1970, as part of the Sherman mine complex.

Shipments from the Cuyuna Range decreased 39 percent from those of 1966. Ore was transported 101 miles by rail from Ironton to the Northern Pacific Railway Co. ore docks at Superior, Wis. Shipments from the Spring Valley district were all by rail, primarily to consuming furnaces at Granite City, Ill., with lesser amounts going to cement manufacturers.

The navigation season for Lake Superior ports shipping Minnesota iron ores began April 12 at Duluth and at Taconite Harbor. The final shipment, consisting of taconite pellets, left Two Harbors on December 28, the latest date on record for shipping Minnesota ores. About 94 per-

cent of all iron ore shipments in 1967 were by lake vessel to lower Lake ports, and thence to consuming districts. United States Steel Corp. has contracted for the construction of a self-unloading cargo vessel, with a capacity of 45,000 gross tons. This vessel, with a length of 858 feet and a beam of 105 feet, is designed to utilize the new Poe Lock scheduled to open in 1968 at Sault Ste. Marie, Mich.

The University of Minnesota Mines Experiment Station, the University's School of Mineral & Metallurgical Engineering, and the Minnesota Geological Survey continued their deep drilling project along the southern edge of the Mesabi Range. Plans were to drill 10 holes, at 10-mile intervals, to intersect the taconite formations at depths of 500 to 1,500 feet. Four holes, ranging in depth from 1,437 to 2,270 feet, were completed in 1967. The drilling was done near Keewatin and Taconite in Itasca County, and Biwabik and Buhl in St. Louis County. Results indicated an extension of known taconite reserves. The drilling was financed by a $100,000 grant from the Minnesota Iron Range Resources & Rehabilitation Commission.

The Mines Experiment Station continued its research on the concentration of semitaconites and oxidized taconite at the pilot plant level using high-intensity magnetic separation followed by flotation concentration. Research on magnetic taconite included magnetic separation, hydrosizer investigations, cyclone classification, and pelletizing.

Research on the utilization of Minnesota iron ores conducted by the Bureau of Mines at its Twin Cities Metallurgy Research Center included investigation of several aspects of iron ore flotation, preparation of prereduced and oxidized iron ore pellets, evaluation of various binding agents for iron ore pellets, application of lignite in iron ore processing, concentration of iron ores, magnetic roasting of nonmagnetic taconite, and studying the crystal structure of various iron-bearing materials in relation to their behavior in metallurgical processing. A report on Bureau of Mines research on nonmagnetic Mesabi Range taconites was published.[2]

Construction work began on the Bureau's demonstration plant near Keewatin which is designed to demonstrate the commercial feasibility of magnetically roasting nonmagnetic taconites, semitaconites, and off-grade iron ores using scrap iron as a reductant. The Bureau plans to produce prereduced pellets containing about 82 percent iron.

[2] Heising, L. F., C. B. Daellenbach, and E. E. Anderson. Lake Superior Iron Resources—Reexamination of Nonmagnetic Taconite Occurrences in the Hibbing, Minn., Area by Flotation, Magnetic Separation, and Petrographic Methods. BuMines Rept. of Inv. 6991, 1967, 22 pp.

Table 5.—Crude iron ore [1] data, in 1967, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production		Shipments		Stocks Dec. 31
		Underground	Open pit	Direct to consumers	To concentrators	
County:						
Crow Wing	76	176	1,177	214	1,177	38
Fillmore	---	-----	83	--------	83	-----
Itasca	---	-----	19,675	--------	19,675	-----
St. Louis	401	225	94,815	10,935	83,648	858
Total	477	401	115,750	11,149	104,583	896
Range:						
Cuyuna	76	176	1,177	214	1,177	38
Mesabi	401	-----	114,489	10,935	103,098	858
Vermilion	---	225	---------	--------	225	-----
Spring Valley district	---	-----	83	--------	83	-----
Total [2]	477	401	115,750	11,149	104,583	896

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Data may not add to totals shown because of independent rounding.

Table 6.—Usable iron ore [1] data, in 1967, by counties and ranges

(Thousand long tons)

County and range	Stocks Jan. 1	Production	Iron content of producton	Shipments	Stocks Dec. 31
County:					
Crow Wing	76	1,041	539	797	320
Fillmore	295	58	27	312	40
Itasca	1,560	6,827	3,948	7,260	1,127
St. Louis	2,729	42,232	24,228	41,088	3,873
Total [2]	4,659	50,157	28,742	49,457	5,360
Range:					
Cuyuna	76	1,041	539	797	320
Mesabi	4,202	48,857	28,055	48,059	5,000
Vermilion	87	202	121	289	------
Spring Valley district	295	58	27	312	40
Total [2]	4,659	50,157	28,742	49,457	5,360

[1] Exclusive of ore containing 5 percent or more manganese.
[2] Data may not add to totals shown because of independent rounding.

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]
1884–1962	65,640	2,372,298	100,200	5,668	2,543,805
1963	515	43,570	774	524	45,383
1964	513	47,256	865	420	49,054
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
Total [2]	69,375	2,613,766	103,527	8,066	2,794,733

[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	Gross weight		Iron content (percent)	Year	Gross weight		Iron content (percent)
	Ore	Iron content			Ore	Iron content	
1963	45,383	25,576	56.36	1965	52,053	29,510	56.69
1964	49,054	27,660	56.39	1966	54,280	30,625	56.42
				1967	50,157	28,742	57.30

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		
1963	7,468	16,857	21,110	37,967	45,435	83.56
1964	10,441	19,267	19,917	39,184	49,626	78.96
1965	11,579	19,039	20,255	39,294	50,873	77.24
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

[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	1966		1967	
	First	Final	First	Final
Duluth, Minn.: DM&IR	Mar. 30	Nov. 27	Apr. 12	Dec. 11
Escanaba, Mich.: C&NW	Mar. 31	Dec. 23	Apr. 7	Dec. 22
Marquette, Mich.:				
Soo Line	Apr. 26	Nov. 20	May 9	Nov. 14
LS&I	Apr. 4	Dec. 13	Apr. 15	Dec. 16
Silver Bay, Minn.: Reserve	Apr. 8	Dec. 13	Apr. 15	Dec. 10
Superior, Wis.:				
GN	Apr. 11	Dec. 1	Apr. 14	Dec. 17
NP-Soo Line	Apr. 22	Oct. 24	May 2	Oct. 25
Taconite Harbor, Minn.: Erie	Apr. 8	Dec. 10	Apr. 12	Dec. 8
Two Harbors, Minn.: DM&IR	May 20	Nov. 20	May 15	Dec. 28

Source: Skillings' Mining Review.

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)	
1963	------	-------	-------	310,121	33.39	12.18	310.121
1964	27,725	36.59	9.68	140,562	32.61	12.38	168,287
1965	32,935	33.99	7.27	217,695	35.47	12.75	250,630
1966	4,035	33.55	8.61	242,020	33.87	14.12	246,055
1967	------	-------	-------	211,387	32.88	14.56	211,387

[1] Direct-shipping and beneficiated ore.

Manganiferous Ore.—Shipments of manganiferous ore (ore containing 5 to 35 percent manganese, natural) were 211,387 long tons, a decrease of 14 percent from those of 1966. All shipments were concentrates of ferruginous manganese ore (ore containing 10 to 35 percent manganese, natural) from stocks. Average natural iron and manganese contents of shipments were 32.9 and 14.6 percent, respectively. Manganiferous ore was shipped from seven Cuyuna Range properties in Crow Wing County by The Hanna Mining Co. and Pittburgh Pacific Co. The latter company was converting the underground portion of its Louise mine near Crosby to an open-pit mine, with plans to begin mining in 1968.

Studies were continued by the University of Minnesota Mines Experiment Station regarding recovery of manganese from Cuyuna Range manganiferous ores by various leaching processes.

At its Twin Cities Metallurgy Research Center, the Federal Bureau of Mines conducted research on the extraction of both iron and manganese products from low-grade Cuyuna Range ores by roasting and autoclave techniques.

Iron and Steel.—American Steel & Wire Division of United States Steel Corp. produced basic pig iron, steel, and coke at Duluth. In mid-1967, North Star Steel Co. began operating a 50-ton capacity electric furnace at St. Paul, producing steel from ferrous scrap.

NONMETALS

Abrasive Stone.—The Jasper Stone Co. produced grinding pebbles and tube-mill liners from a quartzite deposit near Jasper, Rock County. Sales of both types of material decreased in quantity but increased in value from those of 1966.

Cement.—Portland and masonry cements were manufactured at Duluth by Universal Atlas Cement Division of United States Steel Corp., the State's sole producer. Shipments of portland cement remained virtually unchanged in quantity but decreased in value from those of 1966 because of a decline in sales of higher valued portland slag-cement and an increase in sales of types I and II (general use and moderate heat) cement. Masonry cement shipments declined from those of 1966 while shipments of portland cement to ready-mixed concrete companies, highway contractors, and other contractors increased. Sales to building material dealers, concrete manufacturers, and government agencies declined. Raw materials used in the manufacturing process included limestone from Michigan, slag from the nearby U.S. Steel blast furnaces, sand, bauxite, gypsum, iron dust, and air-entraining compounds. Three rotary kilns were operated, using bituminous coal and natural gas for fuel. Shipments were primarily to Minnesota consumers, with lesser amounts shipped to Iowa, Michigan, North Dakota, South Dakota, and Wisconsin. Most of the cement was transported in bulk by rail and by truck.

Shipments of cement to and within Minnesota in 1967 were about 8.4 million barrels of portland cement and 419,000 barrels of masonry cement, representing an increase of 2 percent and a decrease of 3 percent, respectively, from those of 1966. Shipments were received from plants in 11 other States during 1967.

Dundee Cement Co. finished construction of its distribution center on the Upper Harbor of the Mississippi River at Minneapolis. Huron Cement Co., Division of National Gypsum Co., began construction of a distribution center, also located in Minneapolis.

Clays.—Miscellaneous clay and shale was produced in Brown, Carlton, Hennepin, Ramsey, and Redwood Counties. Production increased about 2 percent in quantity and value. Chief reason for the increase was a greater demand for material used in production of lightweight aggregate. Material was also used for the manufacture of building brick, and floor and wall tile. Output of fire clay, all of which was used in the manufacture of vitrified sewer pipe, increased in quantity and value from that of 1966.

The Minnesota Geological Survey continued its investigation of kaolin and other clay resources of the State. The purpose of this study was to provide geologic data useful in developing Minnesota's clay resources. Included in the study were clays and shales from the Minnesota River Valley in Brown, Redwood, Renville, and Yellow Medicine Counties; along the Mississippi River between Little Falls and St. Cloud; an area near Austin, Mower County; and the Glenwood and Decorah Formations in southeastern and east-central Minnesota.

At its Twin Cities Research Center, the Federal Bureau of Mines continued testing the suitability of clays from a portion of the glacial Lake Agassiz basin in St. Louis County for use as taconite concentrate binder. A paper concerning this research was presented at the Minnesota Section A.I.M.E. meeting in Duluth.

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 south-

eastern part of the State. The material was used principally for handmade jewelry and personal collections.

Lime.—Total output of quicklime and hydrated lime in Minnesota increased 8 percent in quantity and value over that of 1966. Minnesota's only commercial lime producer, Cutler-Magner Co. at Duluth, manufactured both quicklime and hydrated lime using limestone transported by lake vessel from Michigan. One rotary kiln was operated, using bituminous coal as fuel. About 83 percent of the company's output was sold for chemical and industrial uses, including paper manufacture, water purification, metallurgical purposes, petroleum refining, and paint manufacture. Lime for soil stabilization, mason's lime, and agricultural purposes comprised the remainder. Most of the lime was consumed within the State with lesser shipments to Iowa, Michigan, Montana, North Dakota, South Dakota, and Wisconsin. American Crystal Sugar Co. produced quicklime for sugar refining 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.

In addition to lime produced and consumed in Minnesota, shipments were also received from Illinois, Iowa, Missouri, Ohio, and Wisconsin.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,702	$3,131	3,922	$3,312
Paving	2,481	1,406	3,679	2,340
Fill	846	319	1,038	491
Other [1]	461	1,185	516	1,353
Total	7,490	6,041	9,155	7,496
Gravel:				
Building	3,123	4,842	3,254	5,387
Paving	15,920	10,562	17,943	13,802
Railroad ballast	405	249	180	114
Fill	1,010	382	1,174	486
Other	29	33	15	16
Total	20,487	16,068	22,566	19,805
Total sand and gravel	27,977	22,109	31,721	27,301
Government-and-contractor operations:				
Sand:				
Building	1	(2)	-------	-------
Paving	2,310	1,247	1,449	794
Fill	118	56	103	48
Other	14	6	49	27
Total	2,443	1,309	1,601	869
Gravel:				
Building	3	2	3	2
Paving	8,703	5,482	7,708	4,882
Fill	165	57	179	78
Other	40	13	-------	-------
Total	8,911	5,554	7,890	4,962
Total sand and gravel	11,354	6,863	9,491	5,831
All operations:				
Sand	9,933	7,350	10,756	8,365
Gravel	29,398	21,622	30,456	24,767
Total	39,331	28,972	41,212	33,132

[1] Includes railroad ballast (1966), blast, engine, filler, foundry, glass, molding, oil (hydrafrac), pottery, porcelain, tile, and other construction and industrial sand.
[2] Less than ½ unit.

Perlite.—Minnesota Perlite Corp. and Zonolite Division, W. R. Grace & Co., produced expanded perlite at plants in Hennepin County from crude material mined outside the State. The expanded product was used for building plaster, concrete aggregate, insulation, texture, and horticultural purposes. Production decreased both in quantity and value. Minnesota Perlite Corp. discontinued production in May 1967.

Sand and Gravel.—Minnesota sand and gravel output set a record high in 1967 of 41.2 million tons valued at $33.1 million. This represented an increase of 5 percent in quantity and 14 percent in value over the previous record set in 1966. Major reason for the gain was an increase of 1.4 million tons of material used for road construction. Sand and gravel for building increased 5 percent in quantity and 9 percent in value. Total sales of industrial sand used for foundry, engine, blast, filler, oil (hydrafrac), pottery, glassmaking, porcelain, molding, tile, and other purposes increased 6 percent in quantity and 11 percent in value. About 75 percent of the sand and gravel production was used for paving, 17 percent for building, and 6 percent for fill. Average value of sand and gravel in 1967 was $0.80 per ton compared with $0.74 in 1966. Sand and/or gravel was produced in 86 of the 87 counties in the State. Counties with production exceeding 1 million tons, in descending order of production, were Hennepin, Dakota, St. Louis, Washington, Stearns, and Clay. Collectively these six counties accounted for 40 percent of all

Table 13.—Production of sand and gravel in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Aitkin	450	$303	Meeker	217	$205
Anoka	W	W	Mille Lacs	128	W
Becker	556	W	Morrison	399	280
Beltrami	171	103	Mower	357	183
Benton	236	200	Murray	184	W
Big Stone	284	W	Nicollet	795	W
Blue Earth	623	526	Nobles	326	203
Brown	186	W	Norman	125	71
Carlton	357	W	Olmsted	318	W
Carver	470	W	Otter Tail	470	W
Cass	315	W	Pennington	66	42
Chippewa	412	329	Pine	383	228
Chisago	510	257	Pipestone	393	193
Clay	1,282	W	Polk	637	W
Clearwater	213	138	Pope	315	249
Cook	201	128	Ramsey	541	531
Cottonwood	301	W	Red Lake	54	41
Crow Wing	190	182	Redwood	550	W
Dakota	3,283	W	Renville	480	W
Dodge	W	W	Rice	558	W
Douglas	831	468	Rock	710	W
Faribault	109	101	Roseau	228	123
Fillmore	99	65	St. Louis	2,896	2,116
Freeborn	599	368	Scott	461	415
Goodhue	107	W	Sherburne	307	308
Grant	404	197	Sibley	122	132
Hennepin	4,798	W	Stearns	1,305	W
Houston	-----	-----	Steele	445	W
Hubbard	10	6	Stevens	137	115
Isanti	W	W	Swift	201	115
Itasca	663	345	Todd	182	98
Jackson	60	47	Traverse	W	W
Kanabec	166	132	Wabasha	97	W
Kandiyohi	582	640	Wadena	121	W
Kittson	86	53	Waseca	W	W
Koochiching	181	141	Washington	2,803	W
Lac qui Parle	168	W	Watonwan	12	6
Lake	455	242	Wilkin	292	150
Lake of the Woods	467	292	Winona	W	W
Le Sueur	883	1,437	Wright	434	290
Lincoln	278	173	Yellow Medicine	187	W
Lyon	222	202	Undistributed [1]	1,164	19,438
McLeod	310	312			
Mahnomen	W	W	Total	41,212	33,132
Marshall	W	W			
Martin	294	213			

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.

the sand and gravel produced in Minnesota. About 94 percent of the commercial production was transported by truck, 4 percent by river barge, and 2 percent by rail. Minnesota supplied about 4.6 percent of the national sand and gravel output.

Stone.—Stone production, consisting of basalt, granite, limestone, marl, and quartzite decreased 15 percent in quantity and 2 percent in value, chiefly because of a 15-percent decline in tonnage of crushed and broken stone. An increase of 16 percent in value of dimension stone moderated the drop in total value of stone production.

Limestone was produced from deposits in 15 south-central and southeastern counties. Major producing counties, in descending order of value, were Blue Earth, Washington, Le Sueur, Scott, and Winona, collectively representing 58 percent of the State limestone value. Limestone accounted for 88 percent of the quantity and 58 percent of the value of stone production in Minnesota. Crushed and broken limestone decreased 16 percent in quantity and in value mainly because of a 737,000-ton decline in the amount of stone used for roadstone and concrete aggregate. Production of limestone for riprap and railroad ballast decreased about 47,000 and 30,000 tons, respectively. Output of agricultural limestone increased approximately 42 percent in quantity and 49 percent in value. About 85 percent of the crushed and broken limestone was transported by truck, 13 percent by water, and 2 percent by rail.

Production of dimension limestone increased substantially. The largest increases were recorded for sales of rough architectural stone and house stone veneer. Nearly all Minnesota dimension limestone production was from Blue Earth, Le Sueur, and Winona Counties.

Granite production decreased 1 percent in quantity and increased 13 percent in value owing to a decline in crushed and broken granite output and greater sales of dimension granite. Eight companies produced granite in seven west-central and central Minnesota counties. Counties with the largest production, in descending order of value, were Stearns, Lac qui Parle, and Big Stone, collectively representing 87 percent in value of all granite produced in Minnesota. Granite accounted for 39 percent of the total value of all stone produced in the State. Dimension granite increased 10 percent in quantity and 16 percent in value, primarily because of increased sales of stone for architectural purposes. Plants in Cold Spring, Delano, and St. Cloud produced finished stone for monuments and architectural purposes.

Production of crushed and broken granite declined 1 percent in quantity and value because of decreased sales of stone for railroad ballast. Crushed granite used for roadstone and concrete aggregate increased substantially both in quantity and value. Other uses for crushed and broken granite were riprap, poultry grit, traction grit, and stone sand.

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

Use		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:					
Rough monumental	thousand cubic feet	21	$73	24	$71
Dressed architectural	do	150	2,102	177	2,665
Dressed monumental	do	74	1,089	70	1,059
Total	approximate short tons [1]	20	3,264	22	3,795
Crushed and broken:					
Concrete aggregate and roadstone	thousand short tons	86	166	121	238
Railroad ballast	do	233	346	194	271
Riprap	do	W	W	6	9
Other [2]	do	26	170	19	159
Total	do	345	682	340	[3] 678
Grand total	do	365	3,946	[3] 363	[3] 4,472

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Average weight of 166 pounds per cubic foot used to convert cubic feet to short tons.
[2] Includes granite for riprap (1966), grit, and stone sand.
[3] Data do not add to total shown because of independent rounding.

Table 15.—Limestone sold or used by producers, by uses

Use		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:					
Rough construction	thousand short tons	(1)	$3	-------	-------
Rubble	do	-------	-------	(1)	(1)
Rough architectural	thousand cubic feet	9	40	67	$315
Sawed	do	32	157	8	49
House stone veneer	do	45	114	99	296
Cut	do	97	1,425	90	1,315
Flagging	do	13	1	43	11
Total [2]	approximate thousand short tons [3]	16	1,740	25	1,987
Crushed and broken:					
Riprap	thousand short tons	151	198	104	136
Concrete aggregate and roadstone	do	3,706	4,377	2,968	3,647
Agriculture	do	324	518	461	772
Railroad ballast	do	44	60	14	19
Other [4]	do	99	433	75	114
Total [2]	do	4,323	5,585	3,622	4,688
Grand total [2]	do	4,339	7,324	3,647	6,675

[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.
[3] Average weight of 160 pounds per cubic foot used to convert cubic feet to short tons.
[4] Includes limestone for filter beds (1966), asphalt, flux, poultry grit (1966–67), and other uses (1967).

Table 16.—Stone production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	Type of stone
Big Stone	2	W	Dimension granite.
Blue Earth	258	$1,191	Crushed and dimension limestone.
Cass	W	W	Marl.
Dakota	W	W	Crushed limestone.
Dodge	W	W	Do.
Fillmore	383	443	Do.
Goodhue	285	326	Do.
Houston	205	220	Do.
Lac qui Parle	3	W	Dimension granite.
Le Sueur	28	724	Crushed and dimension limestone.
Mille Lacs	W	W	Dimension granite.
Mower	252	344	Crushed and dimension limestone.
Nicollet	W	W	Crushed quartzite.
Olmsted	487	558	Crushed limestone.
Redwood	W	W	Dimension granite.
Renville	W	W	Do.
Rice	W	W	Crushed limestone.
Rock	W	W	Crushed and dimension quartzite.
St. Louis	65	95	Crushed basalt.
Scott	370	611	Crushed limestone.
Stearns	228	W	Crushed and dimension granite.
Steele	W	W	Crushed and dimension limestone.
Wabasha	126	W	Crushed limestone.
Wadena	W	W	Marl.
Washington	W	W	Crushed limestone.
Winona	W	W	Crushed and dimension limestone.
Yellow Medicine	W	W	Crushed granite.
Undistributed	1,466	6,929	
Total [1]	4,160	11,442	

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

Quartzite was produced in Nicollet County near New Ulm and in Rock County near Jasper. Output was used for concrete aggregate and roadstone, filters, furnace and converter linings, railroad ballast, riprap, rubble, and other purposes.

Crushed and broken basalt was produced near Duluth, St. Louis County, mainly for concrete aggregate and roadstone, with a lesser amount used for riprap. Production decreased substantially from that of 1966.

Marl, for agricultural purposes, was produced in Cass and Wadena Counties. Output decreased from that of 1966.

Sulfur.—The Great Northern Oil Co. and Northwestern Refinery Co. recovered elemental sulfur, as a byproduct, at refineries near Pine Bend, Dakota County, and St. Paul Park, Washington County. The latter company began recovering sulfur in July, utilizing the Modified-Claus process. Shipments increased both in quantity and value from that of 1966.

Vermiculite.—Exfoliated vermiculite was produced from crude material mined outside the State at two plants in Minneapolis, Hennepin County, and one in St. Paul, Ramsey County. Total value of output remained about the same as in 1966, but the quantity decreased about 2 percent. The exfoliated material was used for various types of insulation, plaster aggregate, concrete aggregate, and agricultural purposes.

MINERAL FUELS

Peat.—Increased demand for peat was evidenced by the 1967 shipments of nearly 14,000 tons which almost equaled the record output of 1964. Production of both moss and reed-sedge peat increased significantly in quantity and value over that of 1966. No shipments of humus peat were recorded in 1967. Peat was produced by five companies in Aitkin, Becker, Carlton, Itasca, Otter Tail, and St. Louis Counties. Material was sold in bulk and in packaged form and was used for general soil improvement, packaging shrubs and other plants, and as an ingredient for potting soils. A 3-year research project was planned by the Minnesota Iron Range Resources & Rehabilitation Commission to examine the possibility of using peat as a waste stabilizer in polluted water. The project would be financed by a grant from the Federal Water Pollution Control Administration, Department of the Interior.

Table 17.—Principal producers and processors of metals, minerals, and mineral fuels

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Abrasive stone—Grinding pebbles and tube-mill liners:			
Jasper Stone Co	Jasper	Rock	
Cement:			
Universal Atlas Cement Division, United States Steel Corp.	Duluth	St. Louis	Portland and masonry, dry process.
Clays and shale: [1]			
North Central Lightweight Aggregate Co., Inc	Minneapolis	Hennepin	Lightweight aggregate.
Ochs Brick & Tile Co	Redwood Falls	Redwood	Pit only, processing plant at Springfield. Brick.
Do	Springfield	Brown	Brick, lightweight aggregate.
Red Wing Sewer Pipe Corp	Goodhue	Goodhue	Vitrified sewer pipe.
Twin City Brick Co	St. Paul	Ramsey	Brick.
Coke:			
American Steel & Wire Division, United States Steel Corp.	Duluth	St. Louis	
Koppers Co. Inc	St. Paul	Ramsey	
Iron ore:			
Cleveland-Cliffs Iron Co.:			
Canisteo	Coleraine	Itasca	Mine and concentrator.
Hill-Trumbull	Marble	----do	Do.
Holman-Cliffs	Taconite	----do	Do.
Sally	Coleraine	----do	Ore treated at Canisteo Plant.
Coons Pacific Co.:			
Coons Pacific Plant	Eveleth	St. Louis	Concentrator.
The Hanna Mining Co.:			
Rabbit Lake	Cuyuna Village	Crow Wing	Mine and concentrator.
Spring Valley	Spring Valley	Fillmore	Stockpile shipments only.
Butler Taconite Project	Nashwauk	Itasca	Mine, concentrator, and agglomerator. Production began March, 1967.
Harrison and Patrick Groups	----do	----do	Stockpile shipments only.
Hunner	Coleraine	----do	Do.
Mississippi Group	Keewatin	----do	Do.
National Steel Pellet Project	----do	Itasca and St. Louis	Mine, concentrator, and agglomerator. Production began June, 1967.
Douglas Group	Chisholm	St. Louis	Stockpile shipments only.
Morton	Hibbing	----do	Do.
Pierce Group	----do	----do	Mine and concentrator.
South Agnew group	----do	----do	Do.
Inland Steel Co.:			
Armour No. 2	Crosby	Crow Wing	Underground mine. Permanently closed June 1967.
Dean	Buhl	St. Louis	Development work only by Snyder Mining Co.
Jones & Laughlin Steel Corp.:			
Hill Annex	Calumet	Itasca	Mine and concentrators.
Lind-Greenway	Grand Rapids	Itasca	Do.
McKinley	McKinley	St. Louis	Development work only.
Schley Group	Gilbert	----do	Mine and concentrator.

See footnotes at end of table.

Table 17.—Principal producers and processors of metals, minerals, and mineral fuels—Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Iron ore—Continued			
Oglebay Norton Co.:			
Thunderbird Mine	Eveleth	do	
Fairlane Plant	Forbes	do	Concentrator and agglomerator.
Pacific Isle Mining Co.:			
Higgins No. 2	Virginia	do	Ore treated at Coons Pacific Plant. Mine closed late in 1967.
Oneida	do	do	First year of operation. Ore treated at Coons Pacific Plant.
Pickands Mather & Co.:			
Danube	Bovey	Itasca	Mine and concentrator.
West Hill	Grand Rapids	do	Mine and concentrator. Property sold to Pacific Isle Mining Co. November 1967.
Erie Commercial Mine	Hoyt Lakes	St. Louis	
Hoyt Lakes Plant	do	do	Concentrator and agglomerator.
Mahoning	Hibbing-Keewatin	do	Mine and concentrator.
Pittsburgh Pacific Co.:			
Sagamore	Ironton	Crow Wing	Stockpile shipments only.
Arne Mine & Embarrass LOSP	Aurora	St. Louis	Do.
Coons	Virginia	do	Ore treated at Coons Pacific Plant.
Corsica Douglas LOSP	McKinley	do	Stockpile shipments only.
Dormer LOSP and Wade LOSP	Kinney	do	Ore treated at Coons Pacific Plant.
Julia Plant	Virginia	do	Concentrator.
Leonidas	Leonidas Village	do	Ore treated at Coons Pacific Plant.
Lincoln	Virginia	do	Ore treated at the Coons Pacific and Julia Plants.
McEwen-Onondaga	Franklin Village	do	Development work only.
Syracuse	White Township	do	Stockpile shipments only.
Wyoming Annex	Virginia	do	Ore treated at Julia Plant.
Reserve Mining Co.:			
Peter Mitchell	Babbitt	St. Louis	Mine and primary crushing.
E.W. Davis Works	Silver Bay	Lake	Concentrator and agglomerator.
Rhude & Fryberger:			
Gross-Nelson	Eveleth	St. Louis	Mine and concentrator.
Hull-Rust	Hibbing	do	Do.
Schroeder Mining Co.:			
Wright	Wykoff	Fillmore	Do.
Snyder Mining Co.:			
Kosmerl Lease Area, Wanless, Whiteside, and Woodbridge.	Buhl	St. Louis	
United States Steel Corp. Minnesota Ore Operations			
Arcturus	Marble	Itasca	Development work only.
Kosmerl	Buhl	St. Louis	Mined by Snyder Mining Co. in conjunction with Whiteside mine.
Minntac	Mountain Iron	do	Mine (formerly known as Pilotac), concentrator, and agglomerator. Agglomerator began production late in 1967.
Extaca Plant	do	do	Agglomerator.
Plummer Group	Coleraine	Itasca	Mine and concentrator.

Trout Lake Concentrator	do	do	Concentrator.
Rouchleau Group	Virginia	St. Louis	Mine and concentrator.
Sherman Group	Fraser	do	Do.
Stephens	White Township	do	Do.
Pioneer	Ely	do	Underground mine and concentrator (Vermilion range). Closed in spring of 1967.
Iron and steel:			
American Steel & Wire Division United States Steel Corp.	Duluth	do	Iron blast furnace and open-hearth furnace.
North Star Steel Co	St. Paul	Ramsey	Electric steel furnace.
Secondary Lead Smelters:			
Gopher Smelting & Refining Co	do	Dakota	
National Lead Co	St. Louis Park	Hennepin	
Lime:			
American Crystal Sugar Co	Chaska	Carver	Quicklime, shaft kiln.
Do	Moorhead	Clay	Do.
Do	Crookston and East Grand Forks.	Polk	Do.
Cutler-Magner Co	Duluth	St. Louis	Quicklime and hydrated lime, one rotary kiln, one batch hydrator.
Manganiferous ore:			
The Hanna Mining Co.:			
Algoma and Merritt No. 2	Crosby	Crow Wing	Stockpile shipments only.
Pittsburgh Pacific Co.:			
Hopkins, Mangan No. 1, Mangan East, Mangan-Stai, and Sultana.	Ironton	do	Stockpile shipments only.
Louise	do	do	Development work only.
Peat:			
Colby Pioneer Peat Co	Wawina	Aitkin	Bog in Aitkin County, plant in Itasca County.
Northland Products Co., Inc	Lake Park	Becker	
Do	Underwood	Otter Tail	
Power-O-Peat Co	Central Lakes	St. Louis	
Red Wing Peat Corp	Cromwell	Carlton	
Expanded perlite:			
Minnesota Perlite Corp	Bloomington	Hennepin	Discontinued perlite production in May.
Zonolite Division W. R. Grace & Co	Minneapolis	do	
Sand and gravel: [2]			
Alexander Construction Co., Inc	Stacy	Chisago	
Do	Rosemount and South St. Paul	Dakota	
Do	Osseo	Hennepin	
Do	Elk River	Sherburne	
Do	Newport	Washington	
Arsenal Sand & Gravel Co	New Brighton	Ramsey	Stationary plant.
Cemstone Products Co	Lakeland	Washington	Do.
Commercial Aggregates, Inc. (Barton Contracting Co.)	Harris	Chisago	
Do	Bloomington, Minneapolis, and Osseo.	Hennepin	Stationary plant at Osseo.
Do	St. Paul	Ramsey	
Do	Cotton	St. Louis	
Do	Hugo, Lakeland, and Scandia	Washington	Stationary plant at Lakeland.
Do	Monticello	Wright	Stationary plant.
Jay W. Craig Co		Aitkin	
Do	St. Francis	Anoka	Pit run.
Do		Cass	

See footnotes at end of table.

Table 17.—Principal producers and processors of metals, minerals, and mineral fuels—Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Sand and gravel—Continued			
Jay W. Craig Co	Bagley	Clearwater	
Do	Rockford	Hennepin	
Do	Ely	St. Louis	
Do	White Bear Lake	Washington	
J.A. Danens & Son, Inc	Edina	Hennepin	Pit run.
Duininck Bros. & Gilchrist	Various locations	Chippewa	
Do	do	Kanabec	
Do	do	Kandiyohi	
Do	do	McLeod	
Do	do	Meeker	
Do	do	Morrison	
Do	do	Murray	
Do	do	Nicollet	
Do	do	Otter Tail	
Do	do	Pope	
Do	do	Redwood	
Do	do	Renville	
Do	do	Rock	
Do	do	Sibley	
Do	do	Stearns	
Do	do	Yellow Medicine	
Fischer Construction Co., Inc	Rosemount	Dakota	
Gopher State Silica, Inc	Le Sueur	Le Sueur	Stationary plant, industrial sands.
Hallett Construction Co	Detroit Lakes	Becker	Stationary plant.
Do	Montevideo	Chippewa	Do.
Do	Sanborn	Cottonwood	
Do	Frontenac	Goodhue	Do.
Do	Elbow Lake	Grant	Pit run.
Do	Mora	Kanabec	
Do	St. Peter	Nicollet	Stationary plant.
Do	Finlayson	Pine	
Do	Edgerton and Woodstock	Pipestone	Pit run at Edgerton and stationary plant at Woodstock.
Do	Villard	Pope	Pit run.
Do	Faribault	Rice	
Do	Luverne	Rock	Stationary plant.
Do	Mountain Iron	St. Louis	
Do	Wadena	Wadena	Pit run.
Do	Waseca	Waseca	Do.
Landseidel & Son, Inc	Wolf Lake	Becker	
Do	Glyndon	Clay	
Do	Hallock	Kittson	
Do	Holt	Marshall	
Do	Mahnomen	Norman	
Do	Crookston	Polk	
Do	Roseau	Roseau	
McLaughlin & Schulz, Inc	Dawson and Milan	Lac qui Parle	
Do	Ivanhoe	Lincoln	

Do	Arco, Garvin, Lynd, and Marshall	Lyon	
Do	Hancock	Pope	
Do	Redwood Falls	Redwood	
Do	Benson	Swift	
Do	Doran, Foxhome, and Rothsay	Wilkin	
Mark Sand & Gravel Co	Various locations	Various counties	
Megarry Brothers, Inc	McGrath	Aitkin	
Do	St. Cloud	Benton	
Do	Orr	St. Louis	
Do	Melrose	Stearns	
Minnesota Silica Sand Co	Columbia Heights	Anoka	Stationary plant, industrial sands.
Minnesota Valley Improvement Co	Appleton	Big Stone	
Do	Barnum	Carlton	
Do	Montevideo	Chippewa	
Do	Ashby and Evansville	Douglas	
Do	Manchester	Freeborn	
Do	Evansville	Grant	
Do	Courtland	Nicollet	
Do	Edgerton	Pipestone	
Do	Edgerton and Luverne	Rock	
Do	Melrose	Stearns	
Do	Appleton	Swift	
Northwestern Gravel Co., Inc	Savage	Dakota	Stationary plant.
J. L. Shiely Co	St. Paul Park	Washington	Do.
Ulland Bros., Inc	Albert Lea, Clarks Grove, Glenville, Hollandale, and Mansfield.	Freeborn	
Do	Austin	Mower	
Do	McGregor	Aitkin	
Do	Cloquet	Carlton	
Do	Grand Marais and Tofte	Cook	
Do	Ely, Lax Lake, and Little Marais.	Lake	
Do	Hinckley	Pine	
Do	Aurora, Cusson, Saginaw, and Virginia.	St. Louis	
Stone:			
Basalt:			
Arrowhead Blacktop Co	Duluth	St. Louis	Stationary plant, crushed and broken.
Granite:			
Cold Spring Granite Co	Ortonville	Big Stone	Dimension.
Do	Odessa	Lac qui Parle	Do.
Do	Isle	Mille Lacs	Do.
Do	Morton	Renville	Do.
Do	Cold Spring, Rockville, St. Cloud, and St. Joseph.	Stearns	Operated finishing plants at St. Cloud and Cold Spring. A crushing plant was also operated at Cold Spring. Dimension.
Delano Granite, Inc	Odessa	Big Stone	Finishing plant at Delano, Wright County. Dimension.
Do	Rockville	Stearns	Dimension.
The Green Co., Inc	Granite Falls	Yellow Medicine	Stationary plant, crushed and broken.
Shiely-Petters Crushed Stone Co., Inc	Waite Park	Stearns	Do.

See footnotes at end of table.

Table 17.—Principal producers and processors of metals, minerals, and mineral fuels—Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Stone—Continued			
Limestone: [2] [3]			
The Babcock Co	Kasota	Le Sueur	Stationary plant, dimension.
Biesanz Stone Co	Winona	Winona	Do.
Bryan Rock Products, Inc	Shakopee	Scott	Stationary and portable plants.
Do	Marine on St. Croix	Washington	
Hector Construction Co., Inc	Harmony	Fillmore	
Do	Brownsville, Caledonia, Houston, LaCrescent, Ridgeway, and Spring Grove	Houston	
Do	Millville	Wabasha	
Do	Witoka	Winona	
Kappers Construction Co	Fountain	Fillmore	Stationary plant.
Edward Kraemer & Sons, Inc	Savage	Dakota	
Mankato Ag Lime & Rock Co	Mankato	Blue Earth	Do.
Mankato Stone Co	----do	----do	Stationary plant, dimension.
Osmundson Brothers	Grand Meadow	Mower	
Quarve & Anderson Co	Various locations	Goodhue	
Do	----do	Olmsted	
Do	----do	Wabasha	
J. L. Shiely Co	St. Paul Park	Washington	Stationary plant.
Do	Savage	Scott	
Vetter Stone Co	Mankato	Blue Earth	Stationary plant, dimension.
Do	----do	Le Sueur	Do.
Marl:			
Richard Nanik Marl Pit	Staples	Wadena	
Sorum's Marl Service	Remer	Cass	
Quartzite:			
New Ulm Quartzite Quarries, Inc	New Ulm	Nicollet	Stationary plant, crushed and broken.
Recovered Sulfur:			
Great Northern Oil Co	Pine Bend	Dakota	Recovered by Claus process
Northwestern Refining Co	St. Paul Park	Washington	Recovered by Modified Claus process
Exfoliated Vermiculite:			
MacArthur Co	St. Paul	Ramsey	
The B. F. Nelson Manufacturing Co	Minneapolis	Hennepin	
Zonolite Division W. R. Grace & Co	----do	----do	

[1] All companies listed under "Clays and Shale" operated pits and processing plants unless otherwise specified; products manufactured are shown under "Remarks" column.
[2] Portable plants were operated at the listed locations unless otherwise specified.
[3] Crushed limestone was produced at the listed locations unless otherwise specified.

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 Nicholas A. Kendall [1] and William H. Moore [2]

Value of Mississippi mineral production increased to $217 million—its highest since 1963. Mineral fuels—petroleum, natural gas, and natural gas liquids—represented 84 percent of the total value and accounted for the $6 million increase in mineral production value over that of 1966. Total value of metals and nonmetals remained virtually unchanged.

Comprehensive studies initiated in 1963 for overall development of water resources of the Pearl and Pascagoula River Basins continued. The Bartlesville Office of Mineral Resources of the Federal Bureau of Mines transmitted to the U.S. Army Corps of Engineers a report entitled, "Mineral Resouces and Industry of the Pascagoula River Basin, Mississippi and Alabama."

[1] Petroleum engineer, Bartlesville Office of Mineral Resources, Bureau of Mines, Bartlesville, Okla.
[2] Director, Mississippi Geological, Economic, and Topographical Survey, Jackson, Miss.

Table 1.—Mineral production in Mississippi [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays—thousand short tons	1,727	$7,489	1,654	$7,852
Natural gas—million cubic feet	156,652	27,257	139,497	24,133
Natural gas liquids:				
Natural gasoline and cycle products—thousand gallons	23,765	1,483	17,939	1,167
LP gases—do	18,621	987	17,794	1,085
Petroleum (crude)—thousand 42-gallon barrels	55,227	146,353	57,147	155,726
Sand and gravel—thousand short tons	12,675	13,563	14,039	15,485
Stone (includes shell)—do	[2] 1,532	[2] 1,641	1,879	2,055
Value of items that cannot be disclosed:				
Cement, iron ore, lime, magnesia, and stone (1966)	XX	12,587	XX	9,507
Total	XX	211,360	XX	217,010
Total in 1957–59 constant dollars	XX	205,482	XX	[p] 209,200

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

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

County	1966 [r]	1967	Minerals produced in 1967 in order of value
Adams	$20,370,135	$24,018,298	Petroleum, sand and gravel, natural gas.
Alcorn	W	W	Clays, sand and gravel.
Amite	3,971,069	3,029,362	Petroleum, natural gas, sand and gravel.
Attala	W	W	Clays, sand and gravel.
Bolivar	49,000	67,000	Sand and gravel.
Carroll	W	W	Sand and gravel, clays.
Chickasaw	72,060	17,443	Natural gas.
Claiborne	18,784	5,000	Sand and gravel.
Clarke	1,107,158	7,370,838	Petroleum, natural gas.
Clay	450,138	563,831	Sand and gravel, natural gas, stone, petroleum.
Coahoma	1,000	----------	
Copiah	W	W	Sand and gravel.
Covington	1,258,775	1,282,503	Sand and gravel, petroleum.
De Soto	W	W	Sand and gravel.
Forrest	7,878,462	6,218,051	Natural gas, sand and gravel, petroleum, natural gas liquids, clays.
Franklin	9,707,480	10,751,639	Petroleum, natural gas, sand and gravel.
Greene	235,090	211,450	Petroleum, natural gas.
Grenada	W	----------	
Hancock	234,982	252,072	Natural gas, petroleum, sand and gravel.
Harrison	W	W	Shell, sand and gravel.
Hinds	4,269,610	3,631,446	Petroleum, sand and gravel, clays, nautral gas.
Holmes	W	W	Sand and gravel.
Itawamba	1,157,319	W	Clays, sand and gravel, natural gas.
Jackson	4,691,555	3,224,808	Lime, magnesia, sand and gravel.
Jasper	23,349,201	25,908,843	Petroleum, natural gas, natural gas liquids, sand and gravel.
Jefferson	2,572,911	2,086,900	Petroleum, natural gas, sand and gravel.
Jefferson Davis	6,171,841	4,973,591	Natural gas, petroleum.
Jones	12,968,867	12,551,303	Petroleum, natural gas, natural gas liquids, clays.
Kemper	W	18,544	Iron ore.
Lafayette	40,000	18,000	Sand and gravel.
Lamar	11,302,501	11,364,291	Petroleum, natural gas.
Lauderdale	66,041	40,986	Clays, sand and gravel.
Lawrence	2,820	53,960	Natural gas, petroleum.
Lee	W	W	Clays, sand and gravel.
Leflore	156,000	55,000	Sand and gravel.
Lincoln	8,766,451	7,704,000	Petroleum, sand and gravel, nautral gas liquids, natural gas, clays.
Lowndes	232,700	585,025	Sand and gravel, clays.
Madison	2,274,216	1,884,305	Petroleum, natural gas liquids, sand and gravel, natural gas.
Marion	8,066,382	9,187,406	Natural gas, petroleum, natural gas liquids, sand and gravel.
Marshall	369,450	401,810	Clays, sand and gravel.
Monroe	2,677,306	2,693,393	Clays, sand and gravel, natural gas, petroleum.
Noxubee	485,633	589,337	Sand and gravel, clays.
Oktibbeha	8,000	26,000	Sand and gravel.
Panola	W	W	Clays, sand and gravel.
Pearl River	2,045,307	1,848,228	Natural gas, petroleum, sand and gravel, clays.
Perry	W	W	Sand and gravel, petroleum.
Pike	16,637,772	11,731,532	Petroleum, natural gas liquids, sand and gravel, natural gas.
Pontotoc	W	W	Sand and gravel, clays.
Prentiss	6,750	W	Clays.
Rankin	7,031,247	5,199,880	Cement, petroleum, stone, sand and gravel, natural gas.
Scott	136,956	139,102	Petroleum, natural gas.
Simpson	3,415,306	2,864,674	Petroleum, natural gas, sand and gravel.
Smith	7,619,319	9,806,823	Petroleum, clays, natural gas, stone, sand and gravel.
Stone	----------	246,000	Sand and gravel.
Sunflower	19,200	W	Clays.
Tate	32,000	64,000	Sand and gravel.
Tippah	W	W	Clays.
Tishomingo	296,500	W	Sand and gravel.
Tunica	32,000	36,000	Do.
Union	604,000	615,000	Do.
Walthall	5,933,018	5,165,376	Natural gas, petroleum.
Warren	W	W	Cement, sand and gravel, stone, natural gas.
Washington	W	W	Sand and gravel.
Wayne	8,444,438	8,417,158	Petroleum, natural gas, sand and gravel.
Wilkinson	4,563,422	6,849,322	Petroleum, natural gas.
Winston	W	W	Clays.
Yalobusha	----------	W	Sand and gravel.
Yazoo	7,145,113	7,509,519	Petroleum, sand and gravel, natural gas.
Undistributed	12,414,715	15,730,921	
Total	$211,360,000	$217,010,000	

[r] Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] The following counties were not listed because no production was reported: Benton, Calhoun, Choctaw, George, Humphreys, Issaquena, Leake, Montgomery, Neshoba, Newton, Quitman, Sharkey, Tallahatchie, and Webster.

Table 3.—Indicators of Mississippi business activity

		1966	1967 p	Change (percent)
Personal income:				
Total	millions	$4,153	$4,449	+7.1
Per capita		$1,777	$1,895	+6.6
Construction activity:				
Building permits	millions	$90.2	$91.1	+1.0
Cement shipments to and within Mississippi	thousand 376-pound barrels	4,708	4,224	−10.3
Cash receipts from farm marketings	millions	$783.6	$797.4	+1.8
Mineral production	do	$211.4	$217.0	+2.7
Factory payrolls	do	$680.0	$709.2	+4.3
Annual average labor force and employment:				
Total labor force	thousands	542.0	536.6	−1.0
Unemployment	do	6.3	8.4	+33.4
Employment:				
Construction	do	31.0	29.5	−4.8
Mining	do	5.7	5.7	-------
All manufacturing	do	165.8	164.6	−0.7
All industries	do	535.7	528.2	−1.4

p Preliminary.

Sources: Survey of Current Business, Construction Review, The Farm Income Situation, Employment and Earnings and Monthly Report on the Labor Force.

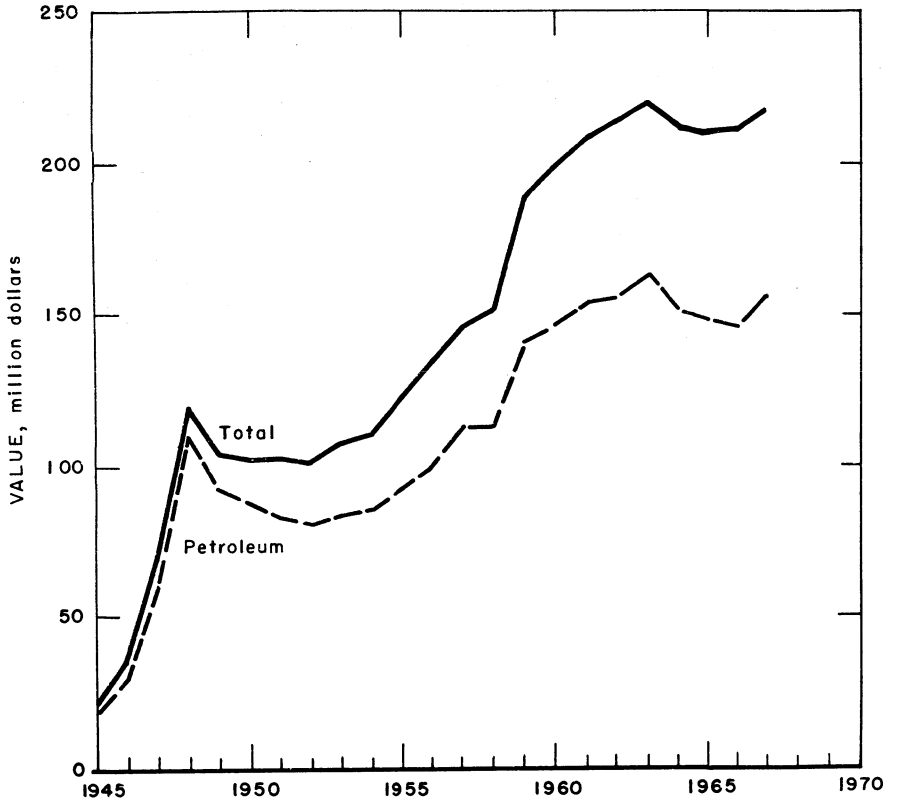

Figure 1.—Value of petroleum and total value of mineral production in Mississippi.

Employment and Injuries.—Overall mineral industry employment remained unchanged and constituted 1.1 percent of the nonagricultural labor force, according to the Mississippi Employment Security Commission. Employment in petroleum and natural gas industries dropped 2.0 percent and constituted 82.5 percent of the labor force in mineral industries.

Two men were killed and one was seriously injured in a chemical plant explosion in Jackson County.

Legislation.—An act passed in 1966 resulted in the establishment of the Mississippi Air and Water Pollution Control Commission in 1967. Its function is to control, prevent, and abate pollution of the air and of the surface and underground waters of the State.

The Bartlesville Office of Mineral Resources assisted in formulating water quality criteria for the State's interstate and coastal waters, as promulgated by the Commission.

Transportation.—International Paper Co., which transports 3.5 billion cubic feet of gas per year through its 16-mile, 6⅝-inch-diameter line from Louisiana to its Natchez plant, was ordered by the Federal Power Commission to show cause why it should not be subject to FPC jurisdiction and why it should not be required to obtain a certificate to continue operating the gas transmission line.

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 petroleum [2]
1963	5,548	586	178	2,292	4,900	366
1964	5,300	700	150	2,300	5,250	300
1965	4,800	710	155	2,290	5,300	380
1966	4,700	750	100	2,300	5,300	410
1967	4,904	827	151	2,193	5,100	373

[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.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Metal	9	318	3	29	-----	1	34.99	630
Nonmetal	960	243	234	1,873	-----	57	30.44	5,019
Sand and gravel	537	278	149	1,423	-----	27	18.97	580
Stone	214	275	59	483	-----	3	6.21	265
Total [1]	1,720	258	444	3,808	-----	88	23.11	2,723
1967:[p]								
Metal	5	271	1	7	-----	-----	-----	-----
Nonmetal	915	260	237	1,905	1	48	25.72	3,954
Sand and gravel	445	262	116	1,140	-----	24	21.05	412
Stone	255	248	63	511	-----	7	13.69	2,093
Total	1,620	259	417	3,563	1	79	22.45	2,547

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

Construction started on the 630-mile, 40-inch Capline, designed to ultimately transport 1,800,000 barrels of crude oil per day from St. James, La., to Patoka, Ill. The line, which will be the largest diameter crude oil line in the United States and the longest 40-inch line in the free world, will cost over $100 million. In Mississippi it will extend from Amite County to De Soto County, a distance of about 280 miles. Source of the crude will be south and offshore Louisiana, as well as Mississippi, the latter entering the line at a pumping station near Liberty.

The line will be operated by Shell Pipe Line Corp. for itself, and for Ashland Oil & Refining Co., Marathon Pipeline Co., Mid-Valley Pipeline Co., Service Pipe Line Co., The Texas Pipe Line Co., and Southcap Pipe Line Co. The latter is a newly formed company owned by Clark Oil & Refining Corp. and Pure Oil Division of Union Oil Co. of California. The oil will be moved by five pumping stations, each consisting of 5,000 horsepower electrically driven pumps, located at St. James, La., Liberty, Jackson, and Sardis, Miss., and Clinton, Ky.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The combined value of natural gas, natural gas liquids, and crude petroleum production increased by $6.0 million, or 3.4 percent compared with 1966. It comprised 84 percent of the value of total mineral production, compared with 83 percent in 1966.

Mississippi again ranked ninth among the oil-producing States. The seven leading petroleum producing counties were, in descending order, Jasper, Adams, Jones, Franklin, Lamar, Pike, and Smith.

Total drilling activity declined 13 percent, compared with a national decline of 11.4 percent. Average depth of all holes drilled was 7,705 feet, 97 feet more than in 1966. Total footage drilled declined slightly, to 5.6 million feet.

The 22 new oilfield discoveries were Hilo, West Pine Ridge, Morgan Town, South Glen Aubin, South Jeanette, and Otter Lake in Adams County; Nancy in Clarke County; Morgan Fork, Tom Branch, Willis Branch and Wesley Chapel in Franklin County; Stringer and Verba in Jasper County; East Waynesboro in Wayne County; South Ireland, West Possum Corner, Alligator Bayou, North Ellis Lake, Crosby, South Day Creek, West Tar Creek, and West Ireland in Wilkinson County.

The Mississippi Geological, Economic, and Topographical Survey published a report on the geology and mineral resources of George County.[3]

According to the Mississippi State Oil and Gas Bulletin, as of December 31, 1967, the State had 343 oil pools and 55 gas pools producing in 324 fields; there were 3,706 wells capable of producing, compared with 3,505 wells in 1966.

Natural Gas.—Four counties—Marion, Jefferson Davis, Forrest, and Walthall—supplied 76 percent of the State's natural gas production.

Reserves dropped 71,856 million cubic feet and represented 0.6 percent of the national reserves. Ratio of reserves to yearly production was 9.6:1 (9:1 in 1966 and 11:1 in 1965).

Mississippi Valley Gas Co. had a storage capacity of 1,150 million cubic feet of gas in the Amory field of Monroe County; United Gas Pipe Line Co. controlled 5,816 million cubic feet of storage capacity in formations of the Jackson Dome in Rankin and Hinds Counties. At yearend, the State gas storage capacity again totaled 6,966 million cubic feet, of which 5,738 million cubic feet constituted working capacity.

Natural Gas Liquids.—Reserves of natural gas liquids in Mississippi increased about 300,000 barrels, according to the American Gas Association, and constituted 0.2 percent of the national reserves, unchanged from that of 1966. Ratio of reserves to yearly production increased from 17:1 in 1966 to 20:1.

Shell Oil Co. completed the Tallahalla Creek plant in Smith County at a cost of $900,000. The refrigerated-absorption plant has a capacity of 10 million cubic feet of gas per day and will produce 41,-

[3] Williams, Charles H., Jr., Theo H. Dinkins, Jr., and Thomas E. McCutcheon. George County Geology and Mineral Resources. Mississippi Geol., Econ., and Topographical Survey Bull. 108, 1967, 277 pp.

000 gallons of butane mix and 11,000 gallons of gasoline per day.

Total capacity of the State's natural gas processing and cycling plants declined to 303.2 million cubic feet per day, owing mainly to shutting down the California Company Cranfield field plant in Adams County.

According to the Oil and Gas Journal, solution caverns in a Forrest County salt dome contained the following fuels as of October 1967: Propane, 3,312,000 barrels; butane, 600,000 barrels; LP gases, 2,000,000 barrels.

Petroleum. — Jasper, Adams, Jones, Franklin, Lamar, Pike, and Smith Counties supplied 64 percent of the State's crude oil production.

An average of 2.9 barrels of salt water was produced with each barrel of crude oil, compared with 2.6 barrels in 1966, reflecting the advancing stages of the various waterflood projects in the State.

Drilling of 335 exploratory wells, with an average depth of 7,786 feet, resulted in the discovery of 22 oilfields, a discovery ratio of 1 out of 15.

An additional and most significant discovery was the Pelahatchie-Norphlet pool in Rankin County. The discovery well flowed at the rate of 1,440 barrels of 51° API gravity oil per day through a 9/64-inch choke, with a tubing pressure of 6,200 pounds per square inch and a gas-oil ratio of 876 cubic feet per barrel. The Jurassic Norphlet Sand, productive from 17,152 to 17,160 feet, has never before yielded oil in Arkansas, Louisiana, or Mississippi. The structure on which the discovery well was drilled reportedly extends 8 to 10 miles north-south and 2 to 3 miles east-west. Development on a spacing of one well per 160 acres is contemplated. The Pelahatchie field was discovered in December 1963 and has been producing through 11 wells from five different Lower Cretaceous formations.

The search to expand Smackover Lime production continued. Twenty exploratory wells were drilled to this objective, resulting in the discovery of the Nancy field in Clarke County. In 1967, emphasis was on developing the Jurassic reserves discovered in previous years. Accordingly, 45 wells were drilled, resulting in 32 producers (a ratio of 7 out of 10), 12 of which were multiple completions. The producing Jurassic wells, with an average initial producing capacity of 483 barrels per well per day, along with other less significant development wells, accounted for the 2-million-barrel increase in petroleum production.

Reserves of crude oil in Mississippi dropped 17.4 million barrels, according to the American Petroleum Institute, and constituted 1.1 percent of the national reserves, compared with 1.2 percent in 1966. Ratio of reserves to yearly production decreased from 6.8:1 in 1966 to 6.2:1 in 1967.

In 1967, the National Stripper Well Association classified 234 wells as having been stripper wells in 1966. The wells represented 9.2 percent of the producing oil wells and 1.5 percent of the State's 1966 reserves.

Four of the State's five plants refined 23 percent of the annual crude oil production; their capacity was increased to 37,500 barrels per stream day. The fifth plant, the Standard Oil Co. of Kentucky refinery at Pascagoula, processed Louisiana crude oil exclusively; its capacity was enlarged to 145,000 barrels per stream day.

Secondary recovery operations accounted for about 9 million barrels, or 16.0 percent of the State's crude oil production.

Petrochemicals.—Chevron Chemical Co., a subsidiary of Standard Oil Co. of California, completed an ammonia plant at the refinery complex of Standard Oil Co. of Kentucky at Pascagoula. The plant, with a capacity of 1,500 tons per day, reportedly is the largest in the world. Gas from Louisiana offshore oilfields was used for feedstock. At this complex, construction was completed on a plant owned by Chervon Chemical Co. for making paraxylene and toluene. The plant has a capacity of 250 million pounds of paraxylene per year, which is isomerized from orthoxylene and metaxylene.

Table 6.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1967, by counties

County	Drilling							Geophysical (reflection seismograph), crew-weeks
	Proved field wells			Exploratory wells			Total	
	Oil	Gas [1]	Dry	Oil	Gas [1]	Dry		
Adams	50	-----	58	6	-----	75	189	--------
Amite	-----	-----	2	-----	-----	6	8	--------
Attala	-----	-----	-----	-----	-----	-----	-----	1
Chickasaw	-----	-----	1	-----	-----	-----	1	--------
Claiborne	-----	-----	-----	-----	-----	1	1	--------
Clarke	23	-----	4	1	-----	9	37	144
Clay	-----	-----	-----	-----	-----	-----	-----	1
Copiah	-----	-----	-----	-----	-----	-----	-----	10
Covington	-----	-----	-----	-----	-----	-----	-----	4
Forrest	-----	-----	2	-----	-----	2	4	1
Franklin	45	-----	38	4	-----	70	157	3
Greene	2	-----	1	-----	-----	-----	3	21
Hancock	-----	-----	-----	-----	-----	1	1	--------
Harrison	-----	-----	-----	-----	-----	1	1	--------
Hinds	-----	-----	-----	-----	-----	1	1	22
Holmes	-----	-----	-----	-----	-----	1	1	3
Humphries	-----	-----	-----	-----	-----	-----	-----	3
Issaquena	-----	-----	-----	-----	-----	1	1	3
Jasper	10	-----	8	2	-----	5	25	105
Jefferson	1	1	6	-----	-----	20	28	4
Jefferson Davis	-----	3	3	-----	-----	-----	6	16
Jones	8	-----	6	-----	-----	1	15	39
Kemper	-----	-----	-----	-----	-----	-----	-----	1
Lamar	1	-----	-----	-----	-----	-----	1	4
Lauderdale	-----	-----	-----	-----	-----	-----	-----	1
Lawrence	-----	-----	-----	-----	-----	-----	-----	12
Leake	-----	-----	-----	-----	-----	-----	-----	3
Lincoln	-----	-----	-----	-----	-----	1	1	8
Madison	2	-----	-----	-----	-----	8	10	5
Marion	-----	4	2	-----	-----	2	8	8
Monroe	-----	-----	1	-----	-----	-----	1	1
Neshoba	-----	-----	-----	-----	-----	-----	-----	4
Newton	-----	-----	-----	-----	-----	-----	-----	2
Oktibeha	-----	-----	-----	-----	-----	-----	-----	6
Pearl River	-----	2	2	-----	-----	2	6	10
Perry	-----	-----	-----	-----	-----	-----	-----	11
Pike	3	-----	1	-----	-----	2	6	--------
Rankin	3	1	3	-----	-----	4	11	57
Scott	-----	-----	-----	-----	-----	6	6	32
Sharkey	-----	-----	2	-----	-----	1	3	3
Simpson	1	1	1	-----	-----	3	6	20
Smith	24	1	4	-----	-----	2	31	78
Stone	-----	-----	-----	-----	-----	-----	-----	3
Walthall	-----	1	2	-----	-----	1	4	13
Warren	-----	1	1	-----	-----	-----	2	16
Washington	-----	-----	-----	-----	-----	-----	-----	1
Wayne	2	1	1	1	-----	6	11	121
Wilkinson	22	-----	21	8	-----	80	131	10
Yazoo	11	-----	9	-----	-----	1	21	59
Total:								
1967	208	16	179	22	-----	313	738	869
1966	221	38	181	27	1	341	809	669

[1] Includes condensate.

Sources: Mississippi State Oil and Gas Board monthly bulletin and Form 10A from International Oil Scouts.

Table 7.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1966	Changes in proved reserves, due to extensions and discoveries in 1967 [1]	Proved reserves Dec. 31, 1967 (production was deducted)	Change from 1966 (percent)
Crude oil—thousand barrels	374,102	41,526	356,686	−5
Natural gas liquids [2]—do	17,015	695	17,312	+2
Natural gas—million cubic feet	1,668,863	44,932	1,597,007	−4

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

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Proved Reserves of Crude Oil, Natural Gas Liquids and National Gas. Tulsa Daily World, No. 208, Apr. 8, 1968, p. 22.

Table 8.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	28,757	$1,755	24,541	$956	53,298	$2,711
1964	27,485	1,644	23,277	780	50,762	2,424
1965	26,582	1,606	22,150	975	48,732	2,581
1966	23,765	1,483	18,621	987	42,386	2,470
1967	17,939	1,167	17,794	1,085	35,733	2,252

Table 9.—Marketed production of natural gas [1]

Year	Million cubic feet	Value (thousands)
1963	176,807	$31,825
1964	180,428	31,385
1965	166,825	28,861
1966	156,652	27,257
1967	139,497	24,133

[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	Production	Value
1963	58,619	$161,788
1964	56,777	151,595
1965	56,183	148,437
1966	55,227	146,353
1967	57,147	155,726

Table 11.—Crude petroleum production, indicated demand, and stocks in 1967, by month

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Mississippi
January	4,657	4,418	3,015
February	4,293	4,958	2,350
March	4,813	4,997	2,166
April	4,628	3,935	2,859
May	4,759	4,933	2,685
June	4,672	5,162	2,195
July	4,913	5,117	1,991
August	4,917	4,740	2,168
September	4,800	4,565	2,403
October	4,965	5,228	2,140
November	4,810	4,782	2,168
December	4,920	4,734	2,319
Total:			
1967	57,147	57,569	XX
1966	55,227	54,886	XX

XX Not applicable.

Table 12.—Crude petroleum produced, by fields [1]

(Thousand 42-gallon barrels)

Field	1963	1964	1965	1966	1967
Baxterville	5,823	5,822	5,592	5,399	5,027
Bay Springs	------	------	970	3,487	3,931
Brookhaven	1,545	1,456	1,299	1,073	(2)
Bryan	2,017	1,773	1,312	1,125	(2)
Eucutta	1,088	1,232	1,050	814	(2)
Heidelberg	3,620	3,491	3,904	3,830	3,891
La Grange, N & S	1,234	1,236	1,245	950	(2)
Little Creek	6,107	5,589	4,137	2,841	1,976
McComb	4,482	4,379	3,837	2,797	1,760
Quitman Bayou	(2)	(2)	(2)	1,392	2,852
Raleigh	1,573	1,511	1,304	1,191	1,124
Smithdale	(2)	1,019	1,155	950	(2)
Soso	2,643	2,380	2,070	1,939	2,129
Summerland	(2)	(2)	1,096	1,291	1,589
Tinsley	2,855	2,650	2,447	2,325	2,293
Yellow Creek, N & W	1,409	1,276	1,191	1,027	(2)
Other fields [3]	24,223	22,963	23,574	22,796	30,575
Total	58,619	56,777	56,183	55,227	57,147

[1] Based on the Oil and Gas Journal data adjusted to Bureau of Mines total.
[2] Included with "Other fields."
[3] Bureau of Mines data.

NONMETALS

Cement.—Shipments of portland cement decreased 20.2 percent; masonry cement increased 0.7 percent. In November, the Mississippi State Highway Department let state and interstate highway construction contracts totaling $10 million.

Clays.—A gain was reported in quantity of fuller's earth sold or used. Total tonnage of miscellaneous clay used for heavy clay products and lightweight aggregate decreased 6 percent and constituted 66 percent of the State's clay production. Fire clay production increased 3 percent. Ball clay was produced in Panola County.

Lime.—International Paper Co. started operating its Vicksburg mill, which has a capacity of 1,000 tons of paper per day. Employment is 400 persons with an annual payroll of over $3 million. In all paper processes, lime is used with chlorine to prepare calcium hypochlorite solutions for bleaching paper pulp.

Magnesium Compounds.—Production of magnesium compounds, used in the man-

ufacture of refractory bricks, decreased 35 percent below that of 1966. Magnesium-bearing lime, made from dolomite mined in Alabama, was used in this process.

Perlite.—Johns Manville Products Corp., Adams County, reported production of expanded perlite.

Salt.—A damage suit, brought by mineral owners against the U.S. Government and arising out of the detonation of a nuclear device in the Tatum salt dome in Lamar County, was settled out of court for $142,164.

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
1963	280	$3,480	230	$1,761	725	$727	1,235	$5,968
1964	270	3,352	286	2,003	775	775	1,331	6,130
1965	280	3,477	299	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

Sand and Gravel.—Production was reported from 51 of the State's 82 counties. The leading producers in order of value were Carroll, Copiah, Hinds, Adams, and Forrest Counties. These five counties produced 42 percent of the tonnage and 39 percent of the value.

Stone and Shell.—Offshore recovery of oyster and clam shell in Harrison County remained virtually unchanged in tonnage but increased 15 percent compared with the 1966 value. Stone production increased 22.5 percent in volume and 24.0 percent in value.

Sulfur.—Recovery of sulfur from refinery and natural gases was practically unchanged in quantity from 1966. Average unit price for the State increased 45 percent.

Phillips Petroleum Co. planned to drill a confirmation well to its 20,000-foot discovery well of the Black Creek field in Perry County, a prolific producer of sulfur. Successful completion would lead to construction of a sulfur extraction plant. Pan American Sulphur Co., heretofore active only in Mexico, acquired a 50-percent interest in the operation. Increases in the price of sulfur to $39 per long ton f.o.b. Gulf Coast, and $52 per long ton in Mexico, stimulated the plans.

METALS

Iron Ore.—Magnolia Mining Co. continued to mine iron ore from several small open pits near Porterville, Kemper County. The ore was shipped by rail to a mill near Birmingham, Ala.

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

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	6,306	$6,266	519	$790	6,825	$7,056
1964	7,479	7,871	346	698	7,825	8,569
1965	7,192	7,785	1,255	932	8,447	8,717
1966	12,307	12,815	368	748	12,675	13,563
1967	13,575	14,299	464	1,186	14,039	15,485

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,629	$2,429	1,021	$907
Paving	2,304	2,171	3,349	3,311
Other [1]	104	182	218	299
Total	5,037	4,782	4,588	4,517
Gravel:				
Building	3,195	3,689	1,416	1,525
Paving	3,783	4,051	7,227	7,759
Railroad ballast	35	13	W	W
Other [2]	257	280	344	498
Total	7,270	8,033	8,987	9,782
Total sand and gravel	12,307	12,815	13,575	14,299
Government-and-contractor operations:				
Sand:				
Paving	4	4	305	763
Fill	142	191	--------	--------
Gravel:				
Paving	10	10	159	423
Fill	212	543	--------	--------
Total sand and gravel	368	748	464	1,186
Grand total	12,675	13,563	14,039	15,485

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes railroad ballast (1966), fill, other, and industrial sand.
[2] Includes railroad ballast (1967), fill, other, and miscellaneous gravel.

Table 16.—Principal producers of metals, minerals, and fuels

Commodity and company	Type of activity	Producing fields	County	Address
Cement: [1]				
Marquette Cement Manufacturing Co	Quarry and plant		Rankin	Chicago, Ill.
Mississippi Valley Portland Cement Co	do		Warren	Redwood, Miss.
Clay:				
American Colloid Co	Mine		Itawamba and Monroe	Skokie, Ill.
Delta Macon Brick & Tile Co	Mine and plant		Noxubee	Macon, Miss.
Dresser Minerals	do		Attala	Houston, Tex.
Filtrol Corp	do		Itawamba and Smith	Los Angeles, Calif.
Holy Springs Brick & Tile	do		Marshall	Holly Springs, Miss.
International Mineral & Chemical Corp	Mine		Monroe	Skokie, Ill.
Jackson Ready-Mix Concrete	Mine and plant		Hinds	Jackson, Miss.
Kentucky-Tennessee Clay Co	Mine		Panola	Mayfield, Ky.
Oil Dri Production Co	do		Tippah	Ripley, Miss.
Tri-State Brick & Tile Co	Mine and plant		Hinds	Jackson, Miss.
Wyandotte Chemicals Corp	Mine		Tippah	Wyandotte, Mich.
Iron ore: Magnolia Mining Co	do		Kemper	Memphis, Tenn.
Lime: H. K. Porter Co., Inc	Plant		Jackson	Pascagoula, Miss.
Magnesium Compounds: H. K. Porter Co., Inc., Refractories Division.	do		do	Do.
Sand and Gravel:				
American Sand & Gravel Co	Stationary		Forrest	Hattiesburg, Miss.
J. J. Ferguson Sand & Gravel	do		Carroll	Greenwood, Miss.
Girod Motor Co., Inc	do		Warren	Vicksburg, Miss.
Green Bros. Gravel Co	do		Copiah	Franklinton, La.
Greenville Gravel Co	Stationary and portable		Washington	Greenville, Miss.
Hammett Gravel Co	Stationary		Holmes and Pike	Lexington, Miss.
St. Catherine Gravel Co	do		Adams	Natchez, Miss.
Traxler Gravel Co., Inc	Stationary and dredge		Copiah	Jackson, Miss.
Shell: Jahncke Service Co., Inc	Dredge		Harrison	New Orleans, La.
Oil and gas:				
Chevron Oil Co		Brookhaven	Lincoln	Houston, Tex.
Do		South Center Ridge	Smith	Do.
Do		Cranfield	Adams and Franklin	Do.
Do		Hub	Marion	Do.
Do		Hub East	do	Do.
Do		Knoxo	Walthall	Do.
Do		East Mallalieu	Lincoln	Do.
Do		West Mallalieu	do	Do.
Do		Mize	Smith	Do.
Do		Pisgah	Rankin	Do.
Do		Puckett	Rankin and Smith	Do.
Do		Raleigh	Simpson	Do.
Do		Reedy Creek	Jones	Do.
Do		Shongelo Creek	Smith	Do.
Gulf Oil Corp		Baxterville	Lamar and Marion	Do.
Do		Bolton	Hinds	Do.
Do		Gwinville	Jefferson Davis	Do.
Do		Heidelberg	Jasper	Do.
Do		East Heidelberg	do	Do.

Do		West Heidelberg	do	Do.	
Do		West Mallalieu	Lincoln	Do.	
Do		Pistol Ridge	Forrest and Pearl River	Do.	
Do		Soso	Jasper, Jones, and Smith	Do.	
Do		EastYellow Creek	Wayne	Do.	
Humble Oil & Refining Co		Alloway	Adams	Do.	
Do		Baxterville	Marion and Lamar	Do.	
Do		Beaver Branch	Adams	Do.	
Do		Bentonia	Yazoo	Do.	
Do		Bryan	Jones and Jasper	Do.	
Do		Chaparral	Wayne	Do.	
Do		Cowpen	Adams	Do.	
Do		East Eucutta	Wayne	Do.	
Do		West Eucutta	do	Do.	
Do		East Fairview	Adams	Do.	
Do		Fayette	Jefferson	Do.	
Do		Gilliard Lake	Adams	Do.	
Do		Gillsburg	Amite	Do.	
Do		Gwinville	Jefferson Davis	Do.	
Do		Hub	Marion	Do.	
Do		Hub East	do	Do.	
Do		Junction City	Clarke	Do.	
Do		Kelly Hill	Wilkinson	Do.	
Do		Knoxo	Walthall	Do.	
Do		Lagrange	Adams	Do.	
Do		North Lake Lucille	do	Do.	
Do		Loring	Madison	Do.	
Do		West Mallalieu	Lincoln	Do.	
Do		Mantua	Adams	Do.	
Do		Maxie	Forrest	Do.	
Do		Otter Lake	Adams	Do.	
Do		Pickens	Madison & Yazoo	Do.	
Do		Pistol Ridge	Pearl River	Do.	
Do		Sandy Hook	Marion	Do.	
Do		Shieldsboro	Adams	Do.	
Do		Sibley	do	Do.	
Do		Waveland	Hancock	Do.	
Do		East Yelow Creek	Wayne	Do.	
Do		North Yellow Creek	do	Do.	
Do		West Yellow Creek	do	Do.	
Meason Operating Co		Bourbon	Adams	Natchez, Miss.	
Do		North Carthage Point	do	Do.	
Do		Clear Springs	Franklin	Do.	
Do		Courtland	Adams	Do.	
Do		Dexter	Walthall	Do.	
Do		Ellis Cliffs	Adams	Do.	
Do		Southeast Fairview	do	Do.	
Do		Fayette	Jefferson	Do.	
Do		North Fayette	do	Do.	
Do		Flat Rock	Franklin	Do.	
Do		North Flat Rock	do	Do.	
Do		North Fort Adams	Wilkinson	Do.	
Do		North Freewoods	Franklin	Do.	
Do		Gilliard Lake	Adams	Do.	
Do		Glasscock	do	Do.	

Table 16.—Principal producers of metals, minerals, and fuels—Continued

Commodity and company	Type of activity	Producing fields	County	Address
Oil and Gas—Continued				
Meason Operating Co		South Glen Aubin	Adams	Natchez, Miss.
Do		Knoxo	Walthall	Do.
Do		Knoxville	Franklin	Do.
Do		Lagrange	Adams	Do.
Do		Lazy Creek	Pike	Do.
Do		Leesdale Tower	Franklin	Do.
Do		West Locust Hill	Adams	Do.
Do		Magnolia	do	Do.
Do		Mantua	do	Do.
Do		North Natchez	do	Do.
Do		Pine Mount	do	Do.
Do		Poplar Grove	do	Do.
Do		Richardson Creek	Franklin	Do.
Do		Rose Hill	Wilkinson	Do.
Do		Roxie	Franklin	Do.
Do		Shieldsboro	Adams	Do.
Do		Sibley	do	Do.
Do		Southwood	do	Do.
Do		Sunnyside	Jefferson	Do.
Do		West Tar Creek	Wilkinson	Do.
Do		Zeigler Creek	Franklin	Do.
Pan American Petroleum Corp		Barber Creek	Scott	Tulsa, Okla.
Do		Bay Springs	Jasper	Do.
Do		Belmont Lake	Wilkinson	Do.
Do		Blackburn	Jones	Do.
Do		West Clara	Wayne	Do.
Do		Clear Springs	Franklin	Do.
Do		Collins	Covington	Do.
Do		Diamond	Wayne	Do.
Do		Dry Bayou	Franklin	Do.
Do		East Fork	Amite	Do.
Do		North East Fork	do	Do.
Do		North Freewoods	Franklin	Do.
Do		Grange	Jefferson Davis	Do.
Do		Hilo	Adams	Do.
Do		South Ireland	Wilkinson	Do.
Do		Kelly Hill	do	Do.
Do		Knoxville	Franklin	Do.
Do		North Knoxville	do	Do.
Do		Lake Mary	Wilkinson	Do.
Do		Lazy Creek	Pike	Do.
Do		Levees Creek	Adams	Do.
Do		Little Creek	Pike	Do.
Do		Locust Hill	Adams	Do.
Do		Lorene	Smith	Do.
Do		Morgan Town	Adams	Do.
Do		Pelahatchie	Rankin	Do.
Do		Pine Mount	Adams	Do.

Do		West Pine Ridge	----do	Do.
Do		Quitman Bayou	----do	Do.
Do		Siloam	Clay	Do.
Do		Stringer	Jasper	Do.
Do		Sylvarena	Smith	Do.
Do		Tallahala Creek	----do	Do.
Do		Thorn	Chickasaw	Do.
Do		Wells Creek	Franklin	Do.
Do		Zeigler Creek	----do	Do.
Sun Oil Co		Baxterville	Lamar	Philadelphia, Pa.
Do		Bolton	Hinds	Do.
Do		Diamond	Wayne	Do.
Do		West Eucutta	----do	Do.
Do		East Franklin	Franklin	Do.
Do		East Heidelberg	Jasper	Do.
Do		Knoxo	Walthall	Do.
Do		Kokomo	----do	Do.
Do		Mantua	Adams	Do.
Do		McComb	Pike	Do.
Do		Mercer	Adams	Do.
Do		Pistol Ridge	Forrest and Pearl River	Do.
Do		Sandy Hook	Marion	Do.
Do		Smithdale	Amite	Do.
Do		East Summit	Pike	Do.
Do		Tom Branch	Franklin	Do.
Do		West Yellow Creek	Wayne	Do.

[1] Also limestone and marl.

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 Division of Geological Survey and Water Resources of Missouri, for collecting information on all minerals except fuels.

By Joseph C. Arundale [1] and James A. Martin [2]

Mineral production in Missouri continued upward; total value of mineral output in 1967 reached a record high of about $237 million.

Principal mineral commodities, accounting for 82 percent of total mineral value, were stone, cement, lead, iron ore, and lime.

Missouri ranked 24th among the States in mineral output and accounted for about 1 percent of total U.S. mineral value. Production from the new lead and iron mining and processing operations under development should raise the State's ranking in future years.

Continued progress highlighted the State's mineral activities in 1967, despite engineering, supply, and labor problems in constructing the mine-mill-smelter complex and in developing the new mining district in southeast Missouri. Planned facilities, with a capacity for producing about 350,000 tons of lead metal per year, were scheduled for completion by mid-1968. The district has one of the world's largest reserves of lead.

The Ozarks region in Missouri has been an area of persistent "underdevelopment."

[1] Physical scientist, Bureau of Mines, Bartlesville, Okla.
[2] Chief, Economic Geology Section, Missouri Division of Geological Survey and Water Resources, Rolla, Mo.

Table 1.—Mineral production in Missouri [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite—short tons	337,076	$4,280	331,780	$4,444
Cement:				
Portland—thousand 376-pound barrels	13,848	46,228	15,044	52,119
Masonry—thousand 280-pound barrels	382	1,075	372	1,172
Clays—thousand short tons	2,329	5,989	2,305	6,220
Coal (bituminous)—do	3,582	14,834	3,696	15,573
Copper (recoverable content of ores, etc.)—short tons	3,913	2,831	3,215	2,458
Iron ore (usable)—thousand long tons-gross weight	1,887	26,450	1,871	26,673
Lead (recoverable content of ores, etc.)—short tons	132,255	39,981	152,649	42,742
Lime—thousand short tons	1,494	17,910	1,434	16,371
Natural gas—million cubic feet	-------	---------	121	30
Petroleum (crude)—thousand 42-gallon barrels	97	W	75	W
Sand and gravel—thousand short tons	10,702	13,540	9,716	12,556
Stone—do	35,240	53,393	36,585	53,953
Zinc (recoverable content of ores, etc.)—short tons	3,968	1,151	7,430	2,057
Value of items that cannot be disclosed: Native asphalt and values indicated by symbol W	XX	288	XX	291
Total	XX	227,950	XX	236,659
Total 1957–59 constant dollars	XX	212,459	XX	p 218,152

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

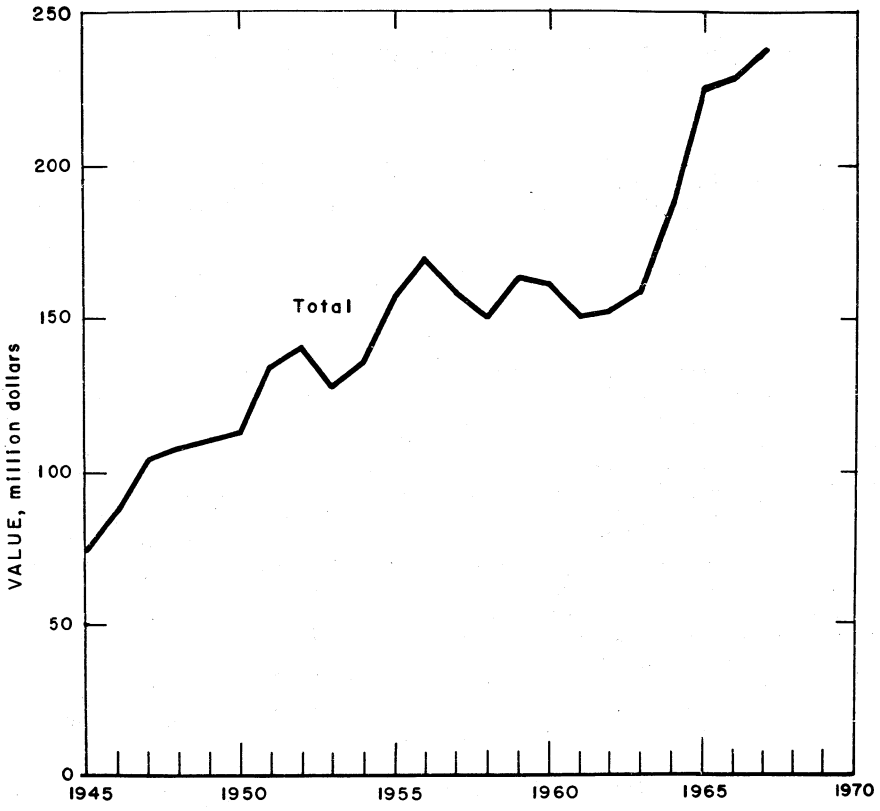

Figure 1.—Total value of mineral production in Missouri.

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

County	1966 [r]	1967	Minerals produced in 1967 in order of value
Adair	----------	W	Stone.
Andrew	W	W	Stone, sand and gravel.
Atchison	$12,131	$10,055	Petroleum.
Audrain	1,458,175	1,100,388	Clays.
Barry	148,920	98,000	Stone.
Barton	216,396	W	Stone, native asphalt.
Bates	W	W	Stone.
Boone	4,280,716	5,118,554	Coal, stone, sand and gravel, clays.
Buchanan	394,584	W	Sand and gravel, stone.
Butler	W	W	Sand and gravel, clays.
Caldwell	148,472	251,377	Stone, natural gas.
Callaway	1,760,938	1,689,471	Clays, stone, coal, sand and gravel.
Cape Girardeau	10,319,770	10,962,897	Cement, stone, clays, sand and gravel.
Carter	----------	W	Stone.
Cass	280,350	252,134	Stone, petroleum, clays.
Cedar	110,685	91,550	Stone.
Christian	----------	W	Do.
Clark	291,546	W	Stone, coal.
Clay	1,288,962	1,055,296	Stone, sand and gravel.
Clinton	838,061	210,181	Stone, natural gas.
Cole	464,280	415,000	Sand and gravel.
Cooper	334,567	W	Stone, sand and gravel.
Crawford	6,354,555	3,994,620	Lead, copper, zinc, clays.
Dade	193,402	132,259	Stone, coal.
Dallas	----------	W	Stone.

See footnotes at end of table.

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

County	1966 [r]	1967	Minerals produced in 1967 in order of value
Daviess	438,496	W	Stone, sand and gravel.
De Kalb	220,834	280,088	Stone.
Douglas	W	W	Sand and gravel.
Dunklin	W	W	Do.
Franklin	593,796	422,187	Stone, clays, sand and gravel.
Gasconade	1,657,593	1,825,713	Clays.
Gentry	W	W	Stone, sand and gravel.
Greene	3,827,328	3,718,981	Stone, lime, sand and gravel.
Grundy	237,842	W	Stone.
Harrison	450,021	360,472	Stone, sand and gravel.
Henry	W	7,642,381	Coal, stone.
Hickory	----------	W	Stone.
Holt	W	W	Do.
Howard	W	W	Do.
Howell	115,355	260,644	Stone, sand and gravel, iron ore.
Iron	9,514,281	8,088,613	Lead, stone, copper, zinc.
Jackson	12,395,635	11,968,650	Cement, stone, sand and gravel, clays, petroleum.
Jasper	3,218,535	3,626,689	Stone, sand and gravel, zinc, lead.
Jefferson	13,196,132	16,391,428	Cement, stone, sand and gravel, clays.
Johnson	613,806	W	Stone.
Knox	W	W	Do.
Laclede	W	W	Do.
Lafayette	544,238	231,622	Stone, sand and gravel.
Lawrence	W	W	Stone.
Lewis	677,000	W	Sand and gravel, stone.
Lincoln	328,396	366,058	Stone, sand and gravel, clays.
Linn	250,659	W	Stone.
Livingston	667,284	924,912	Stone, clays, sand and gravel.
McDonald	W	----------	
Macon	W	W	Coal.
Madison	W	50,000	Stone.
Maries	135,487	W	Clays.
Marion	986,236	W	Lime, stone.
Mercer	W	W	Stone.
Miller	W	58,000	Sand and gravel.
Moniteau	105,134	63,525	Stone.
Monroe	460,115	442,179	Clays, stone, sand and gravel.
Montgomery	688,264	601,060	Do.
Newton	W	213,461	Stone.
Nodaway	613,203	443,163	Stone, sand and gravel.
Oregon	85,500	----------	
Osage	W	W	Clays.
Ozark	82,426	W	Stone, sand and gravel.
Pemiscot	W	W	Sand and gravel.
Perry	287,950	429,713	Stone.
Pettis	W	W	Do.
Phelps	98,727	149,790	Stone, clays, sand and gravel.
Pike	627,093	4,393,063	Cement, stone, clays.
Platte	192,706	222,395	Clays, stone, sand and gravel.
Pulaski	W	W	Sand and gravel.
Putnam	441,216	402,536	Coal, stone.
Ralls	6,437,821	8,350,748	Cement, stone, clays, sand and gravel.
Randolph	W	439,489	Stone.
Ray	821,900	568,295	Stone, sand and gravel.
Reynolds	----------	10,779,502	Lead, zinc.
St. Charles	1,540,836	1,764,165	Stone, sand and gravel, clays.
St. Clair	W	W	Stone.
St. Francois	22,397,256	17,495,362	Lead, stone, lime, copper, iron ore.
Ste. Genevieve	22,074,269	22,098,671	Lime, stone, sand and gravel.
St. Louis	29,019,460	27,354,515	Cement, stone, sand and gravel, clays, petroleum.
Saline	544,543	416,813	Stone.
Scotland	W	W	Do.
Scott	W	W	Do.
Shannon	W	W	Do.
Shelby	----------	3,211	Do.
Stoddard	W	W	Sand and gravel.
Taney	32,400	W	Stone.
Texas	W	W	Sand and gravel.
Vernon	331,784	437,034	Coal, native asphalt, petroleum, stone, sand and gravel.
Warren	254,024	389,956	Stone, clays, sand and gravel.
Washington	41,312,065	41,340,561	Iron ore, lead, barite, copper, zinc, sand and gravel.
Wayne	W	346,006	Stone, iron ore.
Worth	W	W	Stone.
Wright	W	W	Do.
Undistributed	20,535,844	15,915,567	
Total	227,950,000	236,659,000	

[r] Revised.
W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] The following counties were not listed because no production was reported in 1966 or 1967: Benton, Bollinger, Camden, Carroll, Chariton, Dent, Mississippi, Morgan, New Madrid, Polk, Ripley, Schuyler, Stone, Sullivan, and Webster.

Table 3.—Economic indicators of Missouri business activity

		1966	1967 p	Change (percent)
Personal income:				
Total	millions	$12,856	$13,775	+7.1
Per capita		$2,817	$2,993	+6.2
Construction activity:				
Building permits	millions	$479.9	$478.7	−.3
Cement shipments to and within Missouri	thousand 376-pound barrels	9,230	9,355	+1.4
Cash receipts from farm marketings	millions	$1,383.7	$1,364.7	−1.4
Mineral production	do	$228.0	$236.7	+3.8
Factory payrolls	do	$2,549.1	$2,687.6	+5.4
Annual average labor force and employment:				
Total labor force	thousands	1,567.0	1,607.6	+2.6
Unemployment	do	23.8	26.3	+10.5
Employment	do	1,543.2	1,581.3	+2.5
Construction	do	923.9	858.2	−7.1
All manufacturing	do	442.4	449.6	+1.6
Mining	do	8.2	7.0	−3.7

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.

Much of the area is cutover timberland with small isolated communities, no major sources of income, and poor transportation facilities. Various new State and Federal Government programs boosted the economy of the area. The development of a major mining industry in the area, with attendant construction of highways and railroads, large-scale mine, mill, and smelter projects, increased salaries, royalties, and taxes, has improved the economic structure and reduced the need for extensive State-Federal aid in the area.

In the nonmetallics, one cement plant was placed on stream and another completed its first full year of production. An announced increase in capacity by a third company will bring the total cement capacity for the seven plants in the State to nearly 30 million barrels annually.

Southeast Missouri or the "Bootheel" area, was expected to benefit from establishment of a major aluminum reduction industry that will create jobs for at least 1,000 people, including those in service-oriented industries.

A comprehensive report [3] on the mineral and water resources of Missouri was issued. The major part of the report is devoted to discussions of various mineral commodities. A water resources section contains extensive data on both surface and ground water.

Exploration.—Exploratory drilling for lead declined during the year; many companies were concentrating on bringing new facilities into production. Several companies continued drilling in Clark National Forest and plans were reported for resumption of exploration of several magnetic anomalies in the State. Renewed exploratory drilling in coal-bearing areas of Missouri was reported during the year.

Table 4.—Exploratory drilling in Missouri

(Linear feet)

Year	Churn	Rotary	Diamond
1962–63	73,120	8,549	188,120
1964	148,098	34,136	289,225
1965	111,786	5,324	188,071
1966	133,879	4,036	292,699
1967	94,908	37,978	237,031

Transportation.—The rapid expansion and geographic spread of the Missouri mineral industry has required changes and improvements in the State's river, rail, and highway transportation systems and facilities. Missouri River and Mississippi River transportation facilities and problems were studied by several groups to insure that the waterways system not only serves present needs but also will be adequate for future needs.

Short-range and long-range plans were formulated for highways and roads in

[3] U.S. Senate. Mineral and Water Resources of Missouri. Report of the U.S. Geological Survey and the Missouri Division of Geological Survey and Water Resources. S. Doc. 19, 90th Cong., 1st sess., 1967, 399 pp.

Missouri and were coordinated with the developing mineral industry of the State. The Missouri Highway Commission allocated about $183 million for State highway construction and improvements during the year, compared with $170 million in 1966.

A long-range study by the Missouri State Highway Department, made for the American Association of State Highway Officials, revealed that total highway and street construction needs for Missouri, amounting to $5.6 billion, will accumulate between 1967 and 1985. Construction needs represent a tremendous potential market for such mineral materials as stone, sand and gravel, and cement.

The St. Louis-San Francisco Railway Co. dedicated its new $6.5 million "Lead Belt Line." The new rail spur moved its first load of lead concentrates on July 3, 1967, from St. Joseph Lead Co.'s Viburnum mine and mill; the shipment was destined for the company's lead smelter at Herculaneum.

Labor and Employment.—According to the Division of Employment Security, Missouri Department of Labor and Industrial Relations, the mineral industry employed 8,333 workers in 1967, continuing the steady increase in employment in that industry over the past several years. Employment in the metal mining segment showed a substantial increase to 3,171 employees, compared with 2,314 in 1966. Employment in coal mining increased slightly to 676, but was far below employment in that industry a few years ago—a reflection of increased productivity. Employment in nonmetal mining increased to 4,486.

Table 5.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Inquiry rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	398	257	102	783	1	31	40.86	8,684
Metal	2,615	273	713	5,703	3	275	48.75	5,049
Nonmetal and native asphalt	1,126	238	268	2,160	-----	63	29.17	756
Sand and gravel	626	237	148	1,233	1	14	12.17	5,274
Stone	3,848	276	1,060	8,682	8	171	20.62	6,067
Total [1]	8,613	266	2,292	18,560	13	554	30.55	5,194
1967: [p]								
Coal	380	276	105	778	-----	32	41.13	1,069
Metal	2,290	271	622	4,974	2	188	38.20	3,323
Nonmetal and native asphalt	985	230	226	1,822	-----	56	30.73	2,370
Sand and gravel	555	241	134	1,139	-----	16	14.05	1,104
Stone	4,215	262	1,106	9,254	3	176	19.34	2,734
Total [1]	8,425	260	2,192	17,967	5	468	26.33	2,685

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

Environment.—The Missouri Air Conservation Commission issued a set of regulations [4] on air quality and pollution that became effective March 24, 1967. Regulation X was of particular concern to the Missouri coal mining industry because of its restriction on sulfur content of coal. Much of Missouri's coal will not meet the required 2 percent sulfur limit.

Union Electric Co. announced plans to install a system for the removal of sulfur dioxide from the stack emission of coal-fired steam generators. The system will be built at Union Electric's Meramec plant in south St. Louis County. According to the company, tests indicate that the system will remove 83 percent of the sulfur dioxide, almost all the sulfur trioxide, and 99 percent of the fly ash from the flue gases. The removal of 83 percent of sulfur dioxide is the equivalent of burning fuel with 0.5 percent sulfur content.

The Missouri Portland Cement Co.

[4] Missouri Air Conservation Commission. Air Quality Standards and Air Pollution Control Regulations for the St. Louis Metropolitan Area. 1967.

engaged an engineering firm to determine the type of controls necessary to enable its St. Louis plant to comply with St. Louis County's air pollution control program. During the study, the company tried to increase the efficiency of its precipitators, which had not been able to keep emissions down to required standards. The major pollution problem in the cement-making process is emission of a fine white dust.

During 1967 the Southeast Missouri Mining & Milling Division of St. Joseph Lead Co. actively continued a reforestation program and by yearend had planted more than 250,000 trees in the various areas comprising its Missouri operations.

The Petrolite Corp. of St. Louis organized a new subsidiary called International Pollution Control, Inc., and also acquired International Disposal Contractors, Inc., of Evansville, Ind. Petrolite's pollution control subsidiary will engage in liquid and solid waste material disposal through wells, chemical treatment, and incineration. The company will handle waste materials on a contract basis and serve as a waste disposal utility for indutrial complexes.

The Water Resources Advisory Committee was established to assist the Water Resources Board in preparing a comprehensive 5-year water and related land resource plan. The planning effort will be coordinated with the development of a Comprehensive State Plan funded under provisions of the Housing Act of 1954, Section 701, as amended. A framework water plan will be presented as a chapter of the Comprehensive State Plan, scheduled for completion in 1970. The final 2 years of the water and related land resource planning effort will be devoted to project economics, with emphasis on determining State, political subdivision, or private responsibility in implementing the desirable features of the plan. The final 2-year period will also consider legislative and institutional changes that will contribute to implementation.

Final approval by the Federal Power Commission was given for electricity generation at the Cannon Dam project in Ralls, Monroe, and Shelby Counties. Land acquisition by the U.S. Army Corps of Engineers for the 26,000-acre lake was proceeding. The power production phase of Cannon Dam and Reservior calls for a pumpback operation. A second smaller dam will be built downstream from the main dam; water flowing from the primary reservoir will generate power and flow into the second reservior, then be pumped back into the primary reservoir at night when power demand is low.

The Missouri Water Pollution Board completed action on water quality standards for Missouri intrastate streams. The standards are intended to provide information to the public on the water quality to be maintained in streams, and also provide an effective enforcement tool. The Water Pollution Board established 149 monitoring stations throughout the State to detect changes in water quality and to guide necessary corrective action where indicated.

The U.S. Geological Survey, Water Resources Division, successfully completed a cooperative "time-of-travel" study on the Missouri River. The study was undertaken primarily to gain data on travel of pollutants and protect on of water users along the river. A fluorescent dye was used as a tracer to follow particles of water along the 806-mile reach of the river. Results of the study reveal that the effect of pollutants in the Missouri River can be predicted with a high degree of accuracy.

The pollution problems and objectives of the coal industry in Missouri and the abatement objectives and activitites of that industry were outlined.[5] Acid mine water drainage was the principal problem.

Legislation.—The 74th General Assembly of the Missouri Legislature created a joint "Interim Committee on Mining" composed of five membe s of the House and five members of the Senate. The Committee was instructed to study the problem of mining in Missouri, the applicability of mine safety legislation to apply to new equipment and methods of mining now utilized in the several new deep lead and iron mines, and the need for regulation and reclamation of open-pit and other methods of surface mining areas in the State. The Committee was authorized to hold meetings and to prepare and submit a report to the 75th General Assembly, together with the legislative proposals it deems appropriate. Hearings were expected to start early in 1968.

[5] Brundage, Scott. Pollution Abatement by the Coal Industry of Missouri. Pres. at Annual Meeting of the Missouri Water Pollution Control Association, Feb. 26–28, 1967, 9 pp.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Nonmetallic mineral production was valued at about $147 million—62 percent of the State's total mineral value.

Missouri held its position as the leading barite producer, expanding output value by 4 percent. Cement output increased and new facilities were being built. Stone, ranked first in value since 1962, was almost equalled by the value of cement shipments. Sand and gravel output was down because building did not reach previous levels. Reduced output of clay and lime also reflected lower building and industrial activities.

Barite.—Missouri, the leading barite-producing State for 6 consecutive years, produced over one-third of the total U.S. output. Missouri barite was used in the midcontinent and gulf coast areas for a weighting agent in oil well drilling fluids and in the Midwest and East as raw material in paint, glass, and chemical industries.

Table 6.—Barite sold or used by producers

Year	Short tons	Value
1963	286,750	$3,679,764
1964	266,814	3,450,530
1965	328,585	4,219,343
1966	337,076	4,279,770
1967	331,780	4,443,851

Cement.—Missouri was an important cement production center. Plant expansions underway at yearend brought total cement-producing capacity of the State to about 30 million barrels annually. The State was surpassed only by the New York-Pennsylvania area, the Michigan (Chicago-Detroit) area, Texas, and California in cement output.

Dundee Cement Co. officially dedicated its new Clarksville plant in November 1967. The plant and related facilities are situated on 3,700 acres of land in Pike County; limestone and shale reserves are sufficient for more than 400 years at the present production rate of 7 million barrels of cement annually.

A dust collection system was an integral part of the Clarksville plant and reportedly would assure a better than 99 percent dust-free operation. Four electrostatic precipitator units at the feed end of the kiln treat the kiln exhaust gases.

Table 7.—Portland cement production and shipments

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1963	12,692	12,402	$41,640
1964	12,399	12,378	42,618
1965	13,975	13,334	46,034
1966	13,956	13,848	46,228
1967	14,888	15,044	52,119

Cement produced at Clarksville will be transported by barge and rail to major markets. New distribution terminals were constructed at St. Louis, Rock Island, New Orleans, Nashville, Minneapolis-St. Paul, Houston, Mobile, and Chicago, with others planned. In supplying its network of new terminals, Dundee became one of the largest shippers of cement on the inland waterways system. Approximately 65 percent of the Clarksville plant's production was transported by a fleet of 34 covered-hopper barges, each having a 7,500-barrel capacity.

In addition, Dundee transported cement by specially designed railroad cars to its outlying terminals and distributed its cement products locally by highway tank truck.

High-calcium Kimmswick limestone and Maquoketa shale were quarried at the Clarksville location and gypsum was shipped from Iowa. The kiln was fired by Illinois coal, received by rail, and ground to a powder before being pneumatically injected into the kiln.

Universal Atlas Cement Co., Division of U.S. Steel Corp. dedicated its new 3-million-barrel-per-year cement plant near Hannibal in June. The plant, a wet-process operation, has a single 620-foot rotary kiln.

Raw material came from nearby quarries in the Burlington limestone and the Grassy Creek-Saverton-Shales. About 40 feet of the lower Burlington was quarried for high-silica and low-silica limestone for blending purposes. Shale was quarried from

about 40 to 45 feet of Grass Creek-Saverton-Shales below the Burlington. A small quantity of gypsum, used as retarder, was obtained from out-of-State.

The plant's production facilities were operated by a complete computer-control complex, insuring a consistent high-quality product. Two closed-circuit television cameras provided the computer operator with a constant view inside the kiln where pulverized coal burned the limestone and shale slurry mixture into clinkers at 2,600° F. After firing, the clinkers and gypsum were ground into finished cement and stored in silos for shipment by barge, rail and truck to bulk cement distribution stations throughout the Midwest, and to local ready-mix producers.

To support the new plant, Universal Atlas Cement Co. built distribution stations in Bettendorf (Davenport), Iowa, and Summit, Ill. in addition to an existing station in St. Louis. Two new self unloading cement barges will supplement an older cement barge.

At yearend, Mississippi River Corp. announced expansion of the cement-producing capacity of its subsidiary, River Cement Co., at Selma, Jefferson County, by 2 million barrels per year. The present plant was completed in 1965 and marked the company's entry into the cement industry. It acquired several ready-mix companies to provide an outlet for some of the plant's production. The new plant facilities will include a duplicate of the original 560-foot kiln, storage silos, grinding and finishing mill, cement cooler, and a dust collection system capable of eliminating 99 percent of the dust produced.

Clays.—The tonnage of clay and shale mined in Missouri during the year declined slightly; however, value increased by nearly 4 percent. Of the total production, approximately 49 percent was refractory clay, 36 percent was used for cement, and 15 percent was used in structural clay products and lightweight aggregate. Clay and shale used in cement showed the only increase, about 33 percent, during the year.

Missouri ranked third in fire clay production; many of the larger refractory plants were located in the State. Mergers and modernizations involved several of Missouri's refractory manufacturers in 1967.

The merger of United States Gypsum Co. and A. P. Green Refractories Co. became effective at yearend. The A. P. Green plant at Mexico, Audrain County, was reportedly the world's largest.

Table 8.—Clay sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Fire clay [1]		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	850	$3,568	896	$899	1,746	$4,467
1964	1,002	3,905	964	969	1,966	4,874
1965	1,128	4,313	1,098	1,126	2,226	5,439
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

[1] Includes diaspore and burley.

Harbison - Walker Refractories Co. merged with Dresser Industries, Inc., and became a division of Dresser. Harbison-Walker plants are located at Fulton, Callaway County, and Vandalia, Audrain County.

The Missouri Mill and Foundry Clay Co. at High Hill, Montgomery County, was purchased in October 1967 by Combustion Engineering, Inc., of New York City. The 17-year-old firm now operates as a division.

Expansion and modernization by Kaiser Refractories at its Mexico, Audrain County, plant included enlargement and automation of the tunnel kiln, grinding and dry press facilities, and specialty manufacturing facilities. The machine shop was enlarged and a modern office building was constructed. Major items completed included expansion of the finished products warehouse, remodeling of the central stores

area, installation of a new rotary kiln for calcining clay, and a shuttle kiln for producing specialized refractory products. Scheduled for completion by the end of 1968, the new facilities were expected to increase capacity for making fire brick and specialties products and will improve raw materials handling.

At midyear, Missouri Clay Products Co., a subsidiary of St. Joseph Lead Co., began grading and filling for a 1,000-foot railroad spur into its Stoddard County clay deposit. Planned construction included a grinding and drying plant, storage and loading facilities, a laboratory, and an office. The montmorillonite-rich bentonitic clay will be used principally as a binder for iron ore pellets.

Carter-Waters Corp. of Kansas City, the only producer of expanded lightweight shale aggregate in the State, was increasing the capacity of its New Market plant in northern Platte County by installing a new 11- by 175-foot rotary kiln designed to produce 600 cubic yards per day. The project was scheduled for completion in mid-1968.

In October, Hydraulic Press Brick Co. announced plans to abandon its brick plant in St. Louis. The 13-acre site was to be sold as an industrial tract. The company's warehouse in St. Louis will be a distribution point for brick production from company-owned plants in Illinois.

The Federal Bureau of Mines and the Missouri Division of Geological Survey and Water Resources initiated a cooperative clay-testing program. Recognizing that the greater part of St. Louis County, underlain by shale and clay suitable for manufacturing brick, is in an area that was essentially withdrawn from industrial exploitation by zoning laws and urban sprawl, fieldwork started in an area of Lincoln County, considered to be an accessible source of potential but untested raw materials.

Lime.—Missouri lime plants were adding new facilities and equipment. Ash Grove Lime & Portland Cement Co., Springfield, was installing a 200-ton-per-day calcimatic rotating hearth kiln. Mississippi Lime Co., Ste. Genevieve, was adding two preheater-type rotary kilns, each with a capacity of 500 tons per day. Valley Dolomite Corp., Bonne Terre, began production of dolomitic quicklime at midyear; previously, the company produced only dead-burned dolomite.

Table 9.—Lime sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	1,240	$14,386
1964	1,219	14,328
1965	1,442	16,782
1966	1,494	17,910
1967	1,434	16,371

Sand and Gravel.—Tonnage declined for the second consecutive year, falling about 9 percent below 1966 production and nearly 20 percent below the 1965 all-time high. The major drop was in tonnage of construction sand and gravel, reflecting the decline in residential and commercial construction. Industrial sand output approximated output in 1966. Production of alluvial sand and gravel was reported at 70 operations from 41 counties. Silica sand was produced in three counties at five operations. Major sources of construction sand were the Mississippi, Missouri, and Meramec Rivers. All silica sand production was from the St. Peter Sandstone. The Meramec River was the largest single source of gravel in the State.

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

(Thousand short tons and thousand dollars)

Year	Commerical		Government-and-contractor		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	9,808	$11,580	845	$680	10,653	$12,260
1964	10,761	12,762	722	618	11,483	13,380
1965	11,229	12,954	839	781	12,068	13,735
1966	10,454	13,283	248	257	10,702	13,540
1967	9,651	12,488	65	68	9,716	12,556

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

(Thousand short tons and thousand dollars)

Class of operation and use	1966		1967	
	Quantity	Value	Quantity	Value
Commerical operations:				
Sand:				
Building	3,831	$3,547	3,359	$3,139
Paving	629	638	1,043	966
Fill	392	345	366	324
Industrial glass	561	1,406	W	W
Other [1]	533	2,178	1,060	3,725
Total	5,946	8,114	5,828	8,154
Gravel:				
Building	2,274	2,770	1,808	2,269
Paving	1,808	2,114	1,737	1,883
Fill	209	103	116	67
Other [2]	217	182	162	115
Total	4,508	5,169	3,823	4,334
Total sand and gravel	10,454	13,283	9,651	12,488
Government-and-contractor operations:				
Sand: Paving	124	124	1	2
Gravel: Paving	124	133	64	66
Total sand and gravel	248	257	65	68
Grand total	10,702	13,540	9,716	12,556

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes railroad ballast, other construction sand, and various industrial sand (unground and ground).
[2] Includes railroad ballast, miscellaneous gravel, and other construction gravel.

Stone.—Stone has been the major mineral commodity produced in Missouri since 1962 in tonnage and value. Stone will remain the principal commodity in tonnage, but lead and cement are expected to surpass stone value.

Limestone and dolomite were the principal rock resources in Missouri. In 1967, crushed and dimension limestone and dolomite accounted for about 97 percent of the total tonnage of stone. Other rock types were marble, sandstone, granite, and felsite.

Table 12.—Stone sold or used by producers, by uses

Use	1966		1967	
	Quantity	Value	Quantity	Value
Dimension and building:				
Rough construction, short tons	3,386	$114,744	W	W
Dressed (cut or sawed), do.	12,983	2,301,704	13,463	$2,633,132
Other [1], do.	4,250	37,900	6,197	122,984
Total, approximate short tons	20,619	2,454,348	19,660	2,756,116
Crushed and broken:				
Riprap, short tons	3,280,007	2,316,866	2,455,989	1,825,351
Concrete aggregate, roadstone, etc, short tons	18,908,975	25,747,986	20,572,740	26,475,675
Railroad ballast, do.	435,328	210,772	295,420	226,029
Agricultural, do.	3,873,175	6,491,515	3,827,108	6,430,075
Cement, do.	4,248,079	4,248,079	4,852,291	4,852,291
Other [2], do.	4,473,564	11,923,767	4,561,604	11,387,219
Total, do.	35,219,128	50,938,985	36,565,152	51,196,640
Grand total, do.	35,239,747	53,393,333	36,584,812	53,952,756

W Withheld to avoid disclosing individual company confidential data; included in total.
[1] Includes flagging, rubble, and rough architectural stones.
[2] Includes stone for terrazzo, roofing granules, glass, whiting, asphalt filler, fertilizer filler, other filler, coal dust, filter beds, mineral food, poultry grit, lime, refractory, flux, and miscellaneous uses.

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

(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
1963	2,958	$317	29,776,088	$42,711	3,655	$55	1,101,840	$3,047	30,884,541	$46,130
1964	3,226	292	30,567,256	44,586	2,208	29	914,026	3,077	31,486,716	47,984
1965	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

[1] Includes crushed granite, marble, miscellaneous stone, and crushed sandstone.

Increased use of crushed limestone in highway construction accounted for most of the increase in Missouri stone output during the year. A slight decrease in residential building and less industrial construction lowered stone output for these markets. Major uses of crushed stone were concrete aggregate, roadstone, cement and lime manufacturing, agricultural limestone, and riprap. Stone production was reported from 79 of the State's 114 counties. Production of more than 1 million tons each was reported from 10 counties.

Industry increased efforts to reduce air and water pollution and to keep unsightly operations at a minimum. The possibility of satisfying an increasing share of future stone needs from underground mines was studied.

O'Fallon Quarry & Supply Co., St. Charles County, expanded its quarry operation after purchasing a hot-mix asphalt plant from Rock Hill Asphalt and Construction Co. of Clayton. The plant has been permanently set up in the quarry for some years, with the aggregate being furnished by O'Fallon Quarry & Supply Co.

Adrian Materials Co., Boone County, reported completion of its first year of successful underground quarrying. Mining was by room and pillar, with rooms averaging 20 feet in height and 35 feet in width. The quarry was opened in Callaway Limestone of Devonian age.

Asphaltic sandstone for road surfacing was produced by Bar-Co-Roc Asphalt Co. in Barton County and Midwest Silica Rock Co. in Vernon County.

Sulfur.—Interest in the recovery of by-product sulfur was receiving increased attention from various operations in the State, largely as an air pollution abatement attempt.

Plans for building a sulfuric acid plant at St. Joseph Lead Co.'s Herculaneum lead smelter were completed at the end of the year, and construction was scheduled to begin in 1968. The plant, utilizing sulfur dioxide gas resulting from sintering lead concentrates at the smelter, will have a capacity of about 100,000 tons of sulfuric acid per year.

Missouri Lead Operating Co. was installing equipment to make acid at the rate of about 50,000 tons per year at its new lead smelter at Buick. Research on recovery and utilization of sulfur compounds from large fuel-burning installations was also actively conducted during the year.

METALS

Missouri has been the Nation's leading producer of lead for over half a century and is expected to continue in that role. Coproducts of lead production were copper and zinc in appreciable quantities.

In recent years the State has become an important iron ore producer. New mine and plant facilities will have a production capacity of about 3 million tons of high-grade iron ore pellets. Exploration for other iron deposits is continuing.

Aluminum.—Plans for constructing an aluminum reduction plant and a steam-generating plant at New Madrid in southeast Missouri were disclosed late in 1967. The reduction plant would be built by Noranda Manufacturing, Ltd., a major mining firm in Toronto, Canada. Minimum annual capacity would be 60,000 to 70,000 tons of aluminum ingot. A 500,000-kilowatt steam generating plant would be constructed to supply power for the plant.

Copper.—Copper flotation circuits were operated at the Viburnum, Federal, and

Fletcher mills of St. Joseph Lead Co. Circuits were being installed in other mills under construction in the new lead belt to recover copper concentrate. Plans called for smelting the concentrates at facilities outside Missouri.

Exploration continued at a potentially exploitable copper-iron occurrence near Boss, Dent County. This occurrence was found as a result of a magnetic survey made by the State of Missouri.

Iron Ore.—Although Missouri was not among the leading iron ore producing States in 1967, its annual plant capacity totaled 3 million tons of high-grade pellets and the potential for greater production is significant. Several magnetic anomalies associated with iron ore were being explored. Estimates of iron ore reserves of potential commercial value in the State are as much as 1 billion tons.

Table 14.—Iron ore (usable)

(Thousand long tons and thousand dollars)

Year	Quantity	Value
1963	345	$3,085
1964	1,116	14,907
1965	1,784	24,607
1966	1,887	26,450
1967	1,871	26,673

At Pilot Knob, Iron County, development work began in the new mine of Pilot Knob Pellet Co. a joint venture of The Hanna Mining Co. and Granite City Steel Co. A 20-foot-diameter, concrete-lined main shaft and a 15-foot-diameter ventilation shaft were completed. A primary crusher was installed underground to crush and screen the ore before it is moved to the surface.

Construction began on beneficiating facilities to provide the company with an annual rated plant capacity of 1 million tons of high-grade iron ore pellets—250,000 tons more than originally planned. The increase was attributed to the continued growth in the demand for flat-rolled steel products in Missouri and other areas. The mine and pellet plant were scheduled to begin operating in 1968. At the concentrating plant magnetic separators will recover the iron ore. The resulting concentrate will be used to form pellets of ⅜- to ½-inch diameter. The pellets will be heat-hardened in a 200-foot traveling-grate furnace.

The pellets will be shipped to Granite City Steel's plant in Granite City, Ill., about 85 miles from Pilot Knob, Mo. The pellets, averaging 64 percent iron, will enable the company to increase its output of blast furnace pig iron to support the expansion and modernization of steelmaking, rolling, and finishing facilities in progress in 1967.

In addition to its production of iron ore pellets, Meramec Mining Co. installed new equipment at its Pea Ridge mine, Washington County, to produce from the ore high-quality iron oxide for use in the ceramic-ferrite industry. This involved equipment to reduce the silica to less than one-half of one percent from the 1.5 percent found in the Pea Ridge ore. The material is used in fractional horsepower electric motors, television sets, and other applicances. The first commercial test shipment of Meramec iron oxide was made late in 1967.

Installation of underground crushing facilities in the Pea Ridge mine continued and completion was anticipated in the first quarter of 1969. Mining methods were modified during the year to permit greater extraction of ore at the western extremity of the ore body by removal of supporting pillars. The procedure was successful and was reflected in reduced mining costs during the year.

The company completed a research program relating to treatment of high-grade hematite ore found at the Pea Ridge mine. At yearend, Meramec Mining Co. was reviewing the economic aspects of modifying its concentrating and pellet plant to accommodate the ore. The present plant processes mainly magnetite ore.

Table 15.—Ferrous scrap and pig iron consumption

(Thousand short tons)

Year	Ferrous scrap	Pig iron	Total scrap and pig iron
1963	908	33	941
1964	1,029	40	1,069
1965	1,096	42	1,138
1966	1,063	41	1,104
1967	1,051	31	1,082

Lead.—Lead has become the State's most valuable mineral asset. For most of

the 20th century, Missouri has been the Nation's principal source of lead. New deposits found in southeast Missouri were the most important lead discoveries made in this country in the present century and one of the world's largest deposits of this metal. The discoveries resulted in the development of new mines and expansion of existing ore-processing facilities that will greatly increase domestic lead production.

Total reserves in the new district were estimated at as much as 1 billion tons of ore containing 20 to 30 million tons of recoverable lead. The reserve represented between two and three times the total quantity of rcoverable lead produced in Missouri (10.7 million short tons valued at $1.6 billion) and more lead than has been produced in the United States in this century.

Missouri Lead Smelting Co. was nearing completion of its smelter near Bixby, Iron County, located between the Magmont Mine of Cominco and the Buick mine of Missouri Lead Operating Co. (MOLOC).

Ozark Lead Co. was completing its mine and mill at the south end of the new lead belt in Reynolds County at year-end. Production was expected early in 1968 at a rate of 60,000 tons of lead per year. Lead concentrates will be smelted by American Smelting and Refining Company (ASARCO) at its new smelter at Glover.

Table 16.—Mine production of silver, copper, lead, and zinc, in terms of recoverable metals

Year	Mines producing	Material sold or treated Crude ore (short tons)	Silver		Copper	
			Troy ounces	Value (thousands)	Short tons	Value (thousands)
1963	4	3,253,245	131,664	$168	1,816	$1,119
1964	5	4,965,814	---	---	2,059	1,343
1965	5	5,279,420	299,522	387	2,331	1,650
1966	7	[1] 5,387,330	---	---	3,913	2,831
1967	10	[1] 5,563,824	---	---	3,215	2,458

Year	Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	79,844	$17,246	321	$74	$18,607
1964	120,148	31,479	1,501	408	33,230
1965	133,521	41,659	4,312	1,259	44,955
1966	[1] 132,255	[1] 39,981	[1] 3,968	[1] 1,151	43,963
1967	[1] 152,649	[1] 42,742	[1] 7,430	[1] 2,057	47,257

[1] Includes southwest Missouri.

Table 17.—Mine production of lead and zinc in Missouri, in terms of concentrates and recoverable metals [1]

Year	Lead concentrates (Galena)		Zinc concentrates (Sphalerite)		Recoverable metal content [2]			
					Lead		Zinc	
	Short tons	Value [3] (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1963	109,960	$15,054	666	$50	79,844	$17,246	321	$74
1964	167,630	28,125	3,115	205	120,148	31,479	1,501	408
1965	186,368	36,537	8,792	891	133,521	41,659	4,312	1,259
1966	185,410	33,816	8,525	795	132,255	39,981	3,968	1,151
1967	220,096	35,824	15,512	1,412	152,649	42,742	7,430	2,057

[1] Based on Missouri ore "dirt" and old tailing treated at mills.
[2] In calculating metal content of ores from assays, allowance has been made for smelting losses. In comparing values of concentrate "ore" and metal, value for concentrate is that received by producer, whereas value of lead and zinc is calculated from average price for all grades.
[3] Values are arbitrary, because part of lead concentrate is smelted by producer.

Table 18.—Tenor of lead and zinc ore milled and concentrates produced in Missouri [1]

	1966	1967
Concentrate production:		
Lead—short tons	185,410	220,096
Zinc—do	8,525	15,512
Concentrate obtained from:		
Lead—percent	3.44	3.96
Zinc—do	0.16	0.28
Metal content of ore: [2]		
Lead—do	2.45	2.74
Zinc—do	0.07	0.13
Average lead content of galena concentrate—percent	72.79	70.77
Average zinc content of sphalerite concentrate—percent	51.71	53.22
Average value per ton:		
Galena concentrate	$182.38	$162.77
Sphalerite concentrate	$93.27	$91.00
Total material milled—short tons	5,387,330	5,563,824

[1] Includes southwest Missouri.
[2] Figures represent metal content of crude ore only as recovered in the concentrate; data on tailing losses not available.

Construction of the Magmont mine and mill south of Bixly, Iran County, was started in late 1965, and the facilities were expected to begin operation in early 1968. The underground mine will produce more than 1 million tons of ore annually, which will yield 50,000 ton of metallic lead plus quantities of zinc and copper, Cominco American, Inc., and Dresser Industries, Inc., jointly own the mine and mill complex, but Cominco Mines Division was responible for operation of the Magmont property.

St. Joseph Lead Co.'s Fletcher mine and mill, Reynolds County, began operation in February. The Fletcher mine-mill has a designed capacity of 5,000 tons of ore per day, with the mine on two shifts per day and the mill running three shifts, both on a 5-day week. Output, which could yield 60,000 tons of lead per year, was reported regularly exceeding the mill's rated capacity.

The new 12.5-foot-diameter Goose Creek shaft of St. Joseph Lead Co., started in 1966 to provide access to ore reserves north of the existing Indian Creek mine, Washington County, was bottomed at 1,180 feet, and surface facilities were completed. First production from the mine was expected by the third quarter of 1968.

An expansion program, doubling the capacity of the St. Joseph Lead Co.'s Herculaneum Smelter, Jefferson County, was completed in early 1967 after a conversion shutdown period that extended into the opening weeks of the year. Herculaneum production from company concentrates totaled 120,207 tons of finished lead metal in 1967, substantially exceeding the 1966 ouput of 90,729 tons despite unexpected difficulties in operating automated control systems for sintering and furnace processes.

A decision to postpone further development and production at the Higdon mine, Perry County 7 miles northeast of Fredericktown, was announced by The Bunker Hill Co. Higdon had been scheduled to begin operating in 1968 and produce about 15,000 tons of lead annually. Bunker Hill expended over $3.5 million, sinking two 1,500-foot shafts and installing hoisting equipment. The main production shaft had been completed by the end of April. Development of the property for production was deferred because of market conditions. All shafts were cased and sealed and the mine placed on a standby basis.

American Smelting and Refining Company's new lead smelter at Glover in eastern Iron County was nearing completion. Annual capacity was reported from 80,000 tons upward. Concentrates will come from Ozark Lead Co.'s mine at the south end of the new lead district.

Silver.—Among the byproducts and coproducts of metal mining in the State, silver attracted considerable attention because of its worldwide shortage. The potential recovery of 1 million ounces of silver per year from southeast Missouri is significant.

Zinc.—Zinc production in the State has dropped in recent years. Full-scale operation in the new lead district should enable Missouri to regain some of its prominence in zinc and become the fifth or sixth ranking producer. Zinc output for southeast Missouri reached record levels in 1967.

MINERAL FUELS

Small quantities of petroleum and natural gas were produced. Drilling decreased considerably from that of previous years, and prospects improved for in-

creased supplies of natural gas from outside the State.

Bituminous coal output was down slightly, but increased demand seemed likely for new and expanded coal-fired steam power-plants in the State. The favorable outlook was clouded somewhat by uncertainties about the effect of recently imposed restrictions on sulfur content of coal used by installations of less than utility size in the St. Louis metropolitan area and the prospects for further restrictions in other parts of the State.

Coal.—Ground was broken for Empire Electric Co.'s minemouth powerplant and The Pittsburg & Midway Coal Mining Co. (P & M) Barton County coalfield in joint ceremonies September 15, 1967. The 200,000-kilowatt powerplant will be built near Asbury in Jasper County, and is scheduled to begin operations in June 1970. The P & M strip mine will be just across the Japanese-Barton County line in Barton County where P & M holds "substantial reserves" of coal. The company will provide 750,000 tons of coal per year to generate steam for the turbine-generator at the powerplant. Water for the boilers will come from deep wells at the plant site and will be recirculated through a system of condensers and cooling towers to provide maximum economy and minimum consumption of water. Approximately 172 million gallons of water per day will pass through the condensers, but only a fraction of this water will be consumed. The aquifier tapped by the wells is the Roubidoux Formation. Electrostatic precipitators will catch particulate pollutants, and flue gases will vent through a stack 400 feet high.

Table 19.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	3,174	$13,196
1964	3,254	13,285
1965	3,564	14,779
1966	3,582	14,834
1967	3,696	15,573

The 150,000-kilowatt Thomas Hill steam-generating plant in Randolph County was dedicated by Associated Electric Cooperative of Springfield, Mo., on July 16, 1967. The project was already expanding by addition of a second generating unit which will more than double the plant's current output to 400,000 kilowatts. Peabody Coal Co. will supply coal to the facility by rail from its Bee-Veer mine, Macon County, which is capable of supplying 1.5 million tons annually. Cooling water for the generators will be supplied at a rate of 25,000 gallons per minute from the 4,500-acre Thomas Hill reservoir.

Peabody Coal Co. moved the Tebo mine operation in Henry County to a new tract of several hundred acres near Calhoun. Operations had been north of the city since the field was opened in 1958. Two high-grade coal beds, with a combined thickness of 42 inches, were being mined in tandem. Production was expected to average 2,500 to 3,000 tons per day for 1½ years—about double the rate for 1966 at the old location. All coal will continue to be trucked about 30 miles to the Kansas City Power & Light Co. plant at Montrose in southeastern Henry County.

Petroleum and Natural Gas.—Drilling in 1967 in Missouri resulted in 58 wells, according to the Missouri Geological Survey. The total comprised 15 oil wells, 11 dry holes, and 32 service wells. New wells last year totaled 85, with 39 new oil wells and two new gas wells.

According to Missouri Geological Survey, 146 producing wells (as of yearend 1967) produced 75,000 barrels of oil in 1967. Eleven gas wells produced 121 million cubic feet, with an average wellhead value of $0.245 per thousand cubic feet.

The Missouri Oil and Gas Council issued 56 drilling permits during 1967 as follows: Observation wells, two; stratigraphic tests, 24; underground gas storage wells, three; wildcat wells, four; injection wells, 10; and oil wells (field development), 13.

The presence of low-gravity, high-viscosity oil, commonly described as "heavy oil," has been known in western Missouri for at least 100 years. This material, because of its wide distribution and shallow depths, has received much attention as a possible source of petroleum. Several major oil companies expended considerable time and money in attempts to develop methods to recover this oil, most of which is too viscous to flow satisfactorily and be produced from ordinary drill holes. Major

companies that have worked on the problem from the 1950's until recently included the Carter Oil Co., Phillips Petroleum Co., Shell Oil Co., and Marathon Oil Co. These firms conducted extensive experimental programs, including pilot plants, in Vernon and Cass Counties. All of the projects were thermal recovery projects, including in situ combustion (fire flooding) and steam injection procedures. Estimates of oil in place range as high as 30 billion barrels.

Cities Service planned to construct 402 miles of new pipelines between Springfield and Washington, Mo., including about 182 miles of 8- and 16-inch main line, and a new pumping station near Springfield. The original application called for delivery of natural gas to 39 Missouri towns and several industries near the proposed main line, all in areas now lacking natural gas service, Cities Service proposed to construct most of the facilities in 1968, allowing service to begin by the 1968–69 heating season. Estimated annual requirements of the 39 communities would be 3 billion cubic feet the first year.

Cities Service applied to Federal Power Commission for approval to build facilities to handle an additional 200 million cubic feet of natural gas daily. One of the projects involved expansion of the company's gas-transporting system from the Kansas Hugoton field east toward the Kansas City area, including more than 200 miles of new pipeline. The other project would permit the purchase of 100 million cubic feet of gas daily for customers in southwestern Missouri, and would require a 40-mile pipeline from the Arkansas-Missouri border to the company's main line near Joplin.

Laclede Gas Co. continued efforts to expand gas storage within the St. Peter Sandstone in St. Louis and St. Charles Counties. During the year, 37 stratigraphic tests were drilled with an average depth of 400 feet.

Table 20.—Principal producers of metals, minerals, and fuels

Commodity and company	Type of activity	County	Address	Remarks
Native asphalt:				
Bar-Co Roc Asphalt Co	Mine	Barton	Iantha, Mo	Paving material.
Midwest Silica Rock Co	do	Vernon	Sheldon, Mo	Do.
Barite:				
DeSoto Mining Co	do	Washington	DeSoto, Mo	
Dresser Minerals	do	do	Houston, Texas	
General Barite Co	do	do	DeSoto, Mo.	
Milchem, Incorporated	Mine and mill	do	Houston, Texas	Five mines.
National Lead Co., Baroid Division	do	do	do	Three mines.
National Lead Co., DeLore Division	Mill	St. Louis	St. Louis, Mo.	
Ozark Mining Co	Mine	Washington	Potosi, Mo.	
Chas, Pfizer & Co., Inc	Mine and mill	do	Mineral Point, Mo.	
Polite Bros. Mining Co	Mine	do	Cadet, Mo.	
A. W. Wood	do	do	Potosi, Mo.	
Cement:				
Alpha Portland Cement Co	Quarry and plant	St. Louis	Easton, Pa	Also limestone.
Dundee Cement Co	do	Pike	Dundee, Mich	Also clay and limestone.
Marquette Cement Manufacturing Co	do	Cape Girardeau	Chicago, Ill	Also limestone.
Missouri Portland Cement Co	do	Jackson	St. Louis, Mo	Also clay and limestone.
Do	do	St. Louis	do	Do.
River Cement Company	do	Jefferson	do	Also sandstone and limestone.
Universal Atlas Cement Co., Division of U.S. Steel Corp.	do	Ralls	Pittsburgh, Pa	Also limestone.
Clay and shale:				
Allied Chemical Corp	Mine and plant	Gasconade	Morristown, N.J.	
Alton Brick Co	do	St. Louis	Maryland Heights, Mo.	
Carter-Waters Corp	do	Platte	Kansas City, Mo.	
General Refractories Co	do	Audrain	Philadelphia, Pa.	
Do	do	Gasconade	do	
Do	do	Montgomery	do	
Do	do	Osage	do	
Do	do	St. Charles	do	
Joe Gilliam Mining Co	Mine	Monroe	Paris, Mo.	
A. P. Green Refractories Co	Mine and plant	Audrain	Mexico, Mo.	
Do	do	Gasconade	do	
Do	do	Franklin	do	
Do	do	Osage	do	
Harbison-Walker Refractories Co	do	Callaway	Pittsburgh, Pa.	
Do	do	Gasconade	do	
Do	do	Lincoln	do	
Do	do	Warren	do	
Kaiser Refractories	do	Audrain	Mexico, Mo.	
Do	do	Callaway	do	
Do	do	Franklin	do	
Do	do	Gasconade	do	

Table 20.—Principal producers of metals, minerals, and fuels—Continued

Commodity and company	Type of activity	County	Address	Remarks
Clay and shale—Continued				
Kaiser Refractories	Mine and plant	Maries	Mexico, Mo.	
Do	----do	Montgomery	----do	
Do	----do	Osage	----do	
Do	----do	Warren	----do	
Midland Brick & Tile Co	----do	Livingston	Chillicothe, Mo.	
H. K. Porter Co., Inc	----do	Callaway	St. Louis, Mo.	
Do	----do	Crawford	----do	
Do	----do	Franklin	----do	
Do	----do	Gasconade	----do	
Walsh Refractories Corp	----do	Audrain	----do	
Do	----do	Callaway	----do	
Do	----do	Gasconade	----do	
Do	----do	Monroe	----do	
Wellsville Fire Brick Co	----do	Audrain	Wellsville, Mo.	
Do	----do	Montgomery	----do	
Coal:				
Clayton-Hersley Coal Co	Strip mine	Callaway	Fulton, Mo.	
Ellis Coal Company	----do	Vernon	Bronaugh, Mo.	
Hamlin Brothers Coal Co	----do	Clark	Bonaparte, Iowa	
Kirkville Coal Co., Inc	----do	Putnam	Centerville, Iowa	
Madole Bros. Coal Co	----do	Henry	Windsor, Mo.	
Nichols Coal Company	----do	Vernon	Rich Hill, Mo.	
Palmer Coal & Rock Co., Inc	----do	----do	Fort Scott, Kans.	
Peabody Coal Co	----do	Boone	St. Louis, Mo.	
Do	----do	Henry	----do	Two mines.
Do	----do	Macon	----do	
Putnam County Stone Co	----do	Putnam	Unionville, Mo.	
Tyler Coal Co	----do	Dade	Jerico Springs, Mo.	
Veach & Haines	Underground mine	Putnam	Omaha, Mo.	
Iodine (consumption):				
Hoffman-Taff, Inc	Plant	Greene	Springfield, Mo.	
Interstate Chemical Co., Inc	----do	Jackson	Kansas City, Mo.	
Mallinckrodt Chemical Works	----do	St. Louis	St. Louis, Mo.	
Iron Ore:				
The Hanna Mining Co	Underground mine	St. Francois	Cleveland, Ohio	Shipped from stockpile.
Meramec Mining Co	----do	Washington	Sullivan, Mo.	
Plateau Iron Ore Corp	Open pit	Howell	Evansville, Ind.	
Taft Dow, Incorporated	----do	Wayne	Williamsville, Mo.	
Lead and zinc:				
St. Joseph Lead Co	Underground mine	Crawford	Bonne Terre, Mo	Also copper.
Do	----do	Iron	----do	Do.
Do	----do	Washington	----do	Do.
Do	----do	St. Francois	----do	Also copper—no zinc.
Do	----do	Reynolds	----do	
Do	----do	Washington	----do	

Lime:				
Ash Grove Lime & Portland Cement Co	Quarry and plant	Greene	Kansas City, Mo	Also limestone.
Marblehead Lime Co	do	Marion	Chicago, Ill	Do.
Mississippi Lime Co	do	Ste. Genevieve	Alton, Ill	Do.
Valley Dolomite Corp	do	St. Francois	St. Louis, Mo	Also dolomite.
Roofing Granules:				
The Rubberoid Co	Plant	Iron	Annapolis, Mo	Crushed granite.
Sand and gravel:				
Eureka Sand & Gravel Co	Stationary	St. Louis	Eureka, Mo.	
Independent Gravel Co	do	Jasper	Joplin, Mo	Also stone.
Martin Marietta Corp	do	Jefferson	Rockton, Ill	Silica sand.
Mississippi River Sand & Materials Co	Stationary and dredge	St. Louis	St. Louis, Mo.	
Missouri Gravel Co	Dredge	Lewis	Moline, Ill	Also stone.
Pennsylvania Glass Sand Corp	Stationary	St. Louis	Hancock, W. Va	Silica sand.
Do	do	St. Charles	do	Do.
Pittsburgh Plate Glass Co	Stationary underground	Jefferson	Pittsburgh, Pa	Do.
St. Charles Sand Co	Stationary	St. Louis	Bridgeton, Mo.	
Simpson Sand & Gravel	Dredge	Jefferson	Valley Park, Mo.	
Simpson Material Co	do	St. Louis	do	
Stewart Sand & Material Co	Stationary	Jackson	Kansas City, Mo	Also stone.
Taylor Sand & Gravel Co	Stationary, portable, & dredge	Pemiscott	Caruthersville, Mo.	
Welton & Gray Gravel Co	Portable	Douglas	Ava, Mo	Also stone.
Winter Bros. Material Co	Stationary	St. Louis	St. Louis, Mo.	
Stone:				
Feyer Crushed Rock Co	Quarry	Jackson	Kansas City, Mo.	
Busson Quarries, Inc	do	Jefferson	St. Louis, Mo.	
Do	do	St. Louis	do	
Carthage Marble Corp	do	Greene	Carthage, Mo.	
Do	Quarry and underground	Jasper	do	
Central Stone Company	Quarry	Pike	Moline, Ill.	
Do	do	Ralls	do	
The Federal Materials Co., Inc	do	Cape Girardeau	Cape Girardeau, Mo.	
Georgia Marble Co.—Tenn. Division	do	Ste. Genevieve	Knoxville, Tenn.	
Gibbar Bros., Inc	do	Perry	Perryville, Mo.	
Paul Giudicy	do	Jefferson	Pevely, Mo.	
Gordon Bros. Quarries, Inc	do	Holt	Forest City, Mo.	
Green Quarries, Inc	Quarry	Livingston	Carrollton, Mo.	
Do	do	Randolph	do	
Do	do	Ray	do	
Griesemer Stone Company	Underground	Greene	Springfield, Mo.	
Heyward Granite Co	Quarry	Iron	Graniteville, Mo.	
Howard Construction Co	do	DeKalb	Sedalia, Mo.	
Do	do	Pettis	do	
Do	do	Saline	do	
Independent Gravel Co	do	Jasper	Joplin, Mo	Also sand and gravel.
Marble Products Co. of Georgia	do	Jefferson	Atlanta, Ga.	
Do	do	Madison	do	
Midwest Precote Company	do	Clay	Kansas City, Mo.	
Ozark Stone Products, Inc	do	Shannon	Camdenton, Mo.	
Riverview Stone & Material Co	do	St. Louis	Florissant, Mo.	
Roth Building Stone Co	do	Ste. Genevieve	Ste. Genevieve, Mo.	
St. Charles Quarry Co	do	St. Charles	St. Charles, Mo.	
St. Joseph Lead Co	do	St. Francois	Bonne Terre, Mo	Mine tailings.
Southeast Missouri Stone Co	Quarry	Cape Girardeau	Cape Girardeau, Mo.	
Stewart Sand & Material Co	do	Jackson	Kansas City, Mo	Also sand and gravel.

Table 20.—Principal producers of metals, minerals, and fuels—Continued

Commodity and company	Type of activity	County	Address	Remarks
Stone—Continued				
Trap Rock Materials & Engr	Quarry	St. Francois	Iron Mountain, Mo	Mine tailings.
Union Quarries, Inc	Underground	Jackson	Overland Park, Kans.	
Vigus Quarries, Inc	Quarry	Jefferson	St. Louis, Mo.	
Do	do	St. Louis	do	
Weiler Marble Co	do	Ste. Genevieve	Ste. Genevieve, Mo.	
West Lake Quarry & Matl. Co., Inc	do	Scott	Bridgeton, Mo.	
Do	do	St. Louis	do	Also sand and gravel.
Tripoli:				
The Carborundum Co., American Tripoli Division.	Mill	Newton	Seneca, Mo.	
Vermiculite:				
Zonolite Division, W. R. Grace & Co	Exfoliating plant	Jackson	Cambridge, Mass.	
Do	do	St. Louis	do	

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] Ronald P. Collins,[2] and William N. Hale[1]

In 1967 Montana mineral production was valued at $186.5 million, a decline of $58.7 million from the prior year resulting mainly from a nationwide labor dispute that idled the copper industry at midyear. Chiefly as a consequence of the strike-caused curtailment of operations at The Anaconda Company, copper production value was down $42.6 million; silver production value decreased $3.7 million; and lead and zinc values declined $1.1 and $7.5 million, respectively. The lead and zinc values also were affected by termination of mining at the Badger State mine and cessation of operations at the Anaconda zinc smelter.

The value of petroleum production amounted to a record-setting $87.5 million; petroleum was also the State's dominant mineral commodity in terms of value. The combined value of petroleum and copper production continued to grow when considered as a percentage of total value—70.7 percent in 1965, 72.9 percent in 1966, and 73.8 percent in 1967.

[1] Mineral specialist, Bureau of Mines, Albany, Oreg.
[2] Economist, Bureau of Mines, Albany, Oreg.

Table 1.—Mineral production in Montana [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	53	$56	46	$50
Coal (bituminous and lignite) do	419	1,290	371	996
Copper (recoverable content of ores, etc.) short tons	128,061	92,639	65,483	50,063
Gem stones	NA	109	NA	109
Gold (recoverable content of ores, etc.) troy ounces	25,009	875	9,786	343
Iron ore (usable) thousand long tons, gross weight	12	93	10	81
Lead (recoverable content of ores, etc.) short tons	4,409	1,333	898	251
Lime thousand short tons	225	2,116	143	1,765
Manganiferous ore and concentrate (5 to 35 percent Mn) short tons, gross weight	1,755	28	2,763	16
Natural gas million cubic feet	30,685	2,547	25,866	2,173
Petroleum (crude) thousand 42-gallon barrels	35,380	86,273	34,959	87,543
Pumice thousand short tons	22	5	-------	-------
Sand and gravel do	13,816	13,523	12,339	10,655
Silver (recoverable content of ores, etc.) thousand troy ounces	5,320	6,878	2,066	3,203
Stone thousand short tons	4,150	5,212	4,782	6,037
Zinc (recoverable content of ores, etc.) short tons	29,120	8,445	3,341	925
Value of items that cannot be disclosed: Antimony, barite (1966), cement, fluorspar, gypsum, manganese ore, natural gas liquids, peat, phosphate rock, talc, tungsten, uranium (1966), and vermiculite	XX	23,846	XX	22,314
Total	XX	245,268	XX	186,524
Total 1957–59 constant dollars	XX	r 219,890	XX	p 168,908

p Preliminary. r Revised. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes fire clay (1967) and bentonite; included with "Value of items that cannot be disclosed."

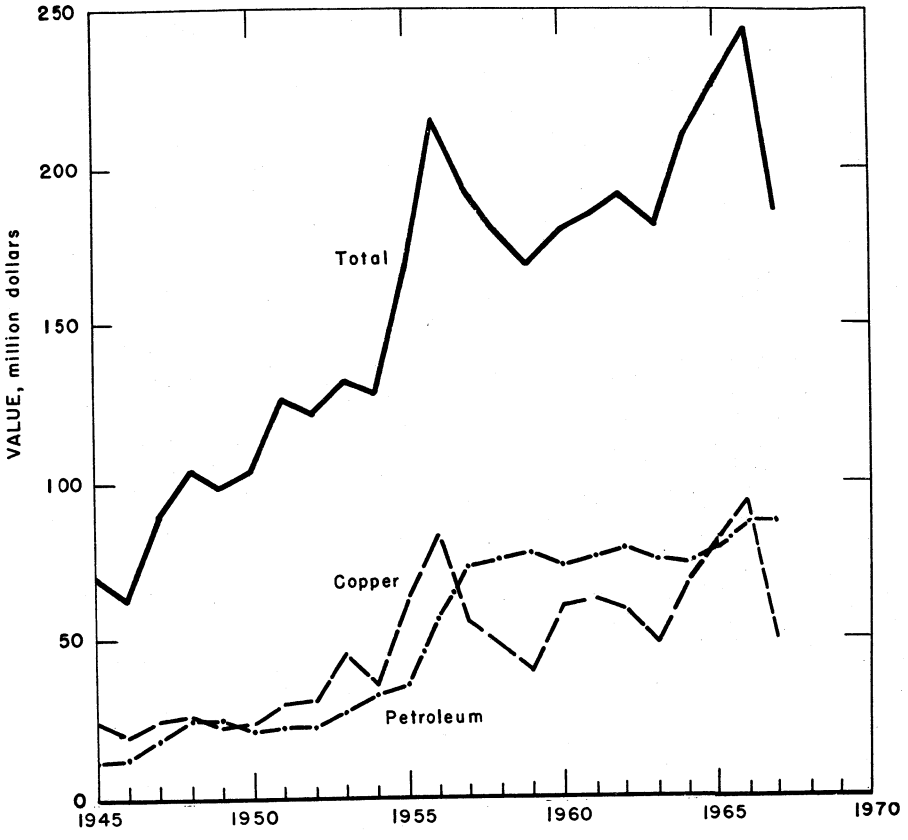

Figure 1.—Value of copper, petroleum, and total value of mineral production in Montana.

The output of primary aluminum from the Columbia Falls reduction plant of Anaconda Aluminum Co. remained nearly equal to the 1966 production figure. By the end of 1968, the scheduled completion date for construction underway, the rated capacity was to be 175,000 tons annually.

Important developments in the petroleum industry included discovery of a petroleum field in the Powder River Basin and a major natural gas field in the Bearpaw Mountains.

Economic Activity and Employment.—Business indicators reflected to a great extent the impact of the copper strike on the State's economic activity. Total and per capita income growths were less than in 1966 by around 2 percent in each category. Building permits, very sensitive to change in the economic climate, declined 13 percent. A significant factor for future employment expansion in the construction sector was the award of an $82.9 million contract for construction of Libby Dam in Lincoln County authorized by the U.S. Army Corps of Engineers.

According to reports of the Montana State Employment Service, the copper strike had pronounced effects on the State's employment picture. An anticipated record-setting labor force of 200,000 was not realized because of the work stoppage involving 7,500 workers employed at plants in Anaconda, Butte, Great Falls, and East Helena. Secondary unemployment was becoming critical toward yearend because of the extended length of the labor dispute.

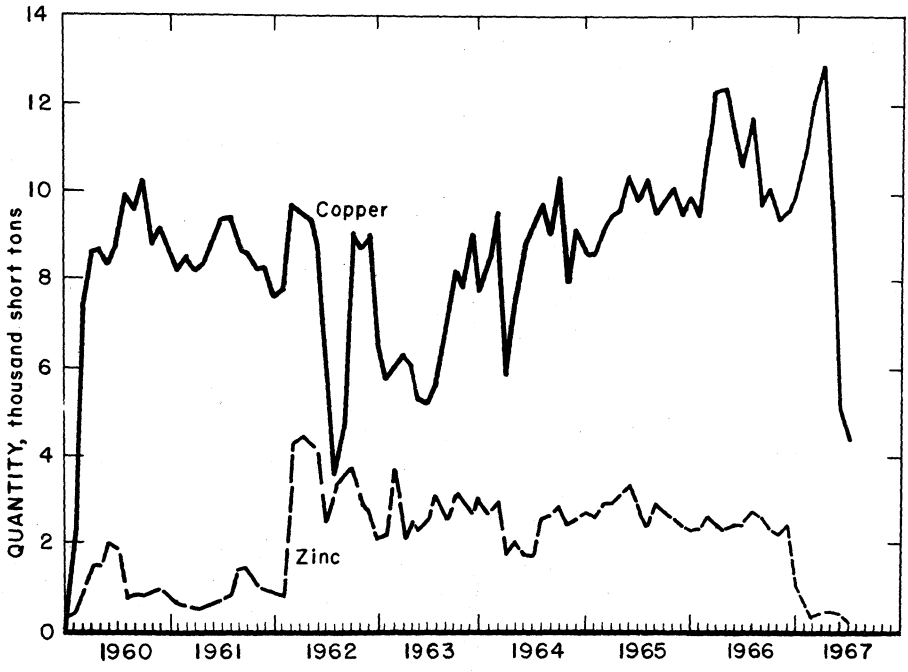

Figure 2.—Mine production of copper and zinc in Montana, by months, in terms of recoverable metals.

Workers in the trades, services, and related sectors were on short work weeks. Many highly paid skilled laborers, estimated at 500 from the Butte area, had left the State to find employment in other industrial sites on the west coast. Wages lost to the economy in the 5½-month period from July 15 to December 31 were estimated at $23.5 million.

Government Programs.—The Office of Mineral Exploration (OME) approved three new contracts and continued three earlier contracts already in effect. Silver Queen Exploration received a $51,600 contract to begin work in 1967 at a Beaverhead County silver property (Silver Queen claims). Development Operating Corp. gained approval of a $90,000 Jefferson County silver project to begin work at the Elkhorn mine in 1967. Work in Madison County was to be conducted by Janus Mining Co. at a gold-silver-copper ore property (Janus Group) under an $87,600 agreement.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967, in order of value
Beaverhead	W	W	Phosphate rock, talc, stone, lead, sand and gravel, silver, zinc, gold, copper.
Big Horn	$537	$773	Petroleum, sand and gravel, lime, stone, coal, natural gas.
Blaine	r 507	662	Petroleum, sand and gravel, natural gas, stone, coal.
Broadwater	239	270	Sand and gravel, iron ore, stone, lead, silver, zinc, gold copper.
Carbon	r 9,023	7,950	Petroleum, stone, natural gas, sand and gravel, coal, gypsum.
Carter	W	W	Clays, petroleum.
Cascade	111	904	Sand and gravel, stone, clays.
Chouteau	W	(1)	Stone.
Custer	328	92	Sand and gravel.
Daniels	11	339	Petroleum, sand and gravel, stone.
Dawson	3,888	4,009	Petroleum, stone, sand and gravel.
Deer Lodge	2,252	2,045	Lime, stone, sand and gravel, tungsten, clays.
Fallon	r 19,794	20,632	Petroleum, sand and gravel, natural gas, stone.
Fergus	369	281	Gypsum, sand and gravel, stone, clays, silver.
Flathead	1,393	653	Sand and gravel, silver, stone, copper, gold.
Gallatin	W	4,020	Cement, stone, sand and gravel, clays.
Garfield	250	408	Sand and gravel, stone.
Glacier	2,269	2,159	Petroleum, sand and gravel, stone.
Golden Valley	121	-------	
Granite	W	W	Phosphate rock, zinc, manganese ore, silver, lead, manganiferous ore, gold, copper.
Hill	135	144	Sand and gravel, stone.
Jefferson	W	5,732	Cement, stone, sand and gravel, silver, zinc, gold, lead, copper, clays.
Judith Basin	116	-------	
Lake	237	167	Sand and gravel, peat, stone.
Lewis and Clark	2,093	818	Zinc, sand and gravel, stone, lead, silver, gold, copper.
Liberty	r 1,948	1,683	Petroleum, natural gas.
Lincoln	W	5,545	Vermiculite, stone, sand and gravel.
McCone	5,557	4,155	Petroleum, stone, sand and gravel.
Madison	1,055	1,404	Talc, stone, sand and gravel, gold, silver, copper, zinc, lead.
Meagher	W	W	Lead, zinc, gold, silver, copper.
Mineral	W	77	Sand and gravel, copper, lead, zinc, silver, gold.
Missoula	947	640	Sand and gravel, stone.
Musselshell	2,686	3,345	Petroleum, coal, sand and gravel.
Park	W	298	Stone, sand and gravel.
Petroleum	7	273	Petroleum, sand and gravel.
Phillips	r 1,382	13	Sand and gravel, stone.
Pondera	871	90	Petroleum, sand and gravel, stone.
Powder River	162	4,410	Petroleum, sand and gravel, coal, stone.
Powell	W	W	Phosphate rock, sand and gravel, gold, lead, silver, zinc.
Prairie	140	W	Sand and gravel.
Ravalli	W	W	Fluorspar, stone, sand and gravel, silver, zinc, lead, gold, copper.
Richland	1,628	1,977	Petroleum, coal, lime, stone, sand and gravel.
Roosevelt	W	5,902	Petroleum, sand and gravel, stone.
Rosebud	2,398	1,970	Petroleum, clays, sand and gravel, stone.
Sanders	244	22	Sand and gravel, lead, antimony, silver, zinc.
Sheridan	6,720	7,204	Petroleum, sand and gravel, coal.
Silver Bow	107,297	53,878	Copper, silver, gold, sand and gravel, zinc, manganese ore, phosphate rock, lead, stone.
Stillwater	r 100	89	Natural gas.
Sweet Grass	113	14	Sand and gravel.
Teton	394	41	Sand and gravel, petroleum.
Toole	r 5,056	4,139	Petroleum, sand and gravel, stone, natural gas.
Treasure	489	11	Sand and gravel.
Valley	67	32	Do.
Wheatland	377	-------	
Wibaux	103	3	Sand and gravel.
Yellowstone	2,825	3,385	Sand and gravel, petroleum, lime, stone, clays.
Combined counties [2]	r 23,690	21,590	
Undistributed [3]	r 35,339	12,276	
Total	245,268	186,524	

r Revised.
[1] Less than ½ unit.
[2] Petroleum and natural gas production from fields underlying two or more counties.
[3] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

Table 3.—Indicators of Montana business activity

		1966	1967 p	Change (percent)
Personal income:				
Total	millions	$1,842.0	$1,934.0	+5.0
Per capita		$2,623.0	$2,759.0	+5.2
Construction activity:				
Building permits	millions	$28.7	$25.0	−12.9
Heavy engineering awards	do	$107.4	$170.6	+58.8
Highway construction contracts awarded	do	$36.5	$46.9	+28.5
Cement shipments to and within Montana	thousand 376-pound barrels	1,412.0	1,091.6	−22.7
Cash receipts from farm marketings	millions	$503.3	$505.9	+.5
Mineral production	do	$245.3	$186.5	−24.0
Annual average employment:				
Total nonagricultural industries	thousands	186.7	189.9	+1.7
Total manufacturing	do	23.0	22.5	−2.2
Lumber and timber industries	do	8.9	8.8	−1.1
Metal-mining and primary-metal industries	do	8.7	6.4	−26.4
Contract construction	do	11.6	11.6	-------
Transportation and utilities	do	17.7	17.8	+.6

p Preliminary.

Source: Survey of Current Business, Construction Review, Pacific Builder & Engineer, Montana Highway Commission, The Farm Income Situation, Montana Labor Market.

Table 4.—Employment for selected mineral industries

Year	Total mining	Metal mining	Nonmetals, including coal	Petroleum and natural gas	Processing	
					Primary metals	Petroleum refining
1963	7,100	4,100	900	2,100	3,200	1,200
1964	7,600	4,800	900	1,900	3,300	1,200
1965	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 p	5,600	3,200	900	1,500	3,200	1,000

p Preliminary.

Source: Montana State Employment Service, Montana Labor Market. Excludes proprietors and self-employed. Industry groups may vary from those in the Bureau of Mines canvass.

Table 5.—Hours and earnings data in mining and related industries

Industry	1963	1964	1965	1966	1967 [1]
Mining:					
Average weekly earnings	$113.85	$114.76	$119.12	$125.51	$131.86
Average weekly hours	41.2	38.9	38.8	39.1	40.2
Average hourly earnings	$2.77	$2.95	$3.07	$3.21	$3.28
Metal mining:					
Average weekly earnings	$110.76	$111.97	$114.39	$122.80	$129.72
Average weekly hours	39.0	37.7	36.9	37.9	39.1
Average hourly earnings	$2.84	$2.97	$3.10	$3.24	$3.32
Primary-metals processing:					
Average weekly earnings	$105.74	$110.40	$116.40	$122.25	$117.08
Average weekly hours	39.9	40.0	40.7	41.3	39.4
Average hourly earnings	$2.65	$2.76	$2.86	$2.96	$2.97

[1] Data for metal mining and primary-metals processing include first 7 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
1963	421	6,837	$43,107	$6,316
1964	433	7,163	45,225	6,314
1965	421	7,456	49,048	6,578
1966	423	7,579	51,262	6,764
1967	414	7,305	52,572	7,197

Source: Unemployment Compensation Commission of Montana, Montana Labor Market. Industries and employment covered under unemployment insurance laws of Montana.

Table 7.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal and peat	104	185	19	153	1	7	52.24	40,352
Metal	4,139	304	1,256	10,050	7	195	20.10	5,611
Nonmetal	911	273	248	1,988	----	33	16.60	552
Sand and gravel	915	193	177	1,425	----	33	23.16	581
Stone	332	250	83	663	----	10	15.08	300
Total [1]	6,401	279	1,784	14,279	8	278	20.03	4,531
1967: [p]								
Coal and peat	90	180	17	134	----	6	44.71	1,162
Metal	NA	NA	793	6,343	7	125	20.81	9,357
Nonmetal	775	252	196	1,566	1	54	35.12	6,146
Sand and gravel	1,085	140	151	1,273	----	25	19.64	399
Stone	375	226	85	678	----	17	25.07	350
Total [1]	NA	NA	1,241	9,995	8	227	23.51	6,992

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

REVIEW BY MINERAL COMMODITIES

METALS

Aluminum.—Previously announced expansion at the Columbia Falls plant of Anaconda Aluminum Co. continued as work neared completion on a fourth and a fifth potline. Scheduled completion of the two potlines in October 1968 would boost the current annual production capacity of 100,000 tons an additional 75,000 tons.

According to The Anaconda Company annual report the Columbia Falls reduction plant operated continuously throughout the year from three potlines and produced 105,785 tons of aluminum, only 36 tons less than the previous year's record production.

Antimony.—Knute Kirkeberg stockpiled a small amount of antimony ore produced from the Stibnite mine in Sanders County.

Cadmium.—The Anaconda Company recovered cadmium as a byproduct from electrolytic sludge at its Great Falls facility. Smelter output was 967,000 pounds of cadmium, 41 percent below the 1966 level, due to the copper strike in the second half of the year.

Copper.—The nationwide copper strike in mid-July virtually stopped production in Montana as an estimated 7,500 workers were idled throughout the State. As a result, production of copper decreased 49 percent below that of 1966. In 28 weeks of operation before the strike, The Anaconda Company Butte mines produced 65,448 tons of copper, of which 61 percent came from Berkeley pit ores.

Prior to the strike, The Anaconda Company continued its program of expansion

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)
1963	117	8	9,506	18,520	$648	4,242	$5,426
1964	110	8	14,872	29,115	1,019	5,290	6,840
1965	121	11	15,634	22,772	797	5,207	6,733
1966	117	5	17,645	25,009	875	5,320	6,878
1967	62	3	9,093	9,786	343	2,066	3,203
1862–1967	-----	------	NA	17,787,367	407,011	859,582	656,967

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	79,762	$49,133	5,000	$1,080	32,941	$7,576	$63,864
1964	103,806	67,682	4,538	1,189	29,059	7,904	84,633
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
1862–1967	8,270,582	2,940,401	945,027	150,301	2,837,346	548,993	4,703,673

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer mines), ore milled, and ore, old slag, copper precipitates, and cleanings shipped to smelters during the calendar year indicated. Owing to rounding, individual items may not add to totals shown.
[2] Does not include gravel washed.

Table 9.—Mine production of gold, silver, copper, lead, and zinc in 1967, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore:							
Dry gold	7	165	44	178	----------	---------	100
Dry gold-silver	9	3,507	379	10,691	4,900	25,000	38,300
Dry silver	19	12,989	169	56,051	21,700	66,900	188,300
Total	35	16,661	592	66,920	26,600	91,900	226,700
Copper	3	9,014,687	8,304	1,817,009	118,056,000	---------	---------
Lead	11	4,107	347	22,926	32,800	922,300	155,500
Lead zinc and zinc [2]	5	36,047	51	136,764	62,600	426,100	3,282,800
Total	19	9,054,841	8,702	1,976,699	118,151,400	1,348,400	3,438,300
Other lode material:							
Gold and gold-silver old tailings [2]	3	208	11	218	----------	---------	---------
Silver old tailings	6	4,868	340	19,974	5,900	2,000	5,300
Copper precipitates	1	---------	-----	---------	[3] 12,782,100	---------	---------
Zinc slag	2	16,016	-----	2,627	----------	353,700	3,011,700
Total	12	21,092	351	22,819	12,788,000	355,700	3,017,000
Total lode material	62	9,092,594	9,645	2,066,438	130,966,000	1,796,000	6,682,000
Total placer	3	(4)	141	26	----------	---------	---------
Grand total	65	9,092,594	9,786	2,066,464	130,966,000	1,796,000	6,682,000

[1] Detail will not necessarily add to total, because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] Includes small amount of copper from zinc slag.
[4] 14,800 cubic yards.

and modernization of copper-producing facilities. At the Kelley mine, the extensive ventilating and airconditioning system was improved and enlarged, and completion of work on the Kelley No. 2 shaft to the 4000 level was accomplished. The third Worthington compressor was put into operation early in March. The main hoisting shaft was completed and concreted to the 4800 level. Work continued on enlarging the 4600 level and on the installation of a new pumping system to take underground water from all Butte mines to the leaching area. Ten Westinghouse pumps, each with a 1,000-gallon-per-minute capacity, were installed to lift the water 4,100 feet.

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)
1963	2	2	16	6	5	40	8	8	56
1964	5	27	270	3	2	22	8	29	292
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

[1] Combined to avoid disclosing individual company confidential data.
[2] Owing to rounding, individual items may not add to totals shown.
[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.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1967, 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	7	-----	315	$11	23,262	$36
Fergus	1	-----	-----	-----	31	(1)
Granite	8	-----	312	11	111,580	173
Jefferson	15	-----	314	11	41,627	65
Lewis and Clark	7	-----	38	1	7,742	12
Madison	8	-----	292	10	5,979	9
Powell	1	1	W	W	W	W
Silver Bow	5	-----	8,339	292	1,856,486	2,878
Undistributed [2]	10	2	176	6	19,757	31
Total [3]	62	3	9,786	343	2,066,464	3,203

County	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
Beaverhead	5	$4	351	$98	48	$13	$162
Fergus	-----	-----	-----	-----	-----	-----	(1)
Granite	4	3	119	33	815	226	447
Jefferson	8	6	39	11	105	29	121
Lewis and Clark	1	1	214	60	1,508	418	492
Madison	W	W	W	W	W	W	21
Powell	-----	-----	2	1	(1)	(1)	W
Silver Bow	65,448	50,036	64	18	816	226	53,450
Undistributed [2]	17	13	109	30	49	14	93
Total [3]	65,483	50,063	898	251	3,341	925	54,785

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 Broadwater, Flathead, Meagher, Mineral, Ravalli, Sanders Counties, and items indicated by symbol W.
[3] Owing to rounding, individual items may not add to totals shown.

Table 12.—Mine production of gold, silver, copper, lead, and zinc, in 1967, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Concentration and smelting of concentrates	8,362	1,946,091	117,615,200	431,500	3,321,500
Direct smelting:					
Ore	932	97,528	562,800	1,008,800	343,500
Old tailings	351	20,192	5,900	2,000	5,300
Precipitates	-----	----------	[1] 12,782,100	----------	----------
Old slag	-----	2,627	----------	353,700	3,011,700
Total	1,283	120,347	13,350,800	1,364,500	3,360,500
Placer	141	26	----------	----------	----------
Grand total	9,786	2,066,464	130,966,000	1,796,000	6,682,000

[1] Includes small amount of copper from old slag.

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)	Silver (lode and placer)
	Lode	Placer		(troy ounces)	(thousand troy ounces)
1963	10	2	9,346	14,287	3,951
1964	10	-----	14,694	20,999	4,614
1965	8	2	15,462	18,420	4,790
1966	5	-----	17,503	21,608	4,864
1967	5	-----	9,041	8,339	1,856
1882–1967	----	-----	[2] 347,728	2,432,166	645,036

	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
1963	79,636	3,185	24,140	$60,850
1964	103,600	2,678	20,239	80,455
1965	115,279	4,594	25,629	97,373
1966	127,885	2,411	22,284	106,749
1967	65,448	64	816	53,450
1882–1967	8,230,420	415,425	2,406,818	4,025,108

[1] Does not include gravel washed.
[2] Complete data not available: 1882–1904.

At the Mountain Con mine, the program of enlarging haulageways and track continued. The 4500 level was enlarged from 9 by 7 feet to 11 by 9 feet, and the track was changed from 18 to 36 gage. A new control tower, overlooking the Berkeley pit, was equipped with radio and closed circuit television to monitor pit operations. Forty-six 65-ton ore trucks at the Berkeley pit were phased out and replaced by 100-ton trucks.

An addition to the Butte concentrator, designed to increase recovery by treating acid-soluble ores not amenable to standard flotation procedures, was completed. Installation of X-ray analysis equipment for automatic "onstream" analyses of copper ores every 20 minutes also was completed.

A new plant was constructed at the Anaconda Reduction Works to receive copper concentrates, shipped as slurry in tank cars from Butte. Two converters and a $2.5 million, 100-ton overhead crane began operating in the converter building at the smelter, and two Allis-Chalmers multistage centrifugal compressors were installed. Construction was begun on an additional Cottrell precipitator.

Exploration programs in Montana were actively carried out by several major min-

ing companies. Uuno M. Sahinen, Associate Director, Montana Bureau of Mines and Geology, in a paper delivered at the Northwest Mining Association Convention, stated that at least 22 companies were actively exploring for metalliferous ores containing copper and associated gold, silver, platinum, and molybdenum.[3]

Bear Creek Mining Co., exploration subsidiary of Kennecott Copper Corp., started underground exploratory work in the Mt. Vernon area of southwestern Lincoln County, drilled the Como copper-gold property in Park County, and did exploratory work in the Ramona Creek area northwest of Philipsburg. Diamond drilling was carried on by two contractors, and an exploration adit was begun to confirm copper showings found by the drilling.

Hecla Mining Co. reportedly found chalcopyrite in exploratory drilling from the 1000 level of the Algonquin mine in the unitized Taylor-Knapp Trout-Contract property in the Philipsburg district. Copper Range Co. explored in the Argenta district of Beaverhead County, and Spokane National Mines, Inc., continued development in the Blue Wing district of Beaverhead County.

As part of the largest exploration program in its history, The Anaconda Company carried on exploration in more than a dozen Montana counties during the year. Work continued on the development of a large porphyry-type copper-molybdenum-silver deposit northwest of Helena.

Gold.—Production of gold exclusive of placer output declined 61 percent to 9,645 ounces, because of the decrease in copper production caused by the strike. Approximately 86 percent of the State total originated in the Butte district as a byproduct of copper production. Placer output from three operations totaled 141 ounces, compared with 423 ounces in 1966.

Little Rockies Mining Co. Ltd., of Canada, core drilled two former producing mines, the Little Ben and the Gold Bug.

Oremont, Inc., reopened one of the old drifts at the Crescent mine, Jefferson County, and began shipping to the Franklin mill near Helena.

Indium.—The Anaconda Company production of indium at the Great Falls smelter was also limited by the copper strike. According to the annual report to the stockholders, 6 months of operation yielded 61,000 ounces of indium.

Iron Ore.—The entire State production of iron ore came from the Iron Cross mine of R & S Iron Co. near Radersburg. Production declined 17 percent from the 1966 level to 10,000 tons of ore.

Lead.—An 80-percent decline in lead output to only 898 tons for 1967 was a result of termination of mining at the Badger State mine and curtailment of byproduct production in July by the copper strike.

The largest amount of lead from production other than by The Anaconda Company at Butte or East Helena came from the Maulden mine (Ida B. Hand), Beaverhead County, where 315 tons of lead from 2,229 tons of ore was recovered.

Downhole drilling from the 940 level of the Nancy Lee mine near Superior, Mineral County, located the ore body on the bottom 1090 level. The North Coeur d'Alene Silver Co., of Troy, planned to mine lead, silver, zinc, and gold from the Snowstorm mine in Lincoln County after completing 225 feet of crosscut. Spokane National Mines, Inc., conducted exploration drilling and development at the Capitol mine near Argenta, Beaverhead County.

The Sam Gaty-Franklin mine in Lewis and Clark County produced 94 tons of lead ore containing 36 tons of lead, plus lesser amounts of silver, zinc, copper, and gold.

The Bureau of Mines published a study of the Pacific Northwest lead-zinc industry.[4]

Manganese.—Less demand for manganese concentrates resulted in a reduction in the total amount of manganese ore and concentrates produced. The ferromanganese plant at Anaconda was dismantled, and

[3] Sahinen, Uuno M. Mineral Developments in Montana—1967. Northwest Mining Association 73d Annual Convention, Spokane, Wash., Dec. 1–2, 1967.

[4] Knostman, Richard W. An Analysis of the Pacific Northwest Lead-Zinc Industry. BuMines Inf. Circ. 8327, 1967, 53 pp.

a small stockpile of manganese dioxide nodules, from which occasional shipments were made, remained at the smelter.

Taylor-Knapp Co. continued mining and processing manganese ores at Philipsburg to be used primarily for batteries. Ore from the True Fissure mine on Camp Creek was trucked to Philipsburg for concentration.

Molybdenum.—Copper Ridge Mines, Ltd., engaged in exploratory drilling for molybdenum along the Montana-Idaho border in the Horse Creek Pass area of Ravalli County.

Silver.—Silver production declined 61 percent from the 1966 level because of the copper strike. Byproduct silver from the Butte mines accounted for 1,856,486 ounces, or 90 percent of the total silver produced.

The large increase in silver prices, caused partly by increasing industrial demand, prompted considerable activity at silver-bearing properties and exploration throughout the State. Exploration activity was reported in Beaverhead, Madison, Jefferson, Cascade, and Lewis and Clark Counties.

Production of silver concentrates was resumed at the Nancy Lee mill in Mineral County, which had been idle since last spring. Ore comes from the Keystone vein on the 640 level of the Nancy Lee mine. The mill building was expanded to house a second larger capacity ball mill and larger flotation cell banks. Mill concentrates were temporarily stockpiled because of the copper strike which closed the East Helena smelter where the ore was normally taken.

Silver Ledge, Inc., extended an adit on the Hidden Treasure mine, northeast of Clinton in Missoula County, to intersect a projection of the Cape Nome mine oreshoot. The shaft at the Jo Dandy mine in Broadwater County was dewatered and the mine reopened to produce silver and lead from the 700 level. Mascot Silver-Lead Mines, Inc., exposed two oreshoots while drifting on the vein from the 200 level.

The Sierra Silver Mining Co., of Phoenix, Ariz., began exploration of the Cadgie Taylor property 2 miles east of Philipsburg. A small amount of silver was shipped from the Montego mine in Fergus County.

Milling-grade silver-lead-copper ore was produced from the New Departure mine in Beaverhead County by Spokane National Mines, Inc., and shipped to the firm's mill at Bannack. Mining in the Quien Sabe shaft of the New Departure mine, which had been discontinued in 1962, was resumed with development of 12 stopes and a screening plant to separate limestone waste from the ore; 3,500 tons of ore from the New Departure mine was stockpiled at the Bannack mill.

Thorium.—Union Pacific Railroad Co. conducted surface geological mapping, a sampling program, and diamond drilling to determine thorium and rare-earth reserves in the Lemhi Pass area of Beaverhead County under an agreement with Sawyer Petroleum Co. of Los Angeles.

Thorium deposits in the Montana portion of the Lemhi Pass district on the Montana-Idaho border were described in in a report of the Montana Bureau of Mines and Geology,[5] done in cooperation with the State Planning Board. Quartz veins are said to contain significant amounts of thorium; rare earth elements are also present with yttrium dominant.

Tungsten.—Minerals Engineering Co., Grand Junction, Colo., through an agreement with General Electric Co., reopened and began reactivation of the Calvert Creek tungsten mine near Wise River in Beaverhead County. The tungsten concentrator at Glen was renovated and enlarged to 250-ton-per-day capacity, and construction was begun on a chemical treatment plant. Plans called for expansion of the present open pit and the driving of a 1,350-foot adit.

Tri-City Concrete Products, Inc., of Deer Lodge, shipped tungsten from the old Bonanza or McCabe property to Union Carbide at Bishop, Calif. During the year, two stopes were started, 200 feet of drift was completed, power was installed, and a new ore bin was built on the property.

New Park Mining Co. engaged in geochemical exploration for tungsten in the northern end of the Pioneer Mountains.

Uranium.—A total of 150 uranium lease applications was made to the State Land Board, mostly in west-central Montana.

[5] Geach, Robert D. Thorium Deposits of the Lemhi Pass District, Beaverhead County, Montana. Montana BuMines and Geol., Spec. Pub. 41, November 1966, 22 pp.

The Board granted 67 uranium mining leases for a rental of 50 cents an acre yearly. Leases were awarded in Madison, Jefferson, Carbon, Carter, Daniels, and Valley Counties.

Zinc.—The 89-percent decline in zinc production was largely due to the shutdown in January of the Anaconda smelter, the major source of zinc production in 1966. Byproduct production was further curtailed by the copper strike in July after which no production was obtained throughout the State. Zinc production from the Badger State mine was terminated in January after all existing undercut cave blocks were mined.

The refurbished electrolytic zinc plant at Anaconda continued to process concentrates shipped from Pine Point, near Great Slave Lake, Northwest Territories, Canada, until the advent of the strike. Shipments were made under a 3-year export license granted by the Canadian Government.

The Taylor-Knapp Co. was the largest lead-zinc producer in Granite County, producing 731 tons of zinc, 100 tons of lead, and 95,048 ounces of silver from the Taylor-Knapp Unit area.

NONMETALS

Barite.—No barite has been produced in Montana since the closure in November 1966 of the Baroid Division, National Lead Co., grinding plant at Greenough, Missoula County.

Cement.—The quantity and value of cement shipments declined 6 and 4 percent, respectively, from 1966 totals. Output was by Kaiser Cement & Gypsum Corp. at Montana City, Jefferson County, and by Ideal Cement Co. at Trident, Gallatin County. Destinations within the State accounted for 45 percent of the cement sold. Shipments also were made to Washington (31 percent), Idaho (9 percent), North Dakota (9 percent), Wyoming (6 percent), Oregon, and Utah (combined less than 1 percent).

Limestone, shale, and silica raw materials for making cement were quarried near the plants. Iron ore used at the Ideal Cement Co. operation came from Radersburg, and iron-bearing slag used by Kaiser Cement & Gypsum Corp. was from East Helena. Gypsum used at both operations was mined at a Fergus County deposit near Lewistown.

Of the total portland cement shipped, 65 percent was transported by rail and 35 percent by truck. The ratio of bulk to paper bag shipments was about 8:1. About 59 percent of the portland cement produced was distributed to firms manufacturing commercial concrete products, such as ready-mixed concrete companies (43 percent), concrete product manufacturers (8 percent), and building material dealers (8 percent). The other 41 percent was sold to highway (3 percent) and other contractors (29 percent), miscellaneous customers (9 percent), and to Federal, State, and local government agencies (less than 1 percent).

To eliminate price cutting and movement by unauthorized or illegal carriers, the rate schedule for transporting cement was adjusted to assure consistent transporting rates for cement in the State.

Clays.—Miscellaneous clay and shale sold or used by producers declined 14 percent, but bentonitic clay output was more than double the 1966 figure. 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.

Shale for expanding into lightweight aggregate came from operations of Treasurelite Division of Treasure State Industrial Products, Inc., near Great Falls, Cascade County, and from the Lockwood Flats pit of Concrete Products Co. (formerly Montana Liteweight Aggregate Co.), near Billings, Yellowstone County. The Montana City pit (Jefferson County) of Kaiser Cement & Gypsum Corp. and the Trident quarry (Gallatin County) of Ideal Cement Co. were sources of clay and shale used in manufacturing cement.

A small amount of fire clay was dug at the Placer fire clay mine near Anaconda, Deer Lodge County.

Bentonite production, highest in the State's history, was largely by two firms, although several companies were actively seeking outlets for the material. National Lead Co. mined bentonite near Colony, Carter County, for use as oilwell-drilling mud. 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 taconite iron ore concentrate. Some bentonite was produced near Glasgow, Valley County, by Brazil Creek Bentonite Co. for use in lining irrigation canals. The company announced that A–D–M Chemicals Division, Ashland Oil & Refining Co., planned to construct a 300,000-ton-per-year processing plant on the company property 18 miles southwest of Glasgow. Plans were to process the bentonite into grades suitable for binders at the Minnesota Mesabi Range taconite-processing plants. Other exploration and development for bentonitic clays included Peter Kiewit Sons' Co. development of bentonite deposits near Harlem, Blaine County, and American Colloid Co. locating and leasing lands for mining bentonite south of Malta, Phillips County.

Fluorspar.—Roberts Mining Co., the only producer, continued to mine fluorspar in Ravalli County. Ore from the Crystal Mountain mine was trucked 26 miles to a sizing and heavy-media separation plant at Darby. Metallurgical-grade fluorspar from the milling operation was marketed largely to the steel industry.

Gypsum.—The tonnage of gypsum mined decreased 23 percent below the 1966 total. Gypsum mined near Heath, Fergus County, from the Shoemaker underground mine by United States Gypsum Co. was calcined and marketed as ground gypsum. Gypsum produced by Bridger Gypsum Co. from an underground mine near Bridger, Carbon County, was sold for agricultural purposes.

Lime.—Output of lime declined 37 percent, and value was 17 percent below the 1966 figures. The drop was related largely to the copper strike which resulted in less lime produced for metallurgical use and for water treatment, although lime used in manufacturing sugar, also was below the previous year output.

Lime was manufactured in Deer Lodge County by The Anaconda Company for metallurgical use and for water treatment. Limestone for the operation came from the company Browns quarry near the lime plant. Holly Sugar Corp., at plants in Big Horn (Hardin) and Richland (Sidney) Counties, and The Great Western Sugar Co. at a plant in Yellowstone County (Billings) manufactured lime for use in sugar refining. All three sugar-refining operations utilized limestone from the Warren quarry (Carbon County) of Big Horn Limestone Co.

The Anaconda Company announced plans to revamp the inoperative Manganese Development Co. kilns at Butte to manufacture lime. Low-magnesium limestone from a quarry west of Drummond, Granite County, was expected to be used at the proposed lime plant and lime slurry was to be transported from the plant 3 miles by rail to the copper concentrator also at Butte.

Phosphate Rock.—The quantity of marketable phosphate rock production increased 8 percent; but value declined 14 percent, largely because of lower values for material marketed from phasing out mining operations in Beaverhead County. Mining continued to be conducted in Beaverhead, Granite, Powell, and Silver Bow Counties.

Phosphate rock from the Canyon Creek and East La Marche mines in Beaverhead County and the Maiden Rock mine in Silver Bow County, all near Melrose, was hauled 23 miles to the Silver Bow elemental phosphorus plant of Stauffer Chemical Co., Industrial Chemical Division, where it was washed and reduced to elemental phosphorus. The phosphorus, kept in the molten state by means of steam-heated storage tanks, was pumped from the tanks to rail tank cars for shipment to company processing plants at Chicago Heights, Ill., and South Gate and Richmond, Calif.

In October, after mining phosphate rock in Montana since 1951 to feed its elemental phosphorus plant at Silver Bow, Stauffer started phasing out its underground phosphate operations near Melrose in favor of low-cost surface mining in the southeast Idaho section of the phosphate field. Long-range plans by Stauffer Chemical Co. include installing both beneficiation and calcining equipment at Soda Springs, Idaho, to produce high-quality acid-grade rock. In July Stauffer Chemical Co. had purchased the Terteling Co. holdings of phosphate rock covering more than 8,000 acres of Federal and State leases and permits near Soda Springs, Idaho. The deposit, minable by strip or surface methods and containing an estimated 100 million tons of furnace- and acid-grade rock, insures the firm's phos-

phate position in the West for many years. Initial ore shipments were made in July from the Soda Springs, Idaho, operation to the elemental phosphorus plant at Silver Bow.

In Granite County, phosphate rock from the Douglas Creek mine was upgraded at the Cominco American, Inc., flotation concentrator near Hall. The concentrate was shipped to fertilizer manufacturing plants at Trail and Kimberley, British Columbia, Canada.

In Powell County, operations of Cominco American, Inc. (Anderson-Brock, Gimlet, and Luke mines), George Relyea (Relyea mine), and A. G. Jackson (Jackson mine) were active. Most of the output, of suitable grade for processing without further beneficiation, 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, Ltd. Some low-grade rock was milled at Hall, and the concentrate was shipped to fertilizer plants in Canada. Phosphate rock was defluorinated to make animal-feed products by Rocky Mountain Phosphates, Inc., at Garrison. Litigation involving air pollution control continued to interrupt operations at the Garrison plant. In September the plant was closed by the Montana State Board of Health pending installation of pollution control equipment by the company to remove 99.9 percent of the fluoride emissions.

Sand and Gravel.—A decline of 11 percent from 1966 figures in sand and gravel output was attributed to less demand for the materials in road construction and maintenance by the Bureau of Public Roads and the State highway department.

Commercial sand and gravel firms operated 44 plants (25 stationary and 19 portable) in producing 2.8 million tons. Government-and-contractor production (largely for roads and dam construction by Federal, State, and local government agencies) totaled 9.5 million tons from 42 plants—three stationary and 39 portable.

Sand and gravel was produced in 47 of the 56 counties in the State. Output exceeded 1 million tons in Yellowstone County, again the leading producer, and Lincoln County. The use distribution of sand and gravel output was road material 81 percent, building 7 percent, and miscellaneous uses, including fill and railroad ballast 12 percent.

Stone.—The tonnage of stone produced increased 15 percent, largely because of increased usage at State highway department road construction projects in Dawson

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	678	$984	810	$1,192
Road material	1,383	1,462	1,558	1,318
Fill	115	75	195	166
Other [1]	193	175	231	309
Total	2,369	2,696	2,794	2,985
Government-and-contractor operations:				
Building			6	8
Road material	10,927	10,325	8,403	7,127
Fill	216	127	1,102	492
Other [1]	304	375	34	43
Total	11,447	10,827	9,545	7,670
All operations:				
Building	678	984	816	1,200
Road material	12,310	11,787	9,961	8,445
Fill	331	202	1,297	658
Other [1]	497	550	265	352
Total	13,816	13,523	12,339	10,655

[1] Sand and gravel used for railroad ballast and miscellaneous and unspecified purposes.

and Jefferson Counties. The U.S. Army Corps of Engineers also contributed to the increase with greater amounts of stone for riprap and rockfill at Libby Dam, Lincoln County. Stone was produced in 35 counties; Jefferson County led in stone production (1.1 million tons), followed by Dawson (800,000 tons), Lincoln (800,000 tons), and Gallatin (400,000 tons) Counties.

Basalt, granite, limestone, marble, miscellaneous stone (unclassified as to type), and sandstone were produced. The basalt, granite, and miscellaneous stone were used largely in road construction (2.5 million tons), but some (600,000 tons) was used as riprap and rockfill in dam construction.

Limestone output of over 1 million tons, valued at $1.3 million, was used largely for manufacturing cement (700,000 tons), for making lime (200,000 tons), for sugar refining (80,000 tons), and for metallurgical purposes (50,000 tons). Some was used in road construction, and limestone from the Warren quarry was shipped to Colorado for corn silage mix by Big Horn Limestone Co. Limestone was produced in Broadwater, Carbon, Deer Lodge, Gallatin, and Jefferson Counties.

Marble from Carbon and Madison Counties and travertine produced in Park County were used mainly for building purposes as dimension stone. Some crushed and sized material included products for marble whiting, terrazzo, and roofing granules. The Livingston Marble & Granite Works travertine quarrying operation at Gardiner and the stone-cutting and slabbing plant at Livingston, both in Park County, were described.[6]

Sandstone, quartz, and quartzite output for use as industrial silica totaled 185,711 tons, valued at $401,360. The material, produced in Beaverhead, Deer Lodge, Gallatin, Jefferson, Missoula, and Ravalli Counties, was used for manufacturing cement and ferrosilicon; for metallurgical purposes as a fluxing ingredient; and for building purposes as dimension stone, roofing chips, and terrazzo. Sandstone output of 243,042 tons, valued at $445,126 from Dawson, Lincoln, and Missoula Counties was used as railroad ballast, and as fill and riprap at dam and road construction projects.

Sulfur.—Production and the average unit value of high-purity elemental sulfur by Montana Sulphur & Chemical Co. advanced above the 1966 totals. Two oil refineries continued to furnish raw material to the recovery plant. Elemental sulfur was recovered by the firm from oil refinery waste gases supplied by the Continental Oil Co. and Humble Oil & Refining Co. operations at Billings.

Talc.—Production of talc increased 30 percent, and value was 38 percent greater than the 1966 totals, owing to additional milling, screening, and materials-handling facilities operating at the Barratts mill southeast of Dillon, Beaverhead County. Talc, mined by two companies, came from one mine in Beaverhead County and three mines in Madison County, The talc was ground and sized at plants in Beaverhead and Gallatin Counties. Some was shipped for processing to a plant at Grand Island, Nebr.

In Beaverhead County, Chas. Pfizer & Co., Inc., Minerals, Pigments, and Metals Division, mined talc at the Smith-Dillon-Crown mine on Axes Creek about 11 miles southeast of Dillon and hauled the material to a company processing mill at Barratts for grinding. Talc from the company Regal-Keystone and Treasure State mines in Madison County also was ground at the Barratts mill. Another company, United Sierra Division, Cyprus Mines Corp., mined talc at the Yellowstone mine in Johnny Gulch, 15 miles south of Cameron in Madison County, and after being hand sorted, the upgraded material was trucked 75 miles to a company grinding plant at Three Forks, Gallatin County. Some was trucked 45 miles from the mine to a Northern Pacific Railway siding at Norris, where it was transshipped to a company processing plant at Grand Island, Nebr.

There was considerable change in the quantity of talc consumed by the ceramic industry. The use distribution of talc by industry (1966 percentages are in parentheses) was paper, 31 percent (36 percent); paint, 25 percent (22 percent); ceramics, 20 percent (9 percent); and exports and miscellaneous uses, including insecticides and rice polishing, 24 percent (33 percent, including usage for refractories, roofing, textiles, and toilet preparations).

[6] The Northwest and Its Resources. Montana Brings Roman Stone Age Up to Date Here. Northern Pacific Railway Co., January–February 1967, pp. 6–8.

Vermiculite.—Crude vermiculite output declined 5 percent from the 1966 production. The open-pit mine near Libby, Lincoln County, of the Zonolite Division, W. R. Grace & Co., continued to be the principal source of vermiculite in the United States. Crude ore was milled at the mine site, and the concentrate was transported to storage facilities near the Kootenai River. The concentrate was carried by conveyor across the river to rail cars on a Great Northern Railway siding. A large quantity of the concentrate was shipped out-of-State to exfoliating plants. Some of it was expanded by the Zonolite firm at the Libby operation, and some was expanded by Robinson Insulation Co. at Great Falls.

MINERAL FUELS

Coal.—Output of bituminous coal and lignite declined 12 percent from the 419,180 tons produced in 1966. Of 12 active mines in seven counties, nine were underground, and three were open-pit operations.

Bituminous coal came from nine mines, eight underground and one open pit, in four counties. The principal source of bituminous coal was the Square Deal Coal Co. Square Deal mine at Roundup, Musselshell County. The county led in bituminous coal production from underground mines followed by Carbon and Blaine Counties. An open-pit operation in Big Horn County was the smallest producer of bituminous coal.

Lignite was produced at three operations, one underground and two open-pit mines. The open-pit Savage mine at Sidney, Richland County, of Knife River Coal Mining Co. led in production. Output was used as fuel at the Sidney steam-electric plant of Montana-Dakota Utilities Co. Lignite also came from an underground mine in Sheridan County and an open-pit operation in Powder River County.

Construction continued at Billings on the Montana Power Co. coal-fired steam-electric generating plant. The firm continued evaluating its position with regard to coal resources necessary to supply future generating plants constructed in Montana. By yearend, Montana Power Co. had an estimated 850 million tons of coal-reserve land leased, and in the next 30 years, it expects to consume an estimated 375 million tons of coal at company electric-generating plants in Montana.

Table 15.—Coal (bituminous) production [1] in 1967, by counties

(Thousand short tons and thousand dollars)

County	Number of mines by type of operation		Production	
	Underground	Strip	Quantity	Value
Big Horn, Blaine, Carbon [2]	2	1	7	$52
Musselshell	6	----	35	295
Total	8	1	42	347

[1] Excludes mines producing less than 1,000 short tons.
[2] Combined to avoid disclosing individual company confidential data.

At a Public Land Law Review Commission hearing in July, the Montana Coal Resources Research Council testified against national standards for reclamation of strip-mined lands as proposed by current Federal legislation. The Council maintained it was wrong to impose national standards on the State lands because of a great variance in conditions on strip-mined land nationally and because of the relatively low value of Montana coal lands for other purposes.

The Montana Bureau of Mines and Geology conducted field mapping programs in Powder River on State and Northern Pacific Railway Co. lands in the Pumpkin Creek and Foster Creek area coalfields.

The Great Falls-Lewistown coalfields in central Montana were described.[7]

Petroleum and Natural Gas.—Recovery of crude petroleum declined 1 percent from the 1966 record high of 35.4 million barrels. Petroleum represented about 47 percent of the State mineral production value. Of the total crude oil produced, over 59 percent came from the Williston Basin. About 39 percent of the crude oil recovered came from four fields—the Pine (3.9 million barrels) and Cabin Creek (3.4 million barrels) fields in the Williston Basin, the Cut Bank (3.4 million barrels) field in north-central Montana, and the

[7] Silverman, Arnold J., and William L. Harris. Stratigraphy and Economic Geology of the Great Falls-Lewistown Coal Field, Central Montana. Montana BuMines and Geol., Bull. 56, April 1967, 20 pp.

Elk Basin (2.8 million barrels) field in south-central Montana. Other fields where crude-oil production exceeded 1 million barrels were Pennel (1.9 million), Lookout Butte (1.8 million), Bell Creek (1.7 million), Weldon (1.5 million), Fred & George Creek (1.1 million), and Flat Lake (1.1 million). An important oil discovery was made in the Muddy sand formation in the Powder River Basin in southeastern Montana. The discovery resulted in delineation of Bell Creek field, comprising 68 sections (43,520 acres), and sparked lease and drilling activity during the latter part of the year over the entire Powder River Basin. The largest auction of oil and gas leases on State-owned lands since the Williston Basin boom in 1952 took place in September when 188,050 acres of State-owned land was auctioned in 2 days for $1.8 million. Most of the land was in the vicinity of the Bell Creek field in southeastern Powder River County and western Carter County. The Bell Creek field, a shallow field where the average depth of wells drilled totaled 4,716 feet, was discovered in June in southeastern Powder River County and had 17 producing wells by September. Development of the field was vigorous, and by December, 86 wells were producing crude oil; one was producing natural gas. Primary recoverable reserves of the Bell Creek discovery were estimated at 50 million barrels with an additional 50 million barrels available using fluid-injection recovery techniques. Production was restricted by the Montana Oil and Gas Conservation Commission to 300 barrels of crude oil per day per well, and development was limited by the Commission to 40-acre spacing for producers. By December, three 8-inch pipelines, each with initial capacity of transporting 30,000 barrels of crude oil per day, connected wells in the field to a terminal of the Butte Pipeline Co. at Alzada. Since the Butte Pipeline Co. pipeline could handle only 20,000 barrels of crude oil per day, further revamping of the pipeline system included plans to connect the system eventually to the Service Pipeline Co. Reno station in Wyoming.

Marketed production of natural gas de-

Table 16.—Oil and gas wells drilled in 1957, by counties

County	Exploratory wells			Proved field wells			Total	
	Dry	Oil	Gas	Dry	Oil	Gas	Wells	Footage
Big Horn	3	-----	-----	3	3	-----	9	39,587
Blaine	24	-----	1	7	-----	7	39	74,274
Carbon	5	1	-----	-----	3	-----	9	29,745
Carter	15	-----	1	-----	-----	1	17	74,979
Cascade	1	-----	-----	-----	-----	-----	1	4,892
Chouteau	4	-----	1	-----	-----	-----	5	12,654
Custer	2	-----	-----	1	-----	1	4	20,618
Daniels	1	1	-----	4	4	-----	10	72,604
Dawson	2	-----	-----	2	8	-----	12	121,975
Fallon	---	-----	-----	1	7	-----	8	70,567
Fergus	1	-----	-----	-----	-----	-----	1	5,990
Garfield	4	-----	-----	-----	-----	-----	4	24,664
Glacier	5	-----	-----	9	12	2	28	87,028
Hill	9	-----	-----	6	-----	1	16	42,397
Liberty	12	-----	1	4	3	1	21	59,882
McCone	3	-----	-----	2	-----	-----	5	33,052
Musselshell	8	1	-----	8	6	-----	23	116,335
Petroleum	3	-----	-----	-----	1	-----	4	15,235
Phillips	5	-----	-----	-----	-----	-----	5	16,380
Pondera	12	-----	-----	3	3	-----	18	45,052
Powder River	18	1	1	12	86	1	119	561,177
Prairie	---	-----	-----	1	-----	-----	1	9,135
Richland	2	-----	-----	1	2	-----	5	59,600
Roosevelt	3	1	-----	5	1	-----	10	74,370
Rosebud	7	-----	-----	4	3	-----	14	67,794
Sheridan	9	1	-----	8	10	-----	28	225,390
Stillwater	1	1	-----	-----	1	-----	3	6,955
Teton	4	-----	-----	-----	-----	-----	4	10,505
Toole	24	-----	-----	21	7	-----	52	128,031
Treasure	1	-----	-----	-----	-----	-----	1	5,893
Valley	1	-----	-----	-----	-----	-----	1	4,900
Yellowstone	2	-----	-----	2	2	-----	6	37,304
Total	191	7	5	104	162	14	483	2,158,964

Source: Oil and Gas Conservation Commission of the State of Montana.

clined 16 percent to 25.9 billion cubic feet (Bcf). Withdrawal of natural gas continued to be highest in the Cut Bank-Reagan field, with output totaling 9.5 Bcf. Keith Block field ranked second with production of 3.6 Bcf; Cedar Creek field, with output of 3.2 Bcf, was third. Over 2 Bcf came from Bowdoin field, and fields exceeding 1 Bcf were Cabin Creek, Elk Basin, Lake Basin, Utopia, and Whitlash. Capacity for underground storage of natural gas totaled 164 Bcf. There were two companies with underground storage facilities located in six counties. Montana-Dakota Utilities Co. utilized underground facilities near Baker, Fallon County, for storing 112.9 Bcf of natural gas. Montana Power Co. utilized underground storage facilities in the Box Elder field (2.8 Bcf), Hill County; Cobb field (29.8 Bcf), Toole and Glacier Counties; and Dry Creek field (7.9 Bcf), Carbon County. The company also utilized underground storage near Shelby (2.4 Bcf), Toole County; and in the Madison limestone formation (8.2 Bcf), in Gallatin County. Exploratory drilling efforts resulted in the discovery of shallow gas reserves in the Eagle sand formation on the north flank of the Bearpaw Mountains, Blaine County, in north-central Montana. The biggest gas discovery since 1930 came in April upon locating the Tiger Ridge gasfield. Indications were that recoverable natural gas reserves of the field might approach 300 Bcf. The State recoverable reserves at the beginning of 1967 totaled 620 Bcf. At yearend there were no pipelines to the field, but several alternatives occurred for marketing gas from the field by High Crest Oils, Inc., manager-operator of the project with 60 percent operating interest. The only nearby outlet, a Montana Power Co. 8-inch pipeline, cuts through the depleted Box Elder gas field and the producing Bowes oil and gas field. Another possibility was to link with the Montana-Dakota Utilities system about 50 miles east. The manager-operator of the project might attempt some marketing on its own. A prime outlet was The Anaconda Company copper refinery at Great Falls, 110 miles distant, which utilizes about 20 million cubic feet per day (MMcfd). Two purchase plans were discussed with Montana Power Co. One plan involved Montana Power Co. furnishing a gathering system and purchasing the wellhead gas for $0.08 per thousand cubic feet; another was that High Crest Oils, Inc., would build a pipeline-gathering system and pressure the gas to the Montana Power Co. pipeline at a higher price. An estimated 20 to 25 MMcfd could be delivered to a pipeline system by High Crest Oils, Inc.

Exploratory drilling totaled 203 wells, of which seven were oil discoveries, five gas wells, and 191 dry holes. Development drilling totaled 280 wells, of which 162 were oil producers, 14 gas wells, and 104 dry holes. Exploratory and development drilling was highest in Powder River County, in the vicinity of the Bell Creek field, where 119 wells were drilled, including 87 oil producers, two gas wells, and 30 dry holes. The average well depth was less than 5,000 feet.

Nine refineries processed 37.1 million barrels of crude oil. Montana wells supplied 29 percent of the crude oil refined; 57 percent came from Wyoming, and 14 percent from Canadian wells.

There were 39 active secondary recovery projects—36 waterflooding and three gas injection. Five waterflood projects were started, and one large project in the Pine field was under construction. An estimated 5.2 million barrels of crude oil, or 15 percent of Montana production, was incremental production from secondary recovery projects.

A permit was approved for Glacier Pipeline Co., an affiliate of Continental Oil Co., to transport by pipeline up to 129,000 barrels of crude petroleum and condensate per day into Billings from Alberta, Canada. The company previously had transported 53,000 barrels of crude oil per day through an 8-inch pipeline from Canada to Billings. The additional 76,000 barrels per day of crude and condensate will be transported to Billings through a 12-inch pipeline expected to be completed in 1968. The two pipelines will supply the expanded capacity of refineries of Continental Oil Co. and Humble Oil & Refining Co., Billings.

The National Resources Committee of the Montana Senate held hearings on a unitization bill for petroleum and natural gas development activities in the State. The measure would empower the Montana Oil and Gas Conservation Commission to approve petroleum and natural gas development of unitized areas with the consent of 80 percent of the parties involved.

Table 17.—Principal producers of metals and minerals

Commodity and company	Type of activity	County	Address
Metals:			
Aluminum:			
Anaconda Aluminum Co	Plant	Flathead	Columbia Falls, Mont.
Do	Rolling mill	Cascade	Great Falls, Mont.
Antimony:			
Knute Kirkeberg	Mine	Sanders	Thompson Falls, Mont.
Copper:			
American Smelting and Refining Company.	Smelter	Lewis and Clark	East Helena, Mont.
The Anaconda Company	do	Deer Lodge	Anaconda, Mont.
Do	Refinery and rolling mill.	Cascade	Great Falls, Mont.
Do	Mine, concentrator precipitating plant.	Silver Bow	Butte, Mont.
Gold:			
Glen H. Allman	Placer	Meagher	White Sulphur Springs, Mont.
Beaver Creek Placer	do	do	Belt, Mont.
Pacific Mines, Inc	Mine	Madison	Virginia City, Mont.
A. K. Scharf	Placer	Powell	Deer Lodge, Mont.
A. Walkup and Crncerich	Mine	Granite	Philipsburg, Mont.
Iron ore:			
R & S Iron Co	Mine	Broadwater	Radersburg, Mont.
Lead and zinc:			
The Anaconda Company	do	Silver Bow	Butte, Mont.
Do	Mill	Deer Lodge	Anaconda, Mont.
Do	Slag fuming plant	Lewis and Clark	East Helena, Mont.
Do	Zinc plant	Cascade	Great Falls, Mont.
Do	do	Deer Lodge	Anaconda, Mont.
John H. Byrd	Mine	Lewis and Clark	Helena, Mont.
Goldsmith Mining Corp	do	Beaverhead	Dillon, Mont.
Hamilton Mines, Inc	do	Meagher	Martinsdale, Mont.
Hand Mines	do	Beaverhead	Dillon, Mont.
Kinley Enterprises	do	Broadwater	Butte, Mont.
Liverpool Mining Co	do	Jefferson	Clancy, Mont.
E. G. Smith	Mine and mill	Mineral	Superior, Mont.
Taylor-Knapp Co	do	Granite	Philipsburg, Mont.
Dick Tunstill	Mine	Granite	Do.
Manganese:			
The Anaconda Company	Stockpile	Deer Lodge	Butte, Mont.
Taylor-Knapp Co	Mine	Granite	Philipsburg, Mont.
Tungsten:			
Minerals Engineering Co	Mine and mill	Beaverhead	Glen, Mont.
Tri-City Concrete Products	Mine	Deer Lodge	Anaconda, Mont.
Overlook Tungsten Mining Co.	do	Silver Bow	Butte, Mont.
Nonmetals:			
Cement:			
Ideal Cement Co	Plant	Gallatin	Trident, Mont.
Kaiser Cement & Gypsum Corp.	do	Jefferson	Montana City, Mont.
Clay:			
Concrete Products Co	Pit and plant	Yellowstone	Billings, Mont.
Hallett Minerals	Pit	Rosebud	Vananda, Mont.
Ideal Cement Co	Pit and plant	Gallatin	Trident, Mont.
Kaiser Cement & Gypsum Corp.	Pit	Jefferson	Montana City, Mont.
Lewistown Brick & Tile Co	Pit and plant	Fergus	Lewistown, Mont.
Lovell Clay Products Co	do	Yellowstone	Billings, Mont.
National Lead Co	do	Carter	Colony, Mont.
Harold Snow	Pit	Deer Lodge	Anaconda, Mont.
Treasurelite, Division of Treasure State Industrial Products, Inc.	Pit	Cascade	Great Falls, Mont.
Fluorspar:			
Roberts Mining Co	Mine and plant	Ravalli	Darby, Mont.
Gypsum:			
Bridger Gypsum Co	Mine	Carbon	Billings, Mont.
United States Gypsum Co	do	Fergus	Lewistown, Mont.
Lime:			
The Anaconda Company	Plant	Deer Lodge	Butte, Mont.
Phosphate rock:			
Cominco American, Inc	Mine and plant	Granite	Drummond, Mont.
Do	Mine	Powell	Do.
A. G. Jackson	do	do	Elliston, Mont.
Relyea Mines	do	do	Garrison, Mont.
Stauffer Chemical Co	Mines (2)	Beaverhead	Butte, Mont.
Do	Mine and plant	Silver Bow	Do.

See footnotes at end of table.

Table 17.—Principal producers of metals and minerals—Continued

Commodity and company	Type of activity	County	Address
Nonmetals—Continued			
Sand and gravel:			
Billings Sand & Gravel	Pit and plant	Yellowstone	Billings, Mont.
Empire Sand & Gravel	do	do	Do.
Engebretson Gravel, Inc	do	Flathead	Kalispell, Mont.
McElroy & Wilken, Inc	do	do	Do.
Midland Materials Co	do	Yellowstone	Billings, Mont.
Montana Sand & Gravel	do	Cascade	Great Falls, Mont.
Oscar J. Mortenson	do	do	Cascade, Mont.
Pioneer Ready-Mix	do	Gallatin	Bozeman, Mont.
Richardson Construction Co	do	Various	Miles City, Mont.
Stone:			
The Anaconda Company	Quarry	Deer Lodge	Butte, Mont.
R. A. Heintz Construction Co.	do	Lincoln	Portland, Oreg.
Ideal Cement Co.	do	Gallatin	Trident, Mont.
Kaiser Cement & Gypsum Corp.	do	Jefferson	Butte, Mont.
Sulfur:			
Montana Sulphur & Chemical Co.	Plant	Yellowstone	Billings, Mont.
Talc and soapstone:			
Chas. Pfizer & Co., Inc	Mine and plant	Beaverhead	Dillon, Mont.
Do	Mine	Madison	Do.
The United Sierra Division of Cyprus Mines Corp.	do	do	Cameron, Mont.
	Plant	Gallatin	Three Forks, Mont.
Vermiculite:			
W. R. Grace & Co., Zonolite Division.	Pit and plant	Lincoln	Libby, Mont.
Exfoliated vermiculite:			
Robinson Insulation Co	Plant	Cascade	Great Falls, Mont.
Mineral fuels:			
Coal:			
Acme Coal Mine	Mine	Sheridan	Coalridge, Mont.
Brophy Coal Co	do	Carbon	Red Lodge, Mont.
Divide Coal Mining Co	do	Musselshell	Roundup, Mont.
Johnie's Coal Mine	do	do	Do.
Knife River Coal Mining Co	do	Richland	Savage, Mont.
Paul Megal	do	Musselshell	Roundup, Mont.
Milk River Coal Mine Co	do	Blaine	Chinook, Mont.
Nies Coal Co	do	Musselshell	Roundup, Mont.
Rosebud Coal Sales Co	do	Big Horn	Decker, Mont.
John H. Schoonover	do	Powder River	Ashland, Mont.
Square Deal Coal Co	do	Musselshell	Roundup, Mont.
Western Coal Co	do	do	Do.
Natural gas processing:			
Union Oil Co.[1]	Plant	Glacier	Cut Bank, Mont.
Union Texas Natural Gasoline Corp.[1]	do	Wibaux and Fallon.	Baker, Mont.
Peat:			
Martin's Peat & Potting Soils.	Mine	Lake	Swan Lake, Mont.
Petroleum refining:			
Big West Oil Co	Refinery	Toole	Kevin, Mont.
Continental Oil Co	do	Yellowstone	Billings, Mont.
Diamond Asphalt Co	do	Blaine	Chinook, Mont.
Farmers Union Central Exchange, Inc.	do	Yellowstone	Laurel, Mont.
Humble Oil & Refining Co	do	do	Billings, Mont.
Jet Fuel Refinery	do	Garfield	Mosby, Mont.
Phillips Petroleum Co	do	Cascade	Great Falls, Mont.
Tesoro Petroleum Co	do	Roosevelt	Wolf Point, Mont.
Union Oil Co	do	Glacier	Cut Bank, Mont.

[1] Liquefied petroleum gases, natural gasoline, and other products.

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 George M. Deutman [1] and William C. Henkes [2]

The value of mineral production in Nebraska continued on a downward trend during 1967, $70.9 million compared with the 1966 figure of $78.5 million. Of the decrease 86 percent was in the nonmetal group and 14 percent in mineral fuels. Mineral fuels accounted for $40 million (56 percent) of the total value of mineral production in 1967, compared with $41.1 million (52 percent) in 1966.

Government Programs.—Contracts awarded for highway construction in Nebraska totaled $32.8 million, a 22-percent decline from the $42.2 million awarded in 1966; contracts awarded for Interstate highway construction decreased 19 percent.[3] Of the State's total designated mileage of 477.5 miles for the National System of interstate and Defense Highways, 334.4 miles were open to traffic at yearend 1967, 34.9 miles more than were completed at yearend 1966.[4]

The U.S. Army Corps of Engineers awarded the following flood protection and bank stabilization projects: Channel repairs on Little Papillion Creek near Omaha; channel stabilization, Phase VIII, Gering Valley; Missouri River Levee bank stabili-

[1] Mining engineer, Bureau of Mines, Denver, Colo.
[2] Petroleum engineer, Bureau of Mines, Denver, Colo.
[3] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1968 . . . and Budgets for Maintenance: Highway Spending Goes for a New Record Despite Federal Aid Cuts. V. 180, No. 14, Apr. 4, 1968, pp. 86–87.
[4] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1967. Press Release FHWA–118, Feb. 14, 1968.

Table 1.—Mineral production in Nebraska [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays—thousand short tons	153	$153	126	$142
Gem stones	NA	5	NA	5
Natural gas (marketed)—million cubic feet	10,196	1,621	8,453	1,454
Natural gas liquids:				
LP gases—thousand gallons	19,670	1,141	20,738	1,223
Natural gasoline and cycle products—do	9,195	653	7,805	578
Petroleum (crude)—thousand 42-gallon barrels	13,850	37,673	13,373	36,775
Sand and gravel—thousand short tons	13,539	14,179	11,739	10,878
Stone—do	5,055	7,916	4,846	7,483
Value of items that cannot be disclosed: Cement, lime, and pumice [2]	XX	15,180	XX	12,330
Total	XX	78,521	XX	70,868
Total 1957–59 constant dollars	XX	r 76,276	XX	68,644

r Revised.
NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Value 1966, f.o.b. mine and/or grinding plant; value 1967, f.o.b. mine.

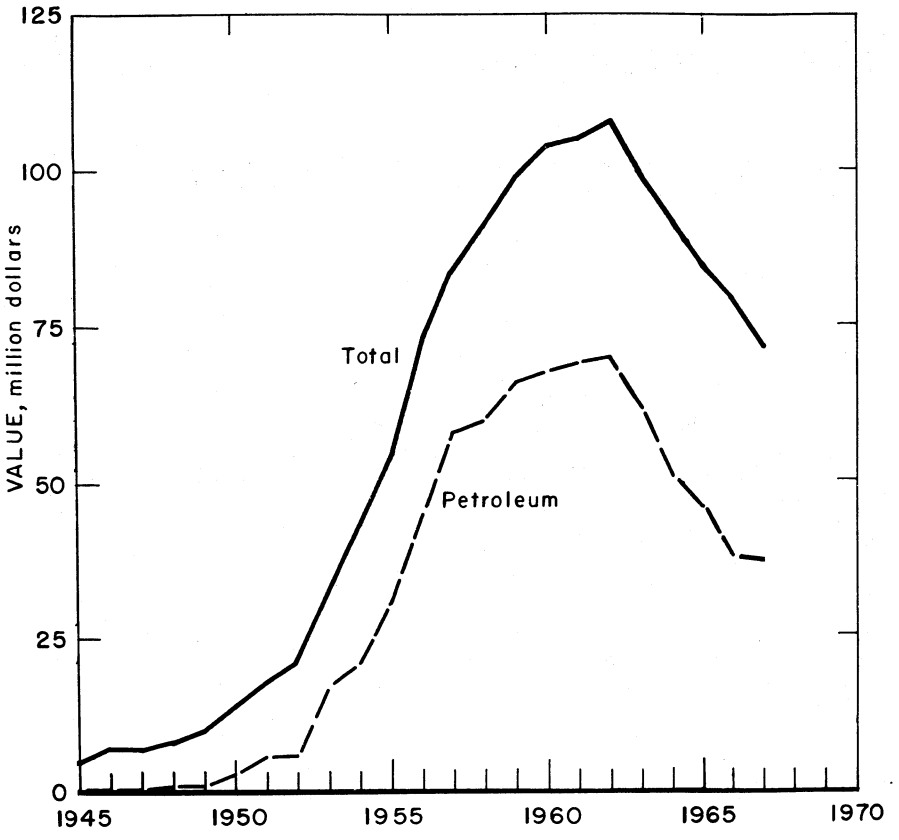

Figure 1.—Value of petroleum and total value of mineral production in Nebraska.

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

County	1966	1967	Minerals produced in 1967 in order of value
Adams	$114,000	$43,000	Sand and gravel.
Antelope	88,000	37,000	Do.
Banner	9,503,000	6,935,000	Petroleum, natural gas, sand and gravel.
Blaine	----------	7,000	Sand and gravel.
Boone	W	W	Do.
Box Butte	52,270	1,000	Do.
Boyd	24,000	14,000	Do.
Brown	100,000	164,000	Do.
Buffalo	556,000	308,000	Do.
Butler	159,000	123,000	Do.
Cass	16,916,979	16,115,951	Cement, stone, sand and gravel, clays.
Cedar	116,000	137,000	Sand and gravel.
Chase	2,000	11,000	Do.
Cherry	18,000	6,000	Do.
Cheyenne	9,858,000	9,267,000	Petroleum, natural gas, LP gases, natural gasoline, sand and gravel.
Clay	82,000	109,000	Sand and gravel.
Colfax	78,000	115,000	Do.
Cuming	W	245,000	Do.
Custer	W	141,000	Do.
Dakota	61,000	48,000	Do.

See footnotes at end of table.

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

County	1966	1967	Minerals produced in 1967 in order of value
Dawes	$13,658	$11,000	Sand and gravel
Dawson	478,000	246,000	Do.
Deuel	338,000	256,000	Natural gas, sand and gravel.
Dixon	60,512	W	Sand and gravel, stone.
Dodge	837,112	617,000	Sand and gravel.
Douglas	1,456,138	1,398,235	Sand and gravel, clays.
Dundy	25,000	20,000	Petroleum, sand and gravel.
Fillmore	12,000	37,000	Sand and gravel.
Franklin	W	72,000	Do.
Frontier	38,000	229,000	Petroleum, natural gas.
Furnas	92,000	56,000	Sand and gravel, petroleum.
Gage	W	237,562	Sand and gravel, stone.
Garden	43,000	38,000	Petroleum, sand and gravel.
Garfield	W	5,000	Sand and gravel.
Grant	2,000	----------	
Hall	1,318,000	912,000	Sand and gravel.
Hamilton	216,000	----------	
Harlan	163,000	86,000	Petroleum, sand and gravel.
Hayes	W	W	Sand and gravel, petroleum.
Hitchcock	703,000	820,000	Petroleum, sand and gravel.
Holt	166,000	166,000	Sand and gravel.
Hooker	14,000	----------	
Howard	92,000	W	Sand and gravel.
Jefferson	W	W	Sand and gravel, clays.
Johnson	11,547	5,000	Sand and gravel.
Kearney	103,000	72,000	Do.
Keith	178,000	248,000	Do.
Keya Paha	9,000	----------	
Kimball	11,841,000	10,672,000	Petroleum, LP gases, natural gasoline, natural gas, sand and gravel.
Knox	298,000	79,000	Sand and gravel.
Lancaster	384,188	257,754	Stone, clays, sand and gravel.
Lincoln	278,000	W	Sand and gravel, petroleum, pumice.
Logan	2,000	29,000	Sand and gravel.
Loup	35,000	10,000	Do.
Madison	530,000	310,700	Sand and gravel, stone.
McPherson	6,000	W	Sand and gravel.
Merrick	145,000	W	Do.
Morrill	2,182,000	1,830,000	Petroleum, sand and gravel, lime, natural gas.
Nance	82,000	W	Sand and gravel.
Nemaha	W	104,161	Stone.
Nuckolls	W	W	Cement, sand and gravel.
Otoe	171,057	W	Stone, clays.
Pawnee	162,130	194,388	Stone, sand and gravel.
Perkins	13,000	18,000	Sand and gravel.
Phelps	244,000	W	Do.
Pierce	86,000	134,000	Do.
Platte	W	751,000	Do.
Polk	W	W	Do.
Red Willow	5,097,000	8,826,000	Petroleum, sand and gravel.
Richardson	381,512	366,450	Stone, petroleum, sand and gravel.
Rock	19,000	6,000	Sand and gravel.
Saline	212,000	208,000	Do.
Sarpy	W	831,004	Stone, sand and gravel.
Saunders	945,000	750,000	Sand and gravel, stone.
Scotts Bluff	2,487,455	1,976,310	Petroleum, sand and gravel, lime, stone, natural gas.
Seward	W	W	Stone.
Sheridan	9,875	----------	
Sherman	21,000	2,000	Sand and gravel.
Sioux	26,782	42,000	Do.
Stanton	77,000	W	Do.
Thayer	132,000	160,000	Do.
Thomas	19,000	27,000	Do.
Thurston	17,000	2,100	Stone.
Valley	156,920	44,000	Sand and gravel.
Washington	W	W	Stone, sand and gravel.
Wayne	47,000	----------	
Webster	112,000	48,000	Sand and gravel.
Wheeler	20,000	9,000	Do.
York	120,000	102,000	Do.
Undistributed [2]	[r] 8,063,823	3,719,157	
Total	78,521,000	70,868,000	

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

[1] The following counties are not listed because no production was reported: Arthur, Burt, Gosper, and Greeley.

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

Table 3.—Indicators of Nebraska business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$4,181	p $4,216	+0.8
Per capita		$2,905	p $2,938	+1.1
Bank debits	millions	$2,262	NA	
New construction:				
Building permits	do	$94.0	$138.1	+46.9
Highway construction contracts awarded	do	$42.2	$32.8	−22.3
Cash receipts from farm marketing	do	$1,855.8	p $1,820.1	−1.9
Mineral production	do	$78.5	$70.9	−9.7
Work force:				
Total labor force (monthly estimated work force average)	thousands	633	637	+0.6
Total employment	do	617	621	+0.6
Total unemployment	do	16	16	
Unemployment rate	percent	2.6	2.5	−3.8
Employment:				
Total agricultural	thousands	120.4	114.2	−5.2
Total non-agricultural	do	432.0	442.6	+2.5
Mining	do	1.8	1.7	−5.6
Contract construction	do	23.4	23.3	−0.4
Manufacturing	do	74.9	80.2	+7.1
Finance, insurance, real estate	do	26.0	26.2	+0.8
Transportation and utilities	do	36.5	36.3	−0.5
Trade	do	108.6	109.0	+0.4
Services and miscellaneous	do	69.8	72.8	+4.3
Government	do	91.0	93.1	+2.3

p Preliminary. NA Not available.

Sources: Survey of Current Business; Engineering News-Record; Statistical Reporting Service, U.S. Department of Agriculture, Denver, Colo.; State of Nebraska; U.S. Department of Commerce, Washington, D.C.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Nonmetal	66	231	15	136		7	51.47	956
Sand and gravel	1,063	209	222	2,050	1	20	10.24	3,340
Stone	516	290	150	1,229		10	8.13	275
Total	1,645	235	387	3,415	1	37	11.13	2,141
1967:p								
Nonmetal	45	231	10	82		2	24.49	147
Sand and gravel	880	203	178	1,703	1	10	6.46	3,835
Stone	525	266	140	1,167		20	17.14	444
Total [1]	1,450	227	328	2,951	1	32	11.18	2,392

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

zation near Bellvue; emergency bank protection at Cedar Island on the North Platte River near La Platte; flood protection, Stage II, near Norfolk; Salt Creek project channel improvements on levees through Lincoln, Stage II, Salt Creek and its tributaries; flood protection, Blackbird Creek near Macy, Missouri River Basin; flood protection at Hooper, Elkhorn River Basin; bank stabilization on the Missouri River in the vicinity of Plattsmouth; and emergency levee repairs on the Platte River in Saunders County near Ashland.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Natural Gas.—Because of depletion of the gas reservoirs, marketed natural gas again declined—17 percent. The State Oil and Gas Conservation Commission reported that dry gas production was 6 billion cubic feet; casing head gas was 3.9 billion.[5] Cheyenne County continued to lead the State in output of natural gas with 66 percent of the total. Within the State, 37 dry gas wells were producing at yearend; 5 were shut in.

The American Petroleum Institute (API) and the American Gas Association (AGA) listed proved reserves of natural gas of 63.8 billion cubic feet at yearend 1967, a 9.0 billion (12-percent) decline from 1966. Extensions, revisions, and additions by new fields in 1967 were much less than production.[6]

Kansas-Nebraska Natural Gas Co. constructed 27 miles of 12-inch and 20 miles of 8-inch gas pipeline.

Natural Gas Liquids.—Output of total natural gas liquids was virtually unchanged from 1966. Production of natural gasoline was down 15 percent; however, the 5-percent increase in the larger quantity of LP gases tended to balance the total. Cities Service Oil Co. purchased the Kimball gasoline plant formerly operated by Antelope Gas Producers Co.

Annual reserve estimates by API and AGA gave the State natural gas liquids reserves of 2.3 million barrels, an 8-percent decline.[7]

Petroleum.—Crude oil production continued to decline but at a much slower rate than during the previous 4 years. Output was 3 percent below that of 1966 because of the depletion of older reservoirs. Although development drilling increased slightly from the 113 wells drilled in 1966, exploratory drilling again declined sharply —from 176 to 107 wells. Wildcat wells accounted for 46 percent of the drilling activity; the success ratio was 9.3 percent, somewhat less than in the previous year. The actual number of discoveries reached a new low.

The 10 discovery oil wells were small in terms of initial production potential. Only one discovery well, in Surge field, had initial daily production of more than 100 barrels; the well, Sundance Oil Co. Beranek No. 1, sec 22, T13N, R54W, Kimball County, was completed for 275 barrels per day from the "J" Sandstone formation (Cretaceous). Another discovery, the Hole-in-Rock field, sec 6, T19N, R55W, Banner County, was completed, pumping 50 barrels of oil per day from the "J" Sandstone; however, the confirmation well, a southeast offset, pumped 475 barrels per day. By yearend four other wells had been staked or begun in the field.

Kimball County continued to lead the State in petroleum production, in spite of an 11-percent decrease in output. Of the five fields in the county, only the Enders with an increase of 11,458 barrels to 493,494 barrels evidenced a gain.

Red Willow County with an 80 percent increase in production, ranked second, displacing Banner and Cheyenne Counties. The gain in Red Willow County production resulted primarily from increased output in the Sleepy Hollow field, where output more than doubled, from 952,904 to 1,993,796 barrels. This was the result of a waterflood program which was begun in October 1966 and which reached full effectiveness in 1967. Notable gains also were reported for the Red Willow County fields of Northwest Sleepy Hollow, Bed Canyon, Ackman, and Silver Creek.

The Willson Ranch field, Banner County, which ranked second in production in 1966, had a decline of 393,111 barrels to 304,361 barrels and dropped to fifth place as a producing field in the State.

As of December 31, 1967, API and AGA estimated State crude oil reserves of 63.2 million barrels, a gain of 6 million barrels. Additions because of revisions and extensions amounted to 18.9 million barrels; new fields added 266,000 barrels.[8]

At yearend, the State reported that 1,430 oil wells were producing; 609 were shut in or temporarily abandoned.[9] Four counties accounted for 87 percent of the producing wells: Kimball was the leading

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[5] Nebraska Oil and Gas Conservation Commission, Sidney, Nebraska. Nebraska Oil Acitivity Summary. 1967, 5 pp.
[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 as of Dec. 31, 1967. V. 22, May 1968, p. 125.
[7] Page 128 of work cited in footnote 6.
[8] Pages 30–31 of work cited in footnote 6.
[9] Work cited in footnote 5.

Table 5.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1966	1967	Principal fields in 1967
Banner	3,463	2,490	Singleton, Willson Ranch, Harrisburg, Johnson, Vedene, Olsen. [1]
Cheyenne	2,873	2,597	Southwest Potter, Doran, Juelfs-Gaylord, Graff.
Dundy	9	7	East Indian Creek, Rock Canyon, Indian Creek.
Frontier	14	83	Bed Canyon. [2]
Furnas	4	2	Wilsonville, Southwest Wilsonville.
Garden	11	11	Richards, McCord.
Harlan	26	27	South Alma, Prairie Dog Creek.
Hayes	1	1	Black Wood Creek.
Hitchcock	253	283	Reiher, Dry Creek, Bush Creek, Culbertson.
Kimball	3,946	3,525	Enders, Sloss, Fernquist, Kimball, Long.
Lincoln	4	4	Red Willow Creek.
Morrill	726	572	Waitman, Dunlap, Lindberg.
Red Willow	1,764	3,183	Sleepy Hollow, Ackman, Northwest Sleepy Hollow, Silver Creek, Midway, Bed Canyon. [3]
Richardson	59	58	Dawson, Falls City, Barada.
Scotts Bluff	697	530	Cedar Valley, Minatare, Stage Hill, [4] Canal, North Minatare.
Total	13,850	13,373	

[1] Partly in Morrill County.
[2] Partly in Red Willow County.
[3] Partly in Frontier County.
[4] Partly in Banner County.

Source: Nebraska Oil and Gas Conservation Commission.

Table 6.—Oil and gas well drilling in 1967, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Banner	3	------	17	20	116,141
Butler	----	------	1	1	2,500
Cheyenne	2	------	16	18	92,557
Dawes	----	------	1	1	3,165
Frontier	1	------	2	3	11,169
Furnas	----	------	1	1	3,628
Gosper	----	------	1	1	3,631
Harlan	----	------	1	1	3,824
Hitchcock	----	------	2	2	6,998
Holt	----	------	1	1	2,592
Keith	----	------	1	1	2,500
Kimball	2	------	14	16	92,999
Lincoln	----	------	1	1	1,716
Morrill	1	------	10	11	49,157
Nance	----	------	1	1	2,893
Red Willow	1	------	12	13	48,641
Richardson	----	------	2	2	5,877
Scotts Bluff	----	------	4	4	21,300
Sheridan	----	------	4	4	18,480
Sioux	----	------	5	5	25,676
Total	10	------	97	107	515,444
Development completions:					
Banner	8	------	17	25	150,847
Cheyenne	9	1	30	40	198,805
Frontier	6	------	------	6	23,612
Hitchcock	1	------	------	1	3,984
Kimball	15	------	25	40	246,448
Morrill	1	------	2	3	13,712
Red Willow	4	------	7	11	42,515
Richardson	1	------	------	1	2,353
Total	45	1	81	127	682,276
Total all drilling	55	1	178	234	1,197,720

Sources: Petroleum Information Corp., 1967 Résumé, Oil and Gas Operations in the Rocky Mountains Region; and Committee on Statistics of Drilling, American Association of Petroleum Geologists.

county with 377 wells, Red Willow had 350, Cheyenne 261, and Banner 255.

The State conducted seven oil and gas lease sales on State land; acreage leased totaled 13,499 acres which brought bonuses of $21,215. Highest bid, $5.50 per acre, was offered at a sale held in January; lowest bid was 50 cents per acre offered at sales held in June and October. The average price paid for the seven sales was $1.57 per acre.

In August prices on most Nebraska crude oils were increased 5 cents per barrel, bringing the posted price for Denver-Julesburg Basin crude to $2.98 per barrel for 40° to 44.9° API gravity oil.

NONMETALS

Cement.—Activity in the cement industry declined; shipments of cement were 18 percent below those of 1966. Ash Grove Lime & Portland Cement Co. and Ideal Cement Co. Division, Ideal Basic Industries, Inc., produced portland and masonry cements in Cass and Nuckolls Counties, respectively. The downward trend in shipments reflected a shutdown for renovation by Ideal Cement Co. The average price per barrel of portland and masonry cements remained approximately the same.

Clay.—Production of clay by Ash Grove Lime & Portland Cement Co., Endicott Clay Products Co., Omaha Brick Works, Western Brick and Supply Co., and Yankee Hill Brick Manufacturing Co. totaled 126,000 tons—an 18-percent decrease from 1966 figures.

Lime.—The volume of lime produced by The Great Western Sugar Co. for use in refining beet sugar decreased 23 percent. The decrease was the result of a smaller tonnage of beets processed at the company's Bayard, Gering, Mitchell, and Scottsbluff plants.

Perlite.—Zonolite Division, W. R. Grace & Co., processed crude perlite from out-of-State sources for use as lightweight aggregate in concrete and plaster.

Pumice.—The tonnage of pumicite ore treated by LaRue-Axtell Pumice Co. from its LeMaster mine in Lincoln County increased 16 percent.

Sand and Gravel.—Sand and gravel production decreased 13 percent in quantity and 23 percent in total value. Output was reported in all but 15 counties from 243 commercial operations and 81 Government crew and contractor operations. The overall average unit value for sand and gravel was $0.93 per ton in 1967.

Stone.—Dimension and crushed limestone, produced in 15 of the State's 93 counties, decreased 4 percent in quantity and 5 percent in value. The average unit value of the stone was $1.54 per ton, a 2-percent decrease from $1.57 per ton in 1966. The three leading limestone-producing counties, in descending order, were Cass, Washington, and Sarpy.

Sargent Calcium Co. completed construction of its new manufacturing plant in Weeping Water. The plant will produce calcium carbonate and dicalcium phosphate for the livestock-feeding industry. Mining of high-quality limestone from the Plattsmouth Ledge was by the room and pillar method.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	2,351	$2,209	2,011	$1,643
Paving	990	918	1,127	1,059
Railroad ballast	(1)	(1)	------	------
Fill	785	680	847	682
Other	[1] 11	[1] 12	17	21
Industrial sand:				
Other	------	--------	1	1
Total	4,137	3,819	4,003	3,406
Gravel:				
Construction:				
Building	1,293	1,545	1,174	1,158
Paving	5,500	6,414	5,230	5,073
Railroad ballast	84	106	2	3
Fill	259	222	34	29
Other	1	1	1	1
Miscellaneous	101	120	177	186
Total	7,238	8,408	6,618	6,450
Total sand and gravel	11,375	12,227	10,621	9,856
Government-and-contractor operations:				
Sand:				
Paving	549	549	240	225
Gravel:				
Building	13	6	15	8
Paving	1,602	1,397	863	789
Total	1,615	1,403	878	797
Total sand and gravel	2,164	1,952	1,118	[2] 1,021
All operations:				
Sand	4,686	4,368	4,243	3,631
Gravel	8,853	9,811	7,496	7,247
Total	13,539	14,179	11,739	10,878

[1] Railroad ballast and "Other" sand combined to avoid disclosing individual company confidential data.
[2] Data do not add to total shown because of independent rounding.

Table 8.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Adams	35	$43	Kearney	80	$72
Antelope	51	37	Keith	260	248
Banner	29	29	Kimball	4	6
Blaine	9	7	Knox	73	79
Boone	W	W	Lancaster	33	18
Box Butte	2	1	Lincoln	366	388
Boyd	11	14	Loup	17	10
Brown	92	164	McPherson	W	W
Buffalo	326	308	Madison	237	237
Butler	152	123	Merrick	W	W
Cass	537	440	Morrill	169	164
Cedar	127	137	Nance	W	W
Chase	30	11	Nemaha	29	29
Cherry	8	6	Nuckolls	38	29
Cheyenne	116	143	Pawnee	13	13
Clay	101	109	Perkins	37	18
Colfax	145	115	Phelps	W	W
Cuming	373	245	Pierce	135	134
Custer	154	141	Platte	666	751
Dakota	49	48	Polk	W	W
Dawes	12	11	Red Willow	73	74
Dawson	358	246	Richardson	14	14
Deuel	71	71	Rock	8	6
Dixon	90	98	Saline	199	208
Dodge	836	617	Sarpy	433	404
Douglas	1,555	1,396	Saunders	865	740
Dundy	2	1	Scotts Bluff	233	267
Fillmore	32	37	Sherman	1	2
Franklin	117	72	Sioux	50	42
Furnas	40	49	Stanton	W	W
Gage	129	165	Thayer	155	160
Garden	9	7	Thomas	34	27
Garfield	7	5	Valley	65	44
Hall	842	912	Washington	57	57
Harlan	13	13	Webster	64	48
Hayes	W	W	Wheeler	13	9
Hitchcock	40	42	York	139	102
Holt	164	166	Undistributed	320	278
Howard	W	W			
Jefferson	190	166	Total	11,739	10,878
Johnson	5	5			

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

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

Use	1966		1967	
	Short tons	Value	Short tons	Value
Dimension stone: Rubble	12,783	$68,281	10,989	$59,988
Crushed and broken stone:				
Riprap	1,982,203	2,371,941	2,004,121	2,170,826
Concrete and roadstone	1,885,875	3,145,080	1,620,819	2,676,740
Agriculture	208,927	358,257	228,157	390,949
Lime	W	W	5,204	9,107
Other	[1] 965,351	[1] 1,972,164	[2] 976,734	[2] 2,175,334
Total	5,042,356	7,847,442	4,835,035	7,422,956
Total stone	5,055,139	7,915,723	4,846,024	7,482,944

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

[1] Includes stone used in asphalt filler, cement, lime, other filler, poultry grit, railroad ballast, and rubber filler.

[2] Includes stone used in asphalt filler, cement, mineral food, other filler, poultry grit, railroad ballast, and rubber filler.

Talc.—The United Sierra Division, Cyprus Mines Corp. processed at Grand Island crude talc produced in California and Montana. The processed material was used in manufacturing ceramics, cosmetics, floor tile, paint, paper, rubber, textiles, and toilet preparations; some of the processed material was exported.

Vermiculite.—The Zonolite Division of W. R. Grace & Co. exfoliated vermiculite for use as concrete and plaster aggregate and loose-fill insulation, and for agricultural use. Output increased approximately 33 percent.

METALS

The American Smelting and Refining Co. (Asarco) refinery in Omaha recovered lead, gold, silver, antimony, and bismuth from lead bullion and other smelter products shipped from Asarco plants outside of Nebraska.

Table 10.—Principal producers and processing plants in 1967

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Cement:					
Ash Grove Lime & Portland Cement Co.	101 West 11th St., Kansas City, Mo. 64105	Plant	Cass	Clay, limestone.	Wet process; six-rotary-kiln cement plant.
Ideal Cement Co., Division Ideal Basic Industries, Inc.	620 Denver National Bldg., Denver, Colo. 80202.	do	Nuckolls	Limestone	Wet process; three-rotary-kiln cement plant.
Clays:					
Ash Grove Lime & Portland Cement Co.	101 West 11th St., Kansas City, Mo. 64105.	Removal of overburden at quarry.	Cass	Cement, limestone.	
Endicott Clay Products Co.	Endicott, Nebr. 68350	Open-pit mine	Jefferson		
Yankee Hill Brick Manufacturing Co.	730 Stuart Bldg., Lincoln, Nebr. 68508.	do	Lancaster		
Natural gas and petroleum: Most of the major oil and gas companies and many smaller companies operate in Nebraska and several commercial directories contain complete lists of them.					
Lime:					
The Great Western Sugar Co.	Box 5308, Denver, Colo. 80217	Four limekilns at beet-sugar refineries.	Morrill, Scotts Bluff		One one-shaft kiln at Bayard, Morrill County; one two-shaft kiln at Gering, one one-shaft kiln at Mitchell, and one two-shaft kiln at Scottsbluff, Scotts Bluff County.
Pumice:					
LaRue Axtell Pumice Co.	Callaway, Nebr. 68825	Open-pit mine	Lincoln		
Sand and gravel (commercial):					
Central Sand & Gravel Co.	Box 626, Columbus, Nebr. 68601.	Six dredging operations.	Butler, Madison, Platte.		One dredging operation in Butler County, two in Madison County, and three in Platte County.
Christensen Sand & Gravel Co.	Fremont, Nebr. 68025	Four pits and plants	Dodge		Four portable crushing and screening plants.
Hartford Sand & Gravel Co.	Box 571, Valley, Nebr. 68064	Pit and plant	Douglas		Stationary crushing and screening plant.
Luther & Maddox Gravel Co.	Grand Island, Nebr. 68801	Four dredging operations.	Hall		
Lyman-Richey Sand & Gravel Corp.	4315 Cuming St., Omaha, Nebr. 68131.	Eleven dredging operations.	Cass, Dodge, Douglas, Morrill, Platte, Sarpy, Saunders.		One dredging operation each in Cass, Morrill, Platte, and Saunders Counties; two each in Dodge and Douglas Counties; and three in Sarpy County.
McCann Sand & Gravel Co.	Valley, Nebr. 68064	Two dredging operations.	Douglas		
Sorensen Sand & Gravel	2851 Potter St., Omaha, Nebr. 68112.	do	Douglas, Sarpy		One dredging operation each in Douglas and Sarpy Counties.
Western Sand & Gravel Co.	Box 268, Lincoln, Nebr. 68501	Four dredging operations.	Cass, Saunders		One dredging operation in Cass County and three in Saunders County.
Stone:					
Ash Grove Lime & Portland Cement Co.	101 West 11th St., Kansas City, Mo. 64105	Quarry and plant	Cass	Cement, clay.	Stationary crushing and screening plant.
Fort Calhoun Stone Co.	1255 South St., Blair, Nebr. 68008.	Quarry and plant	Washington		Do.

Table 10.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Stone—Continued					
Hopper Bros. Quarries	Weeping Water, Nebr. 68463	Six quarries and six plants.	Cass, Nemaha, Otoe, Pawnee.	----------	Quarry near Ashland, quarry and stationary crushing and screening plant near Weeping Water, and one portable plant, Cass County; stationary crushing and screen plant at Ashland, Saunders County; and one quarry and one portable plant each in Nemaha, Otoe, and Pawnee Counties.

The Mineral Industry of Nevada

This chapter has been prepared under a cooperative agreement 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 L. E. Davis [1]

Labor strikes were largely responsible for the decline in value of Nevada's mineral production in 1967 to about $91 million, the lowest since 1964. Strikes which began in mid-July had shut down all copper production by September and halted lead-zinc mining before yearend. The drop in metal production value alone was over $19 million. A depressed construction industry reduced the value of the total mineral output another $2 million. Of the 29 metal and mineral commodities produced in 1967—10 were metal, 17 nonmetallic, and two mineral fuel. Only the output of two metals (gold and mercury) and six nonmetallic minerals (barite, diatomite, lime, pumice and volcanic cinder, salt, and sand and gravel) increased compared with that of 1966. No uranium or sulfur ores were mined during the year, and no geothermal activity was reported.

[1] Physical scientist, Bureau of Mines, San Francisco, Calif.

Table 1.—Mineral production in Nevada [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate (content)--short tons--	68	$63	53	$35
Barite--thousand short tons--	139	933	154	923
Copper (recoverable content of ores, etc.)-short tons--	78,720	56,946	50,771	38,815
Gem stones	NA	100	NA	100
Gold (recoverable content of ores, etc.)--troy ounces--	366,903	12,842	434,993	15,225
Gypsum--thousand short tons--	594	2,023	409	1,412
Iron ore (usable)--thousand long tons, gross weight--	1,000	4,931	641	2,858
Lead (recoverable content of ores, etc.)--short tons--	3,581	1,083	1,500	420
Mercury--76-pound flasks--	3,355	1,482	4,703	2,301
Perlite--short tons--	W	W	10,712	94
Petroleum (crude)--thousand 42-gallon barrels--	r 307	W	279	W
Pumice, pumicite, and volcanic cinder thousand short tons--	55	190	105	236
Sand and gravel--do--	9,085	9,134	10,166	8,644
Silver (recoverable content of ores, etc.) thousand troy ounces--	867	1,122	566	877
Stone--thousand short tons--	2,002	2,519	1,375	2,145
Talc and soapstone--short tons--	4,715	24	2,096	17
Zinc (recoverable content of ores, etc.)--do--	5,827	1,690	3,035	840
Value of items that cannot be disclosed: Brucite, cement, clays, diatomite, fluorspar, lime, lithium minerals, magnesite, molybdenum concentrates (content), peat, salt, tungsten concentrate, uranium ore (1966), and values indicated by symbol W	XX	r 17,555	XX	15,941
Total	XX	r 112,637	XX	90,883
Total 1957–59 constant dollars	XX	r 96,812	XX	p 77,386

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).

Exploration for metals and metal ores reached an alltime high in Nevada mining history. In addition, exploration was underway for at least eight nonmetallic minerals, with clays and talc receiving the most attention. Ten wells were drilled for crude oil in 1967, eight of which were exploratory tests in new areas. Two wells were drilled in the Nye County oilfield, but only one was completed to production.

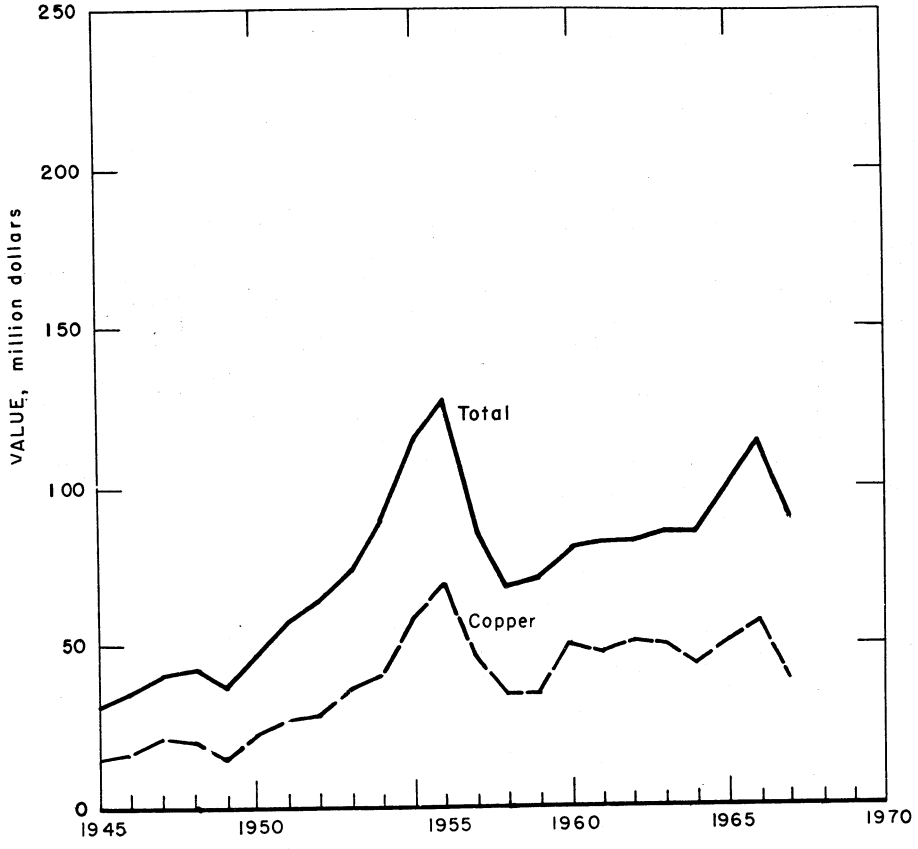

Figure 1.—Value of copper and total value of production in Nevada.

Table 2.—Value of mineral production in Nevada, in counties

County	1966	1967	Minerals produced in 1967 in order of value
Churchill	$606,714	$457,484	Sand and gravel, salt, stone, tungsten.
Clark	11,291,358	9,668,035	Sand and gravel, lime, stone, gypsum, clays, gold, lead, silver.
Douglas	2,355,006	2,112,441	Iron ore, sand and gravel, stone.
Elko	1,066,050	1,695,262	Sand and gravel, copper, barite, stone, antimony, lead, silver, zinc, gold.
Esmeralda	1,802,124	1,845,365	Lithium minerals, diatomite, mercury, talc and soapstone, sand and gravel, clays, gold, silver.
Eureka	10,220,873	12,557,775	Gold, iron ore, sand and gravel, stone, zinc, mercury, lead, barite, silver, copper.
Humboldt	4,198,443	4,126,182	Gold, mercury, sand and gravel, silver, copper, zinc.
Lander	r 945,029	5,837,182	Copper, barite, gold, silver, sand and gravel, antimony, stone.
Lincoln	3,224,134	1,773,641	Zinc, silver, lead, perlite, sand and gravel, copper, gold, pumicite.
Lyon	33,011,545	22,180,892	Copper, cement, stone, diatomite, sand and gravel, silver, gold, clays.
Mineral	52,350	49,656	Barite, stone, sand and gravel, mercury, copper, pumice, silver.
Nye	3,201,340	2,558,951	Magnesite, petroleum, fluorspar, sand and gravel, mercury, peat, brucite, gold, barite, volcanic cinder, clays, lead, zinc, stone, tungsten.
Ormsby	145,890	W	Volcanic cinder, sand and gravel, stone.
Pershing	5,564,641	4,421,416	Diatomite, iron ore, gypsum, sand and gravel, mercury, copper, perlite, stone, tungsten, silver, antimony, lead, gold.
Storey	W	W	Diatomite, pumice.
Washoe	r 2,396,314	2,180,513	Sand and gravel, clays, stone, pumicite and volcanic cinder, gold, silver.
White Pine	r 30,464,251	16,845,617	Copper, gold, molybdenum, silver, lime, stone, sand and gravel, lead, zinc.
Undistributed [1]	r 2,090,938	2,572,588	
Total	r 112,637,000	90,883,000	

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

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

Table 3.—Economic indicators

		1966	1967 p	Change (percent)
Personal income:				
Total	millions	$1,507	$1,610	+6.8
Per capita		$3,497	$3,626	+3.7
Mineral production	millions	$112.6	$90.9	−19.3
Annual average payroll:				
Total [1]	thousands	$68,129	$70,122	+2.9
Mining	do	$2,518	$2,319	−7.9
Contract construction	do	$7,044	$6,325	−10.2
Manufacturing	do	$4,272	$4,190	−1.9
Transportation and utilities [2]	do	$5,482	$5,733	+4.6
Trade (wholesale and retail)	do	$13,152	$13,623	+3.6
Finance, insurance, and real estate	do	$2,993	$3,248	+8.5
Service and miscellaneous	do	$32,335	$34,340	+6.2
Total work force	do	199.2	200.9	+0.9
Unemployment	do	11.7	11.5	−1.7
Annual average employment:				
Agriculture	do	5.0	4.4	−12.0
Mining [3]	do	4.0	3.4	−15.0
Contract construction	do	9.3	7.6	−18.3
Manufacturing	do	7.0	6.7	−4.3
Transportation and utilities	do	11.5	11.6	+0.9
Trade (wholesale and retail)	do	30.3	30.2	−0.3
Finance, insurance, and real estate	do	6.2	6.4	+3.2
Service and miscellaneous	do	63.5	66.8	+5.2
Government	do	30.3	32.2	+6.3

p Preliminary.
[1] Excludes Federal Government.
[2] Excludes railroad.
[3] May vary from Bureau of Mines canvass.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1966:								
Metal	2,123	299	635	5,124	2	146	28.88	3,564
Nonmetal and peat	758	253	192	1,547	----	35	22.62	1,323
Sand and gravel	648	204	132	1,056	----	20	18.94	696
Stone	220	248	55	436	----	5	11.47	459
Total [1]	3,749	270	1,013	8,164	2	206	25.48	2,603
1967: [p]								
Metal	NA	NA	467	3,735	2	99	27.04	4,035
Nonmetal and peat	720	255	183	1,468	1	44	30.66	4,601
Sand and gravel	685	219	150	1,187	----	20	16.84	442
Stone	320	245	79	634	----	10	15.78	393
Total [1]	NA	NA	880	7,024	3	173	25.06	3,218

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

Consumption, Trade, and Markets.—All of Nevada's metal requirements, all of its mineral fuels except some fuel oil produced at a small topping plant at the State's only oilfield, and virtually all of its nonmetallic mineral needs other than construction materials were supplied from out-of-State sources. All of the talc and fluorspar, most of the barite and perlite, and some of the gypsum and limestone were shipped out of the State in crude form. Much of the lime output went to customers in neighboring States. With few exceptions, metal ores, concentrates, and precipitates were processed and smelted outside the State. Nevada's only smelter (copper) was dependent on Nevada ores. All usable iron ore was exported or shipped to steel plants in other states. The tungsten carbide plant, Kennametal, Inc., Mineral County, used concentrates purchased from producers in Arizona, California, Idaho, Montana, Nevada, Texas, and Utah. In Clark County, Titanium Metals Corporation of America produced titanium sponge from titanium minerals imported from Australia and the American Potash & Chemical Corp. electrolytic manganese dioxide plant operated on ore purchased from out-of-State producers.

Trends and Developments.—Exploration for metals and metal ores principally gold, silver, and copper, reached an alltime high. More than 20 mining companies or subsidiaries actively pursued exploration programs in Nevada during 1967. Gold was the most sought after commodity with 14 exploration projects followed by silver with ten, copper six, and mercury five. Exploration was underway in 15 counties for 21 different commodities, 11 metals and 10 nonmetallic minerals. Over 75 percent of the exploratory work was conducted in seven counties Elko, Esmeralda, Eureka, Humboldt, Lander, Nye, and Pershing.

Duval Corp., Lander County, placed its copper concentrator on stream in May. The Anaconda Company, Lyon County, completed expansion of its copper concentrator in July and at yearend had completed its drilling program at the Hall molybdenum property, Nye County. Big Mike Corp., Pershing County, completed its copper precipitation plant in September. Kennecott Copper Corp., White Pine County, began mining ore from the Tripp-Veteran pit west of the mined-out Liberty pit and announced plans to mine, by open pit, the Ruth caved orebody, 1 mile east of the Liberty area. On December 15, the Cordero mine, Humboldt County, yielded its 100,000th flask of mercury. The mine began producing in the 1930's. The Cortez Joint Venture, Eureka County, reported that 3 million tons of open-pit gold ore had been delineated at its Crescent Valley property and completed a preliminary feasibility and engineering report. A decision to bring the property into production was awaiting official announcement by the venture partners at yearend. Carlin Gold Mining Co. began recovering mercury by retorting the precipitate

from its cyanide plant in Eureka County. The mercury was recovered to eliminate the health hazard of mercury fumes in the melting room. The Goldfield Corp. shut down its Getchell gold mine, Humboldt County, in December. The company had stopped mining ore in July. Also in Humboldt County, Jackson Mountain Mining Co. closed its underground iron mine in January. Nevada Barth Corp. ceased all iron mining operations in Pershing County at the end of March.

American Potash & Chemical Corp. planned to expand its Henderson, Clark County, electrolytic manganese dioxide plant from 6,000 to 10,000 tons a year by late 1968 to provide the company, already the largest domestic supplier, with a basis for establishing a permanent position in the international market. Titanium Metals Corporation of America put into operation the first commercial facility of its kind to produce titanium sponge electrolytically. The addition of the electrolytic capacity is a part of an announced expansion that was to increase sponge capacity to 16,000 tons a year and melt capacity to 18,000 tons a year by late 1969 or early 1970. New evaporation ponds were under construction for Foote Mineral Co. at Silver Peak, Esmeralda County, where the company planned to double production of lithium carbonate and to increase its operating staff by 250 percent in the next 3 years. Nevada Refining Co. placed its refinery (topping plant) on stream in May at the Eagle Springs oilfield, Nye County. The company produced fuel oil and planned to install a unit to produce gasoline in 1968. Chas. Pfizer & Co., Inc. took a lease and option on a southern Nye County bentonite property. The Atlas Minerals Division, Atlas Corp., obtained a lease and option on the Gibellini vanadium property, Eureka County, and began an extensive drilling program.

Legislation and Government Programs.—The Nevada Legislature made no revisions or additions to the Nevada State mining laws in 1967. Public land orders by the U.S. Bureau of Land Management withdrew 113,500 acres of land from mineral location under U.S. mining laws of which 98,000 acres in Clark and Nye Counties and 3,100 acres in Humboldt and Pershing Counties remained open to mining and mineral leasing under the Multiple Land Use Act. Land Management also withdrew over 4,500 acres in Clark County for the Valley of Fire State Park and 4,250 acres for the Bureau of Reclamation in White Pine County. Land orders restored 200 acres formerly withdrawn for the Federal Power Commission, to mineral location and leasing in Elko County and 20 acres to mineral leasing only in Clark County. Nevada received U.S. Treasury checks totaling $393,640.83 in bonuses, royalties, and rentals covering mineral leases and permits, less $71,762.82 in payment for flood control work done by the Federal Government for the State near Battle Mountain, Lander County.

Off the 11 (corrected figure) applications received from Nevada producers since enactment of the Lead-Zinc Stabilization Program in October 1962, two had been recertified (after June 1, 1966), two were denied, and seven had been withdrawn, suspended, or disqualified. Payments totaling $1,333 were made on 71.7 tons of lead and 76.3 tons of zinc produced in 1967.

The Bureau of Mines continued to provide consulting service to the Atomic Energy Commission in connection with underground nuclear tests at the Nevada Test Site.

The Bureau of Mines Reno Metallurgy Research Center conducted research on (a) the electrowinning of rare-earth metals and mixed rare-earth metals from oxides in molten salts, (b) the electrolytic preparation of rare-earth-cobalt alloys for study as possible permanent magnet materials, (c) the definition of reactions and mechanisms involved in electrolytic and chemical preparation of metals in molten salt media, (d) the development of process techniques providing effective gold recovery from refractory and carbonaceous ores, (e) the development of methods for extracting, separating, and purifying rare-earth oxides, and (f) the measurement of mechanical properties of refractory metals and preparation and study of high-temperature vanadium-base alloys. Electrolytically produced samarium-cobalt alloy was widely sought by academic and industrial organizations, and was used successfully in the preparation of experimental permanent magnets. Gold recovery values of 96 percent were achieved from refractory carbonaceous gold ores in laboratory tests by a simple treatment step prior to cyanidation.

The electrolytic refining process for obtaining high-purity ductile vanadium metal developed at the Bureau of Mines Boulder City Metallurgy Research Laboratory was adopted by two commercial companies. The Laboratory contracted with the Atomic Energy Commission (AEC) to develop methods for refining various vanadium scrap materials generated by other AEC contractors and returning high-purity metal for reuse. Research on the winning and refining of other specialty metals in molten salt electrolytes resulted in the discovery of methods for accelerating the deposition of beryllium metal from beryllium oxide and the production of hafnium metal from hafnium tetrachloride. Research in the area of solid waste disposal showed that a significant portion of the residues generated in the production of titanium tetrachloride could be recycled with a coincident diminution of disposal problems and a conservation of mineral resources.

The San Francisco Office of Mineral Resources, of the Federal Bureau of Mines was active in furthering the development of gold resources in the sedimentary beds of northeastern Nevada as a part of the National Heavy Metals Program. The region constitutes a newly recognized auriferous province which is in an early stage of development. Inferred reserves of ores, both oxide and carbonaceous, approach 100 million tons. Informed industry and government sources have indicated the area offers one of the most favorable domestic opportunities for discovery of significant new gold deposits of a size and grade to warrant exploitation under existing economic conditions. Available data on the extent and gold content of the area were evaluated economically in the light of existing mining and milling technologies. Special consideration was given to recovery of gold from refractory carbonaceous materials known to constitute the major portion of the region's gold-bearing deposits.

Region II Field Office, Office of Minerals Exploration (OME), U.S. Geological Survey, received seven new applications from persons interested in exploring for Nevada minerals under the OME program. During the year, nine applications were processed and three contracts were let. At yearend, eight contracts were active, five of which were continued from the preceding year.

REVIEW BY MINERAL COMMODITIES

METALS

Antimony.—Ore was produced from the Dry Canyon and Last Chance mines, Lander County, the PA claims, Elko County, and the Hollywood property, Pershing County. The Dry Canyon and Hollywood ores and some of the Last Chance ore were concentrated in the Stevens mill at Austin, Lander County. The remainder of the Last Chance ore was handsorted before shipment. All ores and concentrates were consigned to the antimony smelter at Laredo, Tex.

Copper.—Copper production was down 36 percent from that of 1966, due entirely to a labor strike that brought the industry to a standstill by September. The decline would have been even greater had not the Duval Corp. Copper Canyon-Copper Basin facility, Lander County, come on stream in May. Duval thus became one of Nevada's three major copper producers along with The Anaconda Company, Lyon County, and Kennecott Copper Corp., White Pine County. Big Mike Corp., Pershing County, completed and began production at its copper precipitation plant in September. The company had shipped copper ore to a smelter in 1966. Only three other mines, the Rio Tinto and Copper King copper properties, Elko County, and the Pan American lead-zinc mine, Lincoln County, contributed appreciably to the total copper output. Lesser quantities of copper were recovered as a byproduct from complex lead, zinc, and silver ores. Kennecott operated Nevada's only copper smelter at McGill, White Pine County.

Gold.—Gold output rose nearly 19 percent despite the loss of byproduct metal when labor strikes forced the shutdown of most copper, lead, and zinc mines. Increased production at the Carlin mine and mill, Eureka County, more than offset the loss. Although seven lode gold mines reported production, only two—the Carlin and the Getchell, Humboldt County—yielded more than a few hundred ounces

of gold each. At yearend, The Goldfield Corp. had closed the Getchell mine and cyanide plant. Byproduct gold, recovered in treating ores from other lode mines, declined only 3 percent.

Placer gold recovery was insignificant by comparison. Only the Nevada Porphyry mine, Nye County, yielded more than a few ounces, accounting for over two-thirds of the total recovered.

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)
1963	37	7	13,676	98,879	$3,461	214,976	$275
1964	38	6	13,383	90,469	3,166	172,447	223
1965	48	5	15,817	229,050	8,017	507,113	656
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
1904–67 [4]	--	----	NA	16,450,415	423,785	318,886,212	220,682

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	81,738	$50,351	1,126	$243	571	$131	$54,461
1964	67,272	43,861	809	212	582	158	47,620
1965	71,332	50,503	2,277	710	3,858	1,127	61,013
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
1905–67 [4]	3,161,245	1,346,817	401,714	65,098	497,227	97,434	2,153,816

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 1967, by counties, in terms of recoverable metals

County	Mines producing [1]		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Troy ounces	Value	Troy ounces	Value
Elko	3	--------	5	$175	2,071	$3,210
Esmeralda	------	--------	3	105	8	12
Eureka	4	--------	W	W	3,977	6,164
Lincoln	1	--------	141	4,935	307,841	477,154
Nye	4	2	662	23,170	4,858	7,530
Pershing	4	1	11	385	4,569	7,082
Undistributed [2]	12	2	434,171	15,195,985	242,431	375,768
Total	28	5	434,993	15,224,755	565,755	876,920

County	Copper		Lead		Zinc		Total Value
	Short tons	Value	Short tons	Value	Short tons	Value	
Elko	W	W	12	$3,388	3	$817	$7,590
Esmeralda	------	----------	------	--------	-------	---------	117
Eureka	1	$726	W	W	W	W	6,890
Lincoln	13	9,633	1,397	391,258	2,807	777,187	1,660,167
Nye	------	----------	W	W	W	W	30,700
Pershing	W	W	13	3,584	-------	---------	11,051
Undistributed [2]	50,757	38,805,086	78	21,770	225	62,266	54,460,875
Total	50,771	38,815,445	1,500	420,000	3,035	840,270	56,177,390

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed".
[1] Excludes itinerant prospectors, "sniper," "high-graders," and others who gave no evidence of legal rights to property.
[2] Includes Clark, Humboldt, Lander, Lyon, Mineral, Washoe, White Pine counties and counties indicated by symbol W.

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1967, 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 (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Gold	7	1,084,575	405,379	4,860	-------	-------	-------
Silver	7	1,460	52	7,781	1	6	6
Copper	8	9,164,510	28,466	236,441	50,756	-------	-------
Lead	3	149	9	2,815	(2)	15	5
Lead-Silver	1	103	5	3,898	(2)	13	-------
Lead-Zinc	1	228,509	141	307,841	13	1,397	2,807
Zinc	1	904	---------	831	(2)	69	217
Total	28	10,480,210	434,052	564,467	50,770	1,500	3,035
Other loade material:							
Gold (slag and matte)	(3)	12	695	1,144	1	-------	(2)
Old tailings	(3)	115	14	15	-------	-------	-------
Total	---	127	709	1,159	1	-------	-------
Total lode material	28	10,480,337	434,761	565,626	50,771	1,500	3,035
Placer	5	(4)	232	129	-------	-------	-------
Total all sources	33	10,480,337	434,993	565,755	50,771	1,500	3,035

[1] Details will not necessarily add to totals shown, because some mines produce more than one class of material.
[2] Less than ½ unit.
[3] From property not classed as a mine.
[4] 3,500 cubic yards.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1967, 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	405,400	7,229	---------	---------	---------
Old tailings	14	15	---------	---------	---------
Concentration and smelting of concentrates: Ore	28,331	544,452	48,312	1,400	2,810
Direct smelting:					
Ore	321	12,786	2,458	100	225
Slag and matte	695	1,144	1	---------	---------
Total	434,761	565,626	50,771	1,500	3,035
Placer	232	129	---------	---------	---------
Grand total	434,993	565,755	50,771	1,500	3,035

Iron Ore.—Jackson Mountain Mining Co. closed its Humboldt County underground iron mine in January, and Nevada Barth Corp. ceased all iron ore mining operations in Pershing County at the end of March. As a result, production and shipments of usable iron ore declined 36 percent below 1966 figures. Less than one-third of the shipments were direct shipping grade ore, and all but 16 percent of the total output was exported. Standard Slag Co., Douglas County, produced concentrates for export in its Wabuska plant, Lyon County, while direct shipping grade ores were produced and shipped by Nevada Barth Corp., Eureka and Pershing Counties and Nevada Iron Ore Co., Inc., Pershing County.

At Jean, Clark County, Geo. B. Smith Chemical Works, Inc., was building an iron oxide pigment plant. In 1967, the plant ground iron ore from Utah for the company's Maple Park, Ill., pigment plant and used the off-color material to produce a soluble ferrous sulfate in a batch plant for the agriculture industry. Eventually the

Jean plant was expected to produce a complete line of iron oxide pigments, both natural and synthetic, for Smith's western customers.

Lead.—Although nine lode mines contributed to the total lead output, only four —Diamond Jim group of lead claims, Elko County; Mountain View zinc mine, Eureka County; Pan American lead-zinc mine, Lincoln County; and Good View lead-silver prospect, Pershing County— yielded significant quantities of recoverable lead. The Pan American dominated the lead industry in Nevada with 93 percent of the total output. Production declined 58 percent from that in 1966 as most producers shut down shortly after mid-year when labor strikes closed the smelters. Several 1966 producers confined 1967 operations to exploration and development.

Mercury.—Mercury production increased 40 percent over the 1966 figure, as a result of the rise in the average unit price from $441.73 to $489.26 per flask. The number of producers declined from 29 to 25 and only three—Kollsman Mineral & Chemical Co. (B&B mine), Esmeralda County; Fred H. Lenway Co. (Cordero mine), Humboldt County; and Crofoot Lumber Co. (Red Bird mine), Pershing County—produced more than 100 flasks each, with 15 of the 25 operators reporting less than 10 flasks. As in past years, the Cordero mine was the State's major producer, with two-thirds of total production and shipments. Only five producers, including the three largest, used furnaces to recover the metal; all the others used retorts. Carlin Gold Mining Co., Eureka County, began recovering mercury as a byproduct of gold production. The mercury was recovered by retorting the precipitate from the cyanide solutions.

Table 9.—Mercury production, by methods of recovery

Year	Direct-furnaced		Retorted		Total		Operating mines
	Ore (short tons)	Flasks	Ore (short tons)	Flasks	Flasks	Value [1] (thousands)	
1963	42,768	4,908	356	36	4,944	$937	11
1964	42,635	3,181	653	81	3,262	1,027	21
1965	48,197	2,877	3,575	456	3,333	1,902	42
1966	48,813	3,021	14,633	334	3,355	1,482	29
1967	51,693	4,457	1,567	246	4,703	2,301	25

[1] Value calculated at average New York price.

Molybdenum.—Kennecott Copper Corp. recovered molybdenite in its McGill concentrator, White Pine County, as a byproduct in treating copper ore mined in the nearby Robinson district. As a result of industry-wide strikes during the last half of the year, production and shipments were more than 50 percent below 1966 figures. The Anaconda Company announced that drilling at the Hall molybdenum property near Tonopah, Nye County, had been completed.

Silver.—Recoverable silver output was only 65 percent of that in 1966. Although seven silver properties reported production, a very high percentage of the total was recovered as a byproduct in the treatment of copper and lead-zinc ores. As in 1966, the Pan American lead-zinc mine, Lincoln County, was the State's leading producer of recoverable silver. Lead-zinc ores yielded 54 percent of the total lode silver, copper ores, 42 percent and all others, 4 percent. Only 129 ounces of silver was recovered from placer gold operations in Nevada.

Tungsten.—Seven tungsten properties were active for part of the year. Small quantities of tungsten concentrates were shipped by operators in Churchill and Pershing Counties to the tungsten carbide plant of Kennametal, Inc., near Rawhide, Mineral County. The plant was operated on purchased concentrates, principally from the General Services Administration stockpile, although some came from the above producers in Nevada and from neighboring States. Nevada-Massachusetts Co. shipped some concentrate from stockpile to a California paratungstate plant.

Zinc.—The Mountain View mine, Eureka County, was the only zinc mine in operation during 1967. The Pan American lead-zinc mine, Lincoln County, again dominated Nevada's zinc industry, yielding 92 percent of the total zinc recovered. Virtually all zinc producing mines were shut down shortly after mid-year due to labor strikes that closed smelters. As a result, zinc production dropped 48 percent from that in 1966.

NONMETALS

Barite.—Primary barite production was 6 percent above the 1966 figure; shipments, including that used by producers, rose 11 percent. Shipments of ground barite, virtually all for use in well drilling, increased 40 percent. Lander County mines yielded 80 percent of the output and 81 percent of the shipments. The major producers again were FMC Corp. (Mountain Springs mine) and Dresser Minerals, formerly Magnet Cove Barium Corp., Ltd. (Greystone group). Dresser and National Lead Co. ground barite in their respective plants near Battle Mountain, Lander County, and Dunphy, Eureka County. National Lead contracted some of the barite mining from its own property in Elko County to supply plant requirements.

Cement.—The dry-process portland cement plant of Nevada Cement Co. at Fernley, Lyon County, was the State's only cement producer. Local limestone, and clays, gypsum, and iron ore from deposits in the nearby counties of Washoe, Pershing, and Douglas, respectively, supplied raw materials for the plant. Shipments were only slightly below those of 1966 as increased sales to northern California customers nearly offset a notable decline in the Nevada market.

Consumption of cement in Nevada, including out-of-State receipts, was over 1 million barrels, about 300,000 barrels less than in 1966. The southern Nevada market required about 20,000 barrels more than the northern market.

Clays.—Western Talc Co, formerly Silicates Corp., mined bentonite from pits in three counties—the Francis near Apex, Clark County; the Blanco near Mina, Esmeralda County; and the New Discovery near Beatty, Nye County—and prepared the material for use in cosmetics and pharmaceuticals. In Lyon County, Industrial Minerals & Chemical Co. obtained fuller's earth from its Jupiter deposit near Weeks and sold the prepared mineral for a filtering and decolorizing agent and as a filler in animal feeds. Nevada Cement Co. used miscellaneous clay from its Washoe County pit near Flanigan at its cement plant in Lyon County. Sales of bentonite more than doubled, compared with 1966, and the tonnage of fuller's earth sold rose 9 percent. The quantity of miscellaneous clay consumed was 24 percent less than in 1966.

Diatomite.—Sales of prepared diatomite rose 12 percent above those of 1966. No sales of crude material were reported in 1967. Four deposits were mined—one each in Churchill, Esmeralda, Pershing, and Storey Counties. The Lincoln County deposit of Morgan & Bush was not worked in 1967. Major processing plants were operated in Pershing and Storey Counties by Eagle-Picher Industries, Inc., and in Esmeralda County by GREFCO, Inc. The Churchill County deposit of Cyprus Mines Corp. supplied the company plant in Lyon County. Sales of prepared diatomite, in order of greatest demand, were for filtration, anti-caking agent, fillers, lightweight aggregate, insulation, and abrasive.

Fluorspar.—Production and shipments of fluorspar, lower than in 1966, came from two Nye County mines. Metallurgical grade fluorspar from the Daisy (Crowell) mine of J. Irving Crowell was shipped to a southern California steel plant. Lower grade material from the Goldspar mine was produced by Monolith Portland Cement Co. and used in the producer's California cement plant. Monolith's Mary mine was idle in 1967. Wells Cargo, Inc. reported exploration and development only at its Carp fluorspar mine, Lincoln County.

Gypsum.—A substantial decrease was reported in the output of gypsum used in making gypsum products for the construction industry. Crude gypsum production declined 31 percent from 1966, and calcined gypsum output was down 17 percent. A part of the crude gypsum decline was offset by a reduction in stocks at calcining plants. Also, less crude material was shipped to plants outside the State, being replaced to a degree with shipments of gypsum products. United States Gypsum Co. mined crude gypsum from its Empire

quarry, Pershing County, for use in its nearby Gerlach gypsum products plant, Washoe County. In Clark County, The Flintkote Co. and Fibreboard Corp. mined crude gypsum and produced gypsum products at Blue Diamond and Apex, respectively. Fibreboard Corp. shipped crude and calcined gypsum to company plants in California. At yearend Fibreboard's Lovelock quarry, Pershing County, and Apex quarry and plant, Clark County, had been sold to Johns-Manville Corp.

Lime.—Lime output rose 5 percent over that of 1966, this was chiefly attributable to the new plant of Morrison and Weatherly Chemical Products Co. near McGill, White Pine County, which supplied Kennecott Copper Corp. Previously, Kennecott purchased its requirements from out-of-State sources. Shipments for use in the steel, copper, and paper industries rose; demand for construction use declined. The Flintkote Co. operated three lime plants in Clark County, producing quicklime at Apex, hydrated lime at Sloan, and both products at Henderson. Flintkote shipped lime throughout the western States and exported it to Canada and Mexico. The company planned to install a new 300-ton-a-day kiln at Apex in 1968.

Lithium Compounds.—Foote Mineral Co. produced lithium carbonate at its Silver Peak facility, Esmeralda County, from brines obtained from the nearby Clayton Valley salt marsh. New evaporation ponds were built in 1967, and plans were made to double the plant capacity. However, production was much lower than preliminary estimates indicated, and the output dropped nearly 7 percent below that in 1966.

Magnesite and Brucite.—Basic, Inc., operated open pit magnesite and brucite mines near Gabbs, Nye County. The company upgraded the ore and produced special products and refractory materials in nearby plants. Although most of the ore was consumed in the manufacture of these products, some magnesite and brucite were sold to out-of-State customers. Mine production was down 7 percent for magnesite and up nearly four-fold for brucite, compared with 1966. Combined consumption and shipments of all materials dropped nearly 35 percent, reflecting the generally depressed economic condition of the refractories industry.

Perlite.—Crude perlite sales continued a decline begun in 1958, and no sales of expanded material were reported. Only two mines were active in 1967. In Lincoln County, Combined Metals Reduction Co. (Hollinger pit) and Delamar Perlite (Mackie claims) mined and shipped crude perlite to out-of-State customers. Stockpiled perlite, from the Pearl Hill quarry of United States Gypsum Co., Pershing County, was expanded and used in the company wallboard plant, Washoe County. The Hurry Up claims, Esmeralda County, which produced in 1966, were abandoned by Western Gravel Co., and the property reverted to the original owner.

Pumice (Volcanic Cinder).—The output of pumice, pumicite, scoria, and volcanic cinder rose nearly 91 percent from 1966, principally because of an unusual demand for the materials as drain rock, concrete aggregate, fill, and base material in street construction. Kemway Enterprises mined pumicite from the Lory Free pit, Lincoln County, and prepared the material for use as pozzolan. Pumice from the Cooper pit, Mineral County, and Naturalite group of claims, Storey County, with volcanic cinder from the Cinder Cone deposit, Nye County, and the Steamboat property, Washoe County, were used for concrete aggregate. Savage Construction Co., Ormsby County, and Rilite Aggregate Co., Washoe County, mined scoria and pumicite, respectively, for decorative use, drain rock, fill, road base, and roofing granules. Crude sales rose 71 percent while prepared sales more than doubled compared with those of 1966.

Salt.—Crude salt was harvested from the surface of a dry lakebed near Sand Springs, Churchill County, and sold principally for use in ice control on roads by State and local agencies in Nevada and Idaho. Smaller quantities were purchased by meat packers, tanners, and dairies.

Sand and Gravel.—Sand and gravel production was higher than in 1966 by 1 million tons, but the total value dropped more than $450,000. The chief reason for this apparent inequity was a 442,000-ton decline in commercial (high value) output and a 1.5-million-ton increase in Government-and-contractor (low value) production. Comparatively large amounts of unprepared sand and gravel were used in grading and subsurface work in the con-

struction of Interstate Highway 80 in Churchill, Elko, and Pershing Counties.

Of the 111 sand and gravel operations active in 1967, 40 were classified commercial. Only one of these produced over 500,000 tons. Eight had outputs of 100,000 to 500,000 tons, and 31 produced less than 100,000 tons. All but 16 were in the Las Vegas and Reno areas where the outputs for building construction were substantially below 1966 figures.

Industrial sand production at plants near Overton, Clark County, was virtually unchanged from that of the preceding year with a higher demand for glass sand barely offsetting a decline in foundry requirements.

Table 10.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Churchill	726	$387
Clark	2,952	3,602
Douglas	33	55
Elko	2,674	1,151
Esmeralda	11	6
Eureka	236	162
Humboldt	196	169
Lander	221	98
Lincoln	39	41
Lyon	166	191
Mineral	6	5
Nye	155	180
Ormsby	94	79
Pershing	859	375
Washoe	1,754	2,093
White Pine	44	50
Total	10,166	8,644

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Glass	W	W	W	W
Molding	W	W	W	W
Building	520	$1,204	594	$1,229
Paving	52	99	162	296
Railroad ballast	------	------	(1)	1
Fill	134	105	111	116
Other	183	106	135	72
Gravel:				
Building	607	1,073	380	752
Paving	1,333	1,691	1,084	1,104
Railroad ballast	W	W	1	2
Fill	273	315	222	225
Other	W	W	W	W
Miscellaneous	382	575	357	532
Undistributed sand and gravel [2]	178	781	174	750
Total sand and gravel	3,662	5,949	3,220	5,079
Government-and-contractor operations: [3]				
Sand:				
Building	123	90	1	1
Paving	25	26	126	124
Fill	12	24	10	11
Other	------	------	10	10
Total	160	140	147	146
Gravel:				
Building	217	116	1	1
Paving	4,797	2,629	6,633	3,257
Fill	243	291	132	130
Other	6	9	33	31
Total	5,263	3,045	6,799	3,419
Total sand and gravel	5,423	3,185	6,946	3,565
All operations:				
Sand	1,224	2,431	1,321	2,608
Gravel	7,861	6,703	8,845	6,036
Grand total	9,085	9,134	10,166	8,644

W Withheld to avoid disclosing individual company confidential data.
[1] Less than ½ unit.
[2] Includes fire or furnace sand, other industrial (unground) said, and items indicated by symbol W.
[3] Includes figures for State, counties, municipalities, and other Government agencies.

Stone.—Stone output was more than 600,000 tons below the 1966 figure, due chiefly to a much lower demand for use in highway and flood control projects. Public works contractors and maintenance crews quarried basalt in Lyon County for riprap and roadstone, granite in Churchill and Clark Counties for riprap, and decomposed granite and miscellaneous stone for base material in Clark, Douglas, Elko, Lyon, and Washoe Counties. Limestone comprised the largest percentage of all stone produced. In Clark County, The Flintkote Co. quarried limestone for use as metallurgical flux, and in refining sugar and making glass and lime. Nevada Cement Co. quarried limestone in Lyon County for its cement plant, and Nutritional Additive Corp. in Pershing County for agricultural use. Morrison & Weatherly Chemical Corp. in White Pine County quarried limestone for its lime plant. Marble was quarried in Mineral County by Sonora Aggregates Co. for terrazzo and in White Pine County by Western Marble, Inc., for floor tile. Dimension quartz and quartzite were quarried in Clark and White Pine Counties for building stone. The Castle Rock quarry, Elko County, was the source of high purity quartzite shipped to an Oregon ferrosilicon plant. Basic, Inc., Nye County, obtained quartz from a company quarry for use in making refractories. Southern Pacific Co. used stone from its Palisade quarry, Eureka County, for railroad ballast.

Table 12.—Stone [1] production in 1967, by counties

County	Short tons	Value
Churchill	45,000	$27,900
Clark	W	W
Douglas	40,143	54,776
Elko	28,608	70,216
Eureka	36,115	65,007
Lander	1,300	50
Lyon	W	W
Mineral	350	W
Nye	W	W
Ormsby	42,940	34,352
Pershing	W	W
Washoe	32,483	27,541
White Pine	W	55,380
Other counties	1,147,623	1,809,724
Total	1,374,562	2,144,946

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes stone used in cement and lime.

Talc and Soapstone.—All talc and soapstone production came from three deposits, two talc and one soapstone, in Esmeralda County. In the Goldfield area, two producers worked the Wellington talc property and Chas. Pfizer & Co., Inc. mined soapstone at the White Top deposit. Cyprus Mines Corp. produced and shipped talc from its Oasis mine near the California State line. In the same area, exploration and development was in progress on the Hideout claims, but the White Mule deposit was idle throughout the year. Production and sales dropped more than 50 percent from 1966 figures. All shipments were made to out-of-State grinding plants.

MINERAL FUELS

Peat.—Production of reed-sedge peat from a bog in the Amargosa Desert, Nye County, was down 50 percent from that of 1966. Before yearend the producer had shut down the operation and abandoned the property. The entire output was prepared for use as a soil improvement agent.

Petroleum.—The Nevada Oil and Gas Conservation Commission issued 11 drilling permits in 1967, three more than in 1966. Two wells were drilled at the Eagle Springs oilfield, Nye County. Texota Oil Co. drilled a well that was completed to production on the southwest flank of the field. The pay zone was at a depth of 7,146 feet, several hundred feet below the pay zone of the wells to the east. A completion report was not available at yearend on a test by Western Oil Lands, Inc., about 1,200 feet west of the Texota well. Western deepened a well on the eastern edge of the field and drilled an exploratory well over a mile northeast of the nearest oil production. Both wells were abandoned as dry holes. Four other exploratory wells were drilled in Nye County, all by Gulf Oil Corp., southwest of the field. All were dry holes. Three exploratory tests in White Pine County also were abandoned as dry. Harry Riggs and Tenneco Oil Co. each drilled in the west-central part of the county and Dwight M. Ross, Jr., in the south-central.

Table 13.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1967

County	Drilling [1]							
	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Nye	1	-----	1	-----	-----	5	7	41,869
White Pine	---	-----	-----	-----	-----	3	3	19,035
Total	1	-----	1	-----	-----	8	10	60,904

[1] Does not include one well (7,083 ft.) standing suspended at yearend.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Antimony: Ed Rovetti	P.O. Box 146 Austin, Nev. 89310	Open pit mine	Lander.		
Barite:					
D. A. Mining Co	P.O. Box 94 Battle Mountain, Nev. 89820	----do	----do		
Dresser Minerals	P.O. Box 6504 Houston, Tex. 77005	----do	----do	----------	Grinding plant at Battle Mountain, Nev.
FMC Corp	P.O. Box 3808 Modesto, Calif. 95350	----do	----do	----------	Grinding plant at Modesto, Calif.
Milchem, Inc	Box 22111 Houston, Tex. 77027	----do	----do	----------	Out-of-State grinding plants.
National Lead Co	P.O. Box 1675 Houston, Tex. 77001	----do	Elko	----------	Grinding plant at Dunphy, Nev.
Cement: Nevada Cement Co	Fernley, Nev. 89408	Dry process portland cement plant	Lyon.		
Clays:					
Industrial Minerals	1007 Commercial St. San Carlos, Calif. 94070	Open pit mine	Lyon.		
Western Talc Co	1901 E. Slauson Los Angeles, Calif. 90058	----do	Clark, Esmeralda, Nye.		
Nevada Cement Co	Fernley, Nev. 89408	----do	Washoe.		
Copper:					
The Anaconda Company	P.O. Box 1000 Weed Heights, Nev. 89443	----do	Lyon	Gold, silver	Leaching and precipitation plant and sulfide concentrator.
Duval Corp	P.O. Box 451 Battle Mountain, Nev. 89820	----do	Lander	Gold, silver	Do.
Kennecott Copper Corp	McGill, Nev. 89318	----do	White Pine	Gold	Smelter and concentrator at McGill
Diatomite:					
Eagle-Picher Industries, Inc	P.O. Box 1869 Reno, Nev. 89505	----do	Pershing, Storey.		
GREFCO, Inc	630 Shatto Place Los Angeles, Calif. 90005	----do	Esmeralda.		
Flouspar:					
J. Irving Crowell, Jr	P.O. Box 96 Beatty, Nev. 89003	Underground mine	Nye.		
Monolith Portland Cement Co	65677 Glassell Station Los Angeles, Calif. 90065	Open pit mine	----do		
Gold:					
Carlin Gold Mining Co	300 Park Ave. New York, N.Y. 10022	----do	Eureka	Mercury	Cyanide leaching plant.
The Goldfield Corp	Goldconda, Nev. 89414	----do	Humboldt	Silver	Do. Ceased operations in December.
Gypsum:					
The Flintkote Co	P.O. Box 2678 Terminal Annex Los Angeles, Calif. 900054	----do	Clark	----------	Calcining and board plant at Blue Diamond, Nev.
Fibreboard Corp	1789 New Montgomery St. San Francisco, Calif. 94106	----do	----do	----------	Calcining and board plant at Apex.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Gypsum—Continued					
United States Gypsum Co	101 So. Wacker Dr. Chicago, Ill. 60606	Open mine pit	Pershing		Calcining and board plant at Empire.
Iron ore:					
Nevada-Barth Corp	Carlin, Nev. 89822	do	Eureka, Pershing		Pershing County operation shut down in March.
Standard Slag Co	Box 4400 Reno, Nev. 89501	do	Douglas.		
Lead and zinc: Grand PanAm Company	Pioche, Nev. 89043	Underground mine	Lincoln	Gold, silver	Concentrator at Caselton.
Lime: The Flintkote Co	P.O. Box 57367 Flint Station Los Angeles, Calif. 90057	Rotary kilns, batch and continuous hydrators	Clark		3 plants; located at Apex, Henderson and Sloan.
Lithium: Foote Mineral Co	Route 100 Exton, Pa. 19341	Dry Lake brines	Esmeralda		Evaporating ponds and chemical plant at Silver Peak.
Magnesite: Basic, Inc	845 Hanna Bldg. Cleveland, Ohio 44115	Open pit mine	Nye	Brucite	Concentrator and refractory products plant at Gabbs.
Mercury:					
Kollsman Mineral & Chemical Co	1441 Angelo Drive Beverly Hills, Calif. 90210	do	Esmeralda		Furnaces.
Fred H. Lenway and Co., Inc	100 California St. San Francisco, Calif. 94111	Underground mine	Humboldt		Do.
Crofoot Lumber Co	Rt. 2, Box 625 B Ukiah, Calif. 95482	do	Pershing		Do.
Molybdenum: Kennecott Copper Corp., Nevada Mines Division	McGill, Nev. 89318	Open pit mine	White Pine		Byproduct of copper production.
Peat: Morongo Corp	81 So. Rosemead Blvd. Pasadena, Calif. 91107	Reed sedge bog	Nye		Property abandoned in 1967.
Perlite:					
Combined Metals Reduction Co., Panacalite Division	218 Felt Bldg. Salt Lake City, Utah 84110	Open pit mine	Lincoln		Crushing and screening plant at Caselton.
Delamar Perlite	Pioche, Nev. 89043	Underground mine	do		
Petroleum:					
Nevada Refining Co	Ely, Nev. 89301	Crude oil refinery	Nye		Topping plant producing fuel oil.
Shell Oil Co	1008 W. 6th St. Los Angeles, Calif. 90054	Producing crude oil wells	do		
Texota Oil Co	811 San Jacinto Bldg. Houston, Tex. 77002	do	do		
Western Oil Lands, Inc	380 Linden St. Reno, Nev. 89502	do	do		
Pumice:					
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 St. Las Vegas, Nev. 89102	Open pit mine	Clark		Construction sand and gravel.
Las Vegas Building Materials, Inc	P.O. Box 530 Las Vegas, Nev. 89101	do	do		Do.

Nevada Aggregates & Asphalt	P.O. Box 7424 Peavine Sta. Reno, Nev. 89502	----do----	Washoe	----	Do.
Simplot Silica Products	P.O. Box 308 Overton, Nev. 89040	----do----	Clark	----	2 plants, industrial sand.
Stewart Brothers Co	P.O. Box 2775 Huntridge Station Las Vegas, Nev. 89101	----do----	----do----	----	Construction sand and gravel.
A. Teichert & Son, Inc	P.O. Box 825 Sparks, Nev. 89431	----do----	Washoe	----	Do.
Wells-Cargo, Inc	2894 W. Spring Mountain Rd. Las Vegas, Nev. 89114	Open pit mine	Clark	----	Construction gravel.
WMK Transit Mix, Inc., Sand & Gravel Division	1606 Industrial Rd. Las Vegas, Nev. 89102	----do----	----do----	----	2 plants, construction sand and gravel.
Silver:					
Duval Corp	P.O. Box 451 Battle Mountain, Nev. 89820	Open pit mine	Lander	Copper	Byproduct of copper production.
Grand PanAm Conpany	Pioche, Nev. 89043	Underground mine	Lincoln	Lead, zinc	Byproduct of lead-zinc production.
Kennecott Copper Corp., Nevada Mines Division	McGill, Nev. 89318	Open pit mine	White Pine	----	Byproduct of copper production.
Stone:					
Hatch Rock Quarries, Inc	P.O. Box 765 Mountain View, Calif. 94040	Open quarry	----do----	----	Quartzite.
Morrison & Weatherly Chemical Products	625 E. South St. Lone Pine, Calif. 93545	----do----	----do----	----	Limestone.
Nevada Cement Co	Fernley, Nev. 89408	----do----	Lyon	----	Do.
Lee Reed	Castle Park Montello, Nev. 89830	----do----	Elko	----	2 quarries, quartzite.
W. C. Scott	P.O. Box 104 Overton, Nev. 89040	----do----	Clark	----	Quartz.
Sonora Aggregates Co., Division of Grassi American Co.	111 S. Maple St. So. San Francisco, Calif. 94080	----do----	Mineral	----	Marble.
U.S. Lime Division, The Flintkote Co	P.O. Box 57367 Flint Station, Los Angeles, Calif. 90057	Open quarry	Clark	----	2 quarries, limestone.
Western Marble, Inc	P.O. Box 245 Ely, Nev. 89301	----do----	White Pine	----	Marble.
Talc and soapstone:					
Chas. Pfizer & Co., Inc	P.O. Drawer AD Victorville, Calif. 92394	Open pit mine	Esmeralda	----	Ground at company plant at Victorville, Calif.
Cyprus Mines Corp	P.O. Box 1201 Trenton, N. J. 08606	Underground mine	----do----	----	Ground at company plant in Mexico.
Tungsten:					
Meissner, Hess and Sandoval	560 Western Ave. Lovelock, Nev. 89419	Underground mine	Pershing.		
Del Summers	1095 Elmhurst Ave. Lovelock, Nev. 89419	----do----	----do----		

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 in 1967 was valued at $8.1 million, a 16-percent increase over the 1966 figure; the previous record was $7.7 million in 1965. The increased value and volume were attributed primarily to greater demand for sand, gravel, and stone in highway construction, and increased demand for specific types of stone for building construction. Minerals used in construction continued to dominate production, accounting for over 95 percent of the total value of mineral output in the State.

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in New Hampshire [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	51	$51	42	$42
Mica, sheet—pounds	------	--------	16,000	W
Peat—short tons	175	2	50	(2)
Sand and gravel—thousand short tons	7,626	4,807	8,449	5,137
Stone—do	206	2,091	473	2,887
Value of items that cannot be disclosed: Feldspar, gem stones, and value indicated by symbol W	XX	49	XX	51
Total	XX	7,000	XX	8,117
Total—1957–59 constant dollars	XX	6,780	XX	p 7,915

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] Less than ½ unit.

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

County	1966	1967	Minerals produced in 1967, in order of value
Belknap	W	W	Sand and gravel, peat, stone.
Carroll	W	W	Sand and gravel, stone.
Cheshire	W	W	Do.
Coos	W	$342,974	Do.
Grafton	$932,960	924,370	Sand and gravel, stone, feldspar, clays, mica.
Hillsboro	2,035,305	2,528,479	Stone, sand and gravel.
Merrimack	1,242,472	1,913,933	Sand and gravel, stone.
Rockingham	W	856,299	Sand and gravel, stone, clays.
Strafford	208,290	241,800	Sand and gravel, clays, stone.
Sullivan	W	W	Sand and gravel, stone.
Undistributed [1]	2,581,465	1,309,710	
Total [2]	7,000,000	8,117,000	

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 may not add to totals shown because of independent rounding.

Table 3.—Indicators of New Hampshire business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$1,901	p $2,071	+8.9
Per capita		$2,808	p $3,019	+7.5
Construction activity:				
State highway contracts awarded	millions	$21,443	$32,864	+53.3
Cement shipments to and within New Hampshire	thousand 376-pound barrels	1,011	p 915	−9.5
Mineral production	thousands	$7,000	$8,117	+16.0
Annual average labor force and employment:				
Total labor force	thousands	282.6	287.7	+1.8
Unemployment	do	5.0	5.8	+1.8
Employment:				
Nonagricultural industries	do	235.4	245.2	+4.2
Manufacturing	do	96.0	97.6	+1.6
Durable goods	do	43.4	45.8	+5.5
Nondurable goods	do	52.6	51.8	−1.6
Nonmanufacturing	do	139.4	147.6	+5.9
Construction and mining	do	11.7	12.1	+3.4

p Preliminary.

Sources: New Hampshire Department of Public Works and Highways, New Hampshire Department of Employment Security, U.S. Bureau of Mines, and U.S. Bureau of the Census.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1966:								
Nonmetal and peat	11	221	2	19	----	1	52.80	264
Sand and gravel	422	185	78	652	----	13	19.95	572
Stone	170	244	42	334	----	10	29.92	171
Total	603	202	122	1,005	----	24	23.89	433
1967: p								
Nonmetal and peat	50	264	13	101	----	3	29.73	208
Sand and gravel	385	214	82	708	----	16	22.59	418
Stone	106	246	40	322	----	7	21.76	603
Total	595	227	135	1,131	----	26	22.99	452

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Clays.—Production of clay declined nearly 18 percent from that of 1966. The decline was caused mainly by the closing in late 1966 of the Eno Brick Corp. in Rockingham County. Clay from pits operating in Grafton, Rockingham, and Strafford Counties was used principally in manufacturing building bricks.

Feldspar.—Potash feldspar was produced from only one pegmatite mine during 1967. The Ruggles mine in Grafton County was operated by the Ruggles Mining Co., Inc., the major part of the year; Bell Minerals Co. took over operation of the mine in December. Total value remained about the same as 1966, but production of crude feldspar declined. Unit value of crude ore increased, partly because of increased transportation costs. Ore was selectively mined and hand sorted. Lump feldspar was shipped by truck to a feldspar grinding mill at West Paris, Maine. The finely ground feldspar was used primarily in ceramics and as an abrasive in cleaning compounds.

Gem Stones.—Curio dealers and amateur mineral collectors recovered semiprecious gem stones and other mineral specimens from various locations within the State. Principal areas of interest were associated with pegmatites in Cheshire, Carroll, and Grafton Counties. Material recovered included beryl, amethyst, smoky quartz, and topaz crystals, including some of gem quality.

Mica.—Block mica was produced at the Ruggles mine in Grafton County. Material was shipped to an independent trimmer in Gilsum, Chesire County, for preparation. Because of its low electrical and thermal conductivity and tolerance to fairly high temperatures, trimmed mica is important in the manufacture of electrical and electronic equipment.

Peat.—No peat was produced during 1967. Perkins peat bog in Belknap County was idle, but sold about 50 tons of previously recovered reed-sedge peat from stock. Material was used primarily as a soil conditioner.

Perlite.—National Gypsum Co. at its plant in Portsmouth expanded perlite for use in acoustical plaster. Production of expanded perlite declined during the year, with a decrease in total value of 13 percent. Unit value increased 12 percent during the same period. The raw material used was crude perlite imported from the Western States.

Sand and Gravel.—The 0.8-million-ton increase in production, compared with that of 1966, was utilized in highway construction. Sand and gravel produced by Government-and-contractor operations increased 21 percent in volume and 31 percent in value over the 1966 production, reflecting an increase in the number of active State and interstate highway projects. Commercially produced material decreased 1 percent in volume and 3 percent in value. However, the average value of washed and screened material from commercial plants increased from $1.08 to $1.12 per ton, and unprocessed material increased 6 cents to an average value of $0.46 per ton. Bank-run sand and gravel accounted for 31 percent of commercial production, compared with 21 percent the previous year. Of the 30 commercial sand and gravel operations reporting production in 1967, 11 had an output of less than 50,000 tons, nine produced 50,000 to 100,000 tons, and 10 produced over 100,000 tons each. Eleven percent of the commercially produced material was delivered by rail, primarily to Boston, Mass., for use in ready-mix concrete.

Table 5.—Sand and gravel, and stone production by Government-and-contractor operations, by counties

County	Sand and gravel (thousand short tons)		Stone (short tons)	
	1966	1967	1966	1967
Belknap	557	40	4,898	109
Carroll	108	327	17	678
Cheshire	201	224	933	472
Coos	150	533	----------	2,193
Grafton	743	464	63,844	95,802
Hillsboro	360	592	6,502	453
Merrimack	310	2,105	5,302	14,591
Rockingham	308	213	59	8,777
Strafford	140	298	----------	9,277
Sullivan	363	46	249	218
Unspecified	750	----------	----------	----------
Total	3,990	4,842	81,804	132,570

Stone.—Total reported value of stone production increased 38 percent compared with that of 1966. Of the total 1967 value of production, 70 percent was accounted for by dimension granite, 20 percent by crushed granite and miscellaneous stone, and 10 percent by crushed quartz. Production and value of crushed granite and miscellaneous stone remained near the 1966 level, but increases occurred in dimension granite and crushed quartz. Output of dimension granite increased 19 percent in value and nearly 21 percent in volume. Major increases occurred in curbing and flagging and dressed construction granite. Production and total value of dimension granite for monuments and architectural uses declined slightly during the year. Output of crushed quartz in 1967 more than doubled that of the previous year; total value increased 90 percent. Material was used primarily as exposed aggregate in decorative concrete.

Table 6.—Principal producers

Commodity and company	Type of activity	County	Address
Clay:			
Densmore Brick Co	Pit	Grafton	Lebanon, N.H.
W. S. Goodrich, Inc	do	Rockingham	Epping, N.H.
The Kane-Gonic Brick Corp	do	Strafford	Gonic, N.H.
Feldspar (crude):			
Bell Minerals Co	Underground and open pit	Grafton	West Paris, Maine
Ruggles Mining Co., Inc.[1]	do	do	Grafton, N.H.
Gypsum (calcined): National Gypsum Co	Plant	Rockingham	325 Delaware Ave., Buffalo, N.Y.
Peat: Perkins Peat Bog	Bog	Belknap	Center Barnstead, N.H.
Perlite (expanded): National Gypsum Co	Plant	Rockingham	325 Delaware Ave., Buffalo, N.Y.
Sand and gravel:			
Cold River Sand & Gravel Corp	Pit	Cheshire	P.O. Box 429, Bellows Falls, Vt.
J. J. Cronin Company	do	Hillsboro	P.O. Box 176, N. Reading Mass.
Eaton Jones Sand & Gravel Co., Inc	do	Sullivan	P.O. Box 368, Newport, N.H.
Keene Sand & Gravel, Inc	do	Cheshire	725 Main Street, Keene, N.H.
Manchester Sand, Gravel & Cement Co., Inc.	do	Merrimack and Rockingham	P.O. Box 415, Hooksett, N.H.
McKay & Wright	do	Hillsboro	Milford, N.H.
Thomopoulis Sand & Gravel Pit	do	Rockingham	Londonderry, N.H.
Tilton Sand & Gravel, Inc	do	Belknap	Tilton, N.H.
Stone:			
Granite, dimension:			
Kitledge Granite Corp	Quarry	Hillsboro	Oak Street, Milford, N.H.
The John Swenson Granite Co., Inc.[2]	do	Merrimack	North State Street, Concord, N.H.
Miscellaneous stone, crushed:			
Iafolla Crushed Stone Co., Inc	do	Rockingham	Peverly Hill Rd. Portsmouth, N.H.
Lebanon Crushed Stone, Inc	do	Grafton	Plainfield Rd., West Lebanon, N.H.
Quartz, crushed:			
North Country Aggregates, Inc	do	Hillsboro	P.O. Box 55, S. Lyndeboro, N.H.
Quartz, Inc	do	Sullivan	P.O. Box 234, Keene, N.H.

[1] Also sheet mica.
[2] Also crushed granite.

The Mineral Industry of New Jersey

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the New Jersey Division of Resource Development, Bureau of Geology and Topography, for collecting information on all minerals except fuels.

By Joseph Krickich [1]

The continuing decline in the value of New Jersey mineral production was attributed primarily to the cessation of iron ore mining and to decreased output and lower unit value of other metallic minerals recovered. Mineral valuation totaled $72.7 million, 4 percent below that of 1966. A bright note was the increased output and value of stone and sand and gravel, which reflected a continuing high level of construction activity. Increased values were recorded for all nonmetallic minerals except clay and magnesium compounds.

Mineral production was reported for all counties except Salem. Increased values were reported for 10 counties. Sussex County showed the greatest increase, due to greater production and value of stone, manganiferous residuum, peat, lime, and sand and gravel. These increases more than offset the decreased value of zinc recovered in the county. Somerset County continued as the leading mineral-producing area, and was followed, in decreasing order of value, by Sussex, Cumberland, Morris, and Passaic Counties.

[1] Mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in New Jersey [1]

Mineral		1966		1967	
		Quanity	Value (thousands)	Quanity	Value (thousands
Clays	thousand short tons	488	$1,319	437	$1,189
Gem stones		NA	10	NA	10
Peat	short tons	36,312	489	43,045	542
Sand and gravel	thousand short tons	17,782	29,322	18,626	29,975
Stone	do	12,453	28,056	12,611	28,253
Zinc [2] (recoverable content of ores, etc.)	short tons	25,237	7,319	26,041	7,031
Value of items that cannot be disclosed: Iron ore, lime, magnesium compounds, manganiferous residuum, greensand marl, and titanium concentrate (ilmenite)		XX	9,080	XX	5,747
Total		XX	75,595	XX	72,747
Total 1957–59 constant dollars		XX	71,782	XX	p 69,353

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.

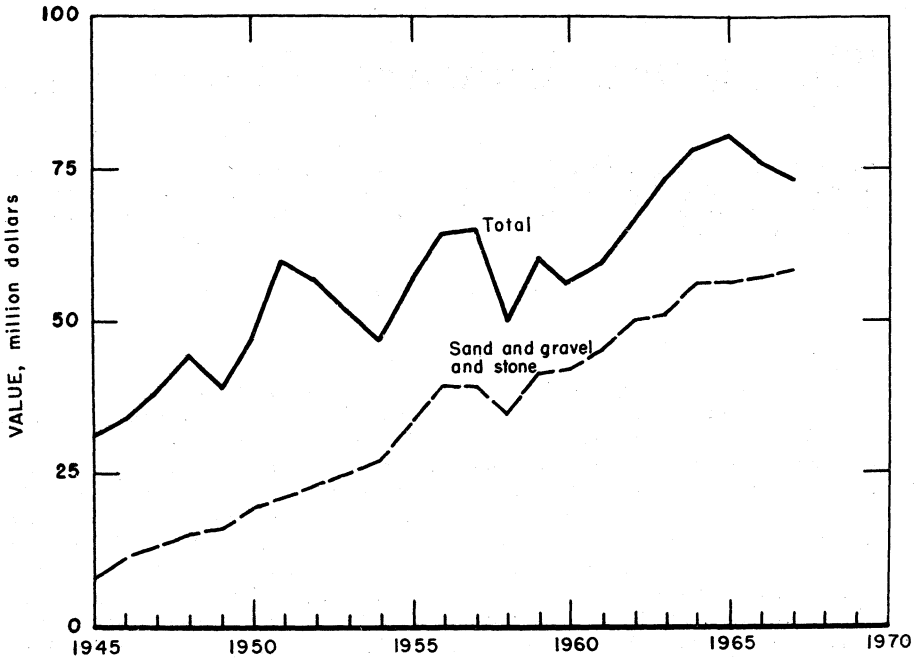

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in New Jersey.

Table 2.—Value of mineral production in New Jersey by counties [1]

County	1966	1967	Minerals produced in 1967 in order of value
Atlantic	$361,000	$399,000	Sand and gravel.
Bergen	1,946,000	W	Sand and gravel, clays.
Burlington	1,500,725	1,993,977	Do.
Camden	1,930,500	2,097,000	Do.
Cape May	W	W	Magnesium compounds, sand and gravel.
Cumberland	11,026,796	10,795,446	Sand and gravel, clays.
Essex	W	W	Stone.
Gloucester	499,500	476,120	Sand and gravel, greensand marl, stone.
Hudson	W	W	Stone.
Hunterdon	1,309,760	1,228,861	Do.
Mercer	W	W	Do.
Middlesex	2,567,748	2,516,160	Sand and gravel, clays.
Monmouth	885,000	1,128,000	Sand and gravel.
Morris	8,866,093	6,602,648	Sand and gravel, stone, iron ore.
Ocean	4,721,270	4,636,781	Sand and gravel, ilmenite.
Passaic	5,118,959	5,268,354	Stone, sand and gravel.
Somerset	12,715,273	13,110,808	Stone, clays.
Sussex	W	12,621,833	Zinc, stone, manganiferous residuum, sand and gravel, peat, lime.
Union	W	W	Stone.
Warren	791,420	974,476	Sand and gravel, peat, stone.
Undistributed [2]	21,355,376	8,897,220	
Total	75,595,000	72,747,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] No production reported in Salem County.
[2] Includes value of gem stones and values indicated by symbol W.

Table 3.—Indicators of New Jersey business activity

		1966	p 1967	Change (percent)
Personal income: [1]				
Total	millions	$23,767	$25,377	+6.8
Per capita		$3,445	$3,624	+5.2
Mineral production [2]	thousands	$75,595	$72,747	−3.8
Construction activity: [3]				
Construction contracts	thousands	$1,651,494	$1,839,815	+11.4
Nonresidential buildings	do	$718,979	$742,431	+3.3
Residential buildings	do	$616,384	$626,193	+1.6
Nonbuilding construction	do	$316,131	$471,191	+49.0
Cement (portland) shipments to New Jersey [2]	thousand 376-pound barrels	9,828	9,855	+.3
Employment (December 1966 and December 1967): [4]				
Manufacturing	thousands	862.5	866.1	+.4
Durable goods	do	456.5	446.8	−2.1
Lumber and wood products	do	5.7	5.3	−7.0
Furniture and fixtures	do	9.3	9.9	+6.5
Stone, clay and glass products	do	39.2	39.1	−.3
Primary metal industries	do	40.3	35.7	−11.4
Fabricated metals, including ordnance	do	62.5	66.0	+5.6
Machinery, except electrical	do	70.8	71.3	+.7
Electrical machinery	do	125.2	122.8	−1.9
Transportation equipment	do	37.1	32.2	−13.2
Instruments and related products	do	35.0	35.3	+.9
Miscellaneous manufacturing industries	do	31.4	29.2	−7.0
Nondurable goods	do	406.0	419.3	+3.3
Nonmanufacturing	do	1,510.2	1,566.3	+3.7
Construction	do	114.4	108.1	−5.5

p Preliminary.
[1] Source: Bureau of the Census, U.S. Department of Commerce.
[2] Source: Bureau of Mines.
[3] Source: F. W. Dodge Division, McGraw-Hill Information Systems Company.
[4] Source: New Jersey Department of Labor and Industry, Division of Employment Security.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Non-fatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1966:								
Peat	19	203	4	31	----	----	----	----
Metal	361	120	43	347	----	11	31.73	998
Nonmetal	347	268	93	742	----	14	18.88	570
Sand and gravel	1,028	262	269	2,222	----	51	22.96	628
Stone	882	244	215	1,800	1	40	22.78	3,898
Total [1]	2,637	237	624	5,141	1	116	22.76	1,786
1967: p								
Peat	21	204	4	34	----	----	----	----
Metal	185	282	52	417	----	22	52.71	1,706
Nonmetal	295	239	71	565	----	17	30.07	639
Sand and gravel	1,115	245	273	2,274	1	45	20.23	3,219
Stone	785	260	204	1,701	1	53	31.75	4,232
Total [1]	2,400	252	604	4,992	2	137	27.85	3,123

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—Nearly 9.9 million barrels of portland cement and 612,000 barrels of masonry cement were shipped into New Jersey. Compared with 1966, portland cement shipments were slightly higher, but masonry cement shipments declined 9 percent. Most of the portland and masonry cement came from plants in eastern Pennsylvania and eastern New York. Limited quantities of portland cement came from Maryland and Texas, and some masonry cement was shipped from Virginia. Distribution terminals were operated at Bayonne, Elizabethport, Jersey City, and Newark.

Clays.—Total clay production decreased by 51,000 tons from 1966. Most of the decline was in production of miscellaneous clay and shale, which accounted for 77 percent of the State's total tonnage. Fire clay output accounted for the remaining tonnage, but contributed 64 percent of the total clay value. Fire clay, used primarily in manufacturing refractory products, was mined in Cumberland and Middlesex Counties. Other uses were for pottery and stoneware, floor and wall tile, architectural terra cotta, for rotary drilling mud and filler material for linoleum and insecticides. Miscellaneous clay and shale was used entirely for manufacturing heavy clay products such as building brick and vitrified sewer pipe. Production was chiefly from Middlesex and Somerset Counties with quantities coming from Bergen, Burlington, and Camden Counties.

Gem Stones.—Collectors obtained various mineral specimens from stone quarries throughout the State, and particularly from old mine dumps at Franklin, Sussex County. Minerals collected included fluorescent calcite, franklinite, willemite, and zincite. Value was estimated at the same level as that of 1966.

Gypsum.—Production and value of calcined gypsum were below the levels of 1966 totaling 347,000 tons valued at $4.1 million. Crude gypsum from other States and foreign sources was calcined at four plants, two in Burlington and one each in Bergen and Camden Counties. The Edgewater, Bergen County plant of Fabricated Products Division of Allied Chemical Corp. was purchased by Celotex Corporation in August. Companies produced calcined gypsum for use in manufacturing plastering, lath, sheathing, wallboard, and other building materials.

Iodine.—Consumption of organic and inorganic iodine by chemical and pharmaceutical companies in the State totaled 396,000 pounds compared with 573,000 pounds in 1966. Mostly imported crude iodine was used for manufacturing medicines, sanitation products, and other chemicals.

Lime.—Hydrated lime increased both in production and value over 1966. Output by one company in Sussex County was used in construction, agricultural applications, sewage treatment, and water purification.

Magnesium Compounds.—Production and value of refractory magnesia dropped below 1966 levels and a reduction in the average unit value was reported. The refractory magnesia was produced in Cape May County from sea water and from out-of-State dolomite. J. T. Baker Chemical Co., Phillipsburg, Warren County, refined various magnesium compounds from purchased material.

Marl, Greensand.—Production of greensand marl was greater in quantity than in 1966, but value was unchanged because of lower unit prices. Output was from one hydraulic mining operation in Gloucester County; the material (natural zeolite) was used for water softening.

Mica.—Molecular Dielectrics, Inc., Clifton, and Synthetic Mica Co., Division of Mycalex Corporation of America, West Caldwell, produced synthetic flake mica used in glass-bonded ceramic materials. Molecular Dielectrics, Inc., continued production of high-quality synthetic mica crystals for splitting and punching. Sheet mica (muscovite block and film) was fabricated at four plants for consumption by the electrical and electronic industries.

Perlite.—Crude perlite mined in Western States was expanded at three plants, one each in Mercer, Middlesex, and Somerset Counties. The Hillside, Union County plant of Certified Industrial Products, Inc., discontinued operations. Output of expanded perlite was reported for the first time from the Trenton, Mercer County, plant of Zonolite Division, W. R. Grace & Co. The Burlington plant of National Gypsum Co. used expanded perlite produced at its Baltimore, Md., plant. Although total State shipments and value dropped below the levels of 1966, totaling 6,000 tons valued at $381,000, the average unit values were greater. Expanded perlite was used primarily in acoustical plaster; other uses included concrete aggregate, loose-fill insulation, soil conditioner, and as filler material.

Pigments.—Metal-base pigments, used primarily for manufacturing paint, were produced at several New Jersey plants. Iron oxide pigments were produced by E. I. du Pont de Nemours & Co., Newark; Columbian Carbon Co., Trenton and Monmouth Junction; and Stabilized Pigments, Inc., Edison. Titanium dioxide was produced by The New Jersey Zinc Co., Gloucester City, and National Lead Co., Perth Amboy. National Lead Co. also manufactured lead pigments at Perth Amboy. Zinc oxide and leaded zinc oxide pigments were produced by Royce Chemical Co., Carlton Hill.

Sand and Gravel.—A continuing high level of highway and building construction resulted in greater production of sand and gravel. Output increased 5 percent, but value rose only 2 percent due primarily to less production of higher priced ground sand. Average unit values for construction sand and gravel remained relatively stable. Although almost all of the production was by commercial operators, limited quantities were produced by Government-and-contractor operations in Atlantic County. Over 13.1 million tons of the commercial output was used in construction as building and paving material compared with 12.4 million tons in 1966. Most of the industrial sand production was for the foundry and glass industry markets. Ground sand production decreased 17 percent, but unground industrial sand output increased. Ground sand was produced in Cumberland, Middlesex, and Ocean Counties.

Sand and gravel was produced in 14 of the State's 21 counties. Morris County led in tonnage, but Cumberland ranked first in value because of higher priced industrial sands. Other important areas with production exceeding 1 million tons were Bergen, Burlington, Camden, Middlesex, and Ocean Counties. Of the 109 commercial operations (104 in 1966) only one had production exceeding 900,000 tons. Eight operators produced between 500,000 tons and 900,000 tons. The majority of producers had tonnages ranging from 25,000 tons to 300,000 tons, with only 18 operators producing below 25,000 tons. Commercial producers processed 16.2 million tons of sand and gravel by washing, crushing, sizing, or screening. Shipments to consumers were primarily by truck (15.4 million tons) and rail (2.5 million tons).

In National Sand and Gravel Safety Competition, Houdaille Construction Materials, Inc. was awarded Certificates of Achievement in Safety for its Kenvil, Riverdale, and Lakewood plants for working without any lost-time injuries.

Stone.—A continuing high level of highway construction in the State's northern and western counties created a steady demand for stone aggregates. An increase in total stone production of 1 percent was attributed primarily to the opening of additional granite quarries in Sussex and Hunterdon Counties. Stone production was reported in 11 counties, led by Somerset, Passaic, Sussex, and Hudson Counties, in decreasing order of value. Types of stone produced included basalt, granite, limestone, marble, oystershell, sandstone, and miscellaneous stone. Basalt (traprock) continued as the leading type of stone quarried, and accounted for 84 and 80 percent respectively, of the State's total production and value. Output was 1 percent below the level of 1966; average value decreased from $2.13 per ton to $2.12. Somerset County with 5.4 million tons and Passaic County with 2.3 million tons were the leading basalt-producing areas. Quarries were also active in Essex, Hudson, Hunterdon, Mercer, and Union Counties. Eighty-eight percent of the output was used as

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	5,182	$5,485	5,173	$5,349
Paving	2,923	2,825	3,570	3,557
Fill	597	315	1,358	578
Glass	W	W	1,031	4,136
Molding	1,817	5,918	1,672	5,269
Blast	141	748	150	705
Engine	24	81	W	W
Ground	157	1,481	130	1,209
Other [1]	1,259	4,704	384	1,282
Total	12,100	21,557	13,468	22,085
Gravel:				
Building	2,879	5,280	2,862	5,196
Paving	1,456	1,707	1,532	1,938
Fill	W	W	558	501
Other [2]	1,327	767	190	249
Total	5,662	7,754	5,142	7,884
Total sand and gravel	17,762	29,311	18,610	29,969
Government-and-contractor operations:				
Sand: Other	1	(3)	--------	--------
Gravel:				
Paving	12	7	14	5
Fill	7	4	2	1
Total	19	11	16	6
Total sand and gravel	20	11	16	6
All operations:				
Sand	12,101	21,557	13,468	22,085
Gravel	5,681	7,765	5,158	7,890
Total	17,782	29,322	18,626	29,975

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes fire or furnace, filtration, oil (1967), and other sand.
[2] Includes miscellaneous (1967) and other gravel.
[3] Less than ½ unit.

concrete aggregate, but quantities also were sold for riprap, railroad ballast, and filler material.

In terms of value, crushed limestone continued to rank second among the types of stone produced. Compared with 1966, output was greater but value declined. Production was from two quarries in Sussex County and one in Warren County. Limestone was sold principally for agricultural stone (agstone), concrete aggregate, filler material, and livestock feed additive. Some of the output was captive tonnage used for manufacturing hydrated lime.

Granite production totaled 1.3 million tons, 19 percent above the tonnage of 1966. The average value decreased from $1.96 per ton to $1.94 per ton. Output, mainly from quarries in Morris, Hunterdon, and Sussex Counties, was used primarily as concrete aggregate; quantities also were sold for riprap and fill. Crushed miscellaneous stone (gneiss) quarried in Passaic County was used exclusively as concrete aggregate and roadstone, and decreased in production and value from 1966 levels. No argillite was produced in Hunterdon County as in previous years. Crushed marble used exclusively in terrazzo was produced in Warren County. Production of dimension sandstone quarried in Hunterdon County was about the same as the previous year. Oystershell from Gloucester County was used in making lime and as poultry grit.

Five quarries in the State were cited for their safety record. In National Safety Competition, quarry group, Certificates of

Achievement in Safety were awarded to the Montclair Heights, Millington, and Summit quarries of Houdaille Construction Materials, Inc.; Riverdale quarry of Braen Industries, Inc.; and Franklin quarry of Farber White Limestone Co. Employees of the five quarries worked without sustaining any lost-time injuries.

Sulfur.—Shipments of byproduct sulfur decreased 9 percent below the totals of 1966, but value was greater because of higher unit values. The price increase was attributed to the tight supply of sulfur and the continuing great demand for fertilizers which was the major market for sulfur. Plants in New Jersey recovered 41,000 long tons of sulfur valued at $1.4 million; average unit value increased from $29.94 in 1966 to $33.68 per long ton. Elemental sulfur was recovered as a byproduct of gas purification using the Baehr, Claus, and Amine processes, at four plants, two in Gloucester and one each in Middlesex and Union Counties. Part of the sulfur was captive tonnage used for various chemical processes, and the remainder was sold for manufacturing sulfuric acid. Humble Oil & Refining Co. recovered hydrogen sulfide at its Bayway refinery in Union County. Liquid sulfur storage and transhipment terminals were operated by Freeport Sulphur Co., Warners; Pan American Sulphur Co., Newark; and Texas Gulf Sulphur Co., Carteret and Paulsboro. Total capacity at the terminals remained at 72,500 long tons per year.

Vermiculite.—One plant in Essex and one in Mercer County produced exfoliated vermiculite from crude material shipped from other States or imported. Production, sales, and value were below 1966 levels. Exfoliated vermiculite was used mainly as loose-fill insulation, plaster, and concrete aggregate, and for agricultural purposes.

METALS

Ferroalloys.—Shipments and value of ferroalloys produced by Shieldalloy Corp., Newfield, Gloucester County, were below those of 1966. The company utilized an aluminothermic furnace, chiefly for the production of ferroalloys of vanadium, titanium, boron, molybdenum, columbium, and columbium-tantalum.

Iron Ore.—Although active iron ore mining ceased in February 1966, a limited quantity of magnetite concentrate was shipped from the inactive Mount Hope mine of Shahmoon Industries, Inc. The company cleaned up the last remaining ore which had been mined, beneficiated, and stockpiled in previous years.

Titanium.—The totals of ilmenite concentrate production and value were below those of 1966, but the average unit value increased substantially. The Glidden Co. mined a titanium-bearing sand deposit at Jackson, Ocean County. The material was concentrated and shipped to Baltimore, Md., for conversion to titanium dioxide for use as a white paint pigment.

Zinc.—Manganiferous zinc ore recovered from the underground Sterling Hill mine in Sussex County was greater in tonnage than in 1966. The ore was crushed and shipped directly to a company-owned smelter at Palmerton, Pa., for recovery of zinc and manganiferous residuum. Zinc recovered was greater in quantity than the previous year, but value declined because of lower unit prices recorded for zinc. Shipments of manganiferous residuum increased compared with the previous year.

MINERAL FUELS

Coke and Coal Chemicals.—Koppers Co., Inc., produced coke and coal chemicals 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 & Refining Co. and Transcontinental Gas Pipe Line Corp. operated underground natural gas (LP gas) storage facilities. The former company operated two facilities in Union County; one propane, with 250,000 barrels capacity and the other butane, with 255,000 barrels capacity. Transcontinental operated a frozen earth liquid natural gas facility in Bergen County with 298,000 barrels capacity.

Peat.—Production and sales of peat were greater than those of 1966. The increases were due chiefly to more active operations and generally higher unit values. Production was from five operations, four in Sussex County and one in Warren

County. Horticultural Products, Inc., discontinued production at Newfoundland, Passaic County, and began production at Vernon, Sussex County. Also at Vernon, Mt. Bethel Humus Co., Inc., began production for the first time. Producers also recovered peat from bogs near Newton, and Stanhope, Sussex County, and at Great Meadows, Warren County. Both humus and reed-sedge peat were produced mostly for soil conditioning. Sales were mainly in bulk form. Peat reserves of actual operations totaled nearly 4 million tons.

Petroleum.—Six active petroleum refineries reported, as of January 1, 1967, a total crude oil capacity of 488,000 barrels per day, slightly less than that of the previous year. Gasoline output capacity increased from 150,100 to 174,500 barrels per day. Other products recovered at the refineries included asphalt, coke, lubricants, and paraffin. For recovering gasoline and other products, companies used catalytic cracking and reforming, thermal cracking, coking, and alkylation processes.

Table 6.—Principal producers

Commodity and company	Type of activity	County	Address
Clays:			
Fire clay:			
Crossman Co	Pit	Middlesex	P.O. Box 38 So. Amboy, N.J.
Daniel Goff Div., Jesse S. Morie & Son, Inc.	do	Cumberland	P.O. Box 35 Mauricetown, N.J.
A. P. Green Refractories Co., Valentine Division.	do	Middlesex	Pennval Road Woodbridge, N.J.
Such Clay Co	do	do	P.O. Box 47 Perth Amboy, N.J.
Miscellaneous clay:			
The Alliance Clay Product Co	do	Camden	P.O. Box 746 Alliance, Ohio
Church Brick Co	do	Burlington	P.O. Box 129 Bordentown, N.J.
Natco, Division of Fuqua Industries, Inc.	do	Somerset	327 Fifth Ave. Pittsburgh, Pa.
New Jersey Shale Brick & Tile Corp.	do	do	P.O. Box 249 Somerville, N.J.
The Rosehill Corp. t/a Oschwald Brick Works.	do	Middlesex	Cliffwood, N.J.
Sayre & Fisher Co. & Divisions [1]	do	do	P.O. Box 472 Sayreville, N.J.
Gypsum, calcined:			
Celotex Corporation	Plant	Bergen	1500 N. Dale Mabry Tampa, Fla.
The Flintkote Co. Building Products Group-East.	do	Camden	480 Central Ave. E. Rutherford, N.J.
Kaiser Gypsum Co	do	Burlington	Delanco, N.J.
National Gypsum Co	do	do	325 Delaware Ave. Buffalo, N.Y.
Ilmenite:			
The Glidden Co	Pit	Ocean	P.O. Box 5 Lakehurst, N.J.
Iron oxide pigments (manufactured):			
Columbian Carbon Co	Plant	Mercer and Middlesex	380 Madison Ave. New York, N.Y.
E. I. du Pont de Nemours & Co Inc	do	Essex	Du Pont Building Wilmington, Del.
Stabilized Pigments, Inc	do	Middlesex	P.O. Box 1364 Edison, N.J.
Lime:			
Limestone Products Corp. of America	do	Sussex	122 Main St. Newton, N.J.
Magnesium compounds:			
Northwest Magnesite Co	do	Cape May	2 Gateway Center Pittsburgh, Pa.
Peat:			
Horticultural Products, Inc	Bog	Sussex	Sussex, N.J.
Hyper Humus Co	do	do	Lafayette Rd. Newton, N.J.
Kelsey Humus Co., Partac Peat Co	do	Warren	Kelsey Park Great Meadows, N.J.
Mt. Bethel Humus Co., Inc	do	Sussex	1270 Broadway New York, N.Y.
Netcong Natural Products	do	do	Lackawanna Drive Stanhope, N.J.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Perlite (expanded):			
Coralux Perlite Corp., of New Jersey	Plant	Middlesex	P.O. Box 251 Metuchen, N.J.
Johns-Manville Products Corp., Celite Division	do	Somerset	22 East 40th St. New York, N.Y.
National Gypsum Co	Plant	Burlington	325 Delaware Ave. Buffalo, N.Y.
Zonolite Division, W. R. Grace & Co	do	Mercer	62 Whittemore Ave. Cambridge, Mass.
Petroleum refineries:			
Chevron Oil Company	do	Middlesex	
Hess Oil & Chemical Company	do	do	
Humble Oil & Refining Co	do	Union	
Humble Oil & Refining Co	do	Hudson	
Mobil Oil Company [2]	do	Gloucester	
Texaco, Inc	do	do	
Sand and gravel:			
Amico Sand & Gravel Co	Pit	Burlington	Norman Ave. Riverside, N.J.
Samuel Braen & Co	do	Bergen	Mahwah, N.J.
Braen Sand & Gravel Co	do	do	Brookside Ave. Wyckoff, N.J.
Ralph Clayton & Sons	do	Ocean	P.O. Box 220, R.D. No. 1 Jackson, N.J.
Houdaille Const. Materials, Inc	do	Morris	10 Park Place Morristown, N.J.
Houdaille Const. Materials, Inc	do	Ocean	10 Park Place Morristown, N.J.
T. Landi & Sons, Inc	do	Morris	Ridgedale Ave. Morristown, N.J.
Morie Division, Jesse S. Morie & Son, Inc	do	Cumberland	P.O. Box 35 Mauricetown, N.J.
National Glass Sand Corp	do	Cumberland	P.O. Box 145 Millville, N.J.
New Jersey Pulverizing Co	do	Ocean	205 W. 34th St. New York, N.Y.
New Jersey Silica Sand Co	do	Cumberland	235 Bala Ave. Millville, N.J.
Pennsylvania Glass Sand Corp	do	do	Hancock, W. Va.
George F. Pettinos, Inc	do	Camden	235 Bala Ave. Bala-Cynwyd, Pa.
Tri-Borough Sand & Stone, Inc	do	do	Haddonfield-Berlin Rd. Gibbsboro, N.J.
Whitehead Brothers Co	do	Cumberland	60 Hanover Rd. Florham Park, N.J.
Smelters (copper):			
American Metal Climax, Inc	Plant	Middlesex	
American Smelting and Refining Company.	do	do	
The Anaconda Company	do	do	
Stone:			
Basalt—crushed:			
Samuel Braen's Sons	Quarry	Passaic	Central Avenue Haledon, N.J.
Callanan Trap Rock Corp	do	Hudson	South Bethlehem, N.Y.
Dock Watch Quarry Pit, Inc	do	Somerset	P.O. Box 245 Martinsville, N.J.
Fanwood Crushed Stone Co	do	do	141 Central Avenue Westfield, N.J.
Great Notch Corp	do	Passaic	U.S. Route 46 Little Falls, N.J.
Houdaille Const. Materials, Inc	do	Hunterdon	10 Park Place Morristown, N.J.
Do	do	Passaic	Do.
Do	do	Somerset	Do.
Do	do	Union	Do.
M. L. Kernan Quarry	Quarry	Essex	500 Tillon Rd. S. Orange, N.J.
Minnesota Mining & Manufacturing Co.	do	Somerset	3M Center St. Paul, Minn.
Orange Quarry Co	do	Essex	318 Eagle Rock Ave. West Orange, N.J.
Somerset Crushed Stone Division, Anthony Ferrante & Sons, Inc.	do	Somerset	Route 202, Mine Brook Rd., Bernardsville, N.J.
Sowerbutt Quarries, Inc	do	Passaic	End of Planten Ave., Prospect Park Borough Paterson, N.J.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Stone—Continued			
Basalt—crushed:			
Trap Rock Industries, Inc	do	Hunterdon	Laurel Avenue Kingston, N.J.
Do	do	Mercer	Do.
Do	do	Somerset	Do.
Union Building & Construction Corp	do	Passaic	315 Howe Ave. Passaic, N.J.
Granite—crushed:			
Braen Industries, Inc	do	Morris	River Road Passaic, N.J.
Glen Gardner Quarry Corp	do	Hunterdon	P.O. Box 344, Glen Gardner, N.J.
Hamburg Quarry, Inc	do	Sussex	Route 23, Hamburg, N.J.
Shahmoon Industries, Inc	do	Morris	R. D. No. 1 Wharton, N.J.
Somerset Crushed Stone Division, Anthony Ferrante & Sons, Inc.	do	Hunterdon	Route 202, Mine Brook Rd. Bernardsville, N.J.
Tri County Asphalt Corp	do	Sussex	Beaufort Ave. Roseland, N.J.
Limestone—crushed:			
Farber White Limestone Co	Quarry	Sussex	Franklin, N.J.
Limestone Prod. Corp. of America	do	do	122 Main Street Newton, N.J.
Oxford Stone Co	do	Warren	P.O. Box 56, Oxford, N.J.
Marble—Crushed:			
The Royal Green Marble Co., Inc	do	do	P.O. Box 101 Phillipsburg, N.J.
Miscellaneous—crushed:			
Passaic Crushed Stone Co., Inc	do	Passaic	Foot of Broad Pompton Lake, N.J.
Oystershell—crushed:			
Jos. Bauder & Sons	Plant	Gloucester	Malaga Road Franklinville, N.J.
Sandstone—dimension:			
H. W. Lindblad	Quarry	Hunterdon	401 Belvedere Ave. Lambertville, N.J.
Sulfur:			
The Anlin Co. of New Jersey	Plant	Middlesex	P.O. Box 6554 Houston, Tex.
Freeport Sulphur Co	do	Gloucester	161 East 42nd St. New York, N.Y.
Industrial Chemicals Division, Allied Chemical Corp.	do	Union	P.O. Box 70 Morristown, N.J.
Vermiculite—(exfoliated):			
Vermiculite Industrial Corp	do	Essex	308 Gilligan Ave. Port Newark, N.J.
Zonolite Division, W. R. Grace & Co	do	Mercer	62 Whittemore Ave. Cambridge, Mass.

[1] Also fire clay.

[2] Also byproduct elemental sulfur.

The Mineral Industry of New Mexico

By R. B. Stotelmeyer [1] and William C. Henkes [2]

Mineral production during 1967 in New Mexico was valued at $874.1 million—an increase of $17.8 million over the 1966 figure. This new record high occurred despite a 6-month labor strike in the copper industry that adversely affected output of metals and despite a large drop in the prices for potassium salts that caused a significant decrease in the value of nonmetals produced. Substantial increases in the output value of nearly all the mineral fuels plus molybdenum and uranium accounted primarily for the overall increase in the value of mineral production.

[1] Mining engineer, Bureau of Mines, Socorro, N. Mex.
[2] Petroleum engineer, Bureau of Mines, Denver, Colo.

Table 1.—Mineral production in New Mexico [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Carbon dioxide (natural)—thousand cubic feet	795,885	$58	771,516	$57
Clays—thousand short tons	W	W	46	74
Coal (bituminous)—do	2,755	9,110	3,463	12,641
Copper (recoverable content of ores, etc.)—short tons	108,614	78,571	75,008	57,345
Gem stones	NA	45	NA	60
Gold (recoverable content of ores, etc.)—troy ounces	9,295	325	5,188	182
Gypsum—thousand short tons	146	545	155	588
Helium—thousand cubic feet	95,900	3,357	71,200	2,492
Lead (recoverable content of ores, etc.)—short tons	1,596	482	1,827	512
Lime—thousand short tons	34	472	17	243
Manganiferous ore (5 to 35 percent Mn) short tons, gross weight	47,590	324	49,323	348
Natural gas (marketed)—million cubic feet	998,076	124,760	1,067,510	138,776
Natural gas liquids:				
LP gases—thousand gallons	816,202	31,832	909,168	40,003
Natural gasoline and cycle products—do	338,732	19,736	338,114	20,730
Perlite—short tons	343,334	3,423	346,586	3,424
Petroleum (crude)—thousand 42-gallon barrels	124,154	352,101	126,144	368,340
Potassium salts—thousand short tons, K_2O equivalent	2,953	108,653	2,883	91,098
Pumice—thousand short tons	245	[2] 787	220	[2] 639
Salt—do	66	716	82	1,036
Sand and gravel—do	15,503	13,029	14,672	14,336
Silver (recoverable content of ores, etc.)—thousand troy ounces	243	314	157	244
Stone—thousand short tons	2,652	4,056	1,391	2,403
Uranium [3] (recoverable content U_3O_8)—thousand pounds	9,340	74,721	11,202	89,615
Vanadium—short tons	W	53	W	W
Zinc (recoverable content of ores, etc.)—do	29,296	8,496	21,380	5,919
Value of items that cannot be disclosed: Cement, fluorspar (1967) iron ore, manganese concentrate (35 percent or more Mn), mica (scrap), molybdenum, tin (1966), and values indicated by symbol W	XX	20,328	XX	23,001
Total	XX	r 856,294	XX	874,106
Total 1957–59 constant dollars	XX	r 822,513	XX	832,858

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] Value 1966, f.o.b. mine and/or grinding plant; value 1967, f.o.b. mine.
[3] Method of reporting changed from short tons of ore and f.o.b. mine value (AEC Circular 5, Revised, price schedule) to recoverable pounds of uranium oxide and f.o.b. mill value.

As a result of new projects announced or under development, the mineral industry of the State may be expected to continue to expand with major increases in the production of copper, coal, natural gas, natural gas liquids, petroleum, uranium, and possibly cement and molybdenum.

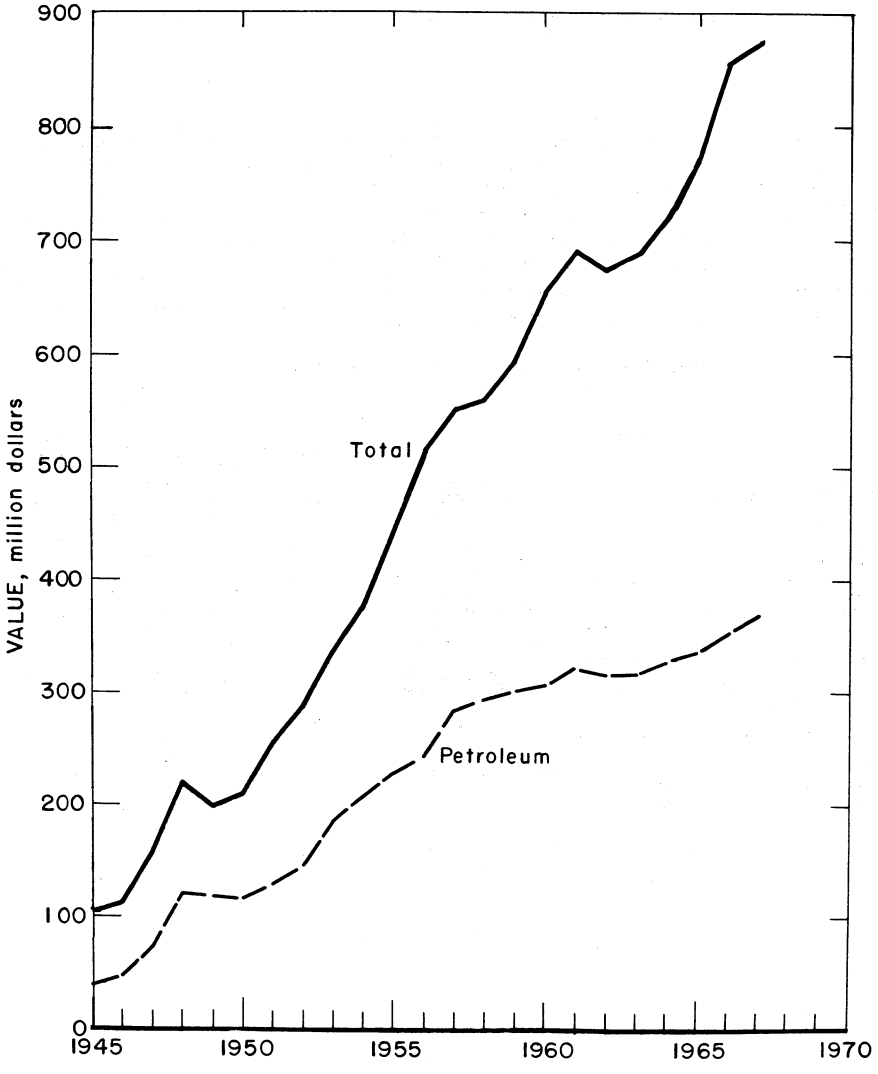

Figure 1.—Value of petroleum and total value of all mineral production in New Mexico.

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

County	1966	1967	Minerals produced in 1967 in order of value
Bernalillo	$9,087,986	$7,389,760	Cement, sand and gravel, stone, clays, pumice.
Catron	W	W	Sand and gravel, salt.
Chaves	17,793,614	19,784,531	Petroleum, natural gas, sand and gravel, stone.
Colfax	W	W	Coal, stone, sand and gravel.
Curry	38,000	4,187	Stone, sand and gravel.
De Baca	53,975	72,000	Sand and gravel.
Dona Ana	2,943,681	1,710,840	Sand and gravel, pumice, clays, stone, fluorspar.
Eddy	173,901,121	162,948,666	Potassium salts, petroleum, natural gas, LP gases, natural gasoline, salt, stone, sand and gravel.
Grant	87,928,094	64,710,471	Copper, zinc, molybdenum, sand and gravel, manganiferous ore, lime, silver, gold, lead, stone.
Guadalupe	265,000	W	Sand and gravel, copper, silver.
Harding	56,481	295,164	Stone, sand and gravel, carbon dioxide.
Hidalgo	W	772,077	Copper, gold, zinc, silver, lead, sand and gravel.
Lea	325,292,906	337,862,460	Petroleum, natural gas, LP gases, natural gasoline, potassium salts, stone, sand and gravel.
Lincoln	150,236	38,577	Iron ore, stone, sand and gravel, pumice, lead, gold, silver.
Los Alamos	75,000	36,000	Sand and gravel.
Luna	122,067	1,277,410	Sand and gravel, clays, stone.
McKinley	r 62,795,736	76,051,019	Uranium, coal, petroleum, molybdenum, stone, sand and gravel, clays, vanadium, natural gas.
Mora	194,000	W	Sand and gravel, mica.
Otero	W	501,410	Sand and gravel, stone, copper, lead, silver.
Quay	364,000	55,000	Sand and gravel.
Rio Arriba	12,339,210	13,719,653	Natural gas, petroleum, LP gases, sand and gravel, natural gasoline, pumice, stone.
Roosevelt	14,459,656	17,369,927	Petroleum, natural gas, LP gases, natural gasoline, sand and gravel, stone.
Sandoval	1,033,734	801,062	Gypsum, pumice, sand and gravel, petroleum, stone coal, natural gas, copper, silver.
San Juan	r 105,178,591	119,552,411	Natural gas, petroleum, LP gases, coal, natural gasoline, helium, sand and gravel, vanadium, uranium, stone.
San Miguel	1,570,630	W	Sand and gravel, stone.
Santa Fe	r 930,526	723,414	Sand and gravel, gypsum, stone, pumice, copper, silver, gold.
Sierra	392,314	1,364,518	Sand and gravel, stone, gypsum, silver, copper, lead, gold.
Socorro	1,155,269	1,552,401	Zinc, lead, sand and gravel, manganese concentrate, iron ore, silver, copper, stone, gold.
Taos	15,161,423	19,420,384	Molybdenum, perlite, sand and gravel, mica, clays stone.
Torrance	W	59,000	Sand and gravel.
Union	W	W	Pumice, sand and gravel.
Valencia	W	W	Uranium, sand and gravel, perlite, stone, pumice.
Undistributed [1]	r 23,010,514	26,033,743	
Total	r 856,294,000	874,106,000	

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

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

Table 3.—Indicators of New Mexico business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$2,400	p $2,430	+1.2
Per capita		$2,323	p $2,365	+1.8
Bank debits	millions	$7,743.8	$7,999.7	+3.3
Total State receipts (fiscal 1965–66 and 1966–67)	do	$707.4	$680.7	−3.8
Total State expenditures (fiscal 1965–66 and 1966–67)	do	$696.7	$674.2	−3.2
Natural gas used	billion cubic feet	1,007.4	1,051.9	+4.4
Electric power produced [1]	million kilowatt hours	8,342.1	9,353.2	+12.1
Construction activity:				
Total construction valuation	millions	$422.3	$283.4	−32.9
Building permits	do	$97.3	$78.6	−19.1
Residential	do	$30.5	$31.6	+3.5
Nonresidential	do	$51.8	$31.2	−39.8
Cash receipts from farm marketing	do	$289.6	$287.0	−0.9
Mineral production	do	$856.3	$874.1	+2.1
Employment: (Monthly average) [2]				
Total agricultural	thousands	9.3	9.2	−1.1
Total nonagricultural	do	303.5	301.1	−0.8
Mining	do	16.3	15.7	−3.7
Construction	do	18.3	17.0	−7.1
Manufacturing	do	18.4	17.9	−2.7
Transportation and utilities	do	20.2	20.1	−0.5
Trade	do	56.9	57.3	+0.7
Finance, insurance, real estate	do	11.4	11.1	−2.6
Services and miscellaneous	do	62.3	64.2	+3.0
Government	do	99.7	97.8	−1.9

p Preliminary.
[1] Includes Four Corners Plant production of 3,547.7 million kilowatt hours in 1966 and 4,205.6 in 1967, most of which is used out of State.
[2] 1967 figures are preliminary.

Source: Bureau of Business Research, The University of New Mexico, Albuquerque, N. Mex. 87106.

Mineral production was recorded in all 32 counties of the State. Value of output ranged from about $4,000 in Curry County, where small amounts of stone and sand and gravel were produced, to $337.9 million in Lea County, where the production of mineral fuels predominated. Major mineral-producing counties, in terms of value of production, were Eddy ($162.9 million), Grant ($64.7 million), Lea ($337.9 million), McKinley ($76.1 million), and San Juan ($119.6 million). The State continued to be the principal source of perlite, potassium salts (potash), and uranium in the Nation.

Employment and Injuries.—Final data for 1966 and preliminary data for 1967 compiled by the Bureau of Mines for employment and injuries in the New Mexico mineral industries, excluding all mineral fuels except coal, are reported in table 4.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	385	165	64	517	1	27	54.14	12,328
Metal	3,299	281	927	7,418	4	359	48.93	6,253
Nonmetal	2,894	348	1,006	8,049	2	226	28.33	3,151
Sand and gravel	1,199	181	217	1,746	--	42	24.05	699
Stone	239	219	52	411	----	12	29.22	506
Total [1]	8,016	283	2,266	18,142	7	666	37.10	4,385
1967: p								
Coal	345	162	56	453	----	23	50.77	711
Metal	3,465	245	850	6,804	3	276	41.00	4,315
Nonmetal	2,745	330	906	7,246	6	209	29.67	5,685
Sand and gravel	1,180	167	197	1,617	1	32	20.41	7,824
Stone	255	198	51	409	----	8	19.56	259
Total [1]	7,990	258	2,059	16,529	10	548	33.76	5,060

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

Legislative and Government Programs.—Several legislative acts of significance to the petroleum and natural gas industry were passed during the year. The State enacted a new law in June giving refiners in New Mexico preferential rights to purchase State-royalty oil from State lands. The six local refineries had been faced with a crude-oil shortage resulting from shipments of most of the oil out of State. The State legislature also approved a bill allowing the oil industry to use brackish water from the Capitan reef (Permian) for waterflooding; the industry was expected to use only about 0.5 percent of the 192 billion barrels of water in the reef. Waterflooding would increase oil production from about 20 to possibly 50 percent. On May 1, the State Oil Conservation Commission issued an order requiring that oilfield brines be injected into disposal wells instead of evaporated in open pits; the Commission estimated that 65 percent of the brines produced were already being injected and that the new rule would regulate the remainder and prevent contamination of fresh water supplies.

Early in the year the U.S. 10th Circuit Court of Appeals, Denver, Colo., remanded to the Federal Power Commission (FPC) the controversial rate case concerning the Permian basin natural gas area on the grounds that insufficient evidence had been presented to establish minimum and maximum rates to producers. This case is of great significance to the Nation's gas industry as well as to that of New Mexico. The U.S. Supreme Court later agreed to hear oral arguments in the case. At year-end, the Court had heard the arguments, and a decision was expected by mid-1968.

A hearing was held in Socorro concerning the proposed inclusion of the Bosque del Apache National Wildlife Refuge in the National Wilderness System. In connection with the proposal the U.S. Geological Survey, cooperating with the Bureau of Mines, published Bulletin 1260–A, B, "Summary Report on the Geology and Mineral Resources of the Salt Creek Area, Bitter Lake National Wildlife Refuge, Chaves County, New Mexico; and Bosque del Apache National Wildlife Refuge, Socorro County, New Mexico".[3]

Pertinent publications by the New Mexico Bureau of Mines and Mineral Resources at Socorro included Bulletin 81, "Summary of the Mineral Resources of Bernalillo, Sandoval, and Santa Fe Counties, New Mexico (Exclusive of Oil and Gas)," and Bulletin 89, "Geology of the Chama Quadrangle, New Mexico."

The State received, from mineral leases and permits, more than $11.6 million from Federal lands managed by the Bureau of Land Management.

Developments in construction utilizing mining technology or entailing mineral extraction included the awarding of bids for the $15 million Galisteo dam project near Waldo in Santa Fe County; also, bids were let for outlet-facility construction at the $50 million Cochiti dam project north of Alburquerque.

The 12.8-mile Azotea tunnel, being dug by a mechanical mole, was 81-percent excavated at the San Juan-Chama diversion project in Rio Arriba County. At the Navajo irrigation project east of Farmington in San Juan County, a 20-foot-diameter, 5-mile-long tunnel was completed. This tunnel, also dug by a tunnel machine, was the second of six to be constructed.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

The value of mineral fuels production increased $42 million or 8 percent. The total value of mineral fuels ($583 million) represented 67 percent of the value of State mineral production, about the same percentage as in 1966. Increases in every category of mineral fuels, except carbon dioxide and helium, resulted in a net increase in total mineral-production value despite substantial declines in the metals and nonmetals classifications.

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[3] Bachman, George O. Mineral Appraisal of the Salt Creek Area, Bitter Lake National Wildlife Refuge Chaves County, New Mexico. U.S. Geological Survey Bull. 1260-A, 1967, 10 pp.
Bachman, George O., and Ronald B. Stotelmeyer. Mineral Appraisal of the Bosque del Apache National Wildlife Refuge Socorro County, New Mexico. U.S. Geological Survey Bull. 1260-B, 1967, 9 pp.

Carbon Black.—The New Mexico Oil & Gas Engineering Committee stated in its annual report[4] that the two carbon black plants, United Carbon Co. and Continental Carbon Co., processed 14.6 billion cubic feet of natural gas to produce 50.1 million pounds of carbon black, slightly lower than in 1966.

Carbon Dioxide.—Output of carbon dioxide declined slightly. The three plants in Harding County continued at about the same level of production as during the previous year, but the plant of Emerald Carbonic Division of Frick Co., in Union County, was idle.

Coal.—Continuing to expand, the output of coal increased 26 percent to 3,463,375 tons; value of production rose 39 percent to $12.6 million. Three mines were operated in Colfax County, two each in McKinley and San Juan Counties, and one in Sandoval County.

According to the annual report of Utah Construction & Mining Co., coal was mined at an annual rate of about 2.5 million tons from the open pit Navajo coal mine near Farmington in San Juan County. The company supplied the coal, under contract, to the nearby Four Corners powerplant. Construction continued on two additional power units at the plant. The increased capacity, to be on stream in 1970, would bring total coal requirements to an annual rate of 8.5 million tons. For access to the 156-inch-thick seam No. 8, more than 11 million tons of overburden had to be removed.

Two new generating units being installed at the Four Corners plant are to be equipped with air pollution control devices costing $4 million. The electrostatic precipitators will consist of 30-foot-long collection plates on which an electric charge is to be placed. Housed in containers 116 feet long, 25 feet wide, and 45 feet deep, the charged plates would attract fly ash produced from burning coal. Following an evaluation at the new units, similar devices may be added to the three existing power units.

At the Navajo mine two 50-cubic-yard draglines are to supplement the existing 45-cubic-yard stripping machine. The company also was evaluating a 30-cubic-yard front-end loader for use in loading coal into 120-ton and 150-ton haulers. Coal, crushed and stacked at the powerplant, was sold by the million British thermal units, not by the ton. Expansion at the mine is expected to cost $30 million; enlargement of the powerplant would require an investment of $168 million.

The first full year of production was recorded at the York Canyon underground coal mine in Colfax County. Reportedly, coal was to be mined at about 700,000 tons per year from the 84-inch York seam for shipment to the Fontana, Calif., steel mill of Kaiser Steel Corp., owner of the mine. Unit trains, each consisting of about 100 railroad cars, were used to ship the coal.

Another principal mine was the McKinley strip mine operated by The Pittsburg & Midway Coal Mining Co., west of Gallup in McKinley County. The average thickness of the seam was 72 inches, as was the seam of the Sundance strip mine east of Gallup. Output from the McKinley mine was purchased by Arizona Public Service Co. Coal from the Sundance mine was sold in local markets.

Underground mines, in addition to the York Canyon mine, were the Franks No. 1 operated by Julius Seidel and the Talbott operated by Talbott Coal Mine, both in Colfax County; the Padilla operated by Padilla Coal Mine in Sandoval County; and the Hogback No. 13 operated by Hogback Coal Co. in San Juan County. The Franks No. 1 and Talbott mines were both in the Sugarite seam which has a thickness of 36 to 39 inches.

Helium.—The Federal Bureau of Mines Navajo helium plant at Shiprock, San Juan County, was the only helium-producing facility in the State. During 1967, the plant produced 71.2 million cubic feet of helium valued at $2.5 million (at the established price of $35 per 1,000 cubic feet, f.o.b. plant or terminal). The decline in production from the 95.9 million cubic feet produced in 1966 was due largely to declining productivity of wells in the Table Mesa field which supplied helium-bearing gas to the plant.

Rail shipments of gaseous helium were made from a shipping terminal at Gallup, connected by pipeline to the plant. Highway semitrailers for transporting

[4] New Mexico Oil & Gas Engineering Committee, Annual Report, v. 1, 1967, p. 406.

gaseous helium were loaded both at the Gallup shipping terminal and the plant. The Navajo plant was not equipped to produce liquid helium.

Late in the year, Kerr-McGee Corp. announced the discovery of helium in its exploratory well, Navajo–I No. 1, sec 34, T 24 N, R 20 W, San Juan County. The well flowed 5.8 million cubic feet of gas per day, 5.5 percent helium, from the McCracken formation (Devonian) at 3,800 to 3,810 feet and 3,815 to 3,832 feet. From Precambrian quartzite, it flowed 3.2 million cubic feet of gas per day, 5.68 percent helium, at various intervals, 3,856 to 3,873 feet, 3,919 to 3,940 feet, and 3,960 to 3,965 feet.

Natural Gas.—Marketed natural gas increased 7 percent over that of 1966; most of this was from fields in Eddy County which registered a 22-percent increase in production. Fifty-one percent of the yield was from the San Juan basin.

The State Oil Conservation Commission reported that, at yearend, 8,567 gas wells were producing from 178 pools; as in the past, casinghead gas was produced from many of the oilfields.

The American Petroleum Institute (API) American Gas Association, Inc., (AGA), and Canadian Petroleum Association in their annual reserve estimates[5] indicated a slight increase in gas reserves to 15.1 trillion cubic feet. New fields and new pools added 62.9 billion cubic feet, and revisions and extensions in existing fields added 1,233.2 billion cubic feet to the reserves. New Mexico continued to be ranked fifth in the Nation in such reserves.

The current deep drilling activity in the Delaware basin of New Mexico and west Texas resulted in several gas discoveries in Eddy County. Texaco Inc. and Pauley Petroleum, Inc., completed their Cotton Draw Unit No. 65, sec 2, T 25 S, R 31 E, as a dual gas discovery in the Wolfcamp (Permian) and Morrow (Pennsylvanian) formations. Initial potential production from the Wolfcamp, from the interval 12,785 to 12,851 feet, was 9.6 million cubic feet per day and from the Morrow, at 14,787 to 14,867 feet, was 21.2 million cubic feet.

Pan American Petroleum Corp. completed its Poker Lake Unit No. 36, sec 28, T 24 S, R 31 E, from the Devonian at 16,526 to 16,660 feet for an initial potential of 42.7 million cubic feet. Later in the year when the well was perforated in the Morrow interval, 14,950 to 15,010 feet, it yielded 2.2 million cubic feet of gas per day.

On the northwest flank of the Delaware basin, Cities Service Oil Co. completed its Big Eddy Unit No. 17, sec 2, T 21 S, R 29 E, for 9 million cubic feet of gas plus 180 barrels of condensate per day from Morrow perforations at 12,696 to 12,800 feet.

Natural Gas Pipeline Company of America completed, on November 9, a $20.6 million pipeline program to link gas production in southeastern New Mexico with its existing pipeline from Moore County, Tex., to midwestern markets. The project included 230 miles of 24-inch and 26 miles of 20-inch pipeline and a 4,000-horsepower compressor station 16 miles west of Lovington. Planned for an initial capacity of 221 million cubic feet per day, the line was to reach an ultimate capacity of 450 million cubic feet within 4 years.

Late in the year El Paso Natural Gas Co. was completing a 49-mile, 20-inch gas pipeline from Lusk to Caprock.

The first attempt at commercial use of nuclear explosions occurred in New Mexico when the 26-kiloton device of Project Gasbuggy was detonated. The test site was in the SW¼ sec 36, T29N, R4W, Rio Arriba County, about 55 miles east of Farmington. The project was designed to increase natural-gas production from low-permeability sandstones in the San Juan basin. The detonation occurred December 10, at 4,240 feet, 40 feet below the base of the gas-bearing, 287-foot-thick Pictured Cliffs formation (Cretaceous). The explosion was to open up a chimney in the Pictured Cliffs sandstone about 160 feet in diameter and 350 feet high, surrounded by a highly fractured zone extending approximately 340 feet laterally and 40 feet vertically. Preliminary post shot investigations indicated that the chimney height was very close to estimates but that the fractures were longer than expected. If successful, this technique of

[5] 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, 1967. V. 22, May 1968, p. 125.

fracturing could increase recoverable gas reserves in the Pictured Cliffs formation by 10 trillion cubic feet, 300 trillion for the Nation. Cost of the project was estimated at approximately $4.7 million, with El Paso Natural Gas Co. paying 40 percent and the remainder being shared by other companies, the U.S. Atomic Energy Commission, and the Federal Bureau of Mines. Final evaluation of the success of the project was not expected before mid-1968.

Natural Gas Liquids.—The annual report of the New Mexico Oil & Gas Engineering Committee[6] tabulated production at the 36 natural gas liquids extraction plants (gasoline plants) as 31.5 million barrels. Of the 997.1 billion cubic feet of raw gas processed at the plants, 886.5 billion cubic feet were returned as dry gas to pipelines for marketing. Output of the plants included 12.1 million barrels of natural gasoline, 4.0 million barrels of butane, 5.1 million barrels of propane, and 10.3 million barrels of composite liquids. The 30 plants in southeastern New Mexico yielded most (69 percent) of the liquids output.

Reserves of natural gas liquids were reported by API and AGA to be 555.7 million barrels, down slightly from the estimate made for 1966. Of the total reserves, 61 percent was credited to the San Juan basin, the balance to the Permian basin. Again New Mexico ranked third in the Nation in reserves of natural gas liquids.

In March, Skelly Oil Co. completed modernization and expansion of its two gasoline plants at Eunice. Daily recovery capacity of the plants was increased from 250,000 to 350,000 gallons of natural gas liquids.

At a cost of $3 million, Northern Natural Gas Co. converted the Hobbs plant to a refrigeration process; new equipment included three 1,620-horsepower compressors, heat exchangers, chillers, and scrubbers. The modifications were reportedly to increase plant efficiency to allow recovery of 98 percent of the propane and all of the butane and natural gasoline.

At yearend Phillips Petroleum Co. and El Paso Natural Gas Co. were completing a multimillion dollar project for processing and transporting natural gas in Lea County. In the Lusk field, Phillips was building a new $2 million gasoline plant with a daily processing capacity of 60 million cubic feet of gas; the extracted natural gasoline was to be refined into finished gasoline at Phillips refineries in Texas. The residue gas from the plant was to be sold to El Paso which, in turn, was constructing a $3.95 million, 49-mile, 20-inch gas pipeline to receive the gas. The gas was to be purchased from Phillips for 16.66 cents per thousand cubic feet for dry gas and 14.51 cents for casinghead gas.

Petroleum.—Output of crude petroleum reached a new high for the fourth successive year, a slight increase over the production of 1966. New Mexico continued to be ranked sixth in the Nation in oil production.

[6] Work cited in footnote 4, v. 1, pp. 399–406; v. 2, pp. 126–127.

Table 5.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1966	1967	Principal fields (those producing more than 1 million barrels) in 1967, in order of production
Chaves	5,883	6,402	Caprock, Cato.
Eddy	18,380	18,797	Empire, Loco Hills, Grayburg, Lusk.
Lea	84,064	84,613	Vacuum, Monument, Hobbs, Justis, Bagley, Denton, Maljamar, Pearl, Crossroads, Lovington, Langlie, Inbe, Eunice.
McKinley	204	312	
Rio Arriba	1,365	1,343	Tocito.
Roosevelt	4,508	5,258	Chaveroo.
Sandoval	7	4	
San Juan	9,743	9,415	Horseshoe.
Total	124,154	126,144	

Source: New Mexico Oil & Gas Engineering Committee. Annual Report 1967. V. 1–2, 661 pp.

Table 6.—Oil and gas well drilling in 1967, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Chaves	4	-----	32	36	126,824
Colfax	---	-----	2	2	10,426
Curry	---	-----	2	2	6,888
Eddy	2	6	22	30	254,049
Guadalupe	---	-----	1	1	945
Lea	17	3	27	47	458,700
McKinley	1	-----	9	10	22,215
Rio Arriba	1	-----	1	2	20,732
Roosevelt	---	1	19	20	89,747
Sandoval	---	-----	7	7	23,847
San Juan	3	1	11	15	30,138
San Miguel	---	-----	1	1	2,252
Santa Fe	---	-----	2	2	8,409
Union	---	-----	4	4	2,560
Valencia	---	-----	1	1	2,480
Total	28	11	141	180	1,060,212
Development completions:					
Chaves	184	2	9	195	682,505
Eddy	61	9	17	87	384,732
Lea	221	9	34	264	2,107,398
McKinley	24	1	3	28	46,498
Rio Arriba	5	82	7	94	551,936
Roosevelt	48	1	9	58	277,932
Sandoval	---	1	1	2	3,500
San Juan	20	147	29	196	865,391
Total	563	252	109	924	4,919,892
Total all drilling	591	263	250	1,104	5,980,104

Sources: Committee on Statistics of Drilling, American Association of Petroleum Geologists (Southeastern New Mexico); Petroleum Information Corp., 1967 Resume, Oil and Gas Operations in the Rocky Mountain Region, pp. C–14, C–15 (Northwestern New Mexico).

Table 7.—Predominant oil and gas discoveries in 1967

County and field	Well	Operator	Location: Section	Location: Township	Location: Range	Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production: Barrels of oil per day	Initial production: Thousand cubic feet of gas per day	Date of completion	Remarks
Eddy County:												
Cabin Creek	No. 1-A James	Phillips Petroleum Co.	2	22 S	30 E	Strawn	12,155–12,167	14,923	288	------	Feb. 27	Flowed. New Field.
Golden Lane	No. 1 Hudson-Federal.	Stoltz & Co	4	21 S	29 E	----do	11,098–11,102	11,653	----	16,300	Nov. 8 (1966)	Do.
Paduca	No. 65 Cotton Draw unit.	Texaco Inc. and Pauley Petroleum, Inc.	2	25 S	31 E	Wolfcamp Morrow	12,785–12,851 14,787–14,867	19,546	---- ----	9,593 21,230	June 15	Do.
Wildcat	No. 17 Big Eddy Unit.	Cities Service Oil Co.	2	21 S	29 E	Morrow	12,696–12,800	12,913	----	9,000	Feb. 28	Do.
Do	No. 1 Springs Unit	Gulf Oil Corp	34	20 S	26 E	Pennsylvanian	8,004–8,062	8,800	----	12,000	Dec. 10 (1966)	Do.
Do	No. 36 Poker Lake Unit.	Pan American Petroleum Corp.	28	24 S	31 E	Devonian	16,526–16,660	16,660	----	42,701	Feb. 27	Do.
Lea County:												
Emerald	No. 1 Aztec-State	E.L.K. Oil Co	15	17 S	36 E	Abo	9,444– 9,480	9,626	1,118	500	Jan. 13	Do.
Kemnitz	No. 1-G State	Midwest Oil Corp	23	16 S	33 E	Pennsylvanian	10,710–10,768	11,540	275	------	Feb. 15	Pumped. New pay.
Antelope Ridge.	No. 1 Antelope Ridge Unit.	Shell Oil Co	27	23 S	34 E	Morrow	13,226–13,278	14,832	----	9,005	Jan. 5	Flowed. New pay. Old well workover.
Brunson, East	No. 2 Ella Drinkard.	Texas Pacific Oil Co.	25	22 S	37 E	Ellenburger	7,783– 7,801 7,842– 7,862	7,895	370 408	439 328	Aug. 14	Flowed. New pay.
Nonombree	No. 3-D State	Midwest Oil Corp	32	13 S	34 E	Pennsylvanian	10,459–10,489	14,348	310	------	Feb. 14	Do.
Lovington	No. 1 Montieth-State.	Southwest Production Co.	19	16 S	37 E	Strawn	11,210–11,244	11,303	626	------	July 31	Do.
McCormack, South.	No. 8 R. E. Cole	Gulf Oil Corp	16	22 S	37 E	Siluro-Devonian. Montoya	7,186– 7,210 7,284– 7,286	7,302	182 147	108 ------	June 15	Do.
Morton, North	No. 1 Mobil-State	Olen F. Featherstone.	32	14 S	35 E	Pennsylvanian	10,428 10,456	10,742	264	------	Aug. 1	Flowed. New field.
Wildcat	No. 1 Daisy Clayton	Ashmun & Hilliard.	22	15 S	33 E	----do	10,164–10,174	10,275	213	------	Dec. 23 (1966)	Do.
Do	No. 1 Hutcherson Unit	Superior Oil Co	27	9 S	34 E	Bough "C"	9,835– 9,844	9,950	202	------	Dec. 20	Do.
Do	No. 2 Lee	Union Texas Petroleum Corp.	23	22 S	37 E	McKee	7,346– 7,365	7,735	192	------	Oct. 29	Do.
Vacuum, North.	No. 1 Gallagher-State	Pennzoil Co	3	17 S	34 E	Lower Wolfcamp	10,689–10,699	10,993	391	------	Jan. 14	Do.
San Juan County:												
Wildcat	No. 2 North Hogback	Walter Duncan Oil Properties	1	29 N	17 W	Dakota	661–663	663	72	------	Jan. 23	Do.
Blanco Area	No. 4 Riddle	El Paso Natural Gas Co.	4	30 N	9 W	Farmington	2,274– 2,304	3,116	50	------	Nov. 9	Flowed. New pay.

Sources: Rinehart Oil News Co., Oil & Gas Yearbook, 1968; Petroleum Information Corp., 1967 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

The number of producing oil wells increased slightly. At yearend, the Oil Conservation Commission reported 16,745 oil wells producing from 645 reservoirs. Of the producing wells, 15,210 (91 percent) were in the Permian basin, as were 594 of the oil pools; the remainder were in the San Juan basin. Ninety-one percent of the oil production was from the four counties in the Permian basin.

Estimates by the API and AGA listed crude-oil reserves of 925.8 million barrels in the State, down 98.8 million barrels from those of 1966. Additions due to revisions and extensions totaled 14.9 million barrels; those resulting from new fields and new pools were 5.5 million barrels.

Drilling activity decreased sharply from that of the previous year. Overall drilling was down 11 percent from the 1,236 wells drilled in 1966; footage drilled also declined. Sixteen percent of the drilling activity was for exploratory wells; there were 28 oil and 11 gas discoveries for an unusually high success ratio of 22 percent. Lea County led in number of wildcat and development wells drilled.

Development drilling in the Cato field, Chaves County, added 141 new producers to the field. Thirty-four producing wells were added to the Chaveroo field in Roosevelt County and 19 in Chaves County.

Among the 28 oil discoveries, the Texas Pacific Oil Co. Ella Drinkard No. 2, sec 25, T 22 S, R 37 E, Lea County, was significant. The well was dually completed from two zones in the Ellenburger formation (Ordovician); from the upper zone, 7,783 to 7,801 feet, initial daily production was 370 barrels of oil; from the lower zone, 7,843 to 7,862 feet, 408 barrels of oil.

Also in Lea County, the Southwest Production Co. Montieth-State No. 1, sec 19, T 16 S, R 37 E, was deepened from its old total depth of 6,650 feet to 11,303 feet. It was completed in the Strawn formation (Pennsylvanian) at 11,210 to 11,244 feet; initial daily potential was 626 barrels of oil.

At yearend Kerr-McGee Corp. was completing an oil discovery in San Juan County about 20 miles southeast of its significant Dineh bi Keyah oilfield in Arizona. The San Juan discovery was the Navajo-J No. 1, sec 23, T 23 N R 20 W completed for a daily gage of 160 barrels of 47.6° API oil from the McCracken formation (Devonian) at 3,982 to 4,008 feet. The new field was named Akah Nez, Navajo for "tall oil."

Early in the year and again in September, posted prices of New Mexico intermediate crude oils were raised 5 cents per barrel to bring the price for that oil to $3.11 per barrel (for 40° to 44.9° API gravity).

Crude-oil runs to stills in the six refineries in the State were 12.4 million barrels. Of the 112.9 million barrels shipped out of State, 40.2 million barrels went to Texas, 30.9 million to Illinois, and 11.6 million to Indiana.

Plateau, Inc., completed a modernization and expansion program at its Bloomfield refinery on March 24. Costing $1 million, the program included a catalytic reformer for upgrading the products, an increase in daily plant crude-input capacity from 1,850 to 2,400 barrels and an increase in storage capacity from 120,000 to 160,000 barrels. The Famariss Oil & Refining Co. also planned to expand daily crude-oil capacity at its Monument refinery from 2,500 to 4,500 barrels.

Early in the year plans were announced for construction of a $20 million petrochemical complex; sites were being considered at Los Lunas and Artesia. Scheduled for completion in 1969, the plant, to be owned by Mercury Chemicals & Petroleum, Inc., was designed to produce annually 280,000 tons of methanol and 100 million pounds of formaldehyde; construction contractor was Chemical Construction Corp. (Chemico).

METALS

The value of metals produced in the State was $172 million, a 3-percent decrease from the 1966 figure of $177.2 million. Substantial increases in output values of uranium, and molybdenum plus smaller increases in the values of lead, manganese concentrate, manganiferous ore, and vanadium were not great enough to offset the $21.2 million decline in the value of copper production, and lesser decreases in gold, silver, tin, and zinc. The principal cause of the decreases in copper, gold, and silver was the labor strike in the copper industry which began on July 15 and continued through the

year. A $2.6 million drop in the value of zinc output, due principally to the closing of a major zinc mine, contributed to the overall decline in metals production.

Copper.—Copper production decreased 31 percent or 33,606 tons in output and 27 percent or $21 million in value. The decline was principally the result of the labor strike against major copper producers, which affected about 1,200 employees at the Kennecott Copper Corp. operations near Silver City. Other copper producers also were affected, because ores and concentrates could not be shipped to struck custom smelters.

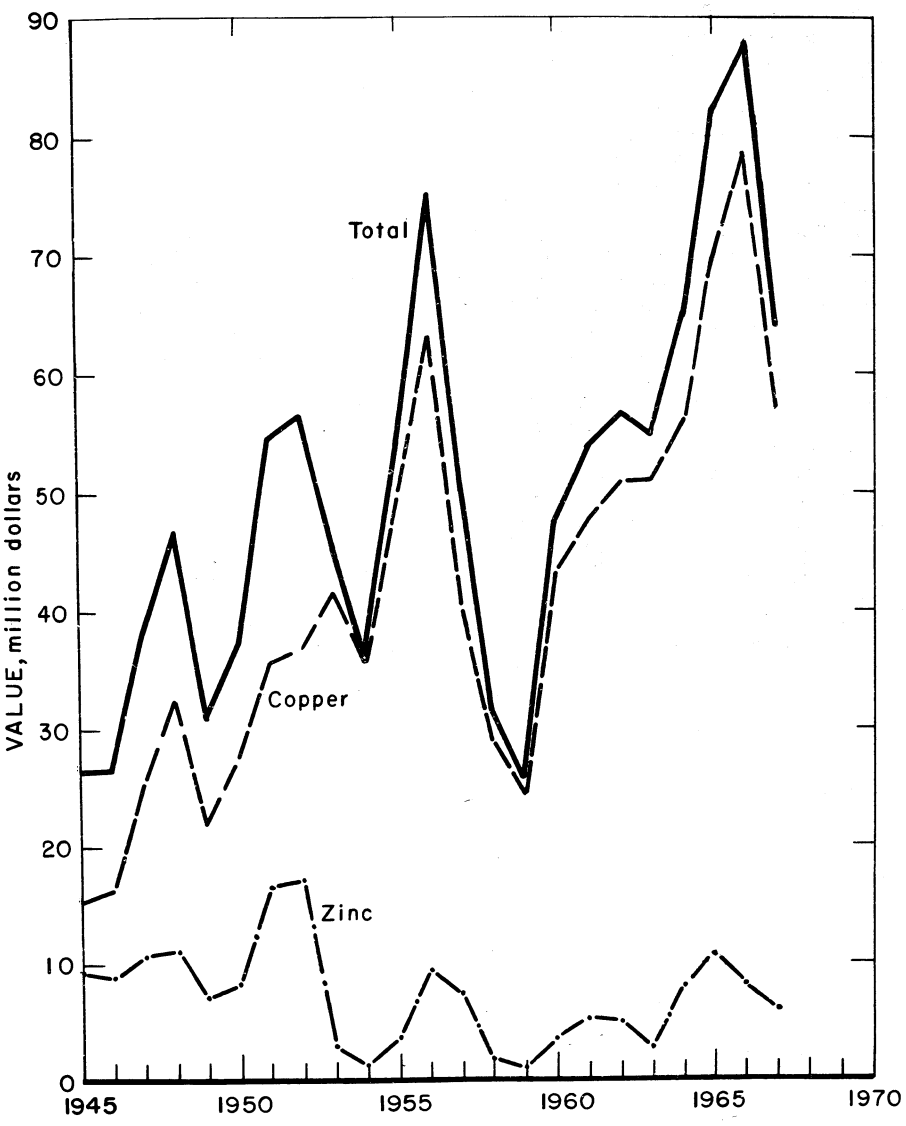

Figure 2.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico. The value of gold, silver, and lead produced annually has been relatively small.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in terms of recoverable metals [1]

Year	Mines producing		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)
1963	25	---	7,404	7,805	$273	256	$328
1964	41	1	7,882	6,110	214	242	313
1965	34	2	9,006	9,641	337	288	372
1966	36	---	9,438	9,295	325	243	314
1967	24	2	4,807	5,188	182	157	244
1848–1967	NA	NA	NA	2,281,248	53,178	74,111	59,254

	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	83,037	$51,151	1,014	$219	12,938	$2,976	$54,947
1964	86,104	56,140	1,626	426	29,833	8,115	65,208
1965	98,658	69,850	3,387	1,057	36,460	10,646	82,262
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
1848–1967	2,873,944	1,317,197	345,866	49,720	1,384,156	273,739	1,753,088

NA Not available.

[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings or slimes retreated, and ore, old tailings, old slag, or copper precipitates shipped to smelters during the calendar year indicated.

[2] Does not include gravel washed or tonnage of precipitates shipped.

Table 9.—Mine production of gold, silver, copper, lead, and zinc in 1967, by counties, in terms of recoverable metals

County	Mines producing [1]		Lode material sold or treated [2] (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
Grant	12	1	4,792,226	3,076	$107,660	109,378	$169,536
Guadalupe	1	---	[3] 26,760	[3] 105	[3] 3,675	[3] 25,591	[3] 39,667
Hidalgo	2	---	37,966	1,982	69,370	21,608	33,492
Lincoln	1	1	(3)	(3)	(3)	(3)	(3)
Otero	1	---	42	---	---	8	12
Sandoval	1	---	10	---	---	19	29
Santa Fe	1	---	1,000	24	840	684	1,060
Sierra	3	---	22	1	35	207	321
Socorro	2	---	(3)	(3)	(3)	(3)	(3)
Total:							
1967	24	2	4,858,026	5,188	181,580	157,495	244,117
1966	36	---	9,437,715	9,295	325,325	242,620	313,708

	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
Grant	74,170	$56,703,569	346	$96,768	19,193	$5,313,870	$62,391,403
Guadalupe	[3] 30	[3] 23,241	[3] 1,404	[3] 393,204	[3] 2,010	[3] 556,461	[3] 1,016,248
Hidalgo	779	595,790	77	21,490	177	48,935	769,077
Lincoln	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Otero	1	612	(4)	56	---	---	680
Sandoval	(4)	191	---	---	---	---	220
Santa Fe	28	21,560	---	---	---	---	23,460
Sierra	(4)	153	(4)	42	---	---	551
Socorro	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Total:							
1967	75,008	57,345,116	1,827	511,560	21,380	5,919,266	64,201,639
1966	108,614	78,571,368	1,596	482,471	29,296	8,495,840	88,188,712

[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 Guadalupe, Lincoln, and Socorro Counties combined to avoid disclosing individual company confidential data.

[4] Less than ½ unit.

Table 10.—Mine production of gold, silver, copper, lead, and zinc in 1967, by class of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold-silver	4	37,343	2,066	24,189	1,559,900	200	4,100
Dry silver	3	472	-----	24	14,400	600	----------
Total	7	37,815	2,066	24,213	1,574,300	800	4,100
Copper	7	4,452,994	2,314	47,354	61,084,800	100	668,000
Copper-zinc and lead-zinc [2]	4	44,042	226	10,938	1,417,400	167,600	992,600
Lead	1	5	-----	12	----------	300	----------
Zinc	5	272,058	575	74,978	730,000	3,485,200	41,095,300
Total	17	4,769,099	3,115	133,282	63,232,200	3,653,200	42,755,900
Other lode material: Copper precipitates	[3] 1	51,112	-----	--------	85,209,500	----------	----------
Placer	2	------	7	-------	----------	----------	----------
Total all sources	26	4,858,026	5,188	157,495	150,016,000	3,654,000	42,760,000

[1] Detail will not necessarily add to total because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] Operations at plants leaching runoff water not counted as producing mines.

Table 11.—Mine production of gold, silver, copper, lead, and zinc in 1967, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Concentration and smelting of concentrates:					
Ore	3,115	132,669	63,178,400	3,653,100	42,755,900
Direct Smelting:					
Ore	2,066	24,826	1,622,400	900	4,100
Copper precipitates	-----	-------	85,209,500	----------	----------
Total	2,066	24,826	86,831,900	900	4,100
Leaching of copper ore	-----	-------	5,700	----------	----------
Placer	7	-------	-----	----------	----------
Grand total	5,188	157,495	150,016,000	3,654,000	42,760,000

At the Kennecott Chino operation production was stopped at the open pit mine; leaching, however, was continued at the mine dumps with supervisory personnel operating the precipitation plant. Copper precipitates were stockpiled pending settlement of the strike. On December 4, the duration of the strike at the Chino mine equaled that of the record 1959 strike, which lasted 143 days. Construction on contracted projects was continued. Completed was a new 626-foot-high smelter stack that was to supplement the old 500-foot stack. Improvements in the copper precipitation section and the installation, at the converters, of oxygen equipment for direct smelting were additional projects undertaken. A total of 5 billion pounds of copper had been produced from the mine as of January 1967. An estimated 250 million tons of ore and almost twice as much waste were mined to obtain the product.

Development continued at the Tyrone mine of Phelps Dodge Corp., 10 miles southwest of Silver City in Grant County. Initial stripping of overburden, begun in April at the $100 million open pit copper mine project, was about 25 percent completed at yearend. Although some ore was uncovered and stockpiled, regular production was not expected to begin before

mid-1969. During the year a new townsite, located between Tyrone and Silver City, was started; plans were to build over 200 homes. Construction was well along at the processing mill that was to have an initial daily capacity of 25,000 tons of ore. Estimated overall grade of the ore body was 0.78 percent copper. Concentrates are to be shipped to Arizona for smelting. Because the development work was done under contract, operations were unaffected by the strike against Phelps Dodge Corp.

Construction was essentially completed at the $15 million Continental copper mine project at Fierro, about 17 miles northeast of Silver City. Although the company, United States Smelting Refining and Mining Co. (USSR&M Co.), was not involved in the copper strike, full production at the new project did not begin because concentrates could not be shipped to struck smelters elsewhere. Beginning in August, development ore was treated at the new 3,000-ton-per-day-capacity mill. During development of the underground copper-zinc-iron ore body, studies showed that an open pit mine was also feasible at the site of the old Continental No.1 mine nearby, and development of this ore body was begun. The underground ore is to be mined from the 600-foot level to the 1,300-foot level. Ores from the Continental No. 1 and the Princess mines were processed at the new mill and the old 300-ton mill at Bayard. Federal Resources Corp. acquired the Bonney-Misers Chest mines from Banner Mining Co. and was negotiating to lease the Phelps Dodge Corp. "85" mine operated by Diversified Mines, Inc. The mines are near Lordsburg in Hidalgo County. The company planned to spend $700,000 to develop the Bonney-Misers Chest mines, including deepening of the shaft from the 16th level another 400 feet. Production at the existing mill was to commence in 1968. It was expected that ore from the "85" mine also would be treated at the mill.

In another development Copper Range Co. obtained an option on the properties of John H. Trigg Co. southwest of Tyrone in Grant County. Included were the Copper Mountain and Copper Leach groups of claims and leaching plants at both locations. The heap-leaching projects were to be the first western operations for the company, which operates two copper mines in Michigan.

Copper was produced at 31 operations in eight counties. However, nearly all of the output was from Grant County, where production was recorded from nine underground mines, three open pit mines, 11 precipitation operations, one dump-leach operation, and one heap-leach operation. The underground mines included the following: The new Continental and the Continental No. 1 of USSR&M Co. (the Continental No. 1 was leased to L. A. Patten & Associates), the Denver mine operated by E. C. Haggard & J. L. Hulson, the Kearney mine which was closed by American Zinc Co. early in the year, the Ontario mine operated by Lovco Mining Co. and Ben Billingsley in the Steeple Rock district, the Oswaldo mine operated by The New Jersey Zinc Co., and the Princess mine of USSR&M Co. (Frank Van Cleave was lessee). In addition to the Chino and Continental open pit mines, some copper output was reported from the Jim Crow open pit operated by Grant County Mining Co. in the Steeple Rock district.

R. E. Roberts produced copper from the Pintada mine in Guadalupe County; some silver was also recovered from this Red Bed deposit. In Hidalgo County Don Still operated the Crystal mine in the San Simon district; most of the county's output, however, was from the "85" mine. In Otero County output of copper was reported by C. E. McCandless of Alamogordo. In Sandoval County the San Miguel mine near Cuba was leased by Elena Mining Corp. to M. C. B. & L. Mining Co., which produced some copper. In Santa Fe County output was reported from the San Pedro mine operated by Silver Bar Mining Co. The only reported copper production in Sierra County was by J. L. & P. W. Harding from the Silver Glance mine in the Chloride district. The Kelly mine, leased to A. B. Baca of Socorro, and the Linchburg mine, leased to L. A. Patten, were operated during the year in Socorro County. Both mines, near Magdalena, are owned by The New Jersey Zinc Co.

All of the lode mines from which copper was produced had output of other metals

such as gold, silver, lead, or zinc. The 11 leaching operations in the Central district of Grant County accounted for 338,900 pounds of copper, less than 1 percent of total production.

Gold.—In anticipation of a higher gold price, prospecting and exploration activities increased. Output declined 44 percent, mainly as a result of the copper strike. With the exception of output from two small placer operations, gold from 14 operations was produced as a coproduct from the extraction of ores containing copper, lead, zinc, or silver. The two placers were the Pine Grove near Pinos Altos in Grant County and the Jicarilla in Lincoln County, operated by C. J. Anderson and Lloyd Hoskins, respectively. Total placer production of gold was 7 ounces.

Iron Ore.—Although output of iron ore was the same as in 1966, value of production increased 10 percent. Dotson Minerals Corp. operated the Jones magnetite mine in Socorro County and the Yellow Jacket hematite-magnetite mine in Lincoln County. The company's magnetic upgrading plant was moved from Coyote to Carrizozo in Lincoln County. Output from the Dotson operations was used as heavy aggregate in concrete and in the manufacture of cement.

The Capitan Iron mine in Lincoln County was operated briefly during the year. E. P. Moe produced ore for use in iron and steel manufacture.

Lead.—Output and value of lead production increased 14 and 6 percent, respectively, despite a lower price received for lead. A significant increase in production from the Linchburg mine near Magdalena in Socorro County was mainly responsible for the rise in State output. The mine, owned by The New Jersey Zinc Co., was leased to L. A. Patten. In Grant County lead production declined at the Hanover mine also owned by New Jersey Zinc and at the Oswaldo mine operated by New Jersey Zinc as lessee.

Lead also was produced at the Ontario mine in the Steeple Rock district, at the Princess mine near Bayard, and at the Royal John mine in the Swartz district of the Mimbres Mountains, all in Grant County. The Ontario was operated by Lovco Mining Co. and Ben Billingsley; the Princess, by Frank Van Cleave who leased it from USSR&M Co.; and the Royal John, by Westamerica Mining and Milling, Inc. In Hidalgo County Don Still operated the Crystal mine in the San Simon district. Little Idaho Mining Co. operated the Maude mine in Lincoln County. C. E. McCandless recovered lead from a mine in Otero County. H. E. L. D. & Co. operated the H. E. L. D. mine and J. L. & P. W. Harding, the Silver Glance mine, both in Sierra County. A. B. Baca operated the Kelly mine in Socorro County.

Most of the ores from the 13 operations were treated at The New Jersey Zinc Co. mill at Hanover and the USSR&M Co. mill at Bayard, both in Grant County, and at the Peru mill of American Zinc Co. at Deming, Luna County. The Peru mill was permanently closed during the year; when American Zinc Co. ceased operations in the Central mining district.

Manganese Concentrate.—Manganese ore from the Nancy No. 1 mine was upgraded at the Black Canyon Mines plant near Socorro prior to shipment to out-of-State users. Plans were made to sink a shaft at the mine in 1968 to reach ore below the present adit level. Luck Mining Co. continued to produce ferruginous manganese ore, an iron-bearing ore containing 5 to 35 percent manganese, from the open pit Luck mine at Boston Hill near Silver City. The ore was shipped directly to the plant of the CF&I Steel Corp. at Pueblo, Colo.

Molybdenum.—With the first full year of operation reported for the Molybdenum Corporation of America (Molycorp) mine-mill complex near Questa in Taos County, molybdenum production increased 18 percent in quantity and 27 percent in value. The increase in State production would have been larger had not the copper-industry strike affected byproduct molybdenum recovery at the Chino copper mine of Kennecott Copper Corp. Molybdenum recovered as a byproduct at

uranium-ore processing operations accounted for about 2 percent of output. This molybdenum was contained in uranium ores mined in McKinley County. The ores were processed at the uranium mill of Kerr-McGee Corp. in the Ambrosia Lake district.

According to the annual report of Molycorp, 9.4 million pounds of molybdenum was produced. Most of the concentrates were shipped to Pennsylvania for treatment. From the open pit mine, 3.9 million tons of ore was milled at a daily rate of 10,800 tons. Output was below expectations mainly due to the difficult milling characteristics of ore from the eastern section of the pit. Feasibility studies continued to be made on the possibility of increasing production. Significant extensions of the mineralized zone were confirmed during a development drilling program west of the pit.

Bear Creek Mining Co., exploration subsidiary of Kennecott Copper Corp., applied to the Federal Forest Service for permission to build an access road to a molybdenum deposit discovered in the White Mountain Wilderness, Lincoln County. Extent of the deposit was to be delineated by additional exploration work. Reportedly, not all of the molybdenum occurrence was within the wilderness area.

The molybdenum concentrates from the Chino copper mine were sent to the Utah plant of Kennecott Copper Corp. for processing. Rhenium also was recovered from these concentrates.

Silver.—A 35-percent decrease (86,000 ounces) in the amount of silver produced (157,000 ounces in 1967) was mainly a result of the labor strike in the copper industry. The metal continued to be produced principally as a byproduct of the treatment of ores also containing gold, copper, lead, or zinc. All of the mines listed in the discussion of copper, with the exception of the leaching operations, had byproduct silver production. In addition, silver was recovered at the Royal John mine operated by Westamerica Mining and Milling, Inc., in Grant County, at the Maude mine operated by Little Idaho Mining Co. in Lincoln County, and at the H. E. L. D. mine and Little Boy Blue mine operated by H. E. L. D. & Co. and Jimmie Zook, respectively, in Sierra County. Nearly all of the output was from Grant, Socorro, and Hidalgo Counties.

Exploration activities were undertaken in the major silver mining districts, because silver prices were the highest registered since 1964. No new silver mines were reported opened, however. The average price of silver was $1.549 per ounce, compared with $1.293 in 1964 through 1966.

Tin.—Although no tin was produced, exploration and development work was continued at the properties of Sierra Associates near the western Sierra County boundary. The property had formerly been controlled by Anommco, Inc. Anommco had shipped concentrates in 1966.

Uranium.—Uranium (recoverable uranium oxide) was produced from 47 operations compared with 57 in 1966, and production gained 20 percent as activities of the industry were increased to meet expanding commitments to the nuclear electric-power market. Production of 11.2 million pounds of uranium oxide (U_3O_8) compared with a recent low of 9.0 million pounds in 1965.

Most of the uranium production (82 percent) came from the 40 operations in McKinley County. San Juan County had four operations and Valencia County had three.

Since the big uranium ore discoveries of the 1950's production has been recorded from about 225 mines. All of the large mines, those from which total ore output exceeded 1 million tons, were still in production at yearend. These mines were Sections 22, 24, and 30 of Kerr-McGee Corp.; Section 23 of Homestake-Sapin Partners; and the Jackpile-Paguate open pit mine of The Anaconda Company.

United Nuclear Corp. announced that beginning in early 1968 one, and possibly two, 1,800-foot shafts were to be sunk at the newly discovered uranium deposits near Church Rock, 7 miles east of Gallup in McKinley County and about 45 miles west of the Ambrosia Lake mining district. A uranium ore processing mill would be constructed if sufficient ore reserves were delineated.

Kerr-McGee Corp. announced that encouraging results were obtained from a drilling program in the Church Rock area on the Navajo Indian Reservation. These properties are north of and adjacent to the United Nuclear properties. An announcement also was made that a uranium mine, the company's sixth in the district,

would be developed at West Section 30 in the Ambrosia Lake district. Kerr-McGee filed an application for consolidation of small tracts on another section in the Ambrosia Lake area. The 1967 State Legislature passed a law that allowed the State geologist to consolidate for mining purposes up to 660 acres of land that had been subdivided into tracts of 2 acres or less on which mining would be uneconomical and impractical. Royalties from any production would be distributed among owners of all tracts or held by the State for 10 years if the owners could not be located. The section applied for by Kerr-McGee contained 1,700 tracts established in 1933.

Homestake-Sapin Partners, a partnership of Homestake Mining Co. and United Nuclear Corp., began development of an underground uranium mine in the Smith Lake area 18 miles northwest of Grants. Daily production was expected to be 300 tons of ore when full output is reached in 1968.

Increased uranium mining and milling activities were noted by the State Employment Service, which reported that employment in the uranium industry of the State increased by 589 persons during the year.

Exploration and development drilling totaled 3.1 million feet. Rotary drilling accounted for 70.2 percent and percussion drilling 23.0 percent.

The four uranium mills operated during the year were those of Kerr-McGee Corp. in McKinley County, Homestake-Sapin Partners and The Anaconda Company in Valencia County, and Foote Mineral Co. in San Juan County. Foote assumed operation of the latter mill as a result of a merger of Vanadium Corporation of America with Foote Mineral Co. The mill near Shiprock was scheduled to be closed in 1968. A small amount of ore was shipped to processing facilities of Union Carbide Corp. in Colorado.

Vanadium.—The increase in the production of vanadium, more than triple that of 1966, was due mainly to increased recovery from uranium-mill liquors. Uranium ores containing significant amounts of vanadium were shipped from the Largo and Mike Smith lease of A & B Mining Co. in McKinley County, and from the Begay 1 and 2, the Nelson Point operations of Foote Mineral, and the Enos Johnson operation of Ray L. Williams, all in San Juan County. The ores, plus vanadium-rich liquids recovered at uranium mills not having vanadium recovery circuits, were processed at the Shiprock mill of Foote Mineral or at facilities of Union Carbide Corp. in Colorado.

Zinc.—Zinc production decreased 27 percent—7,916 tons in quantity and $2.6 million in value—due to the closing of several zinc mines particularly the Kearney mine of American Zinc Co. In addition to closing the mine in Grant County, the firm also closed the Peru flotation mill near Deming in Luna County. About 100 mine and mill workers were affected by the shutdowns.

No production was recorded for the Silver King mine in the Camp Fleming district of Grant County, the Bonney-Misers Chest mines and the Red Hill mine in Hidalgo County, the Bird mine in the Nogal district of Lincoln County, or the Forrester-Silverwave mine and the Mistletoe mine in the Magdalena district of Socorro County. A small amount of zinc had been produced at these properties in 1966.

Most of the zinc ore was treated at the Hanover mill of The New Jersey Zinc Co. Some ore also was treated at the USSR&M Co. mills.

The New Jersey Zinc Co., continuing to be the major zinc producer, operated the Hanover and Oswaldo mines in Grant County and leased the Linchburg mine in Socorro County to L. A. Patten. The other principal zinc mine, the Princess in Grant County, was leased by USSR&M Co. to Frank Van Cleave. Other sources of zinc in Grant County included the Continental properties of USSR&M Co., which are expected to become major sources of zinc upon completion of the new copper-zinc mine project.

The Royal John mine, operated by Westamerica Mining and Milling, Inc., in the Swartz district of Grant County, had some zinc production. In Hidalgo County, output increased at the Crystal mine operated by Don Still in the San Simon district; production declined at the "85" mine near Lordsburg. In Socorro County,

a slight increase was noted in output from the Kelly mine operated by A. B. Baca who leased the mine from The New Jersey Zinc Co.

NONMETALS

A $17.6 million decline in potassium salts (potash) production and declines in portland cement ($1.1 million) and stone ($1.7 million) output values were mainly responsible for a decrease in the overall value of nonmetals production. The value dropped from $138.1 million to $119.1 million, a decrease of 14 percent. Smaller declines in output values of clays, lime, and pumice were noted. A $1.3 million increase in the value of sand and gravel production and smaller increases in other nonmetals outputs were recorded.

Cement.—The value of portland cement shipments declined $1.1 million. Both portland and masonry cement outputs were less as a result of decreased demand by the construction industry. Ideal Cement Co. Division, Ideal Basic Industries, Inc., produced cement at its Tijeras plant northeast of Albuquerque.

Kaiser Cement & Gypsum Corp. postponed construction of a new cement plant at Scholle near the Socorro-Torrance County line due to a decline in home building in New Mexico and adjacent States. Completion of the 1.7-million-barrel plant had been scheduled for 1968.

Clays.—Bernalillo County accounted for most of the value of clay production. Ideal Cement Co. used clay in the manufacture of cement; and Kinney Brick Co., Inc., produced clay for manufacturing brick at its plant in Albuquerque. Clay for brick also was produced by El Paso Brick Co. in Dona Ana County, by Gallup Brick & Tile Co. in McKinley County, and by Louis O. Romero in Taos County.

Other clay production in McKinley County included output by U.S. Mining Corp. of clay used as rotary-drilling mud. Mathis & Mathis produced clay in Luna County for refractory uses such as saggers and pins.

Idle since 1965, the Reese brick plant, south of Silver City, was sold at auction in November.

Fluorspar.—A small amount of fluorspar was produced by North Star Mining & Milling Corp. from the Bishop Cap mine in Dona Ana County. No output had been reported in 1966.

Gypsum.—Gypsum output, increasing slightly, was used mainly in the manufacture of wallboard.

A labor strike was called in May against American Gypsum Co., a division of The Susquehanna Corp., at the company wallboard plant near Albuquerque. Management personnel continued to operate the plant after the 65 production-line workers walked off the job. The strike was ended in December, following an election that halted representation at the plant by a local of the United Cement, Lime, and Gypsum Workers. Gypsum for the plant was purchased from White Mesa Gypsum Co., which operated a mine near San Ysidro, 30 miles northwest of Albuquerque in Sandoval County.

Kaiser Gypsum Co., Inc., continued to obtain gypsum from a quarry at the site of the Rosario wallboard plant south of Santa Fe.

Small amounts of gypsum were produced in Sierra County by Charles Swank of Truth or Consequences and by Associated Materials Co. of Las Cruces. The output was sold locally for agricultural use. Ideal Cement Co. obtained gypsum from Duke City Gravel Products Co. of Albuquerque; the gypsum was added to cement produced at the Tijeras cement plant.

Lime.—All lime production was by Kennecott Copper Corp. which used the lime for metallurgical control at the Hurley copper ore processing plant in Grant County. Output declined 50 percent to 17,000 tons as a result of the strike that closed the operations for half of the year.

Mica.—Production of scrap mica increased about 4,000 tons. Producers were S. A. M. Mining in Mora County and Mineral Industrial Commodities of America, Inc., (M.I.C.A.) in Taos County. Most of the mica was produced by M.I.C.A. at the To-Jo mine. Sericite from the open pit was processed at the Pojoaque dry-grinding plant north of Santa Fe in Santa Fe County. The company began producing roofing mica in addition to that used in paint manufacture.

Sunshine Mica Co. announced in November that a processing plant would be opened at Las Vegas in San Miguel

County. Mica was to be shipped to the plant from various locations in northern New Mexico.

Perlite.—Output of perlite was unchanged, as production continued at four operations. In Taos County output by Grefco, Inc., Johns-Manville Perlite Corp., and United Perlite Corp. was shipped to out-of-State expanding plants. In Valencia County, United States Gypsum Co. mined perlite from a quarry northeast of Grants, which was milled locally. The material was used at other company plants.

Perlite is used principally as building-plaster aggregate, filter aids, and concrete aggregate. New Mexico continued to be the major source of perlite.

Potash.—Although production of potassium salts (potash) declined slightly, value of production declined $17.5 million or 16 percent to $91.1 million. A sharp drop in prices, amounting to about $5.00 per ton of K_2O equivalent, was mainly responsible for the decline in production value. The closing of one operation and the curtailment of production at another also affected output and value. The production declines in the Carlsbad potash basin were related to the start of operations at four mines in the newly discovered potash fields in Saskatchewan, Canada. Reportedly, output from these mines was about the same as from the seven Carlsbad producers. Six more mines were under construction in Canada.

Table 12.—Crude perlite sold or used by producers

Year	Short tons	Value (thousands)
1963	259,113	$2,212
1964	286,329	2,568
1965	331,011	2,905
1966	343,334	3,423
1967	346,586	3,424

United States Borax & Chemical Corp. (U.S. Borax) closed its Carlsbad operation in November, 10 months earlier than had been originally scheduled. By yearend 755 of the 850-man work force had been laid off. Progress in construction at the potash operations of the company in Canada and accumulated inventories contributed to the hastened closing. Beginning production in 1931 under the name U.S. Potash, the company was the first to operate in the Carlsbad potash basin. Although substantial ore reserves were reported, the grade of the ore was too low to sustain operations. Options to purchase the properties were not exercised. London-based Borax Holdings owned 73 percent of U.S. Borax.

International Minerals & Chemical Corp. (IMC) reduced its potash-operations work force by about 50 percent in July. Declining ore grade, lower potash prices, and higher production costs caused the layoff of 385 employees. The company announced that a new metallurgical process would make possible the treatment of mixed sylvite-langbeinite ores previously considered unamenable to treatment. Sylvite is a potassium chloride mineral; langbeinite is a potassium sulfate. Processing of the mixed ore reportedly would involve heavy-media separation of the two minerals. Installation of the new process, at a cost of about $2 million, was to be completed in about 1 year. Although output would not increase, better economies would result. Langbeinite, increasingly in demand, is not present in commercial quantities in the Canadian potash beds. The only other domestic production has been by Duval Corp. at that company's Carlsbad operations.

Duval Corp. temporarily closed the Wills Weaver potash mine, the northernmost mine in the potash basin. The company continued to operate the new Nash Draw mine, the southernmost in the basin, and the Saunders mine located at the refinery near the center of the basin. Because of the wide geographical distribution of the properties, the company decided that a more economic operation could be obtained by closing the one mine and increasing output at the others. The affected employees were offered employment at company operations in Arizona. Sylvite ore was produced at the Saunders mine, and langbeinite at the Nash Draw mine. The Nash Draw also contained sylvite at a higher level in the mine where future production was planned. The company continued research on a new potash refining process; construction began on a sulfate granulation plant.

Potash Corporation of America (PCA) Division, Ideal Basic Industries, Inc., completed expansion of the refining section where chemical-grade muriate was pro-

Table 13.—Potassium salts production and sales

(Thousand short tons and thousand dollars)

Year	Crude salts, mine production		Marketable potassium salts					
			Production			Sales		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value	Gross weight	K_2O equivalent	Value
1963	16,414	3,083	4,504	2,643	$101,458	4,213	2,484	$94,925
1964	17,356	3,122	4,585	2,675	104,861	4,815	2,814	110,772
1965	18,557	3,363	4,919	2,848	117,771	4,607	2,677	110,424
1966	20,105	3,528	5,096	2,953	108,653	4,872	2,827	104,668
1967	18,906	3,434	4,950	2,883	91,098	4,797	2,784	88,788

duced. Muriate is used by the glass, ceramics, and drug industries. Modification of the crushing and milling sections was begun to reduce the amount of fine materials, undesirable for fertilizer use.

National Potash Co., a subsidiary of Freeport Sulphur Co., completed construction of a 35,000-ton-capacity product warehouse at a cost of about $400,000. Potash was produced from the Eddy mine in Eddy County at the western edge of the potash basin and from the Lea mine at the refinery 15 miles to the east in Lea County. The Lea is the only potash mine in Lea County.

Southwest Potash Corp., a division of American Metal Climax, Inc., continued operating at full capacity. At a recently completed compacting plant, fine material resulting from mining and crushing operations was compacted to provide a more useful particle size of fertilizer.

Kermac Potash Co., an equal partnership of Kerr-McGee Corp. and National Farmers Union Development Co., also operated at maximum capacity.

As of December 31, the seven companies operating in the State had stocks on hand totaling 655,400 tons of K_2O equivalent contained in 1.2 million tons of product. Production during the year was 2.9 million tons of K_2O equivalent potassium salts; and sales were 2.8 million tons.

Pumice.—Production of pumice, somewhat lower than in 1966, was recorded at 18 operations in eight counties, compared with 11 mines in six counties the prior year.

Operators active in 1967 but not in 1966 included Associated Materials Co. which produced volcanic cinders for use as concrete aggregate. The company operated the Black Mountain and Black Bear property near Berino in Dona Ana County. Also in Dona Ana County, R. W. Jones began producing cinders from the Black Mountain property near Anthony. Near Carrizozo in Lincoln County, output of scoria was recorded by Gallacher Ranches, Inc., which sold the material for landscaping and by Twin Peaks Products Co., which marketed the output for landscaping and roofing aggregate. In Sandoval County, Utility Block Co., Inc., reportedly began producing pumice from the Esquire claims. The pumice was used as concrete aggregate. Industrial Minerals, Inc., began producing scoria from the Vandaveer mine near Des Moines in Union County; the property had been worked by Patterson Mining Co. in 1966. Output was used as roofing material.

Of the recorded production in 1967, 68 percent was used as concrete aggregate, 16 percent as railroad ballast, 6 percent as landscaping and roofing material, 5 percent as cleansing compounds, and 5 percent for miscellaneous uses.

Salt.—For the first time the value of annual salt shipments exceeded $1 million. Output increased 24 percent and value rose 45 percent from the 1966 levels of 66,000 tons and $716,000 respectively. Nearly all of the output was from Eddy County where the salt was recovered from tailings at potash refineries. Reportedly, Pioneer Salt Co., Pioneer Water Co., Inc., and Williams Salt Co. ceased operations during the year. In Catron County, Southwest Salt Products Co., which produced some solar-evaporated salt from a lake occupying a volcano crater near Quemado, reportedly was closed.

Most of the salt shipped was by New Mexico Salt Co. and The Salt Supply Co., Inc., of Carlsbad. New Mexico Salt Co.

washed and screened the salt into fine and coarse granules. The fine granules were used as livestock feed, either in the form of pressed blocks or as loose material mixed with other feed. The Salt Supply Co., Inc., supplied salt for a variety of uses including livestock feed, highway deicing, oil refining, and water softening. Output was shipped to users in Arizona, Colorado, New Mexico, Oklahoma, and Texas.

Sand and Gravel.—Sand and gravel operations in the 32 counties totaled 165, compared with 177 in 1966. Although output of sand and gravel decreased, value increased 10 percent, or $1.3 million to $14.3 million. Value of shipments ranged from a few thousand dollars each in Curry, Hidalgo, Lincoln, and Union Counties to over $1 million each in Bernalillo, Dona Ana, Luna, Mora, Sierra, and Valencia Counties. Government-and-contractor operations accounted for 79 percent of output; the remainder was produced by commercial operators.

Of the total sold or used, 78 percent of the sand and gravel was washed, screened, or otherwise treated. Portable processing plants were used at 54 operations, stationary plants at 33, and both types at seven.

Highway construction accounted for 91 percent of the 13.4 million tons of gravel and 33 percent of the 1.3 million tons of sand produced. Most of the remainder was used in building construction and as fill.

The following government agencies used sand and gravel: Bureau of Indian Affairs, Bureau of Public Roads, Forest Service, U.S. Army Corps of Engineers, U.S. Atomic Energy Commission, New Mexico State Highway Commission, Arch Hurley Conservation District, and several county and municipal highway departments.

Accounting for 14 percent of total output, 57 out of 88 commercial operations had production of less than 25,000 tons of sand and gravel. Two operations in the 400,000- to 500,000-ton-per-year class accounted for 28 percent of the production.

Hites Sand & Gravel of Roswell was the only producer of industrial sand. Output consisted of a small amount of blasting sand.

Plans for new highway construction assured continuing contracts for sand and gravel. Of the 998.4 miles of designated interstate highway in New Mexico; 623.1 miles were open to traffic at yearend; construction was under way on 99.5 miles; engineering or right-of-way work was in progress on another 211.7 miles, and only 64.1 miles had no work in progress. Total 1968 planned highway contracts for about $45 million were about the same as in 1967.

Stone.—Production of stone decreased nearly one-half, and the value of production declined $1.7 million to $2.4 million. There were 57 operations in 23 counties. This compared with 71 operations in 24 counties in 1966. The output of stone, as well as sand and gravel, fluctuates yearly as a result of changing construction activity.

Most of the output was crushed limestone and crushed miscellaneous stone (649,191 tons and 595,159 tons, respectively), followed by crushed sandstone (74,202 tons) and crushed basalt (69,134

Table 14.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Bernalillo	1,289	$1,587
Catron	449	451
Chaves	438	439
Colfax	37	65
Curry	1	2
De Baca	51	72
Dona Ana	1,669	1,550
Eddy	46	46
Grant	762	736
Guadalupe	59	83
Harding	73	73
Hidalgo	2	3
Lea	W	W
Lincoln	3	2
Los Alamos	36	36
Luna	1,814	1,273
McKinley	52	63
Mora	1,158	1,158
Otero	398	442
Quay	37	55
Rio Arriba	475	559
Roosevelt	W	W
Sandoval	97	125
San Juan	757	826
San Miguel	760	791
Santa Fe	375	497
Sierra	1,774	1,361
Socorro	369	303
Taos	154	173
Torrance	59	59
Union	3	6
Valencia	1,236	1,247
Undistributed	239	253
Total	14,672	14,336

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

Table 15.—Sand and gravel sold or used by producers, by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operation and use	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	899	$1,021	806	$1,006
Paving	135	157	172	210
Fill	52	26	[1] 33	[1] 23
Industrial: Blast	1	1	(1)	(1)
Total	1,087	1,205	1,011	1,239
Gravel:				
Construction:				
Building	1,009	1,298	864	1,354
Paving	1,280	1,433	1,133	1,415
Railroad ballast	(2)	(2)	------	------
Fill	64	49	89	45
Miscellaneous	[2] 14	[2] 9	48	56
Total	2,367	2,789	2,134	2,870
Total sand and gravel	3,454	3,994	3,145	4,109
Government-and-contractor operations:				
Sand:				
Building	3	4	------	------
Paving	488	381	248	228
Other	------	------	5	7
Total	491	385	253	235
Gravel:				
Paving	11,550	8,646	11,048	9,878
Fill	8	4	226	114
Total	11,558	8,650	11,274	9,992
Total sand and gravel	12,049	9,035	11,527	[3] 10,228
All operations:				
Sand	1,578	1,590	1,264	1,474
Gravel	13,925	11,439	13,408	12,862
Total	15,503	13,029	14,672	14,336

[1] Fill and blast sand combined to avoid disclosing individual company confidential data.
[2] Railroad ballast and "Miscellaneous" gravel combined to avoid disclosing individual company confidential data.
[3] Data do not add to totals shown because of independent rounding.

tons). Smaller quantities of dimension stone consisting of basalt, granite, marble, sandstone, and miscellaneous stone were produced, as was crushed granite. Nearly all classes of stone production declined, except for an insignificant yield of dimension sandstone. Production of dimension basalt was unchanged. No dimension limestone was produced; output had been reported in 1966. Output of stone by commercial operators (640,285 tons) declined 23 percent; production by Government-and-contractor operators dropped 59 percent to 751,071 tons.

Crushed limestone and the other crushed stones were used mainly in concrete or as road metal and riprap. Most of the crushed limestone was used to manufacture cement at the Tijeras plant of Ideal Cement Co. Some crushed limestone was also used as stone sand, as flux, and in the manufacture of lime. Small amounts of crushed sandstone were used for decorative purposes.

Commercial stone operations, with production in 1967 but not in 1966, included the following: Hamilton Brothers, Inc., crushed basalt and crushed limestone, McKinley County; Smith & Aguirre, crushed limestone, Dona Ana County; Haake Construction Co., crushed limestone, Eddy County; Radium Springs Marble Co., Inc., marble, Dona Ana County; Manzano Quartz, Inc., crushed sandstone, Bernalillo County; Empire Quarries and Los Com-

Table 16.—Stone production in 1967, by counties

County	Short tons	Value
Bernalillo	W	W
Chaves	71,783	$143,531
Colfax	89,807	155,682
Curry	644	2,187
Dona Ana	W	W
Eddy	W	W
Grant	W	W
Harding	70,395	165,303
Lea	353,600	707,200
Lincoln	W	W
Luna	20	720
McKinley	64,000	94,814
Otero	23,557	58,730
Rio Arriba	2,047	7,653
Roosevelt	32,893	44,927
Sandoval	2,435	6,087
San Juan	9,180	13,830
San Miguel	W	W
Santa Fe	47,930	70,574
Sierra	1,405	2,108
Socorro	556	5,308
Taos	W	W
Valencia	W	W
Undistributed	621,104	924,432
Total	1,391,356	2,403,086

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

padres Mica Co., crushed sandstone, Rio Arriba County; and Los Compadres Mica Co. and Albert Trujillo, dimension sandstone, Rio Arriba County. The following produced miscellaneous stone: Architectural Construction Co., Bernalillo County; Ray Atchison Construction Co., San Juan County; Atowi Materials, Santa Fe County; A. B. Baca Mining & Milling, Draluc Minerals, Inc., and Rocky Mountain Stone Co., Socorro County; and Rare-Tex Corp., San Miguel County.

The following operators reported commercial stone production in 1966 but not 1967: Armstrong & Armstrong, crushed limestone, Chaves and Eddy Counties; Mathis & Mathis, crushed limestone and dimension limestone, Grant County; John W. Moran and Petaca Mining Corp. (one of two operations), crushed sandstone, Rio Arriba County; Builders Block & Stone and Robert and Juan Singh, miscellaneous stone, Dona Ana County; J. W. Jones Construction Co., miscellaneous stone, San Juan County; and Hefner Bros., miscellaneous stone, Socorro County.

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

Year	Short tons	Value	Short tons	Value	Short tons	Value
	Basalt and related rocks (traprock)		Granite		Limestone	
1963	6,716	$8,211	996	$25,997	1,264,243	$2,017,667
1964	42,941	81,376	190	4,140	1,260,898	1,936,041
1965	84,490	248,500	3,445	17,130	1,452,401	2,084,281
1966	135,635	274,627	W	W	1,478,686	2,088,792
1967	[1] 69,134	[1] 110,039	200	15,800	649,191	919,066
	Sandstone		Other stone [2]		Total	
1963	W	W	1,236,783	2,184,264	2,508,738	4,236,139
1964	[3] 6,724	[3] 10,086	[4] 1,449,331	[4] 2,212,383	2,760,084	4,244,026
1965	[5] 88	[5] 2,036	[6] 370,739	[6] 667,616	1,911,163	3,019,563
1966	325,079	492,765	712,345	1,199,448	2,651,745	4,055,632
1967	75,071	132,423	[7] 597,760	[7] 1,225,758	1,391,356	2,403,086

W Withheld to avoid disclosing individual company confidential data; included with "Other stone."
[1] Excludes dimension basalt; included with "Other stone."
[2] Includes marble.
[3] Excludes dimension sandstone; included with "Other stone."
[4] Includes dimension sandstone.
[5] Excludes crushed sandstone; included with "Other stone."
[6] Includes crushed sandstone.
[7] Includes dimension basalt.

Sulfur.—Of 18,523 long tons of byproduct sulfur produced, 18,456 tons were shipped at a total value of $609,304, a 42-percent increase in shipments. In 1966 shipments were 13,022 long tons valued at $273,776. Higher sulfur prices were posted during the year.

Because of the difficulty in determining the State or County 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 were not included in

the mineral-production statistics in table 1.

Marathon Oil Co. began recovering sulfur at the new Indian Basin natural gas processing plant in Eddy County. Other producers were Pan American Petroleum Corp. and Phillips Petroleum Co. at the Empire Abo and Artesia gas plants in Eddy County, and Climax Chemical Co. and Sinclair Oil & Gas Co. at Monument and Tatum in Lea County. Phillips Petroleum used the standard Claus process; others used the modified Claus process.

Vermiculite.—Vermiculite, produced in Montana, was processed at the Albuquerque plant of Southwest Vermiculite Co. The vermiculite was graded and exfoliated before being bagged for use as insulation or aggregate.

Table 18.—Principal producers and processing plants in 1967 [1]

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Carbon dioxide (natural):					
Carbonic Chemical Corp	Box 1016 Albuquerque, N. Mex. 87103	Well and plant	Harding		Extraction plant.
Cement:					
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Denver National Bldg. Denver, Colo. 80202	Plant	Bernalillo	Clay, stone	Dry process; two rotary-kiln cement plants.
Clays:					
Ideal Cement Co	620 Denver National Bldg. Denver, Colo. 80202	Open-pit mine	----do	Cement, stone	
Kinney Brick Co	Box 1804 Albuquerque, N. Mex. 87103	----do	----do		
Coal:					
Kaiser Steel Corp	Box 281 Raton, N. Mex. 87740	Underground mine and plant.	Colfax		Crushing plant, dense media-froth flotation cleaning plant.
The Pittsburg & Midway Coal Mining Co.	Hanover Bldg. 15 West 10th Street Kansas City, Mo. 64105	Strip mine and plant	McKinley		Cleaning plant, chemical and water treatment plant.
Utah Construction & Mining Co.	Box 155 Fruitland, N. Mex. 87416	Strip mine and plant	San Juan		Crushing plant, dust suppression detergent treatment plant.
Copper:					
Diversified Mines, Inc	Box 43 Lordsburg, N. Mex 88045	Underground mine	Hidalgo	Gold, silver, zinc.	
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	Open pit mine, mill, precipitation plant, smelter, and refinery.	Grant	Gold, silver, molybdenum, rhenium.	Flotation mill, precipitation plant, blister and fire-refined copper.
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	Open pit and underground mines, and mill.	----do	Gold, silver, zinc.	Continental and Continental No. 1 mines; new 3,000-ton-per-day flotation mill at Fierro.
Gold:					
Diversified Mines, Inc	Box 43 Lordsburg, N. Mex. 88045	*See* Copper	Hidalgo	Silver, copper, zinc.	
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	----do	Grant	Silver, copper, molybdenum, rhenium.	
Gypsum:					
White Mica Gypsum Co.	312 Val Verde S. E. Albuquerque, N. Mex. 87108	Open-pit mine	Sandoval		
Helium:					
Bureau of Mines	Shiprock, N. Mex. 87420	Plant	San Juan		Extraction plant.
Iron ore:					
Dotson Minerals Corp	Box 115 Socorro, N. Mex. 87801	Open pit mine, tailings and plant.	Lincoln, Socorro		Magnetic upgrading plant at Carrizozo.
Lead:					
The New Jersey Zinc Co	160 Front Street New York, N.Y. 10038	*See* Zinc	Socorro	Gold, silver, copper, zinc.	
Manganese concentrates:					
Goret & Aguilar, Inc	Box 32 Socorro, N. Mex. 87801	Underground mine and mill.	----do		Jigging plant.
Maganiferous ore:					
Luck Mining Co	215 Market Street San Francisco, Calif. 94105	Open pit mine	Grant		

Mica:					
Mineral Industrial Commodities of America, Inc.	Box 2403 Santa Fe, N. Mex. 87501	Open pit mine and plant.	Taos		Dry grinding plant.
Molybdenum:					
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	*See* Copper	Grant	Gold, silver, copper, and rhenium.	Molybdenum recovery circuit at Hurley mill.
Molybdenum Corporation of America.	280 Park Avenue New York, N.Y. 10017	Open pit mine and mill.	Taos		Flotation mill.
Perlite:					
Grefco, Inc	630 Shatto Place Los Angeles, Calif. 90005	Open pit mine and plant.	Taos		Crushing, screening, air-separation plant.
Johns-Manville Perlite Corp	Lompoc, Calif. 93436	----do	----do		Do.
United Perlite Corp	Box 367 Antonito, Colo. 81120	----do	----do		Do.
United States Gypsum Co	101 South Wacker Drive Chicago, Ill. 60606	----do	----do		Do.
Potash:					
Duval Corp	Box 511 Carlsbad, N. Mex. 88220	Three undergound mines and refinery.	Eddy		Refinery flotation and fractional crystallization.
International Minerals & Chemical Corp.	Box 71 Carlsbad, N. Mex. 88220	Underground mine and refinery.	----do		Do.
Kermac Potash Co	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	----do	----do		Do.
National Potash Co	Box 731 Carlsbad, N. Mex. 88220	Two underground mines and refinery.	Eddy, Lea		Do.
Potash Company of America, a division of Ideal Basic Industries, Inc.	Box 31 Carlsbad, N. Mex. 88220	Underground mine and refinery.	Eddy		Do.
Southwest Potash Corp	Box 279 Carlsbad, N. Mex 88220	----do	----do		Do.
United States Borax & Chemical Corp.	3075 Wilshire Road Los Angeles, Calif. 90005	----do	----do		Do.
Pumice:					
General Pumice Corp	Box 449 Santa Fe, N. Mex. 87501	Open pit mine and plant.	Rio Arriba		Crushing and screening plant.
Twin Mountian Rock Co	Box 917 Sheridan, Wyo. 82801	----do	Union		
Salt:					
New Mexico Salt Co	Box 303 Carlsbad, N. Mex. 88220	Tailings recovery and plant.	Eddy		Salt recovered from potash tailings.
The Salt Supply Co., Inc	Drawer SS Carlsbad, N. Mex. 88220	----do	----do		Do.
Sand and gravel (commercial):					
Albuquerque Gravel Products Co.	Box 1352 Albuquerque, N. Mex. 87103	Pit and plant	Bernalillo		Stationary crushing and screening plant.
Allison & Haney, Inc	Box 649 Albuquerque, N. Mex. 87103	Three pits and plant	Bernalillo, Rio Arriba, San Juan.		One pit in each county. One portable crushing and screening plant.
Springer Corp	Box 572 Albuquerque, N. Mex. 87103	Pit and plant	Bernalillo		Stationary crushing and screening plant.
Silver:					
Diversified Mines, Inc	Box 43 Lordsburg, N. Mex. 88045	*See* Copper	Hidalgo	Gold, copper, zinc.	

Table 18.—Principal producers and processing plants in 1967 [1]—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Silver—Continued					
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	*See* Copper	Grant	Gold, copper, molybdenum, rhenium.	
The New Jersey Zinc Co	160 Front Street New York, N.Y. 10038	*See* Zinc	Grant, Socorro	Gold, copper, lead, zinc.	
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	do	Grant	do	
Stone:					
Ideal Cement Co	620 Denver National Bldg. Denver, Colo. 80202	Quarry and plant	Bernalillo	Cement, clay	Stationary crushing and screening plant.
Kennecott Copper Corp., Chino Mines Division.	Hurley, N. Mex. 88043	do	Grant		Do.
Rose Gravel Co	301 West Wood Avenue Carlsbad, N. Mex. 88220	do	Eddy		Do.
Uranium:					
The Anaconda Company	Box 638 Grants, N. Mex. 87020	Open pit mine and mill.	Valencia		Acid-leach process mill.
Foote Mineral Co., (Vanadium Corporation of America)	200 Park Avenue New York, N.Y. 10017	*See* Vanadium	San Miguel	Vanadium	
Homestake Sapin Partners	Box 98 Grants, N. Mex. 87020	One open pit mine, 4 underground mines, mill.	McKinley		Alkaline-leach process mill; mine water product recovery operation.
Kerr-McGee Corp	Box 218 Grants, N. Mex. 87020	Six underground mines and mill.	do	Molybdenum	Acid-leach process mill; mine water product recovery operation.
United Nuclear Corp	Box 1537 Sante Fe, N. Mex. 87501	Five underground mines.	Valencia		
Vanadium:					
Foote Mineral Co., (Vanadium Corporation of America)	200 Park Avenue New York, N.Y. 10017	Three underground mines and plant.	San Miguel	Uranium	Acid-leach process mill.
Ray L. Williams	Box 536 Little Water, N. Mex. 87420	Underground mine	San Juan	do	
Zinc:					
The New Jersey Zinc Co	160 Front Street New York, N.Y. 10038	One underground open pit mine, 2 underground mines, mill.	Grant, Socorro	Gold, silver, copper and lead.	Flotation mill at Hanover, underground open pit mine in Grant County, 1 underground in Grant County and 1 in Socorro County.
United States Smelting, Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	Underground mine and mill.	Grant	Gold, silver, copper, and lead.	Princess mine; flotation mill at Bayard.

[1] Natural gas and petroleum producers are not included; most of the major oil and gas companies and many smaller ones 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]

Value of mineral production in New York declined slightly from the record high of $301 million in 1966. Commodities declining substantially in output and value were cement, iron ore, and zinc. There were substantial increases in output and value for lime, petroleum, salt, and sand and gravel. The quantity of stone decreased but its value increased over $2 million. Construction activity increased significantly in highways, bridges, and related construction, but decreased for buildings both residential and nonresidential. The State continued to rank first nationally in production of garnet, talc, and wollastonite, and to be a major producer of zinc, cement, gypsum, salt, sand and gravel, and stone.

Trends and Developments.—Programs to study the State's water resources continued to receive top priority, with special emphasis on water pollution control. Water standard specifications for maximum pollutants were established and accepted. The U. S. Geological Survey and the U. S. Army Corps of Engineers continued studies on water resources, drainage, and pollution abatement in estuaries, river basins, and lake regions.

[1] Mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in New York [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays—thousand short tons	1,464	$1,726	1,506	$1,814
Emery—short tons	11,102	210	W	W
Gem stones	NA	10	NA	10
Gypsum—thousand short tons	559	2,998	570	3,118
Lead (recoverable content of ores, etc.)—short tons	1,097	332	1,653	463
Lime—thousand short tons	1,096	9,870	1,139	10,570
Natural gas—million cubic feet	2,699	837	3,837	1,201
Peat—short tons	27,211	250	23,053	232
Petroleum (crude)—thousand 42-gallon barrels	1,735	7,925	1,972	9,026
Salt—thousand short tons	4,980	36,203	5,320	41,568
Sand and gravel—do	41,903	43,091	43,500	44,499
Silver (recoverable content of ores, etc.) thousand troy ounces	22	28	31	48
Stone—thousand short tons	34,130	54,543	33,389	56,615
Zinc (recoverable content of ores, etc.)—short tons	73,454	21,302	70,555	19,534
Value of items that cannot be disclosed: Abrasive garnet, cement, iron ore, talc, titanium concentrate, wollastonite and data indicated by symbol W	XX	r 121,482	XX	110,620
Total	XX	r 300,807	XX	299,318
Total 1957–59 constant dollars	XX	284,347	XX	p 281,098

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

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

County	1966	1967	Minerals produced in 1967 in order of value
Albany	W	W	Cement, stone, clays, sand and gravel.
Allegany	W	W	Sand and gravel.
Broome	$1,348,617	$1,936,301	Sand and gravel, stone, clays.
Cattaraugus	1,393,400	1,804,500	Sand and gravel, peat.
Cayuga	861,866	794,080	Stone, sand and gravel.
Chautauqua	227,000	W	Sand and gravel.
Chemung	W	W	Do.
Chenango	335,000	W	Do.
Clinton	W	W	Iron ore, stone, sand and gravel.
Columbia	W	W	Cement, stone, sand and gravel, clays.
Cortland	784,000	721,000	Sand and gravel.
Delaware	W	W	Stone, sand and gravel.
Dutchess	W	W	Stone, sand and gravel, clays.
Erie	14,560,533	14,741,410	Cement, stone, lime, sand and gravel, gypsum, clays.
Essex	W	W	Iron ore, ilmenite, wollastonite, sand and gravel, stone, garnet.
Franklin	309,465	W	Stone, sand and gravel.
Fulton	204,000	187,000	Sand and gravel.
Genesee	3,348,383	3,061,984	Stone, gypsum, sand and gravel.
Greene	17,286,207	18,322,899	Cement, stone, sand and gravel, clays.
Herkimer	W	W	Stone, sand and gravel.
Jefferson	W	W	Do.
Lewis	W	W	Do.
Livingston	W	W	Salt, sand and gravel, stone.
Madison	854,992	866,515	Stone, sand and gravel.
Monroe	4,595,122	4,994,090	Stone, sand and gravel, gypsum.
Montgomery	W	W	Stone, sand and gravel.
Nassau	4,813,500	3,916,250	Sand and gravel, clays.
Niagara	4,266,497	3,969,076	Lime, stone.
Oneida	2,947,000	3,222,000	Stone, sand and gravel.
Onondaga	W	W	Salt, lime, stone, cement, sand and gravel, clays.
Ontario	1,491,395	1,770,760	Sand and gravel, stone.
Orange	1,616,320	1,518,300	Sand and gravel, stone, clays, peat.
Orleans	W	W	Sand and gravel.
Oswego	579,000	571,000	Do.
Otsego	W	W	Do.
Putnam	W	W	Do.
Rensselaer	1,298,450	1,257,140	Sand and gravel, stone.
Richmond	----------	W	Sand and gravel.
Rockland	6,288,000	7,601,598	Stone, sand and gravel.
St. Lawrence	43,159,479	39,448,170	Zinc, iron ore, talc, stone, lead, sand and gravel, silver.
Saratoga	909,426	1,236,332	Stone, sand and gravel.
Schenectady	W	W	Sand and gravel.
Schoharie	W	W	Cement, stone, clays, sand and gravel.
Schuyler	W	W	Salt, sand and gravel.
Seneca	322,663	W	Stone, peat.
Steuben	W	684,000	Sand and gravel.
Suffolk	4,511,000	4,471,000	Do.
Sullivan	W	W	Stone, sand and gravel.
Tioga	356,000	441,000	Sand and gravel.
Tompkins	W	W	Salt, stone, sand and gravel.
Ulster	16,384,204	17,189,004	Cement, stone, clays, sand and gravel.
Warren	7,194,616	6,503,804	Cement, garnet, stone, sand and gravel.
Washington	925,768	943,452	Stone, sand and gravel.
Wayne	655,744	694,060	Do.
Westchester	917,982	885,536	Stone, emery, sand and gravel, peat.
Wyoming	W	W	Salt, stone.
Yates	7,000	8,000	Sand and gravel.
Undistributed [3]	r 156,054,800	155,559,242	
Total [4]	r 300,807,000	299,318,000	

r Revised.
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 do not add to totals shown because of independent rounding.

Table 3.—Indicators of New York business activity

		1966	1967	Change (percent)
Personal income:				
Total	millions	$63,669.0	p $68,315.0	+7.3
Per capita		$3,497.0	$3,726.0	+6.5
Construction activity:[1]				
Construction contracts	millions	$3,960.0	$3,917.0	−1.1
Nonresidential building	do	$1,822.0	$1,729.0	−5.1
Residential building	do	$1,285.0	$1,214.0	−5.5
Nonbuilding construction	do	$852.0	$974.0	+14.3
Cement shipments to and within New York	thousand 376-pound barrels	17,822.0	p 17,604.0	−1.2
Mineral production	thousands	r $300,807	$299,318	−.5
Annual average labor force and employment:				
Total labor force	do	7,585.0	7,715.0	+1.7
Unemployment	do	330.0	315.0	−4.5
Employment:				
Construction	do	260.3	259.9	−.2
Durable goods	do	905.9	899.6	−.7
Stone, clay, and glass products	do	50.3	48.9	−2.8
Primary metals	do	82.9	79.7	−3.9
Fabricated metal products	do	98.3	95.8	−2.5
Miscellaneous durable goods	do	674.4	675.2	+.1
Nondurable goods	do	1,018.3	1,008.7	−1.0
Mining	do	9.5	9.2	−3.2
Petroleum refining and retail industries	do	10.3	10.3	-------
Total nonagricultural	do	6,904.8	7,005.7	+1.5

p Preliminary.
[1] F. W. Dodge Division, McGraw-Hill Information Systems Co.

Sources: Bureau of Mines; U.S. Department of Labor, Division of Employment Security; New York State Department of Labor, Division of Employment.

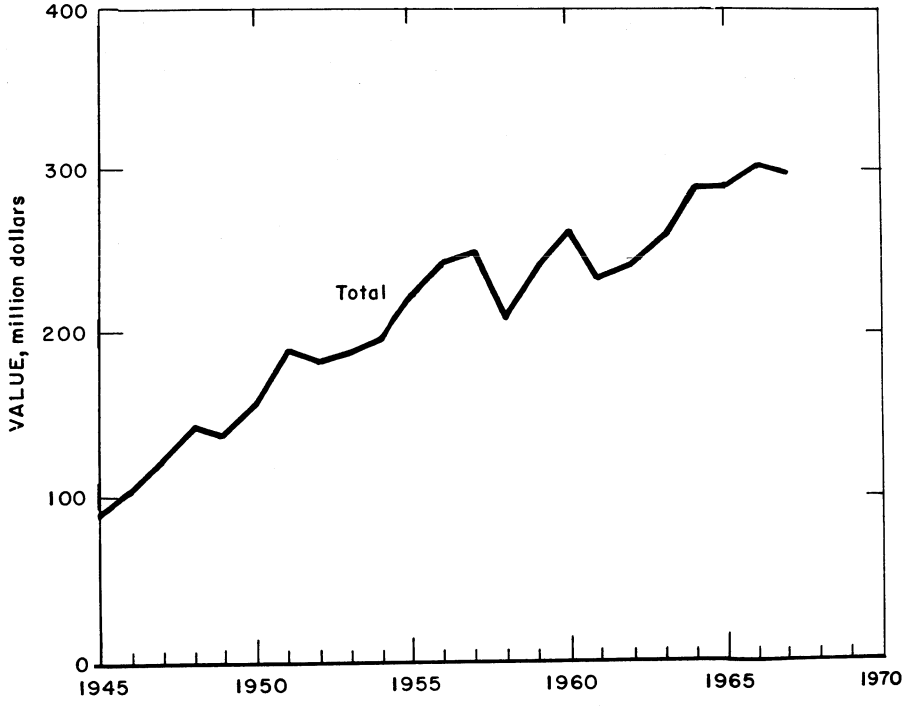

Figure 1.—Total value of mineral production in New York.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Peat	11	191	2	17	----	----	----	----
Metal	1,668	279	465	3,732	4	48	13.93	9,508
Nonmetal	2,396	258	617	4,992	2	124	25.24	3,141
Sand and gravel	2,378	211	501	4,144	2	88	21.72	3,418
Stone	3,683	267	985	8,106	2	126	15.79	2,411
Total	10,136	254	2,570	20,991	10	386	18.86	4,043
1967:[p]								
Peat	11	188	2	17	----	----	----	----
Metal	1,565	266	417	3,334	----	39	11.70	384
Nonmetal	2,040	252	514	4,224	----	117	27.70	766
Sand and gravel	2,175	204	444	3,716	1	76	20.72	2,088
Stone	3,585	251	901	7,420	----	96	12.94	579
Total [1]	9,375	243	2,278	18,711	1	328	17.58	886

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

The Georgia–Pacific Corp. announced plans to build a gypsum wallboard manufacturing plant on the east bank of the Hudson River at Buchanan, Westchester County. Gypsum ore for the new plant will be imported from Nova Scotia.

Amax Specialty Metals, Inc., a subsidiary of American Metal Climax, Inc., expanded capacity for manufacture of zirconium seamless tubing by 50 percent at its plant in Akron.

The major salt companies continued development work in underground operations and in well fields.

Exploratory and development work for oil and gas continued but at a decreased rate compared with 1966 operations.

Zoning restrictions are reducing opportunities for mineral extracting activities in urban areas. For example, at Gates, Monroe County, Dolomite Products Corp. was restricted to the use of only one of three parcels of land for quarrying. In Westchester County, emery quarrying has been reduced because of zoning litigation.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—Aluminum oxide was fused and silicon carbide was made in electric furnaces by two producers in Niagara County. Applications of the finished products include abrasives, refractories, and nonabrasive uses.

Metallic abrasives were produced by two operators in Erie County. Types of output were chilled iron shot and grit, annealed iron shot and grit, and cut wire shot.

Cement.—Although shipments of all types of cement decreased 7 percent in both quantity and value compared with those of 1966 cement ranked first among the State's mineral industries in value. New York continued to rank fifth in production among the cement producing States. The average price of portland cement, which accounted for 97 percent of the cement value, dropped $0.02, to 2.61 per barrel. Shipments of masonry cement decreased, and the average prices of masonry cement declined $0.15, to $2.21 per barrel. Twelve plants were in operation of which 10 were in eastern and two in western New York. Seven plants produced both portland and masonry cement, and five produced portland cement exclusively. One plant discontinued production of natural cement because of quality problems. The Lone Star Cement plant in Columbia County closed in October. Eight counties reported cement production; Greene County ranked first, followed by Albany, Ulster, and Columbia Counties.

The principal raw materials for manufacturing portland cement were cement rock and limestone, of which a total of 7.3 million tons was used. Other raw materials included clay and shale (326,000 tons), gypsum (190,000 tons), sand (34,000 tons), and iron bearing materials (24,000 tons). Air-entraining compounds, grinding aids, bauxite and other materials were also used. Cement plants consumed 665 million kilowatt-hours of electrical energy of which 99 percent was purchased and 1 percent was generated by the cement companies. Atlantic Cement Co. Inc., Albany County, started using a new shale deposit in lieu of slag and clay as they had previously.

Of the combined portland and masonry cement shipped, 45 percent was consumed within the State. New England received 33 percent of the shipments. More than 9,000 barrels of New York cement was exported.

Ready-mixed concrete companies were the leading customers, purchasing 60 percent of the portland cement shipped. Other large customers included concrete product manufacturers, building material dealers, and highway and other contractors. Cement was shipped by truck (70 percent), by railroad (19 percent), and by boat (11 percent). Bulk shipments composed 94 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. Nearly 2 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 about three-fourths of the output. Yearend stocks of portland cement were 4 percent less than those of 1966.

The following quarry operations by cement producers received citations from the National Safety Competition for having had no disabling injuries during 1967: Catskill Quarry, Alpha Portland Cement Co., Cementon, Greene County; Alsen Quarry, Lehigh Portland Cement Co., Cementon, Greene County; Catskill Quarry, Marquette Cement Manufacturing Co., Catskill, Greene County; and Howes Cave 6H Quarry, Penn-Dixie Cement Corp., Howes Cave, Schoharie County.

Clays.—Overall clay production increased 3 percent more than 1966 quantities mainly because of the increased output from Ulster County, where the lightweight aggregate industry is centered. For other miscellaneous clay and shale producers, portland and mortar cement manufacturers enjoyed an increase of over 20 percent, but building brick usage declined by 8 percent. Special clays produced for pottery and abrasive bonding amounted to about the same as 1966 output, and altogether accounted for less than 0.5 percent of the total clays produced. The leading counties, in decreasing order of tonnage of clay and shale produced, were Ulster and Albany in the East and Erie in the West.

Emery.—Three open pit mines in Westchester County were the producers for the entire United States. Total output and value decreased compared with 1966. levels. The quantity used for general abrasive purposes increased 3 percent, but the quantity used as aggregate for heavy duty nonslip floors and pavements decreased 22 percent.

Garnet.—Output of garnet decreased by a small percentage in quantity and value compared with that of 1966. Precisely sized garnet from an open pit mine in Warren County was sold for use in coated abrasives, glass grinding and polishing, and metal lapping. Garnet recovered as a by-product of wollastonite mining in Essex County was sold for use in sandblasting, coated abrasives, wire sawing, skidproof paints, and as an abrasive medium for tumbling semiprecious stones.

Gem Stones.—Except for garnet produced commercially, gem stones and mineral specimens were recovered principally by amateur mineral collectors.

Graphite (Manufactured).—Manufactured graphite was produced at Niagara Falls in Nigara County by four processors, all divisions of major corporations.

Gypsum.—The quantity of crude gypsum produced was 2 percent greater than in 1966, but the total value was 4 percent greater. The average price per ton increased $0.10 to $5.47. Output came from five underground mines, three in Erie County and one each in Genesee and Monroe Counties. Most of the crude gypsum was calcined at company-owned plants for use in manufacturing building material. Some crude gypsum was used as a retarder

in portland cement. Calcining was done at seven plants located in Bronx, Erie (2), Genesee, Monroe, Richmond, and Rockland Counties. Uses for calcined gypsum other than in building materials were in manufacturing plate glass, pottery, planters, industrial molding, and art and coating plasters.

The Akron Mine, Bestwall Gypsum Division, Georgia-Pacific Corp., Akron, Erie County, received a citation from the National Safety Competition for having had no disabling work injuries in the Underground-Nonmetal Group during 1967.

Table 5.—Crude gypsum production

(Thousand short tons and thousand dollars)

Year	Active mines	Quantity	Value
1963	5	647	$3,339
1964	5	653	3,321
1965	5	662	3,511
1966	5	559	2,998
1967	5	570	3,118

Lime.—Production of lime in Onondaga, Niagara, and Erie Counties, increased 4 percent over that of 1966 and the value increased 7 percent. Bethlehem Steel Corp. operated its lime plant in Erie County to supply quick-lime for its basic oxygen furnaces at Lackawanna. All other quicklime output 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. Among the lime-producing States New York ranked sixth in quantity and seventh in value.

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 filler material, loose fill insulation, soil conditioner, lightweight concrete aggregate, and filtering.

Salt.—Production of salt increased 7 percent in quantity over that of 1966 and the value increased 15 percent. The greater relative increase in value was mainly because of a $0.78 per ton increase in value for rock salt. The value per ton decreased for evaporated salt but increased for brine salt. The State ranked fourth in production and third in value among the salt-producing States. There was greater production of evaporated and rock salt, but there was slightly less output of brine salt than in 1966. The most important uses for evaporated salt, based on tonnage, was for manufacturing chlorine and other chemicals. An almost equivalent use was for food processing and seasoning. The principal use for rock salt was for highway ice control in the Northeastern States. A large quantity of rock salt was also used in the manufacture of chemicals. 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.

Table 6.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	4,782	$34,228
1964	4,816	34,216
1965	5,002	35,771
1966	4,980	36,203
1967	5,320	41,568

Sand and Gravel.—Production of sand and gravel increased 4 percent over that of 1966. The average price decreased by $0.01 to $1.02 per ton. Commercial sand output decreased 1.1 million tons. Government-and-contractor operations production increased by 200,000 tons. However, both commercial and government gravel outputs increased 2.5 million tons chiefly for increased paving and filling demands. There were 289 commercial operations and many other locations operated by construction companies working on various Federal, State, county, and local government contracts. Three operations had production in excess of 1 million tons and nine exceeded 500,000 tons. Production from these nine large operators comprised 29 percent of the commercial output. There were 123 small pits in operation, each producing less than 25,000 tons, which accounted for 4 percent of the total commercial output.

Bank-run (unprocessed) sand and gravel amounted to 22 percent of the total output. More than 1 million tons each was reported from Suffolk, Nassau, Broome, Cattaraugus, Dutchess, Oneida, Monroe, Erie, and Ontario Counties in decreasing order of tonnage.

The following sand and gravel plants received citations from the National Safety Competition for having had no disabling work injuries during 1967: The Alfred Station Plant, Buffalo Slag Co., Alfred Station, Allegany County; Barneveld Plant, Eastern Rock Products, Oneida; Boonville Plant, Eastern Rock Products, Oneida; J. J. Harrington Plant, Cayuga; Clifton Springs Plant, DeWitt Concrete Corp., Ontario.

Stone.—Total stone production decreased 2 percent, but the total value increased 4 percent more than in 1966. Stone was the second most valuable mineral commodity produced in the State. Most of the decrease in production was in crushed limestone but an increase in price per ton of crushed limestone contributed to the total increase in value. Dutchess County ranked first in value among the State's 38 stone-producing counties, followed by Rockland, Onondaga, and Erie. Sixteen

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	10,253	$11,774	9,960	$11,823
Paving	4,003	4,331	3,260	4,189
Fill	1,441	1,167	1,406	746
Molding	187	768	W	W
Filtration	19	45	W	W
Other	566	556	524	482
Undistributed [1]	39	57	245	885
Total	16,508	18,698	15,395	18,125
Gravel:				
Building	4,755	6,905	4,969	7,395
Paving	3,659	4,706	4,217	4,804
Fill	1,670	973	2,704	1,656
Undistributed [2]	561	487	643	508
Total	10,645	13,071	12,533	14,363
Total sand and gravel	27,153	31,769	27,928	32,488
Government-and-contractor operations:[3]				
Sand:				
Building	90	135	94	141
Paving	679	449	626	440
Fill	2,766	1,151	2,975	1,238
Other	617	332	637	320
Total	4,152	2,067	4,332	2,139
Gravel:				
Paving	5,819	6,334	6,483	6,885
Fill	4,705	2,892	4,636	2,936
Other	74	29	121	51
Total	10,598	9,255	11,240	9,872
Total sand and gravel	14,750	11,322	15,572	12,011
All operations:				
Sand	20,660	20,765	19,727	20,264
Gravel	21,243	22,326	23,773	24,235
Total	41,903	43,091	43,500	44,499

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes railroad ballast (1966), foundry sand, and engine sand.
[2] Includes railroad ballast and other gravel.
[3] Includes data for State, counties, municipalities, and other Government agencies.

Table 8.—Sand and gravel production by Government-and-contractor operations, by counties

(Thousand short tons)

County	1966	1967	County	1966	1967
Allegany	10	29	Montgomery	6	9
Broome	23	98	Oneida	161	257
Cattaraugus	73	104	Onondaga	468	273
Cayuga	3	25	Ontario	56	32
Chautauqua	190	265	Orange	56	56
Chemung	11	26	Orleans	12	3
Chenango	30	97	Oswego	83	100
Clinton	31	16	Otsego	68	52
Columbia	9	17	St. Lawrence	133	100
Cortland	------	20	Saratoga	47	36
Delaware	33	19	Schenectady	------	7
Dutchess	58	78	Schoharie		3
Essex	137	8	Schuyler	39	28
Franklin	150	93	Steuben	122	151
Fulton	19	--------	Suffolk	------	9
Genesee	17	27	Sullivan	------	5
Herkimer	21	66	Tioga	3	3
Jefferson	142	268	Washington	------	26
Lewis	27	96	Wayne	100	119
Livingston	8	8	Yates	19	22
Monroe	4	--------	Undistributed [1]	12,381	12,921
			Total	14,750	15,572

[1] Includes data unspecified by counties.

counties had stone industries with output valued in excess of $1 million.

Crushed limestone was the predominant type in the State, accounting for 89 percent of the tonnage and 83 percent of the value of all stone produced. Limestone was mined in 30 counties, of which nine reported output exceeding 1 million tons each. The chief uses for crushed limestone were as an aggregate material and for the manufacture of cement and lime. Other uses included agricultural stone, riprap, railroad ballast, asphalt filler, fluxing stone, and whiting. A small quantity of dimension limestone was produced in Niagara and Onondaga Counties.

The following limestone quarries received citations from the National Safety Competition for having had no disabling work injuries during 1967: Plant No. 1, Callanan Road Improvement Co., Albany County; Stafford Quarry, Genesee Stone Products Corp., Genesee County; Jamesville Quarry, Industrial Chemical Division, Allied Chemical Corp., Onondaga County; Oriskany Falls Quarry, Eastern Rock Products, Inc., Oneida County; Tomkins Cove Quarry, Rock Industries Division, Martin Marietta Corp., Rockland County; Norwood Quarry, Agricultural Division, Allied Chemical Corp., St. Lawrence County; and South Lansing Quarry, Cayuga Crushed Stone, Inc., Tompkins County.

Basalt (traprock) was the second-ranking stone and was produced only in Rockland County. Output increased 16 percent over that of 1966. The chief uses were for concrete aggregate, road metal, riprap, and railroad ballast. The West Nyack Quarry, New York Trap Rock Corp., Rockland County, received a citation from the National Safety Competition for having had no disabling work injuries during 1967.

Sandstone was quarried and marketed as dimension stone as well as crushed stone, and continued to rank third in tonnage and value in the State. Output decreased 14 percent, but the value remained essentially the same. Production was reported from seven counties, led by Delaware and Sullivan.

Marble was quarried in Dutchess, Westchester, and St. Lawrence Counties, but none was produced for use as dimension stone. Output was crushed and ground for a variety of uses, mostly for filling and for agriculture.

Slate was quarried and prepared for use as flagging, roofing, and structural stone in Washington County. Output of slate was 22 percent less than in 1966, but value decreased only 4 percent. Granite was quarried and dressed in Essex and Westchester Counties for building stone. Crushed granite from Warren and Westchester Counties

Table 9.—Crushed and broken limestone sold or used by producers by uses

(Thousand short tons and thousand dollars)

Use	1966		1967	
	Quantity	Value	Quantity	Value
Riprap	234	$352	264	$525
Concrete aggregate and roadstone	19,311	33,049	19,895	35,804
Agricultural	515	1,857	371	1,376
Railroad ballast	540	863	244	383
Cement	7,926	6,712	6,890	6,141
Miscellaneous uses, including fluxing stone and lime	2,134	2,926	1,951	2,597
Total	30,660	45,759	29,615	46,826

was used principally for roadstone. Dimension stone granite increased in volume and value over that of 1966 while crushed granite decreased 41 percent in output and 18 percent in value. Overall granite production decreased 31 percent in quantity and increased 17 percent in value. Miscellaneous stone, reported from Rensselaer and Clinton Counties, increased 22 percent in tonnage and 16 percent in value; it was used mostly for roadstone and concrete aggregate.

Talc.—The quantity and value of talc mined was less than in 1966. However, New York continued to be the leading talc-producing State. Two companies mined talc from three underground mines and one open cut 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 paint. Small quantities were used in floor and wall tiles, rubber, and as a minerial filler in other products.

Vermiculite.—Crude vermiculite mined in other States was exfoliated at a plant in Weedsport, Cayuga County. The expanded material was used for loose fill insulation, agriculture, ultralightweight concrete aggregate, and building plaster aggregate.

Wollastonite.—Crude wollastonite was mined and beneficiated at the Willsboro Mine in Essex County by the Oxides Division, Cabot Corp. The operation received a citation from the National Safety Competition in the Underground-Nonmetal Group for having had no disabling work injuries during 1967. The refined material was used as a filler in paints and plastics and as an ingredient in ceramic products.

METALS

Aluminum.—Production of primary aluminum from the Massena plants, St. Lawrence County, of Aluminum Company of America and Reynolds Metals Co., increased slightly in both tonnage and value over than of 1966. The State continued to rank fourth in aluminum production.

Iron Ore.—Mine production of magnetite iron ore decreased 9 percent from two underground mines, one each in Essex and Clinton Counties, and two open pit mines, one each in Essex and St. Lawrence Counties. One underground mine at Chateaugay, Clinton County, operated by Republic Steel Corp. closed permanently June 30. Production of concentrates decreased 14 percent, but mill concentrate stocks still increased. All of the ore was beneficiated, and most of the concentrates were agglomerated before shipment. Shipments were principally for use in the manufacture of pig iron and steel, but some quantities were also used for the manufacture of cement, for heavy media separation, and for ballast.

Lead.—Sharply increased quantities of lead were recovered as a byproduct of zinc mining at the Balmat mine in St. Lawrence County. Production and value increased 51 percent and 40 percent, respectively, compared with 1966. Recovery of lead has varied 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's lead smelter at Herculaneum, Mo.

Silver.—The quantity of silver recovered from lead concentrates shipped

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)	
1963	3	594,245	19,544	$25	$1,009	$218	53,495	$12,304	$12,547
1964	2	683,494	13,306	17	732	192	60,754	16,525	16,734
1965	2	788,961	11,441	15	601	188	69,880	20,405	[1] 20,607
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

[1] Data do not add to total due to rounding.

from the Balmat mine, St. Lawrence County, was 44 percent greater than that of 1966; the value increased 73 percent. Silver recovery, however, usually reflects the demand for silver-free lead rather than the silver content of the concentrate. The average value of silver rose from $1.29 per ounce in 1966 to $1.55 per ounce in 1967.

Table 11.—Mine production of silver, lead, and zinc, in 1967, by months, in terms of recoverable metals

Month	Silver (troy ounces)	Lead (short tons)	Zinc (short tons)
January	1,986	99	5,840
February	2,065	111	5,328
March	2,408	118	5,594
April	2,754	134	5,824
May	2,431	125	6,089
June	2,414	132	6,015
July	2,452	129	5,957
August	2,457	135	6,629
September	2,649	142	6,105
October	2,868	161	6,135
November	3,061	171	5,286
December	3,558	196	5,753
Total	31,103	1,653	70,555

Titanium Concentrate (Ilmenite).—Ilmenite concentrate was recovered as a coproduct of magnetite from an opencut titaniferous-magnetite deposit near Tahawus, Essex County. Shipments and value were 5 percent less than those of 1966. The output was used principally in the manufacture of titanium dioxide pigment.

Zinc.—New York ranked second to Tennessee in U.S. zinc production. Production, all from the Balmat and Edwards mines in St. Lawrence County, decreased 4 percent in output and 8 percent in value. St. Joseph Lead Co. reported progress in sinking the No. 4 shaft at Balmat. The 18-foot-diameter circular shaft, designed for a depth of 3,180 feet, was started in 1966 and reached 1,302 feet in 1967. The shaft will provide access to a new ore body discovered in 1966 and also will permit efficient mining of previously developed reserves. Sufficient additional ore will reportedly be made available to double Balmat's capacity by the early 1970's.

MINERAL FUELS

Natural Gas.—According to the Geological Survey, New York State Museum and Science Service, the production of natural gas increased 42 percent to 3.8 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 96 billion cubic feet was in underground storage reservoirs. The reserves were essentially the same as at the end of 1966. Natural gas was stored underground in eight counties by five companies; rated storage capacity was 101.8 billion cubic feet ultimate.[2] The Oil and Gas Journal[3] reported that Mobile Oil Corp., had capacity to store 631,000 barrels of liquefied petroleum gas (propane, 422,000 barrels; butane, 209,000 barrels) in Steuben County; Suburban Propane Gas Corp. had capacity to store 400,000 barrels of propane in Cortland County; Texas Eastern Transmission Corp. had capacity to store 800,000 barrels of propane in Schuyler County. These storage facilities were in underground caverns mined in salt. In addition, Texas Eastern Transmission Corp. had inground refrigerated storage capacity for 600,000 barrels of liquid natural gas in Richmond County (Staten Island).

[2] Oil and Gas Journal. V. 65, No. 42, Oct. 16, 1967, p. 124.
[3] Oil and Gas Journal. V. 66, No. 22, May 27, 1968, p. 136.

Brooklyn Union Gas Co. had capacity for storing 175,000 barrels of liquid natural gas above ground in Kings County, (Brooklyn).

Peat.—Sales of peat decreased 15 percent in quantity and 7 percent in value from those in 1966. The value per ton increased to $10.06. The peat was used mainly for general soil improvement, but some was used for potting soils, in packing flowers and plants, etc. Orange County was the leading producing area; output also reported from Cattaraugus, Westchester, and Seneca Counties. Bulk shipments accounted for only 53 percent of production. Active operations involved 105 acreas containing indicated reserves of 1.1 million tons.

Petroleum.—Production of crude oil increased 14 percent compared with that of 1966. Wells in the Cattaraugus field, Cattaraugus County, yielded 65 percent of the total; the remainder came from the Allegany field in Allegany and Steuben Counties, and the Busti pool in Chautauqua County. Average prices for crude oil at the well head were $4.63 per barrel in Cattaraugus County, and ranged from $4.35 to $4.53 in other areas. Proved reserves of crude oil at yearend were 8.2 million barrels according to estimates of the American Petroleum Institute.

Table 12.—Marketed production of natural gas

(Million cubic feet and thousand dollars)

Year	Quantity	Value	Average value (cents per thousand cubic feet)
1963	3,962	$1,169	29.5
1964	3,108	963	31.0
1965	3,340	1,029	30.8
1966	2,699	837	31.0
1967	3,837	1,201	31.3

Table 13.—Petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value	Average value per barrel
1963	1,679	$7,707	$4.59
1964	1,874	8,321	4.44
1965	1,632	7,246	4.44
1966	1,735	7,925	4.57
1967	1,972	9,026	4.58

Table 14.—Oil and gas well drilling and total crew-weeks spent in geophysical oil and gas prospecting in 1967

County	Drilling								Geophysical crew-weeks	
	Proved field wells			Exploratory wells			Total			
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage	Gravity Meter method	Reflection seismograph method
Allegany	46	6	-----	-----	-----	1	53	76,117	-----	-----
Broome	---	-----	-----	-----	1	-----	1	2,593	-----	-----
Cattaraugus	51	2	4	-----	-----	5	62	92,473	-----	-----
Cayuga	---	-----	-----	-----	-----	2	2	7,836	-----	-----
Chautauqua	56	3	1	-----	2	4	66	49,400	-----	-----
Erie	---	2	-----	-----	-----	-----	2	3,318	-----	-----
Genesee	---	1	-----	-----	1	2	4	10,322	-----	-----
Livingston	---	-----	-----	-----	-----	1	1	1,687	-----	-----
Ontario	---	-----	1	-----	1	-----	2	3,438	-----	-----
Orleans	---	-----	-----	-----	-----	5	5	12,940	-----	-----
Oswego	---	-----	-----	-----	-----	1	1	2,550	-----	-----
Seneca	---	-----	-----	-----	-----	1	1	4,152	-----	-----
Steuben	---	2	1	-----	2	2	7	29,912	4	3
Wayne	---	-----	-----	-----	-----	4	4	15,093	-----	-----
Ulster and Orange	---	-----	-----	-----	-----	-----	-----	-------	-----	2
Total	153	16	7	-----	7	28	211	311,831	4	5

Source: American Association of Petroleum Geologists and International Oil Scouts Association.

Table 15.—Principal producers

Commodity and company	Type of activity	County	Address	Remarks
Abrasives:				
Artificial:				
The Carborundum Co., Electro Mineral Division.	Plant	Niagara	P.O. Box 423 Niagara Falls, N.Y.	
General Abrasive Co., Inc	do	do	Niagara Falls, N.Y.	
Metallic:				
Cleveland Metal Abrasive Co., Division of Fanner Manufacturing Co.	do	Erie	Brookside Park Cleveland, Ohio	
Pellets, Inc	do	do	533 S. Niagara St. Tonawanda, N.Y.	
Cement:				
Alpha Portland Cement Co	do	Greene	15 South Third St. Easton, Pa.	Also crushed limestone, shale.
Do	do	Onondaga	do	
Atlantic Cement Co., Inc	do	Albany	300 Park Ave. New York, N.Y.	Do.
Century Cement Manufacturing Co	do	Ulster	Rosendale, N.Y.	
Glens Falls Portland Cement Co., Division of The Flintkote Co.	do	Warren	313 Warren St. Glens Falls, N.Y.	Also crushed limestone.
Hudson Cement Division Colonial Sand and Stone Co., Inc.	do	Ulster	1740 Broadway New York, N.Y.	Do.
Lehigh Portland Cement Co	do	Erie	718 Hamilton St. Allentown, Pa.	Do.
Do	do	Greene	do	
Lone Star Cement Corp	do	Columbia (closed in October)	P.O. Box 6237 Richmond, Va.	Do.
Marquette Cement Manufacturing Co	do	Greene	20 N. Wacker Dr. Chicago, Ill.	Also crushed limestone, clay.
Penn-Dixie Cement Corp	Plant	Schoharie	P.O. Box 152 Nazareth, Pa.	Also crushed limestone, shale.
Universal Atlas Cement Co., Division, United States Steel Corp.	do	Columbia	Chatham Center Pittsburgh, Pa.	Do.
Clays (miscellaneous):				
Beacon Brick Corp	Pit	Dutchess	P.O. Box 407 Beacon, N.Y.	
Binghamton Brick Co., Inc	do	Broome	P.O. Box 1216 Binghamton, N.Y.	
Hamburg Shale Co., Inc	do	Erie	38 Main St. Hamburg, N.Y.	
Hudson Lightweight Stone Division Colonial Sand and Stone Co., Inc.	do	Ulster	1740 Broadway New York, N.Y.	
Hudson Valley Lighweight Aggregate Corp	do	do	P.O. Box 437 Mount Marion, N.Y.	
The Jova Brick Works	do	Orange	Roseton, N.Y.	
The Nassau Brick Co., Inc	do	Nassau	P.O. Box 160 Farmingdale, L.I., N.Y.	
Nytralite Aggregate, Inc., Division New York Trap Rock Corp.	do	Ulster	162 Old Mill Rd. W. Nyack, N.Y.	
Powell and Minnock Brick Works, Inc	do	Albany	Coeymans, N.Y.	

Emery:				
De Luca Emery Mine, Inc	----do	Westchester	926 Constant Ave. Peekskill, N.Y.	
Di Rubbo American Emery Ore	----do	----do	Locust Ave. Peekskill, N.Y.	
Peekskill Emery Co	----do	----do	R.D. 2, Route 82 Fishkill, N.Y.	
Garnet:				
Barton Mines Corp	Pit	Warren	North Creek, N.Y.	
Graphite (synthetic):				
The Carborundum Co., Graphite Products Division.	Plant	Niagara	2050 Cory Dr. Sanborn, N.Y.	
Great Lakes Carbon Corp., Graphite Products Divi ion.	----do	----do	299 Park Ave. New York, N.Y.	
Speer Carbon Co., International Graphite & Electrode Division.	----do	----do	Packard Rd. Niagara Falls, N.Y.	
Union Carbide Corp., Carbon Products Division.	----do	----do	270 Park Ave. New York, N.Y.	
Gypsum:				
Crude:				
General Aniline & Film Corp., Ruberoid Division.	Underground	Monroe	South Bound Brook, N.J	Also calcined gypsum.
Georgia-Pacific Corp., Bestwell Gypsum Division.	----do	Erie	Commonwealth Bldg. Portland, Oreg.	Also calcined gypsum, expanded perlite.
National Gypsum Co	----do	----do	325 Delaware Ave. Buffalo, N.Y.	Do.
United States Gypsum Co	----do	Genesee	101 S. Wacker Dr. Chicago, Ill.	Do.
Universal Atlas Cement Co., Division, United States Steel Corp.	----do	Erie	Chatham Center Pittsburgh, Pa.	
Calcined:				
National Gypsum Co	Plant	Bronx	325 Delaware Ave. Buffalo, N.Y.	Also expanded perlite.
United States Gypsum Co	----do	Richmond	101 S. Wacker Dr. Chicago, Ill.	Do.
Do	----do	Rockland	----do	Do.
Iron ore:				
Jones & Laughlin Steel Corp	Pit	St. Lawrence	Star Lake, N.Y.	
Republic Steel Corp	Underground	Clinton	1629 Republic Bldg. Cleveland, Ohio	Also misc. stone. Closed perm. 6/30/67.
Do	----do	Essex	----do	
Lime:				
Bethlehem Steel Corp	Plant	Erie	701 E. Third St. Bethlehem, Pa.	
Union Carbide Corp	----do	Niagara	P.O. Box 299 Marietta, Ohio	
Lime (regenerated):				
International Paper Co	----do	Essex	220 East 42nd St. New York, N.Y.	
Do	----do	Niagara	North Tonawanda, N.Y.	

Table 15.—Principal producers—Continued

Commodity and company	Type of activity	County	Address	Remarks
Natural gas:				
Consolidated Gas Supply	Well	Allegany	Two Gateway Center Pittsburgh, Pa.	
Do	Well	Chemung	Two Gateway Center Pittsubrgh, Pa.	
Do	----do	Livingston	----do	
Do	----do	Madison	----do	
Felmont Oil Corp	----do	Cattaraugus	701 Hooker-Fulton Bldg. Bradford, Pa.	
Iroquois Gas Corp	----do	----do	10 Lafayette Square Buffalo, N.Y.	
Do	----do	Chautauqua	----do	
Do	----do	Erie	----do	
Reserve Gas Corp	----do	----do		
Do	----do	Genesee		
Peat:				
Finger Lakes Peat Moss Co	Bog	Seneca	P.O. Box 286 Geneva, N.Y.	
Mt. Bethel Humus Co., Inc	----do	Orange	1270 Broadway New York, N.Y.	
Sterling Forest Peat Co., Inc	----do	----do	P.O. Box 146 Ruxedo, N.Y.	
Stone Age Humus Corp	----do	Westchester	Armonk, N.Y.	
Sue Peat Co	----do	Cattaraugus	Allegany, N.Y.	
Perlite (expanded):				
Buffalo Perlite Corp	Plant	Erie	100 Sugg Rd. Buffalo, N.Y.	
Petroleum:				
Crude:				
Bradley Producing Corp	Well	Various	313 N. Main St. Wellsville, N.Y.	
DYM Oil Corp	----do	Allegany	Box 550 Olean, N.Y.	
Ebenezer Oil Co	----do	Various	85 N. Main St. Wellsville, N.Y.	
Kendall Refining Co., Division of Witco Chemical Co.	----do	----do	77 N. Kendall Ave. Bradford, Pa.	
Pennzoil Co., Pennzoil United	----do	Cattaraugus	900 Southwest Tower Houston, Tex.	
Richardson Petroleum Corp	----do	Various	Box 109 Wellsville, N.Y.	
Vosburg Oil Co	----do	----do		
Refinerics:				
Mcbil Oil Co	Plant	Erie	Buffalo, N.Y.	
Frontier Oil Refining Corp., Division Ashland Oil & Refining Co.	----do	----do	Tonawanda, N.Y.	
Salt:				
Evaporated:				
International Salt Co	Well	Schuyler	Clarks Summit, Pa.	

Morton Salt Co	----do	Wyoming	110 N. Wacker Dr. Chicago, Ill.	
The Watkins Salt Co., Inc	----do	Schuyler	Box 150 Watkins Glen, N.Y.	Also brine.
Rock:				
Cayuga Rock Salt Co., Inc	Underground	Tompkins	191 Portland Pt. Rd. Myers, N.Y.	
International Salt Co	----do	Livingston	Clarks Summit, Pa.	
Brine:				
Industrial Chemicals Division Allied Chemical Corp.	Well	Onondaga	P.O. Box 70 Morristown, N.J.	Also evaporated salt, crushed limestone.
Sand and gravel:				
Albany Gravel Co., Inc	Pit	Rensselaer	N. Pearl St. and Loudonville Rd. Albany, N.Y.	
Barney & Dickenson, Inc	----do	Broome	Vestal, N.Y.	
Clarence Sand & Gravel Corp	----do	Erie	Ransom and Stage Rds. Clarence N.Y.	
Colonial Sand and Stone Co., Inc	----do	Nassau	1740 Broadway New York, N.Y.	
Country Side Sand & Gravel, Inc	----do	Cattaraugus	South Dayton, N.Y.	
Elmira Transit Mix, Inc	----do	Chemung	Box 231 Easton, Pa.	
Bob Murphy, Inc	----do	Broome	Vestal, N.Y.	
Penn Industries, Inc	----do	Nassau	136 East 57th St. New York, N.Y.	
Pine Hill Concrete Mix Corp	----do	Erie	2255 Bailey Ave. Buffalo, N.Y.	
Steers Sand & Gravel Corp	----do	Suffolk	17 Battery Place New York, N.Y.	
Suffolk Dredging Corp	Dredge	Suffolk	136 East 57th St. New York City, N.Y.	
West Hills Silica Sand Mining Corp	Pit	----do	P.O. Box 62 Farmingdale, L.I., N.Y.	
Smelters (aluminum):				
Aluminum Company of America	Plant	St. Lawrence	1501 Alcoa Bldg. Pittsburgh, Pa.	
Reynolds Metals Co	----do	----do	6601 Broad Street Rd. Richmond, Va.	
Stone:				
Basalt (crushed):				
New York Trap Rock Corp	Quarry	Rockland	162 Old Mill Rd. W. Nyack, N.Y.	
Rock Industries Division Martin Marietta Corp.	----do	----do	18 New Hempstead Rd. New City, N.Y.	Also crushed limestone.
Rockland Materials Corp	----do	----do	P.O. Box 57 Suffern, N.Y.	
Granite (dimension):				
Di Rienzo Brothers	----do	Westchester	107 Main St. Tuckahoe, N.Y.	
Frank Baratta, P. D'Amato and Angelo Cucchiella, T/A Dunwoodie Stone Quarry, Inc.	----do	----do	941 Midland Ave. Yonkers, N.Y.	
Lake Placid Granite Co	----do	Essex	St. Cloud, Minn.	
Lake Street Granite Quarry, Inc	----do	Westchester	Lake Street E. White Plains, N.Y.	Also crushed.

Table 15.—Principal producers—Continued

Commodity and company	Type of activity	County	Address	Remarks
Stone—Continued				
Granite (crushed):				
Northern Materials, Inc	Quarry	Warren	Route 9 Chestertown, N.Y.	
Limestone (dimension):				
Brickyard Falls Farm	----do	Onondaga	R.D. No. 2 Manlius, N.Y.	
Frontier Stone Products, Inc	----do	Niagara	Box 376 Lockport, N.Y.	Also crushed.
Limestone (crushed):				
Buffalo Crushed Stone Co	----do	Erie	10 Park Place Morristown, N.J.	
Callanan Road Improvement Co	----do	Albany	South Bethlehem, N.Y.	
Do	----do	Ulster	Do.	
Dolomite Products Co	----do	Monroe	1150 Penfield Rd. Rochester, N.Y.	Also sand and gravel.
Eastern Rock Products, Inc	----do	Oneida	404 Court St. Utica, N.Y.	Do.
Federal Crushed Stone Corp	----do	Erie	111 Great Arrow Ave. Buffalo, N.Y.	
The General Crushed Stone Co	----do	Onondaga	712 Drake Bldg. Easton, Pa.	
New York Trap Rock Corp	----do	Dutchess	162 Old Mill Rd. W. Nyack, N.Y.	
Niagara Stone Division of Great Lakes Color Printing Corp.	----do	Niagara	Quarry Rd. Niagara Falls, N.Y.	
Marble (crushed):				
Balducci Crushed Stone Co	----do	St. Lawrence	Box 158 Gouverneur, N.Y.	
New York Limestone Corp	Quarry and underground.	Dutchess	50 Haarlem Ave. White Plains, N.Y.	
Universal Marble Products Corp	Quarry	Westchester	Thornwood, N.Y.	
Miscellaneous (crushed):				
Fitzgerald Bros. Construction Co., Inc	----do	Rensselaer	504 Broadway Troy, N.Y.	
Sandstone (dimension):				
Adirondak Stone Quarries, Inc	----do	Franklin	P.O. Box 184 Malone, N.Y.	Quartzite.
American Blue Stone Co	----do	Wyoming	Portageville, N.Y.	
Downsville Stone Co	Processor	Delaware	1 Dock St. Stamford, Conn.	c/o MSR, Inc.
Finger Lakes Stone Co., Inc	Quarry	Tompkins	Box 401 Ithaca, N.Y.	
Willis Hankins	----do	Delaware	Hancock, N.Y.	
Johnston & Rhodes Bluestone Co	----do	----do	East Branch, N.Y.	
W. R. Strong & Son	Processor	----do	43 Wheeler St. Deposit, N.Y.	
Paul Tompkins Estate	----do	----do	Hancock, N.Y.	

Sandstone (crushed):				
Cooney Brothers	Quarry	----do	129 Main St. Tarrytown, N.Y.	
Corbisello Quarries	----do	Broome	Ingraham Hill Rd. Binghamton, N.Y.	
Sullivan Highway Products Co	----do	Sullivan	P.O. Box 392 Monticello, N.Y.	
Slate (dimension):				
Darius Slate Products	Quarry	Washington	Middle Granville, N.Y.	
A. A. Hadeka Quarry	----do	----do	49 South St. Poultney, Vt.	
Jurnak Bros. Slate Co	----do	----do	Granville, N.Y.	
Mc Cullen Slate Co	----do	----do	R.D. 1 Granville, N.Y.	
The A. B. Potter Slate Co. Inc	----do	----do	Poultney, Vt.	
Ritchie Brothers Slate Co	----do	----do	Middle Granville, N.Y.	
Vermont Structural Slate Co., Inc	----do	----do	Prospect St. Fair Haven, Vt.	
Western Slate Co	--do	----do	Box 104 Granville, N.Y.	
Williams Bros. Slate Co	----do	----do	Middle Granville, N.Y.	
Zayacheck Brothers	----do	----do	11 Factory St. Granville, N.Y.	
Talc:				
Gouverneur Talc Co., Inc	Underground	St.Lawrence	Gouverneur, N.Y.	
International Talc Co., Inc	----do	----do	420 Lexington Ave. New York, N.Y.	
Titanium concentrate:				
Ilmenite:				
National Lead Co	Pit	Essex	111 Broadway New York, N.Y.	Also iron ore.
Vermiculite (exfoliated):				
Zonolite Division, W. R. Grace & Co	Plant	Cayuga	62 Whittemore Ave. Cambridge, Mass.	
Wollastonite:				
Cabot Corp., Oxides Division	Underground	Essex	Willsboro, N.Y.	Also garnet.
Zinc:				
St. Joseph Lead Co	----do	St. Lawrence	250 Park Ave. New York, N.Y.	Also lead, 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 V. A. Danielson [1] and Stephen G. Conrad [2]

The mineral industry of North Carolina continued to grow in 1967, contributing $77 million to the State's economy, an increase of about $5 million or 7 percent over that of 1966. The increase was due almost entirely to increased stone production. The principal commodities mined, in order of decreasing value, were stone, sand and gravel, phosphate rock, feldspar, lithium minerals, mica, clay, and talc. Stone production was dominant, contributing 53 percent of the total. 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 production of feldspar, mica, and lithium minerals, second in olivine, and fourth in talc.

[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.

Table 1.—Mineral production in North Carolina [1]

Mineral		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Barite	short tons	------	------	500	$6
Clays [2]	thousand short tons	3,381	$2,241	2,977	2,012
Feldspar	long tons	301,610	3,157	265,690	3,113
Gem stones		NA	15	NA	25
Mica:					
Scrap	short tons	63,480	2,348	69,639	1,751
Sheet	pounds	4,500	1	4,500	W
Sand and gravel	thousand short tons	11,601	11,132	10,014	9,962
Stone	do	[3] 22,377	[3] 36,136	24,507	41,488
Talc and pyrophyllite	short tons	113,366	576	109,393	513
Value of items that cannot be disclosed: Asbestos, cement, clay (kaolin), lithium minerals, olivine, phosphate rock, stone (crushed and dimension marble and dimension slate)		XX	16,272	XX	18,224
Total		XX	71,878	XX	77,094
Total 1957–59 constant dollars		XX	r 69,286	XX	p 74,267

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 kaolin; 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 North Carolina, by counties [1]

County	1966	1967	Minerals produced in 1967 in order of value
Alamance	W	W	Granite, miscellaneous clay, pyrophyllite.
Alexander	W	$20,000	Sand and gravel.
Alleghany	W	W	Traprock, granite.
Anson	W	W	Sand and gravel.
Ashe	W	W	Sand and gravel, granite.
Avery	W	W	Mica, kaolin, sand and gravel.
Beaufort	W	W	Phosphate rock, sand and gravel.
Bertie	$2,000	5,000	Sand and gravel.
Bladen	238,000	131,000	Do.
Brunswick	37,000	51,000	Do.
Buncombe	W	W	Granite, sand and gravel.
Burke	W	W	Do.
Cabarrus	941,847	W	Traprock, granite, sand and gravel.
Caldwell	W	W	Sand and gravel, granite.
Camden	8,000	5,000	Sand and gravel.
Carteret	3,000	4,000	Do.
Caswell	W	W	Granite, sand and gravel.
Catawba	W	W	Granite, miscellaneous clay, sand and gravel.
Chatham	380,811	W	Miscellaneous clay, granite, traprock.
Cherokee	W	W	Marble, talc.
Chowan	2,000	4,000	Sand and gravel.
Clay	W	W	Sand and gravel, limestone.
Cleveland	W	W	Lithium minerals, limestone, mica, granite, feldspar, sand and gravel.
Columbus	59,000	26,000	Sand and gravel.
Craven	W	W	Limestone, sand and gravel.
Cumberland	W	W	Sand and gravel, miscellaneous clay.
Currituck	8,000	16,000	Sand and gravel.
Dare	3,000	3,000	Do.
Davidson	W	W	Traprock, sand and gravel, slate, miscellaneous clay.
Davie	23,000	16,000	Sand and gravel.
Duplin	17,000	20,000	Do.
Durham	W	W	Traprock, miscellaneous clay.
Edgecombe	167,000	136,000	Sand and gravel.
Forsyth	W	W	Granite, sand and gravel.
Franklin	2,000	4,000	Sand and gravel.
Gaston	W	44,000	Do.
Gates	6,000	9,000	Do.
Granville	----------	7,000	Do.
Greene	21,000	16,000	Do.
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	Granite, sand and gravel.
Henderson	W	W	Limestone, granite, miscellaneous clay.
Hertford	6,000	6,000	Sand and gravel.
Hoke	5,000	17,000	Do.
Hyde	1,000	2,000	Do.
Iredell	W	W	Granite, sand and gravel.
Jackson	W	W	Granite, olivine.
Johnston	W	W	Traprock, sand and gravel, miscellaneous clay.
Jones	12,000	8,000	Sand and gravel.
Lee	639,000	374,600	Miscellaneous clay, sand and gravel.
Lenoir	W	W	Sand and gravel.
Lincoln	W	W	Granite, sand and gravel.
Macon	235,584	W	Granite, sand and gravel, mica.
Madison	W	6,000	Barite.
Martin	4,000	2,000	Sand and gravel.
McDowell	W	W	Sand and gravel, granite.
Mecklenburg	W	W	Granite.
Mitchell	3,208,792	3,362,225	Feldspar, mica, sand and gravel, sandstone.
Montgomery	W	W	Sandstone, miscellaneous clay, sand and gravel, slate.
Moore	W	W	Granite, sand and gravel, pyrophyllite.
Nash	W	W	Granite.
New Hanover	W	W	Cement, limestone, miscellaneous clay, sand and gravel.
Northampton	W	W	Sand and gravel.
Onslow	W	W	Limestone, sand and gravel.
Orange	W	W	Pyrophyllite, granite.
Pamlico	1,000	3,000	Sand and gravel.
Pasquotank	12,000	29,000	Do.
Pender	17,000	34,000	Do.

See footnotes at end of table.

Table 2.—Value of mineral production in North Carolina, by counties [1]—Continued

County	1966	1967	Minerals produced in 1967 in order of value
Perquimans	$5,000	$6,000	Sand and gravel.
Person	1,000	3,000	Do.
Pitt	W	W	Granite, sand and gravel.
Polk	W	W	Do.
Randolph	W	W	Granite.
Richmond	16,000	10,000	Sand and gravel.
Robeson	89,000	234,000	Do.
Rockingham	W	W	Granite, miscellaneous clay, sand and gravel.
Rowan	W	W	Do.
Rutherford	W	W	Granite, sand and gravel.
Sampson	17,000	40,200	Miscellaneous clay, sand and gravel.
Scotland	24,000	10,000	Sand and gravel.
Stanly	347,810	284,000	Miscellaneous clay.
Stokes	W	144,000	Miscellaneous clay, sand and gravel.
Surry	W	W	Granite, traprock, sand and gravel.
Swain	102,340	147,611	Limestone.
Transylvania	5,000	3,000	Sand and gravel.
Union	W	W	Traprock, miscellaneous clay, sand and gravel.
Vance	W	W	Granite, sand and gravel.
Wake	W	W	Do.
Washington	2,000	4,000	Sand and gravel.
Watauga	W	W	Do.
Wayne	36,000	76,000	Do.
Wilkes	W	W	Granite, sand and gravel.
Wilson	W	W	Do.
Yadkin	5,000	W	Do.
Yancey	W	W	Mica, olivine, sand and gravel, asbestos.
Undistributed	65,167,816	71,771,364	
Total	71,878,000	77,094,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] The following counties are not listed because no production was reported: Graham, Tyrrell, and Warren

The key economic indicators showed a moderate increase, in general. Total personal income increased over that of 1966 but remained less than the National average. Construction activity, as measured by value of building permits and contracts awarded by the State Highway Commission, increased considerably; however, employment in construction was down slightly from that of 1966. Employment in the entire manufacturing sector of the economy increased but less than the National average.

Trends and Developments.—A new company, Teledyne Titanium, was formed by Teledyne, Inc., to concentrate on development, manufacture, and sale of titanium base alloys. Alloy bars will be produced at the new plant in Monroe, N. C., and shipped to the company's Armetco plant in Ohio for fabrication into titanium wire products.

Tennessee Copper Co. was seeking leases for exploratory drilling on 2,400 acres of land in Alleghany County.

The Ranchers Exploration and Development Corp., of Albuquerque, N. M., obtained an option to purchase the Hamme tungsten mine, near Townsville, in northeastern Vance County. The property contains proven and probable reserves of about 1 million tons of tungsten oxide ore.

The Farmers Chemical Association, Chattanooga, Tenn., announced plans to build a $32 million fertilizer plant at Tunis, Hertford County. The plant will utilize air, water, natural gas, and other material in the manufacture of fertilizer.

The Aluminum Company of America put into operation a second 50,000-ton-per-year potline at its Badin smelter, Stanly County.

A new plant for the production of lightweight concrete aggregate from fly ash was planned by the Nello L. Teer Co., of Durham.

Lone Star Cement Corp. acquired a controlling interest in Carolina Lightweight Aggregate Company. The latter company's product is distributed throughout the Carolinas and into Virginia and other bordering States.

Legislation and Government Programs.—A legislative measure bringing North Carolina into the Interstate Mining Com-

Table 3.—Selected indicators of North Carolina business activity

		1966	1967	Change (percent)
Personal income:				
Total	millions	$11,321	$12,049	+6.4
Per capita		$2,277	$2,396	+5.2
Construction activity:				
Value of building permits	thousands	$174,891	$199,259	+13.9
State Highway Commission:				
Value of contracts awarded	do	$112,671	$138,193	+22.7
Cement shipments to North Carolina	thousand 376-pound barrels	7,126	7,417	+3.9
Cash receipts from farm marketings	millions	$1,295	$1,361	+5.1
Factory payrolls	do	$2,662	$2,795	+5.0
Mineral production	do	$71.9	$77.1	+7.2
Annual average labor force and employment:				
Total labor force	thousands	2,039	2,081	+2.1
Unemployment	do	65	71	+8.7
Employment	do	1,974	2,010	+1.8
Construction	do	94	92	−2.0
Lumber and wood products	do	31	29	−5.3
Food products	do	38	39	+2.9
All manufacturing	do	646	666	+3.1
Total non-farm wage and salary	do	1,533	1,584	+3.4
New business incorporations		3,265	3,530	+8.1
Sales of electric energy	thousands	$26,301	$28,976	+10.1
Export trade	millions	$170.2	$164.5	−3.4
Import trade	do	$177.5	$175.5	−1.1

Source: U.S. Department of Commerce.

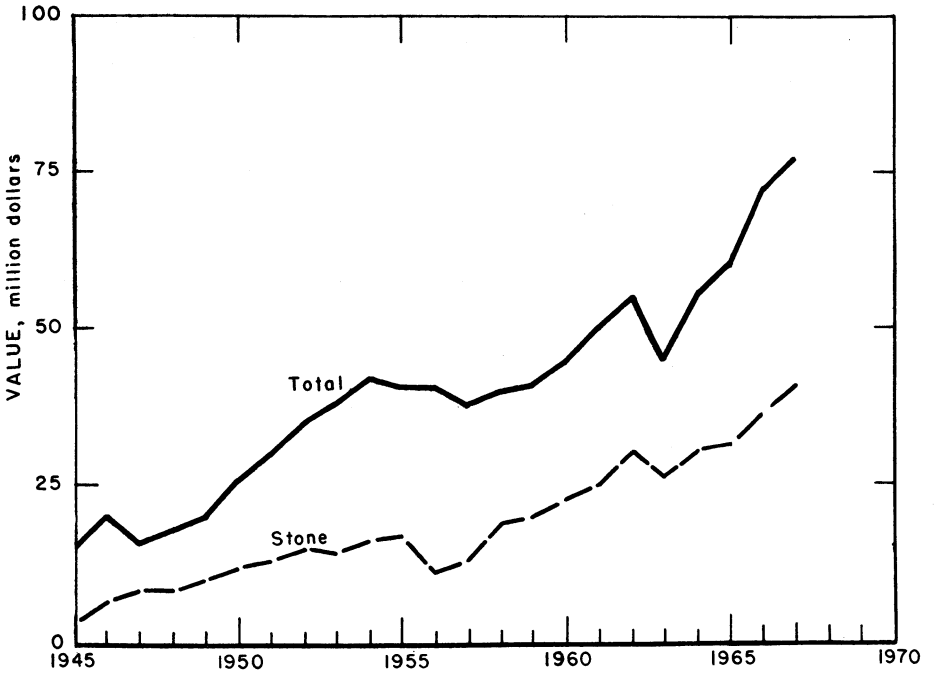

Figure 1.—Value of stone and total value of mineral production in North Carolina.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Metal	2	----	[1]	[1]	----	----	----	----
Nonmetal	1,751	261	457	3,696	----	84	22.73	679
Sand and gravel	1,040	218	227	1,924	----	33	17.15	416
Stone	1,983	243	481	3,995	----	65	16.27	4,358
Total [2]	4,776	244	1,166	9,615	----	182	18.93	2,155
1967: [p]								
Metal	[3]	----	[1]	[1]	----	----	----	----
Nonmetal	1,740	245	426	3,417	----	109	31.90	1,139
Sand and gravel	835	232	193	1,733	----	52	30.01	631
Stone	1,900	254	483	4,020	2	55	14.18	3,480
Total	4,475	246	1,102	9,170	2	216	23.77	2,069

[p] Preliminary.
[1] Less than 500.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than 5.

pact was enacted in June. The compact is an organization of State governments which coordinates and drafts proposals for control of surface mining.

At yearend, 420.6 miles of North Carolina's Interstate Highway System was open to traffic. Work was in progress on an additional 334.3 miles, and work had not yet started on the remaining 15.3 miles.

A pilot desalination plant at Wrightsville Beach, Hanover County, was planned by the Reynolds Metals. The project is founded by a research contract with the Department of Interior, Office of Saline Water.

Duke University was the recipient of a $37,500 grant from the U.S. Geological Survey to search for and study the distribution of gold and other heavy metals on the continental shelf off the coast of North Carolina.

The North Carolina Department of Water and Air Resources published a report on the effect of phosphate mining on the ground-water resources of the Coastal Plain of North Carolina.[3]

REVIEW BY MINERAL COMMODITIES

NONMETALS

The mineral production of the State consisted entirely of nonmetals; no metals or fuels were produced.

Asbestos.—Amphibole asbestos was mined by Powhatan Mining Co. near Burnsville, Yancey County. Output decreased slightly from that of 1966.

Barite.—A small quantity of barite was produced by Fluid Power Pump Co. near Stackhouse, Madison County. This was the first recorded production of barite in the State since 1961.

Cement.—Production of portland cement at the Castle Hayne plant of Ideal Cement Co., New Hanover County, remained virtually unchanged from 1966. Production had been increasing steadily since 1963 when the plant was placed in operation. Three types of portland cement were produced; general use, moderate heat, and low heat. Of the total shipments of portland cement, 51 percent was within the State, 33 percent was to Florida, 14 percent to South Carolina, and the remaining 2 percent to other States and foreign countries. Eighty percent of the masonry cement was shipped to points

[3] DeWiest, R. J. M., A. N. Sayre, and C. E. Jacob. Evaluation of Potential Impact of Phosphate Mining on Ground-Water Resources of Eastern North Carolina. North Carolina Dept. of Water and Air Resources, 1967, 167 pp.

Table 5.—Miscellaneous clay sold or used by producers, by counties

County	1966			1967		
	Number of mines	Short tons	Value	Number of mines	Short tons	Value
Catawba	1	126,000	W	1	W	W
Chatham	3	367,402	$250,038	3	308,486	$210,000
Davidson	1	70,000	21,000	1	W	W
Guilford	1	W	W	1	80,384	53,000
Halifax	2	83,140	W	1	W	W
Lee	3	549,109	377,000	4	477,500	325,600
Montgomery	1	13,413	9,000	2	W	W
Rockingham	2	204,000	W	2	W	W
Rowan	3	280,568	182,900	2	W	W
Sampson				1	30,540	20,200
Stanly	3	443,680	287,000	3	428,680	284,000
Stokes	1	W	W	1	193,663	128,000
Union	1	182,833	119,000	1	166,612	110,000
Undistributed [1]	10	1,060,567	995,113	8	1,290,796	881,277
Total	32	3,380,712	2,241,051	31	2,976,661	2,012,077

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Alamance, Cumberland, Durham, Harnett, Henderson, Johnston, Moore (1966), and New Hanover Counties, and counties indicated by symbol W.

within North Carolina, 15 percent to South Carolina, and the remaining 5 percent to other States. Bulk shipments were predominant: 51 percent by truck, 45 percent by railroad, and the remaining 4 percent by water. Sales of portland cement were to ready-mixed concrete companies (51 percent), highway contractors (25 percent), concrete product manufacturers (11 percent), and others (13 percent).

Clay.—The quantity of miscellaneous clay production decreased about 12 percent and value decreased about 10 percent. In 1967 there were 31 companies in the State mining miscellaneous clay for use in manufacturing lightweight aggregate, brick, vitrified sewer pipe, and other clay products.

Harris Mining Co., Avery County, was again the only producer of kaolin. Production increased 8 percent in quantity and 13 percent in value.

Feldspar.—Production of crude feldspar decreased 12 percent while value decreased 1 percent. Mixed and soda feldspars were the predominant types mined, but some potash type was also produced.

Sales of ground feldspar totaled 308,000 tons, a 9 percent decrease from 1966. Value was $3.1 million, a decrease of 1 percent. Ground feldspar was used mainly for glass and pottery with a small amount used in paint manufacture. Shipments of ground feldspar were made to Ohio (16 percent), Illinois (16 percent), Tennessee (10 percent), West Virginia (9 percent), Texas (7 percent), Indiana (6 percent), Pennsylvania (4 percent), Oklahoma (4 percent), and other States and foreign exports (28 percent).

Lithium.—The only production of spodumene was from the Kings Mountain operation of Foote Mineral Co. in Cleveland County. Production increased 14 percent in tonnage, and value increased 25 percent; both production and value have increased each year since 1962.

Mica.—Scrap mica production was 70,000 tons, an increase of 10 percent, however value was $1.8 million, 25 percent less than in 1966. Ten companies reported output from 13 mines, unchanged from 1966. Cleveland County, with four mines, accounted for 33 percent of the total value of mica production; Yancey County, with one mine, accounted for 26 percent; Mitchell County, with five mines, accounted for 21 percent; Avery and Macon Counties accounted for 20 percent. Ground mica output decreased 7 percent and value 10 percent. Eight mica grinders were active in 1967, one less than in 1966. Five of the operations used dry methods, two used wet methods, and one used both methods. Uses of the ground mica were roofing (41 percent), paint (15 percent), rubber (9 percent); the remaining 35 percent was used for wallpaper, plastic, well drilling, textile coating, and other uses. Production of sheet mica was unchanged at 4,500 pounds.

Table 6.—Ground mica sold or used by producers, by uses

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Roofing	18,491	$621,298	$33.60	19,872	$666,671	$33.55
Paint	8,700	1,155,985	132.87	7,324	979,369	133.72
Rubber	5,314	684,620	128.83	4,538	607,899	133.96
Plastics	503	68,400	135.98	570	76,115	133.54
Other uses [1]	19,159	1,016,778	53.07	16,385	862,014	52.61
Total	52,167	3,547,081	67.99	48,689	3,192,068	65.56

[1] Includes wallpaper, well drilling, textile coating (1967), and other uses.

Olivine.—Output of olivine increased 20 percent in tonnage and 21 percent in value. This set a new production record for the second consecutive year. The material was used for refractories, molding sand, and slag conditioner. Two mines were active in Jackson County and one in Yancey.

Perlite.—Carolina Perlite Co., Inc. expanded perlite at Gold Hill, Rowan County, using crude material from other States. Quantity and value remained about the same.

Phosphate Rock.—Production of phosphate rock at the Lee Creek fertilizer complex of Texas Gulf Sulphur Co., which went into production in April 1966, increased by about 58 percent. The first of two trains of the company's wet processs phosphoric acid plant, a key unit in the fertilizer manufacturing operation, was started up at the beginning of the year. The phosphoric acid plant has a designed capacity of 1,945 tons per day of 54 percent phosphoric acid and uses phosphate rock mined at Lee Creek and sulfur from Texas Gulf Sulphur's Frasch mines in Texas. The sulfuric acid plant is designed to produce 3,050 tons per day. Other units of the fertilizer plant complex produce diamonium phosphate, 720 tons per day capacity; triple superphosphate, 800 tons per day; and superphosphoric acid, 285 tons per day. All of the plants have been so designed that production can be readily increased by the addition of parallel facilities when needed. About half the phosphate rock mined is processed at the complex, and the remainder is sold.

Other companies having interests in the North Carolina phosphate field include: North Carolina phosphate Corp. a firm organized by Agrico Chemical Co., a division of Continental Oil Co. and Kennecott Copper Co.; Dresser Magcobar Division of Dresser Industries Inc., in which Borden Chemical Co., and Dresser Industries have an interest; and FMC Corp.

Sand and Gravel.—Sand and gravel continued to be the second leading mineral commodity produced in the State. Tonnage decreased 14 percent and value decreased by 11 percent from that of the previous year. Sand and gravel was produced in 81 of the State's 100 counties. Commercial sand and gravel was 66 percent of the total; the remainder was government-and-contractor production. There were 48 commercial and 72 government-and-contractor operations. The commercial operations provided all of the sand and gravel used for building purposes, 48 percent of that for paving, and 21 percent of that for railroad ballast, fill, and other purposes. Of the total construction sand and gravel, 68 percent was sand. Nine percent of the total sand and gravel was sold as unprocessed material. Industrial sand was less than 1 percent of the total and included blasting and filtration sand. Forty-eight companies produced sand and gravel in 1967, compared with 47 in 1966. Five of the 48 companies produced 60 percent of the tonnage of commercial sand and gravel; commercial pits were located in 29 counties. Transportation of commercial sand and gravel was 59 percent by truck and 41 percent by railroad.

Table 7.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1966			1967		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Alexander	1	34	$14	1	48	$20
Anson	4	W	W	4	1,946	W
Avery	1	43	30	2	W	W
Beaufort	1	124	39	1	142	43
Bertie	1	8	2	1	19	5
Bladen	1	395	238	1	202	131
Brunswick	1	55	37	1	75	51
Buncombe	7	776	W	2	W	W
Burke	3	85	W	3	W	W
Cabarrus	2	6	4	2	W	W
Caldwell	2	139	231	1	W	W
Camden	1	12	8	1	8	5
Carteret	1	10	3	1	12	4
Caswell	1	14	14	1	8	8
Catawba	1	65	28	1	55	23
Chowan	1	8	2	1	14	4
Cleveland	2	154	W	2	W	W
Columbus	1	101	59	1	31	26
Craven	2	57	W	2	94	W
Cumberland	2	308	W	2	350	W
Currituck	1	12	8	1	24	16
Dare	1	4	3	1	5	3
Davidson	1	357	179	1	358	179
Davie	1	36	23	1	24	16
Duplin	2	25	17	2	28	20
Edgecombe	4	188	167	3	141	136
Forsyth	2	112	138	2	W	W
Franklin	1	4	2	1	9	4
Gaston	2	W	W	2	70	44
Gates	1	9	6	1	13	9
Granville	----	----	----	1	4	7
Greene	1	67	21	1	54	16
Halifax	2	W	W	1	49	19
Harnett	4	1,924	2,194	4	1,987	2,211
Haywood	1	350	W	1	270	W
Hertford	1	22	6	1	25	6
Hoke	1	8	5	1	25	17
Hyde	1	5	1	1	8	2
Iredell	1	63	26	1	72	31
Johnston	1	32	33	1	37	37
Jones	1	40	12	1	28	8
Lee	1	275	262	1	80	49
Lincoln	1	69	34	1	61	30
Macon	----	----	----	1	89	90
Martin	1	14	4	1	10	2
McDowell	3	106	72	4	51	42
Mitchell	2	274	W	3	202	177
Montgomery	1	48	52	1	20	8
Moore	6	541	317	6	523	327
Nash	1	65	26	----	----	----
New Hanover	----	----	----	1	5	3
Northampton	2	200	W	2	W	W
Onslow	1	15	10	1	25	17
Pamlico	1	3	1	1	10	3
Pasquotank	1	18	12	1	42	29
Pender	1	25	17	1	50	34
Perquimans	1	7	5	1	9	6
Person	1	1	1	1	2	3
Pitt	3	146	77	3	200	98
Polk	1	118	61	1	16	6
Randolph	1	11	5	----	----	----
Richmond	1	27	16	1	16	10
Robeson	1	145	89	1	368	234
Rockingham	1	3	3	1	2	2
Rowan	1	55	28	1	53	26
Rutherford	1	111	44	1	106	42
Sampson	1	25	17	1	30	20
Scotland	1	30	24	1	13	10
Stokes	1	48	32	1	25	16
Surry	2	35	47	1	1	2
Transylvania	1	W	W	1	2	3
Union	1	48	36	1	49	37
Vance	----	----	----	1	4	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	1966			1967		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Wake	1	2	$2	1	6	$4
Washington	1	7	2	1	16	4
Watauga	2	62	57	2	W	W
Wayne	2	44	36	2	99	76
Wilkes	1	22	20	1	7	11
Wilson	3	131	93	3	73	63
Yadkin	1	4	5	1	2	3
Yancey	4	108	117	2	W	W
Undistributed [1]	6	3,106	5,958	4	1,512	5,372
Total	128	11,601	11,132	120	10,014	9,962

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Ashe, Clay, Lenoir, and Madison (1966) Counties indicated by symbol W.

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

(Thousand short tons and thousand dollars)

Use	1966			1967		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Paving	3,363	$2,300	$0.68	2,656	$1,859	$0.70
Structural	2,376	2,023	.85	2,563	2,088	.81
Fill	996	616	.62	680	434	.64
Other sands [1]	428	213	.50	548	229	.42
Total	7,163	5,152	.72	6,447	4,610	.72
Gravel:						
Paving	2,643	2,865	1.08	1,989	2,140	1.08
Structural	1,116	1,698	1.52	901	1,652	1.83
Miscellaneous	W	W	W	604	1,488	2.46
Other gravel [2]	679	1,417	2.09	73	72	.99
Total	4,438	5,980	1.35	3,567	5,352	1.50
Total sand and gravel	11,601	11,132	.96	10,014	9,962	.99

W Withheld to avoid disclosing individual company confidential data; included with "Other gravel."
[1] Includes railroad ballast, blast, filtration, and other sands.
[2] Includes railroad ballast, fill, and miscellaneous (1966) gravel.

Stone.—Stone was the principal mineral commodity produced in the State, accounting for over half the total value of mineral output. Of the total stone production, crushed stone accounted for 99 percent of the tonnage and 92 percent of the value. Production of all types of crushed stone, except limestone, showed substantial increases over that of 1966. Crushed granite production increased 15 percent in tonnage and 16 percent in value; crushed marble, 6 percent and 33 percent; crushed sandstone, 51 percent and 28 percent; crushed traprock, 8 percent and 11 percent. Crushed limestone production decreased 10 percent in tonnage and 5 percent in value. Dimension stone production also showed a substantial overall increase in tonnage and value with dimension granite production a major part of the total, increasing 20 percent in tonnage and 41 percent in value. Dimension slate production was unchanged, and dimension marble, a smaller segment of the industry, decreased 33 percent in tonnage and 23 percent in value. The overall increase in the production of stone can be related to certain economic indicators of

Table 9.—Crushed granite sold or used by producers, by counties

County	1966			1967		
	Number of quarries	Short tons	Value	Number of quarries	Short tons	Value
Alleghany	1	W	W	1	3,385	$5,077
Cabarrus	2	92,365	$138,547	1	98,370	147,555
Macon	1	173,846	217,300	1	146,318	146,318
Orange	1	18,885	28,330	1	11,125	16,700
Undistributed [1]	54	14,414,401	21,895,607	58	16,652,932	25,581,806
Total	59	14,699,497	22,279,784	62	16,912,130	25,897,456

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes Alamance, Alexander (1966), Ashe, Buncombe, Burke, Caldwell, Caswell, Catawba, Chatham (1967), Cleveland (1967), Forsyth, Gaston (1966), Guilford, Halifax (1967), Haywood, Henderson (1967), Iredell, Jackson, Lincoln, McDowell, Mecklenburg, Moore (1967), Nash, Pitt, Polk, Randolph, Rockingham, Rowan, Rutherford, Surry, Vance, Wake, Watauga (1966), Wilkes, Wilson, Yadkin (1967), and counties indicated by symbol W.

construction activity (table 3) such as the value of building permits and the value of contracts awarded by the State Highway Commission which increased 14 percent and 23 percent, respectively.

Stone was quarried in 49 counties; granite in 39, traprock in 10, limestone in seven, slate in two, marble in one, and sandstone in one. Commercial stone, excluding quartz, was produced by 27 operators from 87 quarries, 65 granite quarries, nine limestone, eight traprock, two slate, two sandstone, and one marble. The State Highway Department crushed stone from four granite and two traprock quarries. Quartz was recovered as a byproduct of feldspar flotation in Mitchell County.

Talc and Pyrophyllite.—Talc and pyrophyllite production decreased 4 percent in tonnage and 11 percent in value. Talc was sawed into crayons and ground mainly for use in textiles and toilet preparations. Pyrophyllite was ground for use in ceramics, insecticides, paint, refractories, rubber, textiles, and toilet preparations. Talc was produced in Cherokee County and pyrophyllite in Alamance, Moore, and Orange Counties.

Vermiculite.—Lee-V-Lite, Inc., operated an exfoliating plant at Sanford, Lee County, and W. R. Grace & Co., operated another plant at High Point, Guilford County. Both companies used crude vermiculite shipped into the State. The finished product was used principally for loose fill insulation, concrete aggregate, agriculture, and building plaster aggregate.

Table 10.—Principal producers

Commodity and company	Name of operation	County	Address	Remarks
Aluminum: Aluminum Company of America	Badin smelter	Stanly	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	
Asbestos: Powhatan Mining Co	Burnsville mine	Yancey	6721 Windsor Mill Road Baltimore, Md. 21207	
Barite: Fluid Power Pump Co	Van Nest mine	Madison	Box 428 Hot Springs, N.C. 28743	
Cement:				
Masonry and portland:				
Ideal Cement Co	Castle Hayne mine	New Hanover	620 Denver National Bldg. Denver, Colo. 80202	
Clay:				
Kaolin:				
Harris Mining Co	Gusher Knob mine	Avery	Box 429 Spruce Pine, N.C. 28777	
Miscellaneous:				
Borden Brick & Tile Co	Durham mine	Durham	Box 896 Goldsboro, N.C. 27530	
Do	Sanford mine	Lee	----do----	
Boren Clay Products Co	Gulf mine	Chatham	Pleasant Garden, N.C. 27313	
Do	Pleasant Garden mine	Guilford	----do----	
Do	Roseboro mine	Sampson	----do----	
Carolina Solite Corp	Aquadale mine	Stanly	Box 9138 Richmond, Va. 23227	
Pine Hall Brick and Pipe Co	No. 1 mine	Stokes	Box 4325, North Station Winston-Salem, N.C. 27105	
Sanford Brick Corp	Gulf mine	Chatham	Box 38 Gulf, N.C. 27256	
Do	Colon mine	Lee	Drawer 458 Sanford, N.C. 27330	
Do	Norwood mine	Stanly	Box 205 Norwood, N.C. 28128	
Feldspar:				
The Feldspar Corp	Poteat mine	Mitchell	Spruce Pine, N.C. 28777	Also feldspar grinding, and scrap mica.
	Wiseman mine	----do----	----do----	
Foote Mineral Co	Kings Mountain mine	Cleveland	Box 792 Kings Mountain, N.C. 28086	
International Minerals & Chemical Corp	Hawkins mine	Mitchell	Old Orchard Road Skokie, Illinois 60079	Also feldspar grinding, quartz, and scrap mica.
Kings Mountain Mica Co	Patterson mine	Cleveland	Box 709 Kings Mountain, N.C. 28086	
Do	Moss mine	----do----		
Lawson United Feldspar and Mineral Co	Minpro	Mitchell	Minpro, N.C. 28777	Also scrap mica.
Graphite, artificial: Great Lakes Carbon Corp	Morgantown plant	Burke	299 Park Avenue New York, N.Y. 10017	

Table 10.—Principal producers—Continued

Commodity and company	Name of operation	County	Address	Remarks
Lime, regenerated:				
Albemarle Paper Manufacturing Co	Roanoke Rapids limekiln	Halifax	Roanoke Rapids, N.C. 27870	
Riegel Paper Corp	Acme limekiln	Columbus	Riegelwood, N.C. 28456	
U.S. Plywood-Champion Papers, Inc	Canton limekiln	Haywood	133 Parkway Offices Asheville, N.C. 28801	
Weyerhaeuser Co	Plymouth limekiln	Washington	Plymouth, N.C. 27962	
Lithium: Foote Mineral Co	Kings Mountain mine	Cleveland	Box 792 Kings Mountain, N.C. 28086	
Mica, scrap:				
Deneen Mica Co	International mine	Yancey	Newdale, N.C. 28714	Also mica grinders.
The Feldspar Corp	Poteat mine	Cleveland	Spruce Pine, N.C. 28777	
	Wiseman mine	do	do	
Harris Mining Co	Gusher Knob mine	Avery	Box 429 Spruce Pine, N.C. 28777	Also mica grinders.
	Kaolin mine	do	do	Also kaolin.
	Bailey mine	Mitchell	do	
Kings Mountain Mica	Moss mine	Cleveland	Box 709 Kings Mountain, N.C. 28086	
	Patterson mine	do	do	
United States Gypsum Co	Kings Mountain mine	do	101 So. Wacker Drive Chicago, Ill. 60606	
Mica, sheet: Eugene Owenby	Shepherd Knob mine	Macon	Route 4 Franklin, N.C. 28734	
Mica grinders:				
The English Mica Co	Kings Mountain plant	Cleveland	Ridgeway Center Bldg. Stamford, Conn. 06905	
Franklin Mineral Co	Franklin plant	Macon	Box O Wilmington, Mass. 01887	
Olivine:				
E. J. Lavino & Co	Balsam Gap mine	Jackson	3 Penn Center Plaza Philadelphia, Pa. 19102	
Harbison-Walker Refractories, Co	Addie mine	do	Gateway No. 2 Pittsburgh, Pa. 15222	
Northwest Carolina Olivine Co	Wray mine	Yancey	Box 672 Spruce Pine, N.C. 28777	
Perlite, expanded: Carolina Perlite Co	Gold Hill plant	Rowan	Box 741 Hillside, N.J. 07205	
Phosphate rock: Texas Gulf Sulphur Co	Lee Creek mine	Beaufort	200 Park Ave. New York, N.Y. 10017	
Sand and gravel:				
Lessees of B. V. Headrick Gravel and Sand Co.	Lilesville mine	Anson	Lilesville, N.C. 28091	
Becker County Sand & Gravel Co	Fayettesville mine	Cumberland	Box 848, Cheraw, S.C. 29520	
Do	Senter mine	Harnett	do	
Do	Vass mine	Moore	do	
Grove Stone and Sand, Branch of B.V. Headrick Gravel and Sand Co.	Grove mine	Buncombe	Swannanoa, N.C. 28778	
Nello L. Teer Co	Erwin mine	Harnett	Box 1131 Durham, N.C. 27702	
W. R. Bonsal Co., Inc	Bonsal mine	Anson	Box 38 Lilesville, N.C. 27702	

Stone:

Granite, crushed:

A. P. Causby Stone Co	Causby quarry	Burke	Box 236 Morganton, N.C. 28655	
Carl Clement Contracting Co	Whitmill quarry	Caldwell	Route 2, Box 379 Lenoir, N.C. 28645	
Do	Pigeon River quarry	Haywood	do	
Nello L. Teer Co	Rocky Mt. quarry	Nash	Box 1131 Durham, N.C. 27702	
Do	Crabtree quarry	Wake	do	
Do	Gresham quarry	do	do	
Superior Stone Co	Burlington quarry	Alamance	Box 2568 Raleigh, N.C. 27602	
Do	Hickory quarry	Catawba	do	
Do	Siler City quarry	Chatham	do	New, 1967
Do	Kings Mountain No. 2 quarry	Cleveland	do	
Do	Shelby quarry	do	do	
Do	Buchanan quarry	Guilford	do	
Do	Jamestown quarry	do	do	
Do	Pomona quarry	do	do	
Do	Weldon quarry	Halifax	do	New, 1967
Do	Statesville quarry	Iredell	do	
Do	Denver quarry	Lincoln	do	
Do	Arrowood quarry	Mecklenburg	do	
Do	Charlotte quarry	Mecklenburg	Box 2568 Raleigh, N.C. 27602	
Do	Davidson quarry	do	do	
Do	Mallard Creek quarry	do	do	
Do	Matthews quarry	do	do	
Do	Vass quarry	Moore	do	New, 1967
Do	Fountain quarry	Pitt	do	
Do	Ashwood quarry	Randolph	do	
Do	Highpoint quarry	do	do	
Do	Reidsville quarry	Rockingham	do	
Do	Kannapolis quarry	Rowan	do	
Do	Woodleaf quarry	do	do	
Do	Garner quarry	Wake	do	
Do	Knightdale quarry	do	do	
Do	Elm City quarry	Wilson	do	
Do	Neverson quarry	do	do	
Vulcan Materials Co	Enka quarry	Buncombe	Box 7506, Reynolds Station Winston-Salem, N.C. 27106	
Do	Shelton quarry	Caswell	do	
Do	North quarry	Forsyth	do	
Do	Piedmont quarry	do	do	
Do	Stokesdale quarry	Guilford	do	
Do	Pigeon River quarry	Haywood	do	
Do	Whitaker quarry	do	do	
Do	Hendersonville quarry	Henderson	do	
Do	Elkin quarry	Surry	do	
Do	Pilot Mountain quarry	do	do	
Do	Greystone quarry	Vance	do	
Do	No. 115 quarry	Wilkes	do	

Table 10.—Principal producers—Continued

Commodity and company	Name of operation	County	Address	Remarks
Stone—Continued				
Granite, dimension:				
Comolli Granite Co	Pink Salisbury quarry	Rowan	Box 898 Elberton, Ga. 30635	
Duke University	Hillsboro quarry	Orange	Durham, N.C. 27700	
H. P. Stirewalt	Rowan quarry	Rowan	Route 3 Salisbury, N.C. 28144	
Harris Granite Quarries	Balfour quarry	do	Box 1038 Salisbury, N.C. 28144	
Do	Collins quarry	do	do	
Do	Shuping quarry	do	do	
North Carolina Granite Corp	Mt. Airy quarry	Surry	Box 151 Mt. Airy, N.C. 27030	
Limestone, crushed:				
Cogdill Limestone Co., Inc	Cogdill quarry	Henderson	Box 116 Fletcher, N.C. 28732	
Ideal Cement Co	Castle Hayne quarry	New Hanover	620 Denver National Bldg. Denver, Colo. 80202	Also miscellaneous clay.
Fletcher Limestone Co., Inc	Fletcher quarry	Henderson	Fletcher, N.C. 28732	
Nantahala Talc & Limestone Co	Brasstown quarry	Clay	Andrews, N.C. 28901	
	Hewitt quarry	Swain	do	
Superior Stone Co	Kings Mountain No. 1 quarry	Cleveland	Box 2568 Raleigh, N.C. 27602	
Do	Kings Mountain No. 2 quarry	do	do	
Do	New Bern quarry	Craven	do	
Do	Castle Hayne quarry	New Hanover	do	
Do	Belgrade quarry	Onslow	do	
Marble, crushed and dimension:				
Moretti-Harrah Marble Co	Pleasant Valley quarry	Cherokee	Box 330 Sylacauga, Ala. 35150	Formerly Columbia Marble Co.
Slate, dimension:				
Jacob's Creek Stone Co., Inc	Flagstone quarry	Davidson	Mt. Gileda, N.C. 27306	
Do	Edenboro quarry	do	do	
Sandstone, crushed (quartz):				
The Feldspar Corp	Wiseman mine	Mitchell	Spruce Pine, N.C. 28777	
Do	Poteat mine	do	do	
International Minerals & Chemical Corp.	Hawkins mine	do	Old Orchard Road Skokie, Ill. 60079	
Lawson United Feldspar and Minerals Co.	Minpro Mine	Mitchell	Spruce Pine, N.C. 28777	
Southern Aggregates, Inc	Montgomery quarry	Montgomery	Box 1198 Roanoke, Va. 24006	
Thomas & Woody Mining Co	Eldorado	do	Box 315 Spruce Pine, N.C. 28777	
Traprock, crushed:				
Ararat Rock Products Co	Alleghany quarry	Alleghany	223 Willow St., Mt. Airy, N.C. 27030	
Do	Surry quarry	Surry	do	
Nello L. Teer Co	Durham quarry	Durham	Box 1131 Durham, N.C. 27702	
Do	Princeton quarry	Johnston	do	

Superior Stone Co.	Lexington quarry	Davidson	Box 2568 Raleigh, N.C. 27602
Do.	Hicone quarry	Guilford	do.
Do.	Bakers quarry	Union	do.
Young Stone Co., Inc.	Gold Hill quarry	Cabarrus	Box 11424 Charlotte, N.C. 28209
Talc and pyrophyllite:			
Pyrophyllite:			
Boren & Harvey, Inc.	Snow Camp mine	Alamance	Box 7247 Greensboro, N.C. 27407
General Minerals Co.	Glendon mine	Moore	Box 3504 Greensboro, N.C. 27402
Piedmont Materials Co., Inc.	Hillsboro mine	Orange	P.O. Box 7247 Greensboro, N.C. 27407
Standard Minerals Co., Inc.	Moore mine	Moore	Robbins, N.C. 27325
Talc: Hitchcock Corp.	Nancy Jordan No. 4 mine	Cherokee	Murphy, N.C. 28906
Vermiculite, exfoliated:			
Lee-V-Lite, Inc.	Sanford plant	Lee	Box 543 Sanford, N.C. 27330
W. R. Grace & Co.	High Point plant	Guilford	Cambridge, Mass. 02138

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 Paul McIlroy [1] and William C. Henkes [2]

Mineral production in North Dakota in 1967 was valued at $97.5 million, 5 percent less than in 1966. Most of the value came from mineral fuels—coal (lignite), natural gas, natural gas liquids, peat, and crude petroleum. The production value of uranium decreased sharply while stone and sulfur values increased significantly.

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

Table 1.—Mineral production in North Dakota [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays—thousand short tons	r 76	r $100	W	W
Coal (lignite)—do	3,543	6,976	4,156	$7,967
Gem stones	NA	1	NA	1
Natural gas (marketed)—million cubic feet	46,585	7,547	40,462	6,636
Natural gas liquids:				
LP gases—thousand gallons	91,884	3,859	88,665	3,901
Natural gasoline and cycle products—do	23,200	1,415	23,284	1,443
Petroleum (crude)—thousand 42-gallon barrels	27,126	69,170	25,315	65,818
Sand and gravel—thousand short tons	10,145	10,568	8,822	9,118
Stone—do	170	305	596	1,092
Value of items that cannot be disclosed: Lime, molybdenum, peat, salt, uranium [2] (recoverable content U_3O_8), and value indicated by symbol W	XX	r 2,327	XX	1,562
Total	XX	r 102,268	XX	97,538
Total 1957–59 constant dollars	XX	r 100,389	XX	94,854

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] Method of reporting changed from short tons of ore and f.o.b. mine value (AEC Circular 5, Revised, price schedule) to recoverable pounds of uranium oxide and f.o.b. mill value.

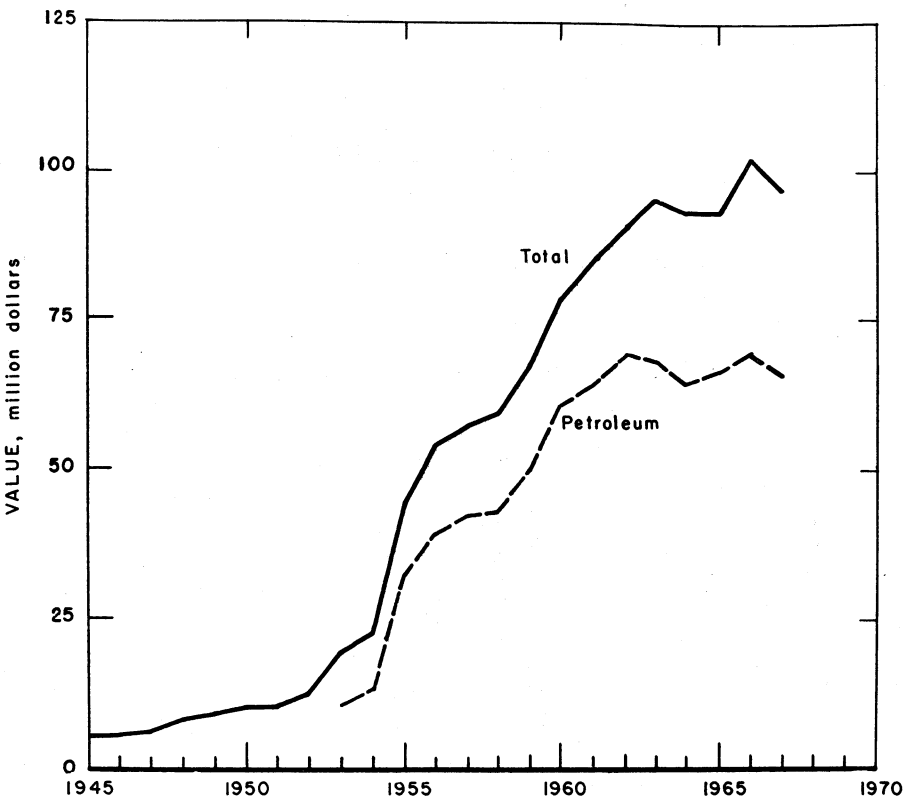

Figure 1.—Value of petroleum and total value of mineral production in North Dakota.

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

County	1966	1967	Minerals produced in 1967 in order of value
Adams	$74,804	$76,076	Coal (lignite), sand and gravel.
Barnes	455,000	543,000	Sand and gravel.
Benson	369,000	213,000	Do.
Billings	r 6,639,991	6,472,775	Petroleum, natural gas, uranium, sand and gravel, molybdenum.
Bottineau	7,151,000	6,500,900	Petroleum, sand and gravel, natural gas, peat.
Bowman	2,275,331	2,501,950	Petroleum, coal (lignite), stone, sand and gravel, natural gas.
Burke	11,637,988	9,939,394	Petroleum, natural gas, coal (lignite), LP gases, natural gasoline, sand and gravel.
Burleigh	575,338	952,109	Sand and gravel, stone, coal (lignite).
Cass	64,000	147,000	Sand and gravel.
Cavalier	315,000	87,000	Do.
Dickey	73,000	127,282	Sand and gravel, stone.
Divide	1,038,324	1,015,279	Petroleum, sand and gravel, natural gas, clays.
Dunn	100,000	62,000	Petroleum, natural gas.
Eddy	509,169	395,000	Sand and gravel.
Emmons	135,000	209,000	Do.
Foster	170,169	174,083	Sand and gravel, stone.
Golden Valley	10,000	15,000	Sand and gravel.
Grand Forks	730,000	444,000	Do.
Grant	163,697	96,156	Sand and gravel, coal (lignite).
Griggs	80,000	533,310	Sand and gravel, stone.
Hettinger	W	39,000	Sand and gravel.
Kidder	115,420	329,000	Do.
La Moure	68,000	W	Do.
Logan	1,554	88,000	Do.

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

County	1966	1967	Minerals produced in 1967 in order of value
McHenry	$140,000	$184,000	Petroleum, sand and gravel, natural gas.
McIntosh	W	200,000	Sand and gravel.
McKenzie	23,405,000	20,531,000	Petroleum, natural gas, LP gases, natural gasoline, stone, sand and gravel.
McLean	390,249	698,316	Sand and gravel, stone, coal (lignite).
Mercer	4,456,517	5,328,402	Coal (lignite), sand and gravel.
Morton	876,448	252,152	Sand and gravel, clays, coal (lignite).
Mountrail	3,307,000	2,770,000	Petroleum, natural gas, sand and gravel.
Nelson	370,000	125,000	Sand and gravel.
Oliver	311,453	298,793	Coal (lignite), sand and gravel.
Pembina	W	W	Lime, sand and gravel.
Pierce	387,000	433,000	Sand and gravel.
Ramsey	416,000	134,000	Do.
Ransom	34,000	203,000	Do.
Renville	5,866,000	5,690,000	Petroleum, natural gas, sand and gravel.
Richland	393,000	132,000	Sand and gravel.
Rolette	362,000	135,000	Do.
Sargent	----------	141,000	Do.
Sheridan	51,000	13,000	Do.
Sioux	1,000	162,460	Stone, sand and gravel.
Slope	W	305,000	Petroleum, sand and gravel.
Stark	r 759,139	2,979,218	Petroleum, coal (lignite), sand and gravel, natural gas, molybdenum, uranium.
Steele	96,000	126,070	Sand and gravel, stone.
Stutsman	351,858	445,400	Do.
Towner	W	36,000	Sand and gravel.
Traill	274,000	57,000	Do.
Walsh	511,000	127,000	Do.
Ward	1,464,360	1,241,077	Coal (lignite), sand and gravel, petroleum, natural gas.
Wells	16,000	175,000	Sand and gravel.
Williams	24,273,136	23,144,805	Petroleum, natural gas, LP gases, salt, natural gasoline, sand and gravel, stone, coal (lignite).
Undistributed [1]	r 1,004,481	510,128	
Total	r 102,268,000	97,538,000	

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

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

Table 3.—Indicators of North Dakota business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$1,533	p $1,588	+3.6
Per capita		$2,384	p $2,485	+4.2
Bank debits	millions	$6.8	$7.3	+7.4
Building permits	do	$30.3	$38.5	+27.1
Highway construction contracts awarded	do	$33.4	$30.8	−7.7
Freight car loadings	thousand tons	16,576.5	14,600.1	−11.9
Truck gross ton-mile tax (fiscal year July 1-June 30)	millions	$1.5	$1.5	--------
Cash receipts from farm marketing	do	$869.6	p $857.9	−1.3
Mineral production	do	$102.3	$97.5	−4.7
Work force:				
Total labor force (monthly estimated work force average)	thousands	252.9	248.0	−1.9
Total employment	do	241.8	237.6	−1.7
Total unemployment	do	11.4	11.0	−3.5
Unemployment rate	percent	4.4	4.2	−4.5
Employment:				
Total agricultural	thousands	70.6	65.2	−7.6
Total non-agricultural	do	147.7	149.7	+1.4
Mining	do	1.9	1.9	--------
Contract construction	do	9.0	8.4	−6.7
Manufacturing	do	8.9	8.7	−2.2
Finance, insurance, real estate	do	6.4	6.5	+1.6
Transportation and utilities	do	12.2	12.2	--------
Trade	do	41.7	41.8	+.2
Services and miscellaneous	do	25.5	26.7	+4.7

p Preliminary.

Sources: Survey of Current Business; Engineering News-Record; Statistical Reporting Service, U.S. Department of Agriculture, Denver, Colo.; State of North Dakota; U.S. Department of Commerce, Washington, D.C.

Employment and Injuries.—Final employment and injury data for 1966 and preliminary data for 1967—excluding all mineral fuels industries except coal—are shown in table 4.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal and peat	287	220	63	494	--	17	34.44	10,234
Metal	52	264	14	111	--	1	9.02	9
Nonmetal	29	258	7	57	--	1	17.39	626
Sand and gravel	714	176	126	1,059	--	20	18.89	409
Stone	16	69	1	9	--	--	-----	------
Total [1]	1,098	192	211	1,729	--	39	22.55	3,192
1967: [p]								
Coal and peat	255	215	55	431	--	14	32.48	1,462
Metal	5	26	(2)	1	--	--	-----	------
Nonmetal	35	249	9	69	--	4	57.71	519
Sand and gravel	620	159	98	933	1	15	17.15	6,677
Stone	120	196	23	187	--	--	-----	------
Total [1]	1,035	179	186	1,622	1	33	20.97	4,251

[p] Preliminary.
[1] Data may not add to total shown because of independent rounding.
[2] Less than ½ unit.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Lignite).—Production and consumption of lignite coal, continuing its upward trend, increased 17 percent over 1966 quantities, to an alltime high of 4.2 million tons in 1967. Production value increased 14 percent, to $8 million.

Of 21 respondents, four operators—Knife River Coal Mining Co.; Truax-Traer Coal Co. Division, Consolidation Coal Co., Inc.; Baukol-Noonan, Inc.; and Lignite Division, The North American Coal Corp.—produced over 90 percent of the State total.

Operation of the unit-train transportation concept—one commodity, one destination—was initiated by Northern Pacific Railway Co. to serve the 172-megawatt powerplant of United Power Association near Stanton. The entire train, more than 4,000 tons (42 cars), can be unloaded in less than 10 minutes. The plant was supplied by the Indian Head strip mine near Zap owned by The North American Coal Corp.

Table 5.—Coal (lignite) sold or used [1], by counties

(Short tons)

County	1966		1967	
	Number of mines operating (all strip)	Quantity	Number of mines operating (all strip)	Quantity
Adams	1	21,162	1	16,236
Bowman	1	112,933	1	137,102
Burke	3	479,873	3	497,159
Burleigh	1	5,808	1	4,722
Grant	3	17,924	3	14,238
Hettinger	1	2,318	--	----
McLean	2	38,380	2	36,904
Mercer	3	2,343,472	3	2,876,309
Morton	3	16,414	3	12,993
Oliver	1	110,849	1	110,519
Stark	3	91,885	3	96,592
Ward	2	293,821	2	349,734
Williams	1	8,000	1	3,014
Total	25	3,542,839	24	4,155,522

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

Federal Bureau of Mines experiments on the production of carbon disulfide from lignite coals[3] could make North Dakota a major source of carbon disulfide. U.S. annual consumption of this chemical, which is essential in making rayon and cellophane, is over 660 million pounds, worth $30 million.

The new, 200-megawatt, lignite-burning generating plant being constructed for Minnkota Power Cooperative, Inc., which is due on the line in 1970, seems to assure the increased consumption of lignite. North Dakota coal reserves of over 350 billion tons were the largest in the United States.

Natural Gas.—Because the reservoirs were further depleted, output of dry natural gas declined 36 percent. Production of casinghead gas also declined but at a much slower rate. Total gas output declined 13 percent. None of the State's eight successful wildcat wells were classed as gas discoveries. Three gasoline plants removed liquids from the casinghead gas before it was delivered to Montana-Dakota Utilities Co.

Early in the year the North Dakota Public Service Commission gave tentative approval to Midwest Natural Gas Co. of South Dakota for constructing a gas pipeline system in the eastern part of the State. The system, which would serve 44 communities in 17 counties, would cost approximately $19 million. Gas for the southern part of the system was to be obtained from Northern Natural Gas Co., and that for the northern part from Canadian sources. Negotiations were still underway at yearend.

Natural Gas Liquids.—Because of the decline in casinghead-gas production, output of natural gas liquids was correspondingly lower. Of the three gasoline plants—Hunt Industries at North Tioga, Signal Oil and Gas Co. at Tioga, and Texaco Inc. at Lignite—the latter two produced sulfur as well as liquids.

Peat.—Mined and processed for use as a soil conditioner, peat output from bog deposits in Bottineau County increased 200 percent in value and 220 percent in quantity.

Petroleum.—The recent upward trend in crude oil production was broken when output dropped 7 percent below the 1966 figure of 27.1 million barrels. A significant factor in the overall decrease was the 14-percent decline in output from the Beaver Lodge field, largest producer in the State. Contributing causes were the depletion of older reservoirs, and the lack of major new reserves. In the 103 fields with 123 reservoirs, 2,063 oil wells, of which

[3] Sondreal, E. A., A. M. Cooley, and R. C. Ellman. Bench-Scale Production of Carbon Disulfide From Lignite Char and Sulfur. BuMines Rept. of Inv. 6891, 1967, 20 pp.

360 were State classified as marginal wells, were producing at yearend. In May, Shell Oil Co. increased its posted prices for some North Dakota crude oils by 3 cents per barrel bringing the top price to $2.71 per barrel for 40.0° to 44.9° API oil. Estimated [4] known primary- and secondary-recoverable reserves were 713.7 million barrels, an increase of 7 percent over those of the previous year. As in the past most of the reserves (77.2 percent) were in Mississippian rock. Reserves in rocks of Ordovician age declined slightly, to 7.1 percent of the total.

[4] Folsom, Clarence B., Jr. North Dakota Crude Oil Inventory as of Jan 1, 1968. North Dakota Geol. Survey, Miscellaneous Series No. 36, 1968, p. 1.

Table 6.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1966	1967	Principal fields in 1967 in order of production
Billings	2,180	2,363	Fryburg, Medora, Rocky Ridge.
Bottineau	2,642	2,399	Newburg, South Westhope, Wiley, Haas, Mohall.
Bowman	754	711	Cedar Creek.
Burke	2,992	2,669	North Tioga, Rival, Black Slough, Northeast Foothills, Foothills.
Divide	352	328	North Tioga, Stoneview.
Dunn	33	23	Lost Bridge.
McHenry	43	41	Pratt.
McKenzie	7,490	6,297	Antelope, Charlson, Blue Buttes, Hawkeye, Clear Creek.
Mountrail	1,139	959	Tioga, White Earth, East Tioga.
Renville	2,252	2,145	Sherwood, Glenburn, Mouse River Park.
Slope	70	107	Eleven Bar.
Stark	111	1,016	West Dickinson, Dickinson, Buffalo Creek.
Ward	5	37	Southwest Aurelia.
Williams	7,063	6,220	Beaver Lodge, Capa, Grenora, Tioga.
Total	27,126	25,315	

Source: North Dakota Geological Survey.

Table 7.—Oil and gas well drilling in 1967, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Billings	----	------	4	4	38,732
Bottineau	----	------	5	5	21,265
Bowman	2	------	------	2	18,299
Burke	----	------	3	3	22,868
Burleigh	----	------	4	4	16,042
Cavalier	----	------	1	1	2,502
Divide	----	------	3	3	20,691
Dunn	----	------	2	2	18,599
Emmons	----	------	1	1	3,772
Golden Valley	----	------	3	3	28,146
McHenry	----	------	2	2	8,554
McKenzie	2	------	1	3	26,405
Mountrail	----	------	1	1	7,360
Renville	1	------	11	12	59,641
Slope	----	------	2	2	22,670
Stark	----	------	4	4	38,024
Ward	----	------	6	6	35,836
Wells	----	------	1	1	3,800
Williams	3	------	------	3	25,028
Total	8	------	54	62	418,234
Development completions:					
Billings	3	------	3	6	48,272
Bottineau	8	------	7	15	57,524
Bowman	----	------	1	1	8,317
Burke	14	------	4	18	119,111
McKenzie	7	------	------	7	54,897
Renville	10	------	6	16	79,371
Stark	21	------	5	26	209,453
Ward	1	------	1	2	13,015
Total	64	------	27	91	589,960
Grand total	72	------	81	153	1,008,194

Source: Committee on Statistics of Drilling, American Association of Petroleum Geologists.

Secondary-recovery projects were begun in the Madison pools at the Blue Buttes, Hofflund, Charlson, Flaxton, Lignite, and Black Slough fields. The North Dakota Geological Survey estimated[5] that these projects added 39.7 million barrels of oil to the State's reserves.

Overall drilling in the State was down 16 percent from the 183 wells drilled in 1966; exploratory drilling decreased 17 percent. Stark County had the highest level of development drilling because of activity in the West Dickinson-Dickinson area. Continental Oil Co. discovered the West Dickinson field, 3 miles west of the Dickinson field, in late 1966; field development proved that the two fields had a common reservoir. The Northeast Foothills field in Burke County also was the site of considerable development drilling.

Of the eight discovery wells completed during the year, three were new pay discoveries, and the rest were new fields. Based on initial production potential, the Pan American Petroleum Corp. discovery in Williams County seemed most significant. The well, No. 1 Hove, was completed for a daily flow gage of 756 barrels of 42° API oil from the Bakken formation (basal Mississippian) through perforations at 9,900 to 9,914, 9,932 to 9,940, and 9,952 to 9,961 feet. Also in Williams County were two of the new pay discoveries, both in the Tioga field—one in the Red River formation (Ordovician) and one in the Duperow (Devonian). The Lone Tree field discovery, Ward County, appeared to be of major importance; the well, Tom Vessels, No. 1 Doolittle, was completed pumping 240 barrels per day from the Madison formation (Mississippian). According to the State Geological Survey, these new discoveries added 6.6 million barrels to the oil reserves; revisions to existing fields added 25.7 million barrels.[6]

Twelve oil and gas lease sales of Federal and State lands resulted in the leasing of 128,362 acres for a total bonus of $238,299. Three of the sales school lands, totaled 57,764 acres and brought bonuses of $120,965, an average of $2.09 per acre. Three sales of Bank of North Dakota lands covered 26,133 acres for which $43,610 was paid in bonuses. Four sales by the Fort Berthold Indian Agency brought $69,843 in bonuses for 43,686 acres, an average of $1.60 per acre. The Federal Bureau of Land Management held two sales involving a total of 779 acres for which a total bonus of $3,881 was paid, an average of $4.99 per acre. The highest bonus bid was $30 per acre for Bank of North Dakota land in an April sale.

NONMETALS

Notwithstanding the dramatic increase in the value of stone produced, total value of nonmetal production decreased 5 percent from 1966.

Clays.—Clay production decreased from that in 1966. Its predominant use was for lightweight aggregate. A lesser amount was used for brick. A small quantity of bentonite, less than 0.1 percent, was produced for manufacturing mortar.

Lime.—The value and quantity of lime production decreased 11 percent. American Crystal Sugar Co. continued as sole producer for use in its sugar factory at Drayton.

Salt.—Production of salt by solution mining increased 14 percent in value and 12 percent in quantity. Seventy-five percent of the production was consumed within the State. Consumption by the cattle industry continued to be the major market. Other uses included food processing, oil refining, railroad-car refrigeration, water softening, and ice removal from roads.

Sand and Gravel.—Although the quantity and value of sand and gravel production decreased, 13 and 14 percent respectively, it comprised more than 9 percent of the total value of mineral production.

Of the 570.8 miles designated Interstate and Defense Highway System in North Dakota, 392.2 miles were open to traffic. Work on 116 miles was in progress, leaving 62.6 miles for future contracts.[7]

Government crews and contractors produced 53 percent of the State output and 50 percent of the total value. Production came from 378 operators—35 Government-crew, 169 Government-contractor, and 174 commercial operations—52 less than in 1966. The average value of all

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[5] Page 2 of work cited in footnote 4.
[6] Page 2 of work cited in footnote 4.
[7] Federal Highway Administration. Quarterly Report on the Federal-Aid Highway Program. Dec. 31, 1967. Press Release FHWA-118, Feb. 14, 1968.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	538	$645	349	$415
Paving	927	889	565	621
Fill	121	101	142	138
Other	1	1	1	1
Total	1,587	1,636	1,057	1,175
Gravel:				
Construction:				
Building	516	737	333	647
Paving	2,524	3,106	2,520	2,600
Railroad ballast	207	103	111	46
Fill	215	169	101	72
Miscellaneous	10	4	41	46
Total	3,472	4,119	3,106	3,411
Total sand and gravel	5,059	5,755	4,163	4,586
Government-and-contractor operations:				
Sand: Paving	2,144	2,034	1,595	1,577
Gravel:				
Building	128	128	-------	-------
Paving	2,772	2,609	3,064	2,955
Fill	42	42	-------	-------
Total	2,942	2,779	3,064	2,955
Total sand and gravel	5,086	4,813	4,659	4,532
All operations:				
Sand	3,731	3,670	2,652	2,752
Gravel	6,414	6,898	6,170	6,366
Total	10,145	10,568	8,822	9,118

sand and gravel produced remained essentially unchanged at $1.03 per ton.

Stone.—Production of stone increased 251 percent and exceeded $1 million in value for the first time. Concrete and roadstone accounted for 69 percent of the quantity and 75 percent of the value. The remainder of the production was used for riprap on flood control projects of the U.S. Army Corps of Engineers, and by the North Dakota Water Commission.

Sulfur.—Elemental sulfur was recovered at natural gas processing plants at Lignite in Burke County and at Tioga in Williams County. The value of the sulfur shipped increased 16 percent over that of 1966.

METALS

Iron Ore.—Economically valuable iron ore could be the cause of magnetic anomalies in Pembina County. Deep drilling was recommended by geologists to delineate any ore. The availability of North Dakota lignite could prove to be the key for economic utilization of iron ore.

Molybdenum.—Only one company, Mining and Metals Division, Union Carbide Corp., reported recovery of molybdenum from lignite ash contained in lignite ores mined in Billings and Stark Counties. Value of production increased 12 percent over 1966.

Uranium.—Production of uranium oxide from uraniferous lignites continued to decrease, the value being 9 percent of the 1966 production value. Only two operators reported production—Union Carbide Corp. and Geo Resources, Inc., in Billings and Stark Counties. The ash obtained from the burning of strip-mined lignite ores was shipped to mills in Colorado for recovery of uranium and molybdenum.

Table 9.—Principal producers in 1967

Commodity and company	Address	Type of activity	County [1]	Other commodities/Remarks
Clays:				
Baukol-Noonan, Inc	Noonan, N. Dak. 58765	Two open-pit mines	Divide, Morton	
Hebron Brick Co	Hebron, N. Dak. 43025	Open-pit mine	Morton	
Coal (lignite):				
Baukol-Noonan, Inc	Noonan, N. Dak. 58765	Strip mine and plant.	Burke	Thermal drying, crushing and oil treatment plant.
Consolidation Coal Co., Inc., Truax-Traer Coal Co. Division.	111 N. Wabash Ave., Chicago, Ill. 60602	Three strip mines and three plants.	Burke, Mercer, Oliver, Ward.	One mine and thermal drying, crushing, and oil treatment plant near Columbus and one near Velva; one mine and crushing and oil treatment plant near Stanton.
Knife River Coal Mining Co	Beulah, N. Dak 58523	Two strip mines and two plants.	Bowman, Mercer	One mine and crushing and oil treatment plant near Gascoyne and one near Beulah.
The North American Coal Corp., Lignite Division.	12800 Shaker Blvd., Cleveland, Ohio 44120	Strip mine and plant.	Mercer	Crushing and oil treatment plant.
Lime:				
American Crystal Sugar Co	Boston Bldg., Denver, Colo. 80202	Plant	Pembina	Shaft kiln at beet sugar refinery near Drayton.
Natural gas and petroleum: [2]				
Amerada Petroleum Corp	Box 2040, Tulsa, Okla. 74101	Crude oil wells	Antelope, Beaver Lodge, Blue Buttes, Charlson, Fryburg	
American Oil Co	Box 6610–A Chicago. Ill. 60680	Refinery	Morton	Refinery at Mandan.
California Oil Co. (Chevron Oil Co.) Western Division.	Box 599, 1700 Broadway, Denver, Colo. 80201	Crude oil wells	Glenburn	
Cardinal Petroleum Co	411 Medical Arts Bldg., Billings, Mont. 59101	----do	West Dickinson South Westhope	
Chandler & Associates (Chandler-Simpson, Inc.)	1401 Denver Club Bldg., Denver, Colo. 80202	----do	Sherwood	
Continental Oil Co	1300 Main St., Houston, Tex. 77001	----do	West Dickinson	
Hunt Oil Co. (Hunt Industries)	1401 Elm, Dallas, Tex. 75202	Crude oil wells and gasoline plant.	North Tioga	Propane, butane, natural gasoline. Refrigeration-absorption gas processing plant.
Marathon Oil Co	539 S. Main St., Findlay, Ohio 45840	Crude oil wells	Glenburn	
Monsanto Co., Hydrocarbons & Polymers Division.	800 N. Lindbergh Blvd., St. Louis, Mo. 63116	----do	Black Slough, Glenburn, Sherwood	
Pan American Petroleum Corp	Box 591, Tulsa, Okla. 74101	Crude oil wells	Black Slough, Rival, Sherwood	
Petroleum, Inc	300 W. Douglas, Wichita, Kans. 67202	Crude oil wells	Sherwood	
Placid Oil Co	Beck Bldg., Shreveport, La. 71101	----do	----do	
Shell Oil Co	50 W. 50th St., New York, N.Y. 10020	----do	Cedar Creek	

Table 9.—Principal producers in 1967—Continued

Commodity and Company	Address	Type of Activity	County [1]	Other commodities/Remarks
Natural gas and Petroleum—Continued				
Signal Oil and Gas Co	Box 17126, Los Angeles, Calif. 90017	Crude oil wells and gasoline plant.	Tioga-Beaver Lodge	Combined gasoline, LP gas, sulfur, absorption gas processing plant, sulfur recovery unit.
Skelly Oil Co	Box 1650, Tulsa, Okla. 74101	Crude oil wells	Clear Creek	
Superior Oil Co	First City National Bank Bldg., Houston, Tex. 77002	do	Medora, West Dickinson	
Tenneco Oil Co	Box 2511, Houston, Tex. 77001	do	Glenburn	
Texaco Inc	Box 52332, Houston, Tex. 77052	Crude oil wells and gasoline plant.	Blue Buttes, Charlson	Propane, butane, natural gasoline, sulfur. Refrigeration-absorption gas processing plant, sulfur recovery unit.
Texota Oil Co	477 San Jacinto Bldg., Houston, Tex. 77002	Crude oil wells	Glenburn	
Union Oil Company of California	Box 7600, Los Angeles, Calif. 90055	do	Sherwood	
Union Texas Petroleum Corp	Box 2120, Houston, Tex. 77001	do	Black Slough, Glenburn	
Peat:				
Peat Products Co	841 4th St., Bismarck, N. Dak. 58501	Strip mine	Bottineau	
Salt:				
Dakota Salt & Chemical Co	General Carbon Bldg., West Haven Rd., Lawrenceville, Ill. 62439	Solution mining	Williams	
Sand and gravel:				
Bradshaw Gravel Supply	Arvilla, N. Dak. 58214	Two pits and two plants.	Grand Forks, Walsh.	One stationary crushing and screening plant near Fordville and one near Arvilla.
Minot Sand & Gravel Co	Box 116, Minot, N. Dak. 58702	Pit and plant	Ward	Stationary crushing and screening plant.
Northern Improvement Co	Bismarck, N. Dak. 58501	Fourteen pits, plants.	Burleigh, Grant, Kidder, Morton, Sioux, Williams	One portable and one stationary crushing and screening plant.
Rugby Sand & Gravel	Route 1, Rugby, N. Dak. 58368	Pit and plant	Pierce	Stationary crushing and screening plant.
Sheyenne Sand & Gravel, Inc	Box 178, Sheyenne, N. Dak. 58374	do	Eddy	Do.
Stone:				
Anderson Sand & Gravel, Inc	Box 456, Carrington, N. Dak. 58421	Quarry and plant	Foster	Stationary crushing and screening plant.
Hansted Sand & Gravel	Route 1, Jamestown, N. Dak. 58401	do	Stutsman	Semi-portable crushing and screening plant.
Sulfur:				
Signal Oil and Gas Co	Box 17126, Los Angeles, Calif. 90017	Gas processing plant	Williams	See Natural gas and petroleum.

Texaco Inc	Box 52332, Houston, Tex. 77052	----do----------	Burke----------	Do.
Uranium:				
Geo Resources, Inc	Box 754, Williston, N. Dak. 58801	Open-pit mine-------	Billings----------	
Union Carbide Corp., Mining and Metals Division.	270 Park Ave., New York, N.Y. 10017	Two open-pit mines and plant.	Billings, Stark	Molybdenum. Burning plant at Belfield.

[1] For natural gas and petroleum, principal fields rather than counties are shown.
[2] Principal producers in the major fields.

The Mineral Industry of Ohio

By Joseph Krickich [1]

For the sixth consecutive year, value of mineral production in Ohio increased, establishing a record high of $498.9 million and exceeding that of 1966 by $10.8 million. Record high production of bituminous coal and salt offset declines in portland cement shipments and lime and petroleum production, resulting in an overall value gain of 2 percent. Production and value of clays, stone, and sand and gravel remained relatively stable.

Mineral production was reported in all of the State's 88 counties except Clermont and Fulton. Harrison and Belmont Counties, with value of mineral output of $45.1 million and $43.5 million, respectively, were the State's leading mineral-producing areas. Values in excess of $10 million were recorded for 14 other counties.

[1] Mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Ohio [1]

Mineral		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:					
Portland	thousand 376-pound barrels	15,181	$48,740	14,726	$46,860
Masonry	thousand 280-pound barrels	976	2,785	946	2,730
Clays	thousand short tons	5,089	14,522	4,670	15,185
Coal (bituminous)	do	43,341	164,444	46,014	176,921
Gem stones		NA	3	NA	3
Lime	thousand short tons	3,858	50,997	3,636	48,817
Natural gas	million cubic feet	43,133	10,223	41,315	9,957
Peat	short tons	5,214	84	7,301	100
Petroleum (crude)	thousand 42-gallon barrels	10,899	32,700	9,924	31,427
Salt	thousand short tons	5,138	35,735	5,407	39,549
Sand and gravel	do	43,851	52,909	43,196	52,888
Stone	do	45,002	72,900	45,458	72,534
Value of items that cannot be disclosed: Abrasive stone and gypsum		XX	1,998	XX	1,917
Total		XX	488,040	XX	498,888
Total 1957–59 constant dollars		XX	490,735	XX	p 492,349

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 Ohio, by counties [1 2]

County	1966	1967	Minerals produced in 1967 in order of value
Adams	$1,362,852	$1,281,896	Stone.
Allen	1,369,627	1,528,689	Stone, sand and gravel.
Ashland	W	271,404	Sand and gravel, clays.
Ashtabula	W	W	Lime, sand and gravel.
Athens	1,591,870	1,932,708	Coal, stone, sand and gravel, clays.
Auglaize	W	W	Stone, sand and gravel, clays.
Belmont	33,847,850	43,470,379	Coal, stone.
Brown	120,871	W	Sand and gravel, stone.
Butler	3,001,000	3,341,000	Sand and gravel.
Carroll	1,133,731	1,636,442	Coal, clays, sand and gravel.
Champaign	W	W	Sand and gravel, peat.
Clark	W	W	Sand and gravel, lime, stone.
Clinton	W	W	Stone, sand and gravel.
Columbiana	7,097,442	W	Coal, clays, sand and gravel.
Coshocton	13,730,729	W	Coal, sand and gravel, stone.

See footnotes at end of table.

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

County	1966	1967	Minerals produced in 1967 in order of value
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	$2,095,274	$2,357,912	Stone, lime, clays.
Erie	3,966,174	4,108,124	Stone, sand and gravel.
Fairfield	W	W	Sand and gravel.
Fayette	718,938	741,559	Stone.
Franklin	10,307,668	W	Sand and gravel, stone, lime, clays, peat.
Gallia	1,724,174	1,110,800	Coal, stone, sand and gravel.
Geauga	1,319,029	W	Sand and gravel, stone.
Greene	W	W	Cement, stone, sand and gravel, clays.
Guernsey	4,750,087	5,262,646	Coal, stone.
Hamilton	W	4,750,681	Sand and gravel, stone.
Hancock	W	968,607	Stone, clays, lime.
Hardin	W	W	Stone.
Harrison	43,807,793	45,133,328	Coal, stone, clays.
Henry	W	W	Sand and gravel, clays.
Highland	W	W	Stone, sand and gravel, clays.
Hocking	563,949	353,743	Coal, clays, sand and gravel.
Holmes	1,523,829	1,678,291	Clays, coal, stone, sand and gravel.
Huron	54,000	148,659	Sand and gravel, stone, peat.
Jackson	4,604,185	4,956,074	Coal, clays, stone, sand and gravel.
Jefferson	19,075,645	18,525,684	Coal, clays.
Knox	W	2,046,000	Sand and gravel.
Lake	W	W	Salt, lime, sand and gravel, stone.
Lawrence	9,744,323	8,268,306	Cement, clays, stone, coal, sand and gravel.
Licking	W	W	Sand and gravel, clays.
Logan	911,636	638,197	Stone, sand and gravel.
Lorain	W	W	Stone, sand and gravel, abrasives.
Lucas	W	W	Cement, stone, sand and gravel, clays.
Madison	W	W	Stone, sand and gravel.
Mahoning	W	W	Stone, coal, clays, peat.
Marion	1,540,229	1,663,443	Stone, sand and gravel, clays.
Medina	W	W	Sand and gravel, clays.
Meigs	W	W	Sand and gravel, coal, salt.
Mercer	W	W	Stone.
Miami	W	W	Stone, sand and gravel.
Monroe	W	W	Coal, sand and gravel, stone.
Montgomery	4,658,041	W	Sand and gravel, stone.
Moran	W	W	Coal, sand and gravel, stone.
Morrow	W	54,000	Sand and gravel.
Muskingum	W	W	Cement, stone, coal, sand and gravel, clays.
Noble	W	W	Coal, stone.
Ottawa	7,700,649	8,166,389	Stone, lime, gypsum.
Paulding	W	W	Cement, stone, clays.
Perry	W	W	Coal, sand and gravel, clays, stone.
Pickaway	W	W	Sand and gravel, stone.
Pike	W	W	Do.
Portage	4,360,637	3,576,675	Sand and gravel, stone, peat.
Preble	W	W	Lime, stone, sand and gravel.
Putnam	549,531	582,591	Stone, lime, clays, sand and gravel.
Richland	W	W	Sand and gravel, clays, peat.
Ross	W	W	Sand and gravel, stone.
Sandusky	26,424,387	24,312,569	Lime, stone, sand and gravel.
Scioto	W	2,291,033	Stone, clays, sand and gravel.
Seneca	W	W	Lime, stone, clays.
Shelby	375,738	463,986	Sand and gravel, stone.
Stark	12,925,662	11,967,891	Cement, sand and gravel, stone, coal, clays, peat.
Summit	W	W	Salt, lime, stone, cement, sand and gravel, clays.
Trumbull	233,000	W	Sand and gravel.
Tuscarawas	15,136,065	15,435,350	Coal, clays, sand and gravel, stone.
Union	W	W	Stone, sand and gravel.
Van Wert	908,790	620,084	Stone, clays.
Vinton	732,170	1,056,470	Coal, stone, clays.
Warren	1,331,000	1,437,000	Sand and gravel.
Washington	W	W	Coal, sand and gravel.
Wayne	W	W	Salt, sand and gravel, stone, clays, coal.
Williams	W	227,000	Sand and gravel.
Wood	1,880,978	2,114,432	Stone.
Wyandot	W	W	Stone, lime, sand and gravel, clays, peat.
Undistributed [3]	240,860,667	270,408,325	
Total	488,040,000	498,888,000	

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

[1] Clermont and Fulton Counties not listed, since no production was reported.

[2] Natural gas and petroleum values are not listed by counties, since 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 (1967), and values indicated by symbol W.

Table 3.—Indicators of Ohio business activity

	1966	1967 p	Change (percent)
Personal income: [1]			
Total ---millions--	$31,670	$33,590	+6.1
Per capita	$3,056	$3,212	+5.1
Mineral production ---thousands--	$488,040	$498,888	+2.2
Construction activity:			
Construction contracts [2] ---thousands--	$2,720,067	$2,924,425	+7.5
Nonresidential buildings ---do----	$1,098,827	$1,310,479	+19.3
Residential buildings ---do----	$951,256	$1,112,172	+16.9
Nonbuilding construction ---do----	$669,984	$501,774	−25.1
Cement (portland) shipments to and within Ohio thousand 376-pound barrels--	19,125	18,484	−3.4
Annual average employment: [3]			
Total civilian labor force ---thousands--	4,141.6	4,228.7	+2.1
Total unemployed ---do----	122.3	136.3	+11.4
Total manufacturing ---do----	1,401.8	1,398.6	−.2
Durable goods ---do----	1,002.5	995.7	−.7
Stone, clay, and glass products ---do----	71.2	67.8	−4.8
Primary metal industries ---do----	186.1	177.7	−4.5
Fabricated metal products ---do----	154.4	152.9	−1.0
Machinery, except electrical ---do----	217.8	224.8	+3.2
Electrical machinery ---do----	146.3	146.3	-----
Transportation equipment ---do----	153.7	151.9	−1.2
Nondurable goods ---do----	399.3	402.9	+.9
Food and kindred products ---do----	82.7	83.4	+.8
Printing and publishing ---do----	67.3	69.2	+2.8
Rubber and plastics products ---do----	100.0	100.1	+.1
Total mining activity ---do----	2,136.7	2,213.3	+3.6
Mining and quarrying ---do----	18.7	19.1	+2.1
Contract construction ---do----	153.8	152.8	−.7
Transportation and utilities ---do----	207.7	209.5	+.9
Total agricultural ---do----	120.1	115.2	−4.1
Total all other [4] ---do----	360.7	365.3	+1.3

p Preliminary.
[1] Source: Bureau of the Census, U.S. Department of Commerce.
[2] Source: F. W. Dodge Division, McGraw-Hill Information Systems Company.
[3] Source: Division of Research and Statistics, Ohio Bureau of Employment Services.
[4] Includes self-employed, domestics, unpaid family workers and those involved in labor disputes.

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

Year and industy	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
1966:								
Coal	7,659	232	1,779	14,304	12	373	26.92	6,515
Peat	17	117	2	15	----	-----	-------	-------
Nonmetal	2,694	258	695	5,561	----	119	21.40	1,103
Sand and gravel	2,248	240	541	4,534	3	69	15.88	4,714
Stone	5,402	282	1,524	12,478	2	210	16.99	2,060
Total [1]	18,020	252	4,541	36,891	17	771	21.36	3,968
1967: [1]								
Coal	8,100	236	1,914	15,200	4	375	24.93	2,985
Peat	18	131	2	15	----	-----	-------	-------
Nonmetal	2,570	265	682	5,439	----	132	24.27	577
Sand and gravel	2,360	231	546	4,560	4	62	14.48	5,796
Stone	5,505	271	1,493	12,095	1	168	13.97	1,268
Total [1]	18,555	250	4,637	37,308	9	737	20.00	2,420

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

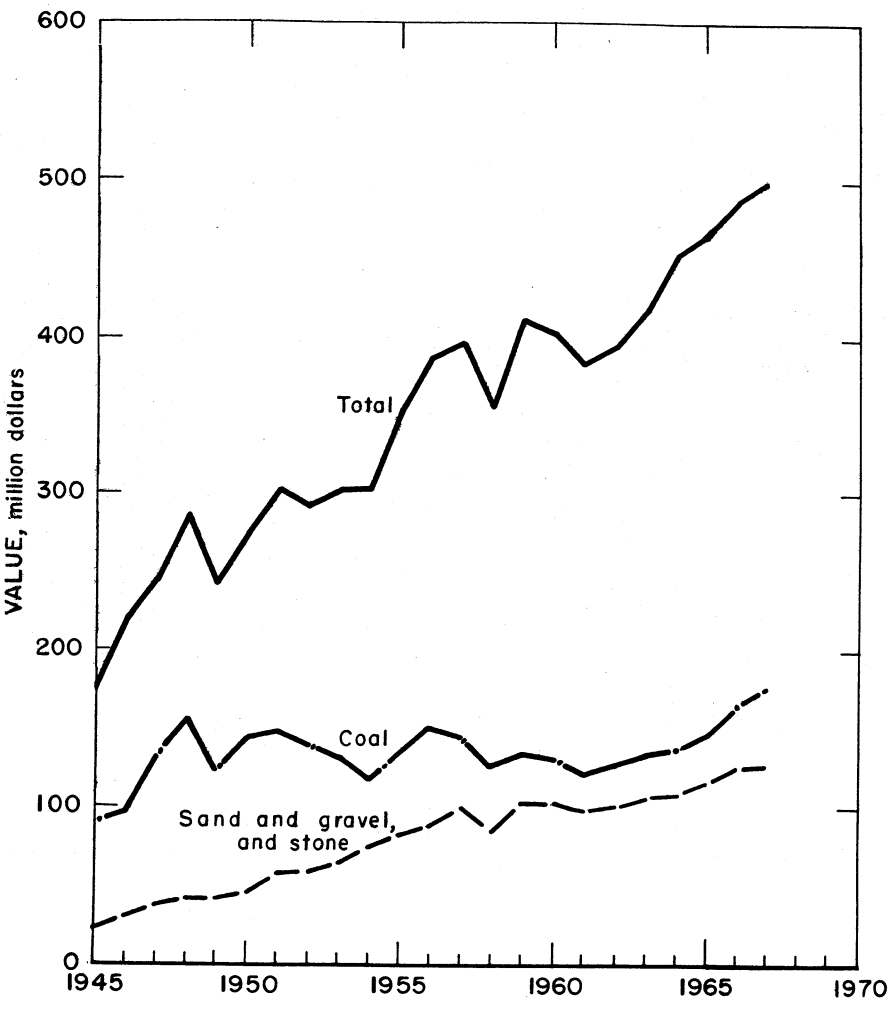

Figure 1.—Value of coal, sand and gravel, and stone and total value of mineral production in Ohio.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stones.—Abrasive stone (grindstone) production has continued to decrease, since The Hall Grindstone Co. at Constitution, Washington County, discontinued business in July 1966. All 1967 production, at one operation in Lorain County, was a byproduct of sandstone quarrying at Amherst by Cleveland Quarries Co.

Cement.—Production, shipments, and value of portland cement decreased as plants operated at about 75 percent of the capacity compared with 81 percent in 1966. Lower production and shipments also were recorded for masonry cement.

Average value per barrel of portland cement dropped from $3.21 in 1966 to $3.18; average value of masonry cement increased $0.04 to $2.89. Apparent cement consumption in the State totaled 18.5 million barrels of portland cement and 1.4 million barrels of masonry cement. Of this total, 50 percent of the portland cement and 48 percent of the masonry cement were supplied by Ohio cement producers and the remainder came from plants in other States, notably Michigan and Pennsylvania.

Nine plants were active, two each in Greene and Lawrence Counties and one each in Lucas, Muskingum, Paulding, Stark, and Summit Counties. Greene County continued to be the principal cement-producing area. In addition to supplying consumers in Ohio, cement producers made shipments to other States. Of the total cement shipments, 14 percent of the portland cement and 6 percent of the masonry cement went to Michigan. Indiana received approximately 8 percent of the portland cement and 9 percent of the masonry shipments, and West Virginia, 7 percent of the portland and 8 percent of the masonry cement. Shipments of both types of cement also were made to Kentucky, Pennsylvania, and Virginia. Masonry cement was produced at seven of the nine plants. The Diamond Portland Cement Co., Division of The Flintkote Co. discontinued packaging masonry cement at its Middle Branch, Stark County, plant and will phase out this portion of its cement business.

Portland cement shipments by type of customer were as follows: Ready-mixed concrete companies 9.3 million barrels, concrete product manufacturers 2.4 million barrels, highway contractors 2 million barrels, and building material dealers 790,000 barrels. The rest went to other contractors and miscellaneous customers. Nearly 13 million barrels was shipped by truck and 1.8 million barrels by rail. Most of the cement was delivered in bulk form, with only 7 percent of the portland cement shipped in containers.

More than 3.6 million tons of limestone, cement rock, and marl were used by producing companies as primary raw materials. Other materials used included clay and shale 541,000 tons, sand 89,000 tons, gypsum 118,000 tons, and iron-bearing materials 21,000 tons. Nearly 665,000 tons of bituminous coal was used for clinker production or power generation. Other fuels used included natural gas and fuel oil. Cement companies used 379.2 million kilowatt-hours of electrical energy. Of the electricity, 72 percent was purchased from public utilities and 28 percent was generated by the cement companies. A total of 28 kilns, ranging in size from 100 to 450 feet in length, and measuring from 5 to 14½ feet in diameter, was in operation during the year. The largest kiln operation in the four plants using the dry process measured 13½ feet at the upper end and 12 feet at the lower end, and 425 feet in length. Three kilns, 450 feet long, were in operation in plants using the wet process, the largest of which measured 14½ feet in diameter.

In National Safety Competition, Universal Atlas Cement Division, United States Steel Corp., The Diamond Portland Cement Company, Division of The Flintkote Co., and Southwestern Portland Cement Co. were awarded Certificates of Achievement in Safety for working in 1967 without any disabling injuries.

Clays.—Production of clays (fire clay and miscellaneous clay and shale) was below that of 1966 primarily because of lower demand in the major markets for Ohio clay. Clay used in refractories totaled 832,000 tons compared with 980,000 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	
1963	10	16,300	16,218	$53,244	2,064
1964	10	15,606	15,553	50,647	2,079
1965	9	14,599	14,786	47,499	1,600
1966	9	15,755	15,181	48,740	2,271
1967	9	14,773	14,726	46,860	2,224

in 1966. Production of clay used in heavy clay products (mainly building brick) declined 5 percent to 2.8 million tons; clay used for manufacturing cement decreased by 32,000 tons to 644,000 tons. Output of shale used for manufacturing lightweight aggregate also decreased. Fire clay comprised 43 percent of the total clay production and was used chiefly in refractories and for manufacturing heavy clay products. Most of the miscellaneous clay and shale output was for manufacturing heavy clay products. Other uses of Ohio clay included pottery and stoneware, floor and wall tile, and as rotary drilling mud. Fire clay was produced in 16 counties; Tuscarawas, Columbiana, Stark, and Jackson Counties led in output and supplied 67 percent of the output. Miscellaneous clay and shale was produced in 34 counties; Cuyahoga, Tuscarawas, Greene, and Starke Counties were the leading areas.

Gem Stones.—Gem and mineral specimen collectors were active at mines and quarries throughout the State. Value remained the same as that of 1966. Specimens collected included calcite, celestite, flint, and jasper.

Gypsum.—Production and value of crude gypsum was slightly below that of 1966; the average unit price also declined. Output from one underground mine and one open pit in Ottawa County was calcined at nearby plants. Crude gypsum shipped from outside the State also was calcined at the Lorain plant of National Gypsum Co. In National Safety Competition, the Gypsum mine of United States Gypsum Co. worked 66,291 man hours without any disabling injuries and was awarded a Certificate of Achievement in Safety.

Iron Oxide Pigments.—Minnesota Mining & Manufacturing Co. discontinued the production of red iron oxide pigment at its Copley plant at the end of 1966.

Lime.—Production of lime decreased and was 6 percent below the record high year 1966. Lower demand for all major categories of lime was reported. Production of chemical and other industrial lime decreased for the first time since 1957. Although higher unit values were reported for three of the four major uses of lime, total value of lime decreased 4 percent below that of 1966. Only agricultural lime decreased in average value per ton from $15.07 in 1966 to $14.55. The greatest change was in building lime, which increased in value from $18.36 to $22.05 per ton. Ohio supplied 20 percent of the national lime output and continued as the leading lime-producing State.

Of the total lime production, 2.1 million tons was captive tonnage or was marketed in Ohio. Significant shipments were made to Pennsylvania (289,000 tons), Indiana (264,000 tons), Michigan (207,000 tons), New York (172,000 tons), and Illinois (156,000 tons). Quantities also were exported to Canada, Chile, Australia, and the West Indies. Operators used mostly shaft-type kilns for manufacturing quicklime. Hydrated lime producers used both batch and continuous hydrators. Fuels used by producers included bituminous coal, coke, natural gas, and fuel oil.

Regenerated lime was produced in Montgomery and Ross Counties. Seventy percent of the primary lime production, chiefly quicklime, was used for chemical and other industrial uses. Sandusky County continued as the leading area for lime production, accounting for 1.3 million tons valued at $16.7 million.

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 [1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1963	24	$393	369	$7,003	1,820	$22,187	994	$16,374	3,207	$45,957
1964	23	352	374	7,561	2,147	26,209	1,120	19,186	3,664	53,308
1965	27	410	327	6,425	2,387	27,905	1,090	18,468	3,831	53,208
1966	17	253	299	5,490	2,574	28,740	968	16,514	3,858	50,997
1967	16	234	257	5,672	2,550	28,548	812	14,364	3,636	48,817

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

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, and for soil conditioning. The Cleveland Gypsum Co., Division of Cleveland Builders Supply Co., installed a perlite dust collection system at its Cleveland plant. The fine perlite dust will be sold as a lightweight filler material.[2]

Salt.—Production of salt increased for the ninth consecutive year and established a new high of 5,407,000 tons as output rose 5 percent above that of 1966. Value increased $3.8 million to $39.5 million. Rock and evaporated salt production was greater but brine output declined. Salt recovered from underground mines in Cuyahoga and Lake Counties was sold chiefly for highway ice control and in chemical applications. Brine production from wells in Lake and Summit Counties was mainly captive tonnage used for manufacturing chlorine and soda ash. Evaporated salt produced in Cuyahoga, Meigs, Summit, and Wayne Counties was marketed for a wide variety of uses including pressed blocks. 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. Morton Salt Co. began to

[2] Rock Products. V. 70, No. 2, February 1967, p. 117.

Table 7.—Sand and gravel sold or used by producers by classes of operations and uses

(Thousand short tons and thousand dollars)

Class of operations and use	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	7,044	$7,799	7,058	$8,020
Paving	8,678	9,011	8,149	8,732
Fill	1,881	1,234	1,413	929
Molding	543	2,311	475	2,093
Fire or furnace	173	523	138	423
Other [1]	962	3,082	1,081	3,342
Total	19,281	23,960	18,314	23,539
Gravel:				
Building	7,024	8,223	7,357	8,882
Paving	13,716	16,851	12,959	16,478
Railroad Ballast	12	9	W	W
Fill	1,931	1,095	2,035	1,182
Other [2]	1,773	2,721	2,152	2,662
Total	24,456	28,899	24,503	29,204
Total sand and gravel	43,737	52,859	42,817	52,743
Government-and-contractor operations:				
Sand:				
Paving	7	2	175	62
Fill	8	2	--------	--------
Total	15	4	175	62
Gravel:				
Paving	84	38	127	46
Fill	15	8	77	37
Total	99	46	204	83
Total sand and gravel	114	50	379	145
All operations:				
Sand	19,296	23,964	18,489	23,601
Gravel	24,555	28,945	24,707	29,287
Grand total	43,851	52,909	43,196	52,888

W Withheld to avoid disclosing individual company confidential data.
[1] Includes the following sands: Glass, blast, engine, filtration, ground, and other.
[2] Includes miscellaneous and other gravel, and data indicated by symbol W.

expand production by one third at its Fairport underground mines by the addition of new mining, hauling, and hoisting equipment. The mine, opened in 1959, was the State's first underground salt mine.

Sand and Gravel.—Sand and gravel production dropped 1 percent below the record high achieved in 1966. The decline was attributed primarily to less demand for materials used in construction. Commercial production of sand and gravel used in highway and building construction totaled 35.5 million tons, 939,000 tons below that of 1966. Demand for other construction sand and gravel was greater but was insufficient to overcome the overall decline. In addition, industrial sand

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

(Thousand short tons and thousand dollars)

County	1966		1967	
	Quantity	Value	Quantity	Value
Allen	114	$112	100	$142
Ashland	241	242	W	W
Ashtabula	176	225	135	177
Auglaize	287	321	348	379
Butler	2,668	3,001	2,942	3,341
Carroll	W	W	20	23
Champaign	328	358	W	W
Clark	1,094	1,101	1,286	1,310
Clinton	W	W	61	56
Columbiana	116	145	118	160
Coshocton	887	882	943	972
Cuyahoga	942	1,100	658	779
Erie	W	W	135	342
Franklin	5,816	6,289	5,254	6,142
Geauga	757	1,196	780	1,228
Greene	1,044	1,022	916	897
Hamilton	4,545	5,338	4,025	4,740
Hancock	61	60	------	------
Henry	63	85	71	92
Huron	W	W	144	127
Jackson	1	4	2	5
Knox	901	1,953	815	2,046
Lake	537	526	236	247
Lawrence	W	W	169	181
Licking	706	716	1,139	1,072
Logan	202	214	125	161
Lorain	459	627	518	730
Lucas	825	533	554	371
Madison	W	W	173	191
Marion	W	W	262	237
Medina	690	710	623	711
Miami	582	630	654	719
Montgomery	3,386	3,648	2,924	3,240
Morrow	W	W	55	54
Muskingum	591	672	676	W
Portage	2,696	3,868	2,401	3,446
Preble	166	201	155	183
Putnam	------	------	20	20
Richland	486	537	509	545
Ross	733	730	702	671
Shelby	271	285	339	371
Stark	1,798	2,215	1,600	2,180
Summit	1,111	1,143	1,422	1,266
Trumbull	195	233	W	W
Tuscarawas	1,160	1,481	1,331	1,772
Union	W	W	227	151
Vinton	3	2	------	------
Warren	1,180	1,331	1,221	1,437
Washington	335	408	436	452
Wayne	440	469	447	560
Williams	W	W	227	227
Wyandot	W	W	223	226
Undistributed [1]	5,258	8,296	5,075	8,509
Total	43,851	52,909	43,196	52,888

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

[1] Includes Athens, Brown, Crawford, Darke, Defiance, Fairfield, Gallia, Highland, Hocking, Holmes, Meigs, Monroe, Morgan, Perry, Pickaway, Pike, Sandusky, and Scioto Counties, some sand and gravel unspecified by county (1967), and data indicated by symbol W.

output and value decreased below that of 1966 and totaled 1.3 million tons valued at $5.5 million. Average value for industrial sand increased from $4.07 per ton in 1966 to $4.12. Industrial sands were sold chiefly for molding, glass manufacturing, and furnace construction and repair.

Producers were active in 68 counties; Franklin, Hamilton, Butler, Montgomery, and Portage Counties in descending order, led in output. Seven other counties had production exceeding 1 million tons. Commercial producers processed 88 percent of the total tonnage by washing, screening, sizing, or crushing. Nearly 40.7 million tons of sand and gravel was shipped to consumers by truck and the remainder by rail or water. The number of commercial operations totaled 468; 191 reported production below 25,000 tons and accounted for 41 percent of the total output. Five operations produced from 500,000 tons to 1 million tons and three operations had output exceeding 1 million tons.

Fifteen plants were awarded Certificates of Achievement in National Safety Competition for operating in 1967 without any disabling injuries. Those awarded certificates were Allied Chemical Corp., Fabricated Products Division, American Aggregates Corporation (five plants), Blaney Sand & Gravel Co., Inc., Dravo Corporation, Ohio Gravel Co. Division (two plants), Hamilton Gravel Co., Middletown Sand & Gravel Co., Wm. Miller Sand & Gravel Co., Seville Sand & Gravel Inc., and Standard Slag Co. (two plants).

Slag (Iron-Blast-Furnace).—According to the National Slag Association, processed iron-blast-furnace slag production totaled 5.9 million tons valued at $10.2 million. Output was 4 percent below that of 1966; the average unit price dropped from $1.92 per ton to $1.74 but was greater than the national average of $1.69. Of the total processed slag, 69 percent was screened air-cooled material; the remainder consisted of granulated and lightweight (expanded) slag. Most of the air-cooled slag was used as aggregate for concrete and bituminous construction, highway and airport construction, and as railroad ballast. Granulated slag was used chiefly in highway construction and for manufacturing hydraulic cement. Expanded slag was used chiefly as lightweight aggregate in concrete masonry blocks and in lightweight concrete. Nationally, the State continued to rank second in production of processed slag, accounting for 20 percent of the national output. Processing plants were centered chiefly near steelmaking facilities in Cleveland, Middletown, and Youngstown.

Stone.—Total stone (limestone and sandstone) production increased 1 percent above that of 1966 but value decreased by $366,000. The decrease in value was attributed to less demand for dimension stone. Crushed limestone production was 1 percent greater and accounted for 98 percent of the total stone tonnage. Miscellaneous uses of crushed limestone included whiting, filter beds, stone sand, paper, glass and alkali manufacture, poultry grit, fertilizer and aphalt filler and for dust abatement in coal mines. Dimension limestone production dropped sharply, totaling 6,000 tons valued at $51,000. Main uses of dimension limestone were in architectural and construction applications. The num-

Table 9.—Crushed and broken limestone sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1966		1967	
	Quantity	Value	Quantity	Value
Riprap	255	$366	455	$545
Concrete aggregate and roadstone	24,523	32,685	26,211	35,014
Fluxing stone	4,851	6,926	4,416	6,352
Agriculture	2,218	4,037	2,170	3,765
Railroad ballast	1,014	1,274	945	1,176
Cement	4,619	6,924	4,379	6,218
Lime	5,594	10,664	5,002	9,593
Miscellaneous uses	1,175	3,017	1,007	2,938
Total [1]	44,249	65,893	44,584	65,602

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

ber of limestone-producing counties remained at 56; Sandusky County was the foremost area for production, supplying 11 percent of the total limestone tonnage. Other leading areas were Erie, Wyandot, Mahoning, Ottawa, and Lucas Counties.

Dimension sandstone production and value were below those of 1966 totaling 126,000 tons valued at $4.7 million. Most of the dimension sandstone was sawed and dressed architectural stone but some was fabricated for steel furnace linings. Quantities of construction, curbing, and flagging stone also were produced. Crushed and broken sandstone production was 742,000 tons valued at $2.2 million compared with 560,000 tons valued at $1.8 million in 1966. Fifteen percent of the crushed sandstone was sold for concrete aggregate and roadstone but quantities also were marketed for refractory (ganister), riprap, glass manufacturing, foundry, and other uses. Of the 14 sandstone-producing counties, Lorain and Geauga Counties were the leading areas for production.

For the third consecutive year, the Barberton, Summit County, underground limestone mine of Pittsburgh Plate Glass Co., Chemical Division, won the Sentinal of Safety trophy in National Safety Competition sponsored jointly by the Bureau of Mines and the American Mining Congress. Workers at the mine achieved the notable safety record by working 286,518 man hours without sustaining any disabling injuries. The mine has been in safety competition for 7 years. In the quarry group of National Safety Competition, American Aggregates Corp., J. E. Baker Company, East Ohio Limestone Company, The France Co. (four quarries), National Gypsum Company, National Lime & Stone Co., (four quarries), Ohio Lime Company, Standard Slag Company, Toledo Stone & Glass Sand Company, and United States Gypsum Company all won Certificates of Achievement in Safety for their respective safety records.

Sulfur (Recovered Elemental).—Sun Oil Company recovered elemental sulfur at its Toledo Refinery. While production, shipments, and value were below that of 1966, a 9-percent increase in the average unit price was reported. The company recovered sulfur by the catalytic oxidation of hydrogen sulfide.

Vermiculite (Exfoliated).—Crude vermiculite shipped from out of State was exfoliated at the Cleveland plant of The Cleveland Gypsum Company, Division of Cleveland Builders Supply Company. The exfoliated vermiculite was marketed for plaster and concrete aggregate, horticultural and other industrial applications.

MINERAL FUELS

Coal (Bituminous).—Production of bituminous coal reached a record high, exceeding by 136,000 tons the previous high of 45.9 million tons established in 1920. For the sixth consecutive year production increased and was 6 percent greater than that of 1966. The average value per ton also continued to increase—$3.84 per ton compared with $3.79 in 1966. Output from strip mines accounted for 63 percent of the total tonnage; 33 percent came from underground mines and the remainder from auger mines. The total number of active mines producing 1,000 tons or more declined from 426 in 1966 to 401. Underground mines decreased by 22; strip and auger mines decreased by one and two, respectively. Output was reported in 25 counties; Harrison and Belmont Counties with 10.8 million and 10.6 million tons, respectively, were the leading coal-producing areas. Production from strip mines was 29.2 million tons, 2 percent greater than that of 1966. Average value per ton increased from $3.54 in 1966 to $3.59. Harrison County which produced 5.7 million tons, was the leading area for strip-mined coal. Jefferson, Belmont, Coshocton, and Tuscarawas Counties, each with production exceeding 2 million tons, also were leading producing areas. Equipment used by strip mine operators included 43 electric, 17 diesel-electric, 460 diesel, and 16 gasoline shovels or draglines. Most of the power equipment had dipper capacities of less than 3 cubic yards; 15 shovels and 16 draglines had capacities greater than 12 cubic yards.

Table 10.—Bituminous coal production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	36,790	$136,113
1964	37,310	137,776
1965	39,390	146,028
1966	43,341	164,444
1967	46,014	176,921

Table 11.—Coal (bituminous) production, by counties [1]

(Thousand short tons and thousand dollars)

County	1966					1967				
	Number of mines			Total production		Number of mines			Total production	
	Underground	Strip	Auger	Quantity	Value	Underground	Strip	Auger	Quantity	Value
Athens	8	2	1	187	$717	7	1	----	260	$992
Belmont	13	22	6	8,286	33,619	10	18	7	10,647	43,257
Carroll	2	8	1	275	906	1	10	1	434	1,488
Columbiana	6	34	13	1,356	4,440	5	30	16	1,264	4,219
Coshocton	6	10	4	2,761	11,855	4	11	4	2,860	12,073
Gallia	6	7	2	288	960	6	3	2	173	474
Guernsey	--	6	1	1,845	4,710	----	10	1	1,986	5,231
Harrison	6	17	3	10,650	43,506	7	19	4	10,826	44,860
Hocking	1	7	2	87	342	----	7	----	56	189
Holmes	--	5	1	244	815	----	5	1	177	536
Jackson	4	17	2	855	3,068	4	20	2	990	3,416
Jefferson	8	39	10	4,787	18,040	4	33	11	4,718	17,608
Lawrence	--	3	----	W	W	----	2	----	W	W
Mahoning	--	14	----	501	1,903	----	12	----	563	2,151
Meigs	4	-----	1	30	94	2	1	----	68	203
Monroe	1	-----	----	W	W	1	-----	----	W	W
Morgan	--	3	----	W	W	----	3	----	1,011	3,569
Muskingum	6	8	----	283	924	3	12	1	620	1,830
Noble	--	12	5	2,222	6,862	----	11	3	2,076	6,868
Perry	6	10	2	2,133	8,324	5	11	1	2,170	8,489
Stark	--	17	1	525	1,636	----	13	1	445	1,445
Tuscarawas	8	23	7	2,995	10,427	6	29	6	2,855	10,124
Vinton	4	5	----	154	604	2	8	----	219	925
Washington	--	3	1	200	707	----	2	----	177	W
Wayne	--	2	----	24	57	----	2	----	17	W
Undistributed	XX	XX	XX	2,653	9,928	XX	XX	XX	1,400	6,974
Total [2]	89	274	63	43,341	164,444	67	273	61	46,014	176,921

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.

Nearly 15.2 million tons of coal was recovered from underground mines, 2.1 million tons more than in 1966. Average value per ton increased by $0.01 to $4.39. Production was reported in 15 counties but over half of the underground tonnage came from Belmont and Harrison Counties. The trend toward greater mechanization at Ohio underground mines continued as the number of continuous mining machines increased from 59 to 66. Nearly 8.5 million tons of coal was mined and loaded by continuous mining machines. Operators used mainly shuttle cars and conveyors in conjunction with the continuous miners.

Coal tonnage recovered from auger mines totaled 1.6 million tons, 6 percent below that of 1966. Average value per ton also decreased—$3.38 compared with $3.54 the previous year. Auger-mined coal was produced in 15 counties; Noble and Columbiana Counties were the leading areas for production. Operators used 50 augers for recovering coal compared with 53 in 1966.

Twenty coal cleaning and preparation plants were active, one less than in 1966. Producers cleaned 17.2 million tons of coal of which only 958,000 tons was cleaned by pneumatic methods and the remainder was cleaned by washing. Of the total tonnage cleaned, 67 percent was from underground mines, 32 percent from strip mines, and the remainder was from auger mines. Over 3.9 million tons of coal was dried after cleaning at nine preparation plants. At mines having crushing and treatment facilities, 24.2 million tons of coal was crushed and nearly 5 million tons treated with dust-allaying or antifreezing materials. Production at captive mines totaled 6.3 million tons compared with 4.5 million tons in 1966. Of the State's total coal output, 29.5 million tons were shipped by rail or water, 13.7 million tons by truck and the rest was consumed locally.

Preliminary employment data indicates that an average of 8,100 men worked 15.2

million man-hours compared with nearly 14.3 million man-hours in 1966. Only four fatalities were recorded compared with 12 the previous year. Of the four fatalities, three were at underground mines caused by falls of roof and the other was at a strip mine. The number of nonfatal injuries totaled 375. The State's fatal injury rates of 0.26 per million man-hours and 0.09 per million short tons were the lowest in the Nation and were well below the national averages of 0.90 and 0.38, respectively. In National Safety Competition, the Crescent Valley No. 7 mine of Hanna Coal Co., Division of Consolidation Coal Co., was the winner of the surface group competition and was awarded a trophy for having the best safety record of the year. The mine worked 218,255 man-hours without any disabling injuries. Also in the same competition, three other mines of the company (West Farm No. 22, Bradford No. 16, and Georgetown No. 24) as well as Magnolia Mining Co. (Mapleton mine), Belville Mining Co., Inc. (strip mine), and Mineral Transport, Inc. (Mineral Patterson mine), were awarded Certificates of Achievement in Safety for working without any disabling injuries. In National Safety Competition for underground coal mines, the Coshocton mine of Mason & Sons Coal Co., Inc., and the Low Ash No. 2 mine of Monroe Coal Co. also were given Certificates of Achievement for their safety records.

Coke and Coal Chemicals.—Production of oven-coke decreased 5 percent below that of 1965 and totaled 8.1 million tons valued at $139 million.

Peat.—Shipments and value were greater than that of 1966, but the average value per ton decreased from $16.19 to $13.68. The increase was attributed primarily to more active operations. Prices declined as operators reported more lower-priced bulk sales. Output was from 11 counties; Stark County with four operations ranked first in tonnage. Of the total sales, 40 percent was moss peat, 32 percent humus, and 28 percent was reed-sedge peat. Most of the peat was sold in bulk and used chiefly for soil conditioning.

Petroleum and National Gas.—Production and value of both petroleum and natural gas declined compared with that of 1966. According to the American Association of Petroleum Geologists, total well completions declined from 1,312 to 1,261 but total footage drilled increased from 3,733,000 to 4,088,000. A total of 1,179 development and 82 wildcat completions were reported. Development wells were drilled in 42 counties; Stark, Perry, Licking, and Morgan Counties were the leading areas. Wildcat completions were reported in 34 counties; Huron and Stark Counties with eight wells each were the leading areas for wildcat activity. The number of wildcat completions dropped from 138 in 1966 to 82. Most drilling operators in Ohio used cable tool equipment. According to the Division of Oil & Gas, Ohio Department of Natural Resources, 14,638 petroleum wells were productive at the end of 1967.

Reserves on December 31, 1967, were 762,731 million cubic feet of natural gas (14.73 pounds per square inch absolute, at 60°F), and 92.1 million barrels of crude petroleum, according to the American Gas Association and American Petroleum Institute. Compared with the end of 1966, reserves of natural gas increased by 7,516 million cubic feet but crude petroleum reserves decreased by 9.1 million barrels. According to a survey, three companies operated natural gas storage facilities having total capacity of 407,075 million cubic feet. Operators of natural gas storage areas were East Ohio Gas Co. (four areas), Manufacturers Light & Heat (one area), and Ohio Fuel Gas Co. (14 areas).[3] Permian Corp. operated its Edison natural gas processing plant in Morrow County. Propane, butane, and LP-gas mix were recovered by the refrigeration-absorption process at the plant which formerly was operated by McWood Corp.

Nine petroleum refineries were active; total crude oil capacity as of January 1, 1967, was 460,700 barrels per day, 3,500 barrels less than in 1966. Gasoline output capacity totaled 221,605 barrels per day compared with 187,000 barrels the previous year. Other products recovered at the refiinery included asphalt, coke, lubricant, and paraffin. For recovering gasoline and other products companies used catalytic and thermal cracking and reforming, hydrocracking, coking, and alkylation processes. Refineries were operated at Canton,

[3] Oil and Gas Journal. V. 66, No. 22, May 27, 1968, p. 136.

Cincinnati, Cleves, Heath (Newark), Lima, Oregon, and Toledo (three plants).

Several legislative and regulatory changes affecting the State's oil and gas industry were enacted during the year. The Ohio Legislature passed laws strengthening control of plugging of wells and modifying the bonding requirements for Ohio-based operators. The State also enacted specific legislation governing the subsurface disposal of industrial liquid waste. Permits were granted to two steel companies and one oil refinery-chemical company for industrial liquid-waste wells. Two of the wells were drilled but will not be operative until the middle of 1968. Since March 1965, wells drilled below the top of the Clinton sandstone or an equivalent stratigraphic zone have been required to be on 10-acre drilling units with specified minimum distances from unit boundaries. Rules and regulations adopted on November 1, 1967, specified spacing of all new wells with minimum distances from unit boundaries. The size of the drilling units and the spacing vary with the depths of the wells. Thus, Ohio now has spacing rules and regulations for every new well drilled for oil and gas within the State. Other rules and regulations were adopted to govern secondary-recovery operations.[4]

[4] American Association of Petroleum Geologists, Bulletin. V. 52, June 6, 1968, pp. 959–964.

Table 12.—Oil and gas well drilling in 1967, by counties

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Adams	---	---	---	---	---	1	1	2,039
Ashtabula	---	1	---	---	1	---	2	7,313
Athens	9	4	6	---	---	1	20	33,577
Belmont	2	---	---	---	---	---	2	3,840
Carroll	26	2	1	3	---	---	32	168,047
Champaign	---	---	---	---	---	1	1	1,963
Columbiana	2	19	---	---	---	---	21	111,617
Coshocton	53	12	23	1	---	2	91	193,008
Crawford	1	---	---	1	---	5	7	21,167
Delaware	1	---	---	---	---	1	2	5,347
Erie	2	---	1	---	1	6	10	39,103
Fairfield	4	1	3	---	---	1	9	24,253
Fulton	---	---	---	---	---	2	2	6,146
Gallia	2	---	1	---	---	---	3	5,273
Guernsey	2	1	2	---	---	---	5	15,852
Hardin	---	---	---	---	---	1	1	1,921
Hocking	42	18	6	---	---	---	66	191,904
Holmes	---	8	1	---	---	---	9	23,650
Huron	3	2	1	---	---	8	14	54,962
Jefferson	7	---	4	---	---	---	11	13,063
Knox	25	27	14	---	---	1	67	177,612
Lawrence	---	8	1	---	---	---	9	31,861
Licking	91	29	14	---	---	1	135	348,398
Logan	---	---	---	---	---	1	1	1,860
Lorain	1	7	---	1	---	2	11	29,041
Mahoning	1	4	---	---	---	---	5	26,527
Marion	2	---	---	---	---	---	2	5,780
Medina	6	8	21	---	1	---	36	97,346
Meigs	4	---	2	---	---	1	7	11,792
Mercer	1	---	---	---	---	---	1	1,224
Monroe	6	9	3	---	1	---	19	32,351
Morgan	26	13	61	2	1	4	107	311,979
Muskingum	26	20	4	---	---	---	50	150,678
Noble	3	1	2	1	---	1	8	25,098
Ottawa	---	---	---	---	---	1	1	2,284
Perry	94	33	13	---	---	1	141	428,249
Portage	2	29	---	1	---	---	32	143,431
Putnam	1	---	---	1	---	---	2	3,255
Richland	---	---	1	---	---	4	5	20,797
Scioto	---	2	---	---	---	---	2	650
Seneca	---	---	---	---	---	1	1	2,573
Shelby	1	---	1	1	---	---	3	4,107
Stark	132	58	1	5	2	1	199	1,000,423
Summit	---	3	---	---	---	---	3	13,361
Tuscarawas	11	21	2	---	---	1	35	150,065
Vinton	6	1	---	---	---	2	9	15,311
Warren	---	---	---	1	---	1	2	4,891
Washington	12	16	10	1	3	1	43	72,454
Wayne	5	8	1	---	---	---	14	47,413
Wyandot	---	---	2	---	---	---	2	2,905
Total	612	365	202	19	10	53	1,261	4,087,761

Source: American Association of Petroleum Geologists (AAPG).

METALS

Aluminum.—Production and value of primary aluminum produced at the Hannibal reduction plant of Ormet Corp. were greater than those of 1966. Ormet Corp., jointly owned by 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-Matheson operated a casting and rolling mill adjacent to the reduction plant. Annual capacity of the reduction plant remained at 180,000 tons.

Beryllium.—Beryllium metal, alloys, and compounds were produced from hand-sorted beryl by the Brush Beryllium Corp. at Elmore. Production was mostly beryllium and beryl-copper master alloy.

Ferroalloys.—Shipments of ferroalloys were below those of 1966. Production at nine plants consisted mainly of ferroalloys of boron, columbium, chromium, manganese, silicon, silvery pig iron, silicomanganese, titanium, and vanadium. Plants were located at Ashtabula, Beverly, Brilliant, Cambridge, Jackson, Marietta, Philo, Powhatan Point, and Vancoram. Ohio continued as the foremost producer among the 16 ferroalloy-producing States.

Iron and Steel.—According to the American Iron and Steel Institute, steel production was 20.4 million tons, 11 percent below that of 1966. Of the total, 10.8 million tons was produced in open-hearth furnaces, 7.5 million tons by the basic oxygen process, and the remainder was electric steel. Compared with that of 1966, open-hearth production declined sharply but basic oxygen steel increased 30 percent. Pig iron production totaled 14.4 million tons; shipments were 14.3 million tons valued at $866.8 million. Shipments declined by 1.9 million tons and value decreased 10 percent. Nearly 12.1 million tons of basic pig iron was produced, 1.4 million tons less than that of the previous year. At the 18 plants, 36 of the 46 blast furnaces were active.

Steel plants received 4.2 million tons of domestic and 2.9 million tons of imported iron ore. Receipts were 3.4 million tons less than those of 1966 but receipts of agglomerated material having a higher iron content increased by 138,000 tons. Agglomerates received at plants totaled 13.1 million tons, of which 11.2 million tons was regular iron ore pellets. Most of the foreign iron ore was imported from Labrador and other parts of Canada and from Venezuela with lesser quantities coming from Africa, Chile, and Brazil. Blast furnaces consumed 4.1 million tons of domestic and 1.1 million tons of foreign iron ore. In addition, nearly 2.1 million tons of limestone and 951,000 tons of dolomite were consumed as fluxing material. Tonnages of other materials consumed were pellets (regular) 10.3 million, sinter (regular) 3.8 million, coke and coke breeze 9.5 million, home and purchased scrap 959,000, slag scrap 234,000, mill cinder and roll scale 702,000, open-hearth, basic oxygen, and Bessemer slag, 782,000, and flue dust 118,000.

Over 4.8 million tons of slag and 169,000 tons of scrap were produced at blast furnaces and 718,000 tons of flue dust was recovered.

Titanium.—Reactive Metals Inc., jointly owned by 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, Nev., was rolled and fabricated at Toronto by Titanium Metals Corporation of America (TMCA). Cabot Titanium Corp. produced titanium pigments (titanium dioxide) used in manufacturing paint at its Ashtabula plant.

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 Co., Cincinnati, produced zircon- and zirconia-based 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	Type of activity	County	Address	Remarks
Abrasives: Metallic:				
Cleveland Metal Abrasive Co., Division of Fanner Manufacturing Co.	Plant	Cuyahoga	Brookside Park Cleveland, Ohio	
Do	do	Lucas	do	
Globe Steel Abrasives Co	do	Richland	P.O. Box 1247 (annex) Mansfield, Ohio	
Metal Blast, Inc	do	Cuyahoga	871 East 67th St. Cleveland, Ohio	
The National Metal Abrasive Co	do	do	3560 Norton Rd. Cleveland, Ohio	
Steel Abrasives, Inc	do	Butler	Hamilton, Ohio	
Cement:				
Alpha Portland Cement Co	do	Lawrence	15 South Third St. Easton, Pa.	Also cement rock.
Columbia Cement Co	do	Muskingum	Zanesville, Ohio	Also shale and limestone.
The Diamond Portland Cement Co., Division of The Flintkote Co.	do	Stark	Middle Branch, Ohio	Also clay, shale, limestone.
Marquette Cement Manufacturing Co	do	Lawrence	20 North Wacker Dr. Chicago, Ill.	Also cement rock, limestone, shale.
Medusa Portland Cement Co	do	Lucas	P.O. Box 5668 Cleveland, Ohio	Also sand, shale, limestone.
Peninsular Portland Cement Division General Portland Cement Co.	do	Paulding	709 Clay St. Ft Wayne, Ind.	Also clay and limestone.
Pittsburgh Plate Glass Co	do	Summit	P.O. Box 31 Barberton, Ohio	Also limestone.
Southwestern Portland Cement Co	do	Greene	P.O. Box 191 Fairborn, Ohio	Also clay and limestone.
Universal Atlas Cement Division United States Steel Corp.	do	Greene	Chatham Center, Box 2969 Pittsburgh, Pa.	Also clay and limestone.
Clay:				
Fire:				
AFC Corporation (formerly American Fire Clay & Products Co.)	Pit	Mahoning	P.O. Box 157 Canfield, Ohio	
The Belden Brick Co	do	Tuscarawas	P.O. Box 910 Canton, Ohio	
Cedar Heights Clay Co	do	Jackson	P.O. Box 368 Oak Hill, Ohio	
General Clay Products Corp	do	Tuscarawas	1445 W. Goodale Blvd. Columbus, Ohio	
Harbison-Walker Refractories Co	do	Lawrence	2 Gateway Center, Pittsburgh, Pa.	
International Minerals & Chemical Corp. Industrial Minerals Division.	do	Scioto	Old Orchard Rd. Skokie, Ill.	
Natco, Division of Fuqua Industries, Inc	do	Stark	327 Fifth Ave. Pittsburgh, Pa.	
Do	do	Mahoning	do	
North American Refractories Co	do	Tuscarawas	National City East 6th Building Cleveland, Ohio	

Table 13.—Principal producers—Continued

Commodity and company	Type of activity	County	Address	Remarks
Clay—Continued				
H. K. Porter Co., Inc	Underground	Columbiana	Porter Building Pittsburgh, Pa.	
Do	do	Jefferson	do	
Shepfer & Moomaw Bros., Inc	Pit	Tuscarawas	Sugarcreek, Ohio	**Also miscellaneous clay.**
The Stone Creek Brick Co	Underground	do	Stone Creek, Ohio	
U.S. Ceramic Tile Co	Pit	Stark	East Sparta, Ohio	**Also shale.**
Miscellaneous clay and shale:				
American Vitrified Products Co	do	Columbiana	701 National City Bank Building Cleveland, Ohio	
The Belden Brick Co	do	Tuscarawas	P.O. Box 910 Canton, Ohio	
Cleveland Buiders Supply Co	do	Cuyahoga	2100 West Third St. Cleveland, Ohio	
The Galena Shale Tile & Brick Co	do	Delaware	Galena, Ohio	
General Clay Products Corp	do	Holmes	1445 West Goodale Blvd. Columbus, Ohio	
General Wadsworth Brick Corp	do	Medina	P.O. Box 340 Wadsworth, Ohio	
Hydraulic Press Brick Co	do	Cuyahoga	705 Olive St. St. Louis Mo.	
Ludowici-Celadon Co	do	Perry	75 East Wacker Dr. Chicago, Ill.	
Marion Brick Corp	do	Marion	Box 468 Marion, Ohio	
The Ohio Clay Co	do	Cuyahoga	5151 Warner Rd. Cleveland, Ohio	
The Richland Shale Brick Co	do	Richland	Box 328 Mansfield, Ohio	
U.S. Concrete Pipe Company	do	Tuscarawas	2121 East Ohio Building Cleveland, Ohio	
Coal (bituminous):				
Central Ohio Coal Company	Strip	Guernsey	P.O. Box 1230 Zanesville, Ohio	
Hanna Coal Company, Division of Consolidation Coal Co.	Underground	Harrison	Cadiz, Ohio	
Do	Strip	Belmont	do	
Do	do	Harrison	do	
The North American Coal Corporation	Underground	Belmont	12800 Shaker Blvd., Cleveland, Ohio	
Do	do	Monroe	do	
Oglebay Norton Company	do	Belmont	Box 6508, 1200 Hanna Bldg., Cleveland, Ohio	
Peabody Coal Company	Strip	Coshocton	301 North Memorial Dr. St. Louis, Mo.	
Do	do	Perry	do	
Simco Peabody Company	do	Coshocton	do	
The Youghiogheny & Ohio Coal Corp	Underground	Harrison	4614 Prospect Ave. Cleveland, Ohio	

Ferrolloys:				
Foote Mineral Co. (formerly Vanadium Corp. of America).	Plant	Guernsey	Dept. 602, Route 100 Exton, Pa.	
Do	do	Jefferson	do	
Interlake Steel Corp	do	Washington	310 S. Michigan Ave. Chicago, Ill. 60604	
Jackson Iron & Steel Co	do	Jackson	Jackson, Ohio 45640	
Ohio Ferro-Alloys Corp	do	Jefferson	837 30th N.W. Canton, Ohio	
Do	do	Muskingum	do	
Do	do	Belmont	do	
Union Carbide Corp	do	Ashtabula	270 Park Ave. New York, N.Y.	
Do	do	Washington	do	
Gypsum: Crude:				
Celotex Corporation	Pit	Ottawa	1500 North Dale Mabry Tampa, Florida	Also calcined.
United States Gypsum Company	Underground	do	101 South Wacker Dr. Chicago, Ill.	Do.
Calcined: National Gypsum Co	Plant	Lorain	325 Delaware Ave. Buffalo, N.Y.	
Lime: Primary:				
The J. E. Baker Co	do	Sandusky	P.O. Box 1189 York, Pa.	
Basic, Incorporated	do	Seneca	845 Hanna Building Cleveland, Ohio	
Cuyahoga Lime Company	do	Cuyahoga	Menlo Park, N.J.	
Diamond Shamrock Corp	do	Lake	Union Commerce Buliding Cleveland, Ohio	
Grand River Lime Company	do	Lake	Delaware, Ohio	
The National Lime & Stone Co	do	Wyandot	First National Bank Building Findlay, Ohio	
Ohio Lime Co	do	Sandusky	Woodville, Ohio	
Chas. Pfizer & Co., Inc	do	do	836 National Bank Building Toledo, Ohio	
Pittsburgh Plate Glass Co	do	Summit	Barberton, Ohio	
Standard Lime & Refractories Co	do	Sandusky	2000 First Nat'l Bank Bldg., Baltimore, Md.	
Union Carbide Corp., Chemical & Plastics	do	Ashtabula	P.O. Box 299 Marietta, Ohio	
United States Gypsum Co	do	Ottawa	101 South Wacker Dr. Chicago, Ill.	
Regenerated:				
City of Dayton, Department of Water	do	Montgomery	1044 Ottawa Street Dayton, Ohio	
Mead Corp., Chillicothe Division	do	Ross	Chillicothe, Ohio	
Peat:				
Corell Peat Moss Co	Bog	Stark	Box 340, Rt. 1 Beach City, Ohio	
Green Oaks Peat Moss Co	do	Portage	R. D. No. 4 Ravenna, Ohio	
The Humus Co	do	Wyandot	2628 South Michigan St. South Bend, Ind.	
Lantz Peat Moss, Inc	do	Stark	4594 Fulton Dr., N.W. Canton, Ohio	
Louis Meyer	do	Darke	Route 5, Greenville, Ohio	

Table 13.—Principal producers—Continued

Commodity and company	Type of activity	County	Address	Remarks
Peat—Continued				
Montgomery Peat Moss	Bog	Huron	Route 1, Plymouth, Ohio	
Dan E. Poljack	do	Cuyahoga	19675 Sheldon Rd. Middleburg Hts., Ohio	
Reynolds Farm, Inc	do	Richland	Route 1, Shelby, Ohio	
Raymond Sheets	do	Stark	3832 12th St. Canton, Ohio	
Sphagum Peat Moss Products	do	Champaign	Route 1, West Liberty, Ohio	
W. C. Utzinger & Sons	do	Franklin	State Route 104 Grove City, Ohio	
Perlite (expanded):				
The Cleveland Gypsum Co., Division Cleveland Builders Supply Co.	Plant	Cuyahoga	2100 West Third St. Cleveland, Ohio	Also exfoliated vermiculite.
National Gypsum Co	do	Ottawa	325 Delaware Ave. Buffalo, N.Y.	
Philip Carey Corporation	do	Hamilton	Wayne Ave. Cincinnati, Ohio	
U.S. Gypsum Co	do	Ottawa	101 South Wacker Dr. Chicago, Ill.	
Petroleum refineries:				
Ashland Oil and Refining Co	do	Stark	1409 Winchester Ave. Ashland, Ky. 41101	
Chevron Asphalt Company	do	Hamilton	555 Market St. San Francisco, Calif. 94105	
Gulf Oil Corp	do	do	Pittsburgh, Pa. 15219	
Do	do	Lucas	do	
The Pure Oil Co. Division of Union Oil Company of California.	do	Licking	Union Oil Company of California Union Center, Los Angeles 90017	
Do	do	Lucas	do	
The Standard Oil Company (Ohio)	do	Allen	Midland Bldg. Cleveland, Ohio 44115	
Do	do	Lucas	do	
Sun Oil Company	do	do	1608 Walnut St. Philadelphia, Pa.	Also byproduct sulfur.
Salt:				
Brine:				
Diamond Shamrock Corp	Well	Lake	300 Union Commerce Building, Cleveland, Ohio	
Pittsburgh Plate Glass Co	do	Summit	P.O. Box 31 Barberton, Ohio.	Also evaporated.
Evaporated:				
Diamond Crystal Salt Co	do	do	916 So. Riverside St. Clair, Mich.	Also brine.
Excelsior Salt Works, Inc	do	Meigs	P.O. Box 267 Pomeroy, Ohio	
Morton Salt Co., Division of Morton International, Inc.	do	Wayne	110 No. Wacker Dr. Chicago, Ill.	
Rock:				
International Salt Co., Inc	Underground	Cuyahoga	Clarks Summit, Pa	Also evaporated.
Morton Salt Co., Dvision of Morton International, Inc.	do	Lake	110 No. Wacker Dr. Chicago, Ill.	

Sand and gravel:			
American Aggregates Corp	Pit	Franklin	Garst Ave. at Ave. B Greenville, Ohio
Do	----do	Montgomery	----do
American Materials Corp	----do	Butler	P.O. Box 154 Hamilton, Ohio
The Central Silica Company	----do	Perry	806 Market St. Zanesville, Ohio
Lorain Elyria Sand Co	Dredge	Lorain	1840 Idaho Ave. Lorain, Ohio
Wm. Miller Sand & Gravel Co	Pit	Franklin	1287 Jackson Pike Columbus, Ohio
The Millwood Sand Company	----do	Knox	806 Market St. Zanesville, Ohio
Moraine Materials Co	----do	Montgomery	2500 East River Rd. Dayton, Ohio
Morrow Gravel Company	----do	Warren	3535 Round Bottom Rd. Cincinnati, Ohio
Ohio Gravel Co., Division of Dravo Corp	----do	Butler	5253 Wooster Rd. Cincinnati, Ohio
Do	----do	Hamilton	----do
Pennsylvania Glass Sand Corp. Industrial Silica Division	----do	Portage	Gravel Operations Department Hancock, W. Va.
R. W. Sidley, Inc	----do	Geauga	Thompson, Ohio
Spring Construction Co	----do	Coshocton	P.O. Box 126 West Lafayette, Ohio
The Standard Slag Company	----do	Portage	1200 Stambaugh Building Youngstown, Ohio
Tri-State Material Corporation	Dredge	Meigs	Box 1933 Parkersburg, W. Va.
Smelters:			
Aluminum: Ormet Corp	Plant	Monroe	
Titanium sponge: Reactive Metals, Inc	----do	Ashtabula	
Zinc: American Zinc Oxide Company	----do	Franklin	
Stone:			
Limestone, (crushed):			
Armco Steel Corp	Quarry	Miami	P.O. Box 911 Piqua, Ohio
Basic, Inc	----do	Seneca	845 Hanna Building Cleveland, Ohio
Bessemer Cement Co., Division of Diamond Shamrock Corp.	----do	Mahoning	800 Stambaugh Building Youngstown, Ohio
Carbon Limestone Co	----do	----do	Lowellville, Ohio
Davon, Inc	----do	Adams	Box 5765 Columbus, Ohio
Marble Cliff Quarries Co	----do	Franklin	2100 Tremont Center Columbus, Ohio
National Lime & Stone Co	----do	Wyandot	Findlay, Ohio
Do	----do	Crawford	First National Bank Building Findlay, Ohio
Ohio Lime Co	----do	Sandusky	Woodville, Ohio
Chas. Pfizer & Co., Inc	----do	----do	836 National Bank Building Toledo, Ohio
Sandusky Crushed Stone Co., Inc	----do	Erie	P.O. Box 527 Sandusky, Ohio

Table 13.—Principal producers—Continued

Commodity and company	Type of activity	County	Address	Remarks
Stone—Continued				
Limestone (crushed)—Continued				
Standard Slag Co., Marblehead Stone Division	Quarry	Ottawa	1200 Stambaugh Building Youngstown, Ohio	
Wagner Quarries Co	do	Erie	East Market St. Sandusky, Ohio	
Woodville Lime & Chemical Co	do	Sandusky	Box 218 Woodville, Ohio	
Limestone (dimension):				
Gregory Stone Co., Inc	do	Miami	R.D. No. 1 Ludlow Falls, Ohio	
Northern Ohio Stone Co	do	Seneca	Flat Rock, Ohio	Also crushed limestone.
Wilbur O. Webster DBA Webster Stone Co	do	do	R.D. No. 1, Bloomville, Ohio	
Sandstone (crushed):				
Walter C. Best, Inc	do	Geauga	Box 87, Chardon, Ohio	
A. P. Green Refractories, Co., Durex Division	do	Pike	P.O. Box 255 Oak Hill, Ohio	Quartzite.
Harbison-Walker Refractories Co	do	Geauga	2 Gateway Center Pittsburgh, Pa.	Do.
Pittsburgh Plate Glass Co. Chemical Division	do	Summit	P.O. Box 31 Barberton, Ohio	
Southern Silica, Inc	do	Ross	Box 22, Richmondale, Ohio	
Sandstone (dimension):				
Briar Hill Stone Co	do	Coshocton	Glenmont, Ohio	
Do	do	Holmes		
Cleveland Quarries Co	do	Lorain	Amherst, Ohio	Also grindstones.
The Taylor Stone Co	do	Scioto	McDermott, Ohio	
The Waller Brothers	do	do	do	

The Mineral Industry of Oklahoma

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

By Robert B. McDougal [1] and William E. Ham [2]

Mineral output in Oklahoma in 1967, valued at $1.03 billion, was the highest in the State's history. The record value resulted primarily from increased output of petroleum, natural gas, and natural gas liquids and was coupled with minor gains in copper, clays, gypsum, lime, stone, and tripoli. Cement and sand and gravel declined owing to a reduced volume of construction; lead and zinc output dropped as a result of decline in market prices.

[1] Geologist, Bureau of Mines, Bartlesville, Oklahoma
[2] Geologist, Oklahoma Geological Survey, Norman, Oklahoma

Table 1.—Mineral production in Oklahoma [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays [2] thousand short tons	745	$754	744	$869
Coal (bituminous) do	843	4,935	823	4,703
Gypsum do	785	2,212	804	2,266
Helium, grade A thousand cubic feet	352,400	12,333	309,100	9,835
Lead (recoverable content of ores, etc.) short tons	2,999	907	2,727	764
Natural gas million cubic feet	1,351,225	189,172	1,412,952	202,052
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons	576,124	35,715	568,905	35,846
LP gases do	986,254	44,381	1,005,633	49,276
Petroleum (crude) thousand 42-gallon barrels	224,839	654,281	230,749	676,095
Salt thousand short tons	W	W	10	76
Sand and gravel do	6,040	7,565	4,540	5,280
Stone do	15,334	17,393	16,355	18,932
Zinc (recoverable content of ores, etc.) short tons	11,237	3,259	10,670	2,954
Value of items that cannot be disclosed: Bentonite, cement, copper, lime, silver, tripoli, volcanic ash, and value indicated by symbol W	XX	24,484	XX	23,178
Total	XX	997,391	XX	1,032,126
Total 1957–59 constant dollars	XX	r 970,453	XX	p 994,159

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

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

County	1966 r	1967	Minerals produced in 1967 in order of value
Alfalfa	$11,642,243	$9,013,584	Petroleum, natural gas, natural gas liquids, sand and gravel.
Atoka	W	W	Stone, petroleum.
Beaver	53,319,812	53,735,609	Natural gas, petroleum, natural gas liquids, volcanic ash.
Beckham	15,461,381	12,998,122	Natural gas, natural gas liquids, petroleum.
Blaine	7,792,300	9,602,082	Petroleum, natural gas, gypsum, natural gas liquids.
Bryan	2,243,730	1,896,598	Petroleum, natural gas, sand and gravel, stone.
Caddo	17,133,272	23,058,606	Petroleum, natural gas, gypsum, natural gas liquids, stone, sand and gravel.
Canadian	1,918,394	1,960,342	Natural gas, petroleum, sand and gravel, clays, gypsum.
Carter	60,912,497	62,411,222	Petroleum, natural gas liquids, natural gas, stone.
Cherokee	W	W	Stone.
Choctaw	W	897,333	Stone, sand and gravel.
Cimarron	16,806,545	14,923,174	Helium, natural gas, petroleum, natural gas liquids.
Cleveland	15,690,763	17,712,525	Petroleum, natural gas liquids, natural gas.
Coal	2,605,382	2,563,744	Petroleum, natural gas, stone.
Comanche	3,028,630	3,102,827	Stone, natural gas, gypsum, petroleum.
Cotton	6,145,845	4,836,064	Petroleum, sand and gravel, natural gas.
Craig	708,015	323,641	Coal, petroleum, natural gas.
Creek	35,685,166	34,046,202	Petroleum, natural gas liquids, stone, natural gas, clays.
Custer	3,978,885	4,124,936	Petroleum, natural gas, clays.
Dewey	19,099,554	24,129,387	Petroleum, natural gas, natural gas liquids, clays.
Ellis	4,762,021	13,285,372	Natural gas, petroleum.
Garfield	33,645,152	43,174,996	Petroleum, natural gas, natural gas liquids, sand gravel.
Garvin	69,475,115	71,896,729	Petroleum, natural gas liquids, natural gas.
Grady	24,859,174	22,968,075	Petroleum, natural gas, natural gas liquids.
Grant	6,846,325	7,207,463	Petroleum, natural gas, natural gas liquids.
Greer	212,406	359,230	Stone, petroleum, sand and gravel, clays, natural gas.
Harmon	W	65,000	Salt.
Harper	23,165,109	19,717,617	Natural gas, natural gas liquids, petroleum, stone.
Haskell	8,184,349	7,227,677	Natural gas, coal, stone.
Hughes	5,496,229	5,211,961	Petroleum, natural gas.
Jackson	2,733,668	3,151,024	Copper, petroleum, gypsum, sand and gravel, silver, stone, natural gas.
Jefferson	3,251,280	3,107,429	Petroleum, natural gas.
Johnston	W	W	Sand and gravel, stone.
Kay	14,181,452	14,383,726	Petroleum, natural gas liquids, sand and gravel, natural gas, stone.
Kingfisher	44,983,889	46,398,399	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa	1,384,044	1,456,636	Stone, petroleum, sand and gravel, natural gas.
Latimer	6,423,722	10,759,930	Natural gas, stone.
Le Flore	1,680,736	2,706,421	Natural gas, stone, sand and gravel, coal.
Lincoln	15,823,310	14,132,241	Petroleum, natural gas liquids, natural gas.
Logan	12,500,903	11,894,195	Petroleum, natural gas, natural gas liquids, sand and gravel.
Love	10,363,617	9,226,712	Petroleum, natural gas, natural gas liquids.
Major	23,462,670	27,699,427	Petroleum, natural gas, natural gas liquids, sand and gravel.
Marshall	6,298,004	5,877,969	Petroleum, natural gas liquids, natural gas.
Mayes	6,079,801	W	Cement, stone, clays, petroleum.
McClain	24,191,654	24,725,618	Petroleum, natural gas, natural gas liquids, sand and gravel.
McCurtain	874,383	792,176	Stone, sand and gravel, natural gas, petroleum.
McIntosh	289,441	141,354	Natural gas, petroleum.
Murray	3,505,028	3,715,930	Stone, petroleum, sand and gravel, natural gas.
Muskogee	5,566,475	4,911,593	Petroleum, stone, sand and gravel, coal, natural gas.
Noble	7,216,034	6,939,017	Petroleum, natural gas, natural gas liquids.
Nowata	3,219,634	2,820,034	Petroleum, stone, natural gas.
Okfuskee	7,092,603	6,398,654	Petroleum, natural gas, natural gas liquids.
Oklahoma	19,247,900	20,651,355	Petroleum, natural gas liquids, natural gas, sand and gravel, clays.
Okmulgee	5,381,009	4,265,739	Petroleum, natural gas, coal.
Osage	59,752,569	54,197,364	Petroleum, stone, natural gas.
Ottawa	5,094,928	4,765,970	Zinc, stone, lead, tripoli.
Pawnee	5,076,313	5,608,262	Petroleum, stone, natural gas, sand and gravel.
Payne	7,885,281	8,186,652	Petroleum, natural gas, stone.
Pittsburg	1,398,878	1,567,812	Natural gas, stone, clays.
Pontotoc	20,697,308	20,474,523	Petroleum, cement, stone, sand and gravel, natural gas liquids, clays, natural gas.
Pottawatomie	13,125,235	12,526,094	Petroleum, natural gas, sand and gravel.
Pushmataha	W	407,689	Stone, sand and gravel.
Roger Mills	245,657	582,751	Petroleum, natural gas.

See footnotes at end of table.

Table 2.—Value of mineral production in Oklahoma by counties [1]—Continued

County	1966 r	1967	Minerals produced in 1967 in order of value
Rogers	$11,941,909	$12,152,199	Cement, coal, petroleum, stone, clays, natural gas.
Seminole	26,952,329	26,539,415	Petroleum, natural gas liquids, natural gas, stone, clays.
Sequoyah	2,747,026	2,943,725	Lime, stone, natural gas, sand and gravel.
Stephens	76,720,810	78,325,173	Petroleum, natural gas, natural gas liquids.
Texas	53,076,322	61,213,242	Natural gas, petroleum, natural gas liquids, sand and gravel, stone.
Tillman	1,005,800	783,922	Petroleum, sand and gravel.
Tulsa	9,322,394	9,156,722	Petroleum, stone, sand and gravel, clays, natural gas.
Wagoner	544,739	544,414	Petroleum, stone, natural gas.
Washington	7,756,359	6,310,441	Do.
Washita	1,007,075	857,354	Natural gas, petroleum, gypsum.
Woods	5,568,541	7,329,635	Natural gas, petroleum, salt.
Woodward	4,858,856	9,606,605	Natural gas, petroleum, natural gas liquids, sand and gravel.
Undistributed	6,043,120	9,440,339	
Total	997,391,000	1,032,126,000	

r Revised.
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

	1966	1967 p	Change, percent
Personal income:			
Total—millions	$6,099.0	$6,545.0	+7.3
per capita	$2,462.0	$2,623.0	+6.5
Construction activity:			
Building permits—millions	$185.9	$228.8	+23.1
Heavy engineering awards—do	$56.3	$36.4	−35.3
State highway commission:			
Value of contracts awarded—do	$74.6	$80.1	+7.4
Value of contract work performed—do	$68.9	$91.1	+32.2
Cement shipments to and within Okla. thousand 376-pound barrels	5,366	5,258	−2.2
Cash receipts from farm marketings—millions	$852.6	$825.0	−3.2
Mineral production—do	$997.4	$1,032.1	+3.5
Factory payrolls—do	$679.0	$727.2	+7.1
Annual average labor force and employment:			
Total labor force—thousands	954.1	978.9	+2.6
Unemployment—do	34.4	34.7	+.9
Employment:			
Construction—do	34.4	32.8	−4.7
Lumber and wood products—do	113.3	116.4	+2.7
Food products—do	119.4	119.7	+.3
All manufacturing—do	42.1	41.4	−1.7
All industries—do	610.5	633.9	+3.8

p Preliminary.

Sources: Survey of Current Business, Construction Review, Oklahoma Business Bulletin, Oklahoma State Highway Department, The Farm Income Situation, Oklahoma Employment Security Commission, U.S. Army Corps of Engineers Tulsa District, and Bureau of Mines. Statistical Abstract of the United States 1967.

More than 97 percent of the total mineral value was attributed to the output of mineral fuels and related products. Petroleum was produced in 64 counties and natural gas was produced in 66 counties. The oil and gas occurred in a wide zone extending from the northeastern to the western and southwestern sections of the State. Helium was extracted from natural gas in Cimarron County. Nonmetals were produced in 58 counties, mostly in the northeast, north-central, and central parts of the State and in the Arbuckle and Wichita Mountains in the South. Output of metals was confined to Ottawa and Jackson Counties.

Employment and Wages.—The Oklahoma Employment Security Commission reported mineral industry employment was 41,400 persons in 1967, of which 39,600 were in oil and gas drilling and production.

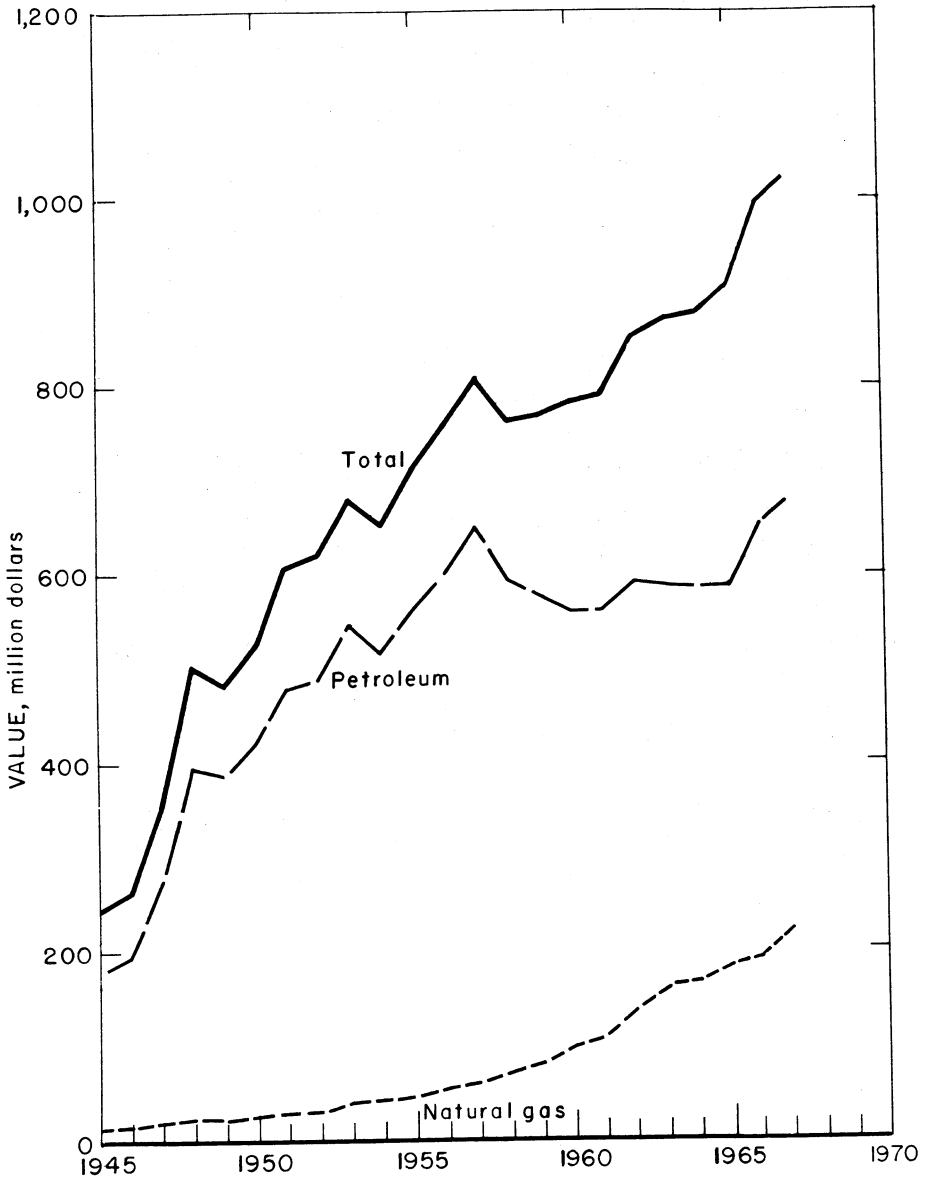

Figure 1.—Value of natural gas, petroleum, and total value of mineral production in Oklahoma.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	217	197	43	337	-------	7	20.75	842
Metal	323	244	79	631	-------	11	17.44	456
Nonmetal	558	243	135	1,082	-------	23	21.26	1,741
Sand and gravel	396	265	105	889	-------	22	24.74	809
Stone	1,136	268	305	2,527	1	62	24.93	4,916
Total [1]	2,630	253	666	5,467	1	125	23.05	2,853
1967: [p]								
Coal	210	210	44	335	1	7	23.88	18,767
Metal	400	270	108	867	1	34	40.38	14,524
Nonmetal	525	241	127	1,009	1	30	30.71	8,216
Sand and gravel	265	276	73	617	-------	17	27.55	319
Stone	1,165	263	306	2,556	-------	70	27.38	623
Total [1]	2,565	256	658	5,385	3	158	29.90	5,378

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

Under the Oklahoma Employment Security Act, which covers establishments employing four or more persons, the mineral industries in 1967 paid $305 million in wages to 39,300 persons compared with $299 million in wages paid to 40,600 persons in 1966.

Government Programs.—Authorized lock and dam structures in the Arkansas-Verdigris Rivers Navigation System in Oklahoma were under construction at the end of 1967—lock and dam No. 14, Fort Smith, Ark., No. 15 (Robert S. Kerr), and No. 16 (Webbers Falls) on the Arkansas River and Nos. 17 and 18 on the Verdigris River. Construction of the powerhouse at Keystone Dam on the Arkansas River west of Tulsa neared completion.

Construction continued at other Tulsa District, U.S. Army Corps of Engineers projects as follows: Broken Bow Dam on Mountain Fork River and Pine Creek Dam on Little River in McCurtain County; and the low water regulating dam below Keystone Dam.

The Bureau of Reclamation, U.S. Department of the Interior, completed the Arbuckle Dam on Rock Creek southwest of Sulphur, Murray County.

Construction was nearly complete at the Chimney Hollow pumped storage project of the Grand River Dam Authority.

Payments were made to mine operators in the Tri-State, Ottawa County, under the Lead-Zinc Mining Stabilization Program as the market price of lead dropped below 14.5 cents per pound (price at which payment is made) to 14 cents per pound on October 10, 1966. Zinc producers became eligible May 1, 1967, when the market price fell to 13.5 cents per pound, a full cent less than that at which payment is made.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Proved recoverable reserves in each of the three liquid mineral fuel categories declined in 1967, the first triple loss recorded in modern Oklahoma oil history, according to the American Petroleum Institute and the American Gas Association. A combination of fewer discoveries and increased production from existing reserves resulted in the decrease of crude petroleum, natural gas, and natural gas liquid reserves.

The American Association of Petroleum Geologists statistical data on well drilling indicated that Oklahoma, with 437 wells, ranked fifth in the Nation in exploratory drilling. Accumulated exploratory drilling totaled 2.3 million feet with wells averaging 5,366 feet in depth in constrast to an average depth of 6,046 feet in 1966. The

2,415 field development wells drilled in 1967 totaled 11 million feet, averaging 4,564 feet per well, compared with an average of 4,562 feet per well in 1966.

Mid-Continent Pipe Line Co. completed a 40-mile, 8-inch crude oil pipeline between Enid and Orlando, connecting existing gathering systems serving Grant, Garfield, Alfalfa, Logan, Noble, and Payne Counties.

Skelly Pipe Line Co. completed its Osage Pipe Line System, a 135-mile, 8-in crude oil line which connects Cushing Okla. tank-farm facilities to the Skelly Oil Co. refinery complex at El Dorado, Kans., to meet the increased demand for crude at the refinery.

Mobil Oil Corp.'s Chitwood and Sholem-Alchem gas plants in Grady and Stephens Counties, Okla., respectively, were connected to the Mobil Pipe Line Co. Lone Grove, Tex., pumping station by a 54-mile, 6-inch gas liquids pipeline. The line is part of a system connecting existing facilities in southern Oklahoma fields with 134 miles of new pipe to refineries and chemical plants in the Beaumont, Tex., area.

In November, Northern Natural Gas Co. began using its new 369-mile, 30-inch natural gas pipeline from Kermit, Tex., to the company's main line at Beaver, Okla. Natural gas from Texas' Permian Basin will move through the line.

In May 1966, the Oklahoma Corporation Commission issued an order banning all unlined oilfield pits, effective June 1, 1967, in an effort to curb oilfield pollution. Oil and gas operators are required to install linings in earthen saltwater pits in connection with oil and gas drilling operations to prevent seepage into the ground. Failure of an operator to comply will result in the Commission's shutdown of production from all leases on which unlined pits are located.

Carbon Black.—Production of carbon black from petroleum distillate at Continental Oil Co.'s Ponca City refinery was nearly 12 percent lower in quantity and over 16 percent less in value in 1967 than in 1966.

Coal.—Low-ash bituminous coal was produced by 10 operators at 11 mines (nine strip, one auger, and one underground) in six counties of which Rogers, Haskell, and Craig Counties led in quantity and value of output. Five other producers, who mined less than 1,000 tons each, were active in Haskell, Latimer, Le Flore, and McIntosh Counties. Three companies supplied 89 percent of the total coal output.

Over 99 percent of the coal produced in the State was derived from strip mines and one auger mine. Strip mine production decreased nearly 2 percent and underground output dropped more than 73 percent. Ninety-eight percent of the coal was shipped to consumers by rail and the remainder was hauled by truck.

Table 5.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	1,008	$5,667
1964	1,028	5,474
1965	974	5,520
1966	843	4,935
1967	823	4,703

Unit train operations, which reduced transportation costs from $2.75 to $1 per ton, began in January, from the Peabody Coal Co. strip mine near Chelsea to a Kansas City, Mo., power generating plant. The St. Louis-San Francisco Railroad agreed to the special rate.

As a result of the complaint filed by the Oklahoma Corporation Commission with the Interstate Commerce Commission, more equitable coal-hauling rates became effective at the end of March. Railroad freight rates that had been in effect for 20 years and reported to be 97 cents and $1.05 per ton more on coal shipped northward from points in Oklahoma were made competitive with Kansas rates for northern markets.

Underground mines being developed at yearend by Howe Coal Co. (subsidiary of Garland Coal & Mining Co.) near Heavener, Le Flore County, and Kerr-McGee Corp., near Stigler, Haskell County, should reverse the declining trend of coal production in Oklahoma. The Howe Coal Co. mine is scheduled for operation early in 1968. Coal will be loaded into hopper cars at the mine site, carried by unit train to Port Arthur, Tex., and loaded into ocean-going vessels for export to steel mills in Japan.

Kerr-McGee Corp. began constructing a 20-foot-diameter, concrete-lined shaft 1,380 feet deep near Stigler as part of a

multimillion-dollar coal mine and metallurgical coking plant operation.

Helium.—The Federal Bureau of Mines helium plant at Keyes, Cimarron County, is the only helium producing facility in the State. In 1967, the plant produced 309.1 million cubic feet of helium (99.995 percent purity) a decrease of 43.3 million cubic feet from the 1966 production level. Production was valued at $9.8 million on the basis of the Bureau of Mines established sales price of $35 per 1,000 cubic feet (f.o.b. plant).

Sales (shipments) of helium from the Keyes plant totaled 273.4 million cubic feet. The balance of production was placed in underground storage in the Cliffside gasfield near Amarillo, Tex., as part of the helium conservation program. Shipments from the plant are made by railroad tank cars or highway semitrailer trucks. All shipments are of gaseous helium; the plant is not equipped to produce liquid helium.

Natural Gas.—Oklahoma ranked third in the Nation in natural gas production as 66 counties, led by Texas, Beaver, Harper, Latimer, and Ellis Counties, in descending order, reported natural gas output. Production was obtained from over 7,400 wells, exclusive of casing head gas wells.

Phillips Petroleum Co.'s Wildcat No. 1–A Flaming in Washita County, dry at a depth of 21,959 feet, was abandoned late in August. Minor gas flows from three horizons, at depths between 15,500 and 17,000 feet in the Springer Formation, did not warrant further testing to determine the exact producing horizon.

Chevron Oil Co. announced plans to deepen tests in the Springer Formation from 17,040 feet to 18,200 feet in its No. 1 Rush Springs Unit, Grady County. The geological discovery opened Grady County's Southwest Rush Springs Field. The preceeding month the company reported completing the State's deepest producer-the No. 2 Rush Springs Unit.

Table 6.—Marketed production of natural gas [1]

Year	Million cubic feet	Value (thousands)
1963	1,233,883	$160,405
1964	1,316,201	166,747
1965	1,320,995	182,297
1966	1,351,225	189,172
1967	1,412,952	202,052

[1] Comprises gas either sold or consumed by producers, including losses in transmission, amounts added to storage, and increases in gas pipelines.

At yearend proved recoverable reserves of natural gas in Oklahoma were approximately 14.7 cubic feet of gas reserve for each cubic foot produced. The American Gas Association reported that new discoveries found through exploratory drilling added 277 billion cubic feet to the gas reserve; another 495 billion cubic feet was added through extension and revision of existing reserves.

Underground natural gas storage facilities in nine counties had a total capacity of 74.2 billion cubic feet of working gas volume (above minimum working pressure) and 123.7 billion cubic feet of cushion gas volume (below minimum working pressure). Current maximum storage capacity is 303 billion cubic feet. Available storage capacity permitted continuous production and conservation of casinghead gas from oil wells during periods of low gas demand.

Natural Gas Liquids.—Seventy-nine natural gasoline plants (Federal Bureau of Mines helium extraction plant excluded from total) recovered almost 1.6 billion gallons of natural gas liquids in 1967. Liquefied petroleum (LP) gases accounted for 64 percent of the volume and 58 percent of the value; natural gasoline and cycle products comprised the remainder.

Service Gas Products Co. began operating its new 15-million-cubic-feet-per-day refrigerated-absorption plant near Aline in Alfalfa County. Four plants under construction at yearend and scheduled for completion early in 1968 included the Pan American Petroleum Corp. 80-million-cubic-feet-per-day (MMcfd) Elmwood

Table 7.—Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

	Proved reserves, Dec. 31, 1966	Changes in proved reserves, due to revisions, extensions and new discoveries in 1967	Proved reserves, Dec. 31, 1967 (production was deducted)	Changes from 1966 (percent)
Crude oil thousand 42-gallon barrels	1,518,244	163,188	1,458,948	−3.9
Natural gas liquids [1] do	475,605	21,491	455,753	−4.2
Natural gas million cubic feet	20,122,191	772,040	[2] 19,403,806	[2] −3.6

[1] Includes condensate, natural gasoline, and LP gases.
[2] Change reflects net additions and withdrawals in storage.

Source: American Gas Association, American Petroleum Institute, and Canadian Petroleum Association Proved Reserves of Crude Oil, Natural Gas Liquids and Natural Gas in the United States and Canada as of December 31, 1967. V. 22, May 1968.

Table 8.—Natural gas liquids production

(Thousand gallons and thousand dollars)

Year	Natural gasoline and cycle products		LP gases		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	555,467	$35,131	810,894	$28,981	1,366,361	$64,112
1964	554,053	34,011	880,804	28,055	1,434,857	62,066
1965	570,129	34,561	894,665	32,208	1,464,794	66,769
1966	576,124	35,715	986,254	44,381	1,562,378	80,096
1967	568,905	35,846	1,005,633	49,276	1,574,538	85,122

plant in Beaver County and its 34-MMcfd Hitchcock plant in Blaine County, the Shell Oil Co. 75-MMcfd absorption plant near Seiling, Dewey County, and the Sun-ray DX Oil Co. 5-MMcfd Wakita plant in Grant County. Apache Gasoline Co. closed its Ardmore plant in the West Brock field, Carter County.

The American Gas Association reported proved recoverable reserves of natural gas liquids at yearend in Oklahoma at 455.8 million 42-gallon barrels, about 5.3 percent of the U.S. total. Exploratory drilling added 6.8 million barrels to the recoverable reserve; development drilling added over 14.7 million barrels through extensions and revisions to existing fields.

Yearend underground storage capacity of natural gas liquids amounted to 2,616,000 barrels at 15 sites in seven counties.

Petroleum.—Crude petroleum output totaled 230.7 million barrels from 80,970 oil wells, compared with 224.8 million barrels from 80,583 oil wells in 1966. Daily average production of crude oil was 632,184 barrels, or 7.8 barrels per well per day—up from 7.6 barrels daily in 1966. Average indicated daily demand for crude oil was 636,367 barrels, 5.8 percent greater than in 1966.

Table 9.—Crude petroleum production

(Thousand 42-gallon barrels and thousand dollars)

Year	Quantity	Value
1963	201,962	$587,709
1964	202,524	587,320
1965	203,441	587,944
1966	224,839	654,281
1967	230,749	676,095

Petroleum output was prorated by the Oklahoma Corporation Commission under the Interstate Oil Compact to maintain a balance between production and indicated demand. The Commission retained the crude oil production allowable at 50 percent of the depth-acreage formula through March; however, for April the allowable was reduced to 46 percent. At the request of the Oklahoma Independent Petroleum Association, the Commission altered the depth-acreage formula for 10-acre spaced

wells from 2,000 feet deep or shallower to 3,000 feet deep or shallower, resulting in a 2-barrel-per-day raise in the allowable for shallow wells. The May allowable was further reduced to 42 percent of the depth acreage formula as mounting crude inventories caused Oklahoma to follow other major oil-producing States and cut back output. The 42 percent factor was retained through June. Owing to the Middle East crisis, the July and August allowable was raised to 50 percent; however, late in July the allowable was further increased to 54 percent and made retroactive to July 1—highest percentage factor since the depth-acreage formula went into effect in December 1961. This rate continued through the end of 1967.

Table 10.—Crude petroleum production, indicated demand, and stocks, in 1967, by months.

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Oklahoma
January	20,038	19,982	17,852
February	18,267	18,166	17,953
March	20,115	20,842	17,226
April	18,988	17,049	19,165
May	19,385	19,417	19,133
June	18,596	19,757	17,972
July	19,508	19,928	17,552
August	19,604	20,063	17,093
September	18,902	18,615	17,380
October	19,468	20,976	15,872
November	18,835	17,926	16,781
December	19,043	19,553	16,271
Total 1967	230,749	232,274	XX
Total 1966	224,839	r 221,925	XX

XX Not applicable.
r Revised.

In an effort to boost Oklahoma's declining exploration rate the Corporation Commission in July increased the State's discovery wells allowable to 200 percent of the Table A (depth-acreage formula) retroactive to July 1. Despite a 20-percent increase to 120 percent of the discovery allowance by the Commission in 1966, exploration and the number of wells on discovery allowance continued to drop.

Petroleum production was reported in 64 counties, of which Stephens, Carter, Garvin, Osage, and Kingfisher Counties led in the order named. Production of petroleum from 65,387 wells in unallocated fields, including discovery, secondary recovery projects, and stripper wells, accounted for 41.8 percent of the total output. The balance was derived through 15,583 wells in allocated fields.

A secondary waterflood project designed to extend the life of the Healdton field was announced in August. The field was divided into five areas based upon geologic conditions, with each area to be operated by the major operator involved. Mobil Oil Corp., Shell Oil Co., Sinclair Oil & Gas Co., Edwin L. Cox-Jake L. Hamon, and Union Oil Co. of California were to operate the project. Cox-Hamon, Shell, and Union of California anticipated flooding operations by the first of 1968. Mobil and Sinclair expect to begin flooding operations by the first of 1969. Completion of the project will require about 15 years in each area.

The Interstate Compact Commission, in cooperation with the National Stripper Well Association, reported that on January 1, Oklahoma had 57,241 stripper wells which produced 90.8 million barrels, or 48.3 percent of overall proved oil reserves in Oklahoma on January 1, 1967.

The average price per barrel of crude petroleum at the wellhead was $2.93, up from $2.91 in 1966. While most purchasers of Oklahoma crude petroleum raised the price 3 to 8 cents per barrel in 1967, others eliminated the high-gravity penalty on crude oil bought in the Oklahoma Panhandle.

Table 11.—Oil and gas wells drilled in 1967, by counties

County	Proved field wells			Exploratory wells			Total
	Oil	Gas	Dry	Oil	Gas	Dry	
Alfalfa		5	1	1		4	11
Atoka						1	1
Beaver	10	35	35	1	3	2	86
Beckham	1	8	3		1	4	17
Blaine	3	33	18	1		4	59
Bryan			1			3	4
Caddo	17	1	7			1	26
Canadian		23	7	1	2	3	36
Carter	67	5	32			7	111
Cimarron	16	2	6	1		2	27
Cleveland	10		16	3		8	37
Coal	4	1	4	1		2	12
Comanche	40	3	16	1		4	64
Cotton	7		7			3	17
Craig	3						3
Creek	76	6	20	1		5	108
Custer	2		1		2	2	7
Dewey	28	8	10	3	2	1	52
Ellis	4	15	14	1		2	36
Garfield	88	35	5	2	3	5	138
Garvin	26	7	39	1	2	15	90
Grady	7	1	5	1	1	3	18
Grant	7		3		1	8	19
Greer	1		1			2	4
Harmon						3	3
Harper	2	21	12	1	2	6	44
Haskell		6	11			1	18
Hughes	17	24	12	1	2	4	60
Jackson						2	2
Jefferson	11		17			13	41
Johnston						2	2
Kay	14	3	10	2	2	5	36
Kingfisher	95	5	9	8		4	121
Kiowa	3		11	1		4	19
Latimer		21	10			2	33
Le Flore		16	16		3	1	36
Lincoln	13	3	18		1	22	57
Logan	21	5	4	2	1	6	39
Love	12		14	1		3	30
McClain	14	2	6	1	1	6	30
McIntosh		2			1	1	4
Major	63	15	7	2	1	5	93
Marshall	2		4	2	1	1	10
Mayes						4	4
Murray			5	1		14	20
Muskogee	18		8			1	27
Noble	9	1	10	1	1	10	32
Nowata	35		8		1	3	47
Okfuskee	18	5	9	1		4	37
Oklahoma	6	4	3			2	15
Okmulgee	35	4	15				54
Osage	125	10	47	4	2	12	200
Pawnee	28	1	6	5		5	45
Payne	27	2	22	2		12	65
Pittsburg		13	4		5	7	29
Pontotoc	34	1	7			4	46
Pottawatomie	30		11	2		9	52
Roger Mills	6	10	2	1		3	22
Rogers	19	1	8			2	30
Seminole	33	3	22	4		8	70
Sequoyah		4	2		2		8
Stephens	39	6	22			11	78
Texas	34	17	23	3	1	6	84
Tillman	15					4	19
Tulsa	13	1	5				19
Wagoner	9		17			1	27
Washington	42		4				46
Washita		1				1	2
Woods	18	20	25		3	9	75
Woodward	1	13	12		3	9	38
Total	1,278	428	709	64	50	323	2,852

Table 12.—Production of crude petroleum, by fields

(Thousand 42-gallon barrels)

Field [1]	1963	1964	1965	1966	1967
Allen	1,445	2,150	2,192	2,636	2,773
Atlantic	1,450	1,363	1,190	998	------
Bowlegs	1,110	1,208	1,048	952	847
Burbank	13,685	13,417	12,017	10,655	8,795
Camrick	2,322	2,225	2,166	1,881	1,597
Cement	3,340	3,040	2,831	2,671	2,609
Cumberland	1,133	1,141	1,039	990	------
Cushing	2,828	3,075	3,110	3,499	3,978
Dover-Hennessey	9,010	8,667	(2)	------	------
Edmond, West	1,150	1,052	1,605	1,961	1,417
Enid, Northeast	1,460	2,148	2,143	2,196	2,170
Eola-Robberson	3,384	3,433	3,473	3,632	4,492
Garber	751	730	1,096	1,258	1,144
Glenn Pool	3,303	3,851	4,092	4,153	3,838
Golden Trend	13,427	14,292	13,544	13,440	12,952
Healdton	2,506	2,600	2,677	3,036	3,386
Hewitt	2,461	2,895	2,974	3,764	4,072
Knox	1,838	1,887	1,687	1,612	1,525
Loco	1,848	1,734	1,788	2,138	1,874
Moore, West	685	1,129	1,014	921	------
Muskogee	1,101	1,047	1,089	1,454	------
Naval Reserve	2,170	1,702	1,686	1,587	1,214
Oklahoma City	2,300	2,112	1,978	1,922	1,941
Payne	2,274	1,969	1,722	2,076	2,338
Postle	470	1,752	2,105	3,307	4,502
Putnam	912	2,076	3,081	4,879	6,130
Ringwood	1,340	1,314	1,074	5,533	4,969
Seminole	785	968	1,122	1,115	1,025
Sho-Vel-Tum	24,995	26,660	28,769	30,712	32,232
Slick	1,129	1,114	1,180	1,147	------
Sooner Trend	------	------	9,680	11,496	16,753
St. Louis	1,535	1,470	1,454	1,406	1,467
Stroud	702	1,161	1,151	1,220	1,239
Other fields	93,113	87,142	85,664	94,592	99,470
Total	201,962	202,524	203,441	224,839	230,749

[1] Based on Oil and Gas Journal data adjusted to Bureau of Mines total.
[2] Consolidated into Sooner Trend in April 1965.

Thirteen operating refineries had a total daily operating capacity of 425,500 barrels of crude oil and 218,610 barrels of cracked gasoline on January 1, 1967, up from 421,830 barrels and 158,790 barrels, respectively, a year earlier. Trumbull Asphalt Co., Oklahoma City, shut down its 900-barrel-per-day crude oil refinery. Crude oil runs to stills, total receipts, intrastate receipts, and yearend stocks for 1966 and 1967, in thousand barrels are shown in the following tabulation:

Year	Runs to stills	Total receipts	Intra-state receipts	Stocks Dec. 31
1966	149,817	149,588	109,850	1,352
1967	154,526	155,056	115,427	1,819

Apco Oil Corp., completed installation of a 1,645-barrel-per-day hydrofluoric acid alkylation unit at its Cyril refinery. Sunray DX Oil Co. increased catalytic reforming capacity to 41,500 barrels per stream day at its Tulsa refinery. The company reportedly was revamping and replacing existing alkylation, crude vacuum tower, and merox units as its Duncan refinery.

NONMETALS

Nine nonmetals produced in 1967 were valued at $48.6 million, about 4.8 percent of the State's total mineral production value, representing a decline of 4 percent in value from 1966.

Cement.—Oklahoma construction activity in 1967 was about 13 percent below that of 1966 and accounted for much of the reduced output of cement in 1967. Cement was processed from the Pitkin Limestone of the Mississippian System in Mayes County, the Viola Limestone of the Ordovician System in Pontotoc County, and the Oologah Limestone of the Pennsylvanian System in Rogers County.

Clays.—Clay and shale were mined from sources near the surface primarily for use

in brick and tile products, and to a lesser extent, in expanded clay products, portland cement, and pottery. Bentonite was processed for filter and absorbent uses. Oklahoma Brick Co. began an expansion project to double plant capacity of its brick-making facility at Union City. Five new warming ovens, a 150-foot wind tunnel dryer, and a 340-foot tunnel kiln are scheduled for construction.

Table 13.—Clays sold or used by producers [1]

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	898	$911
1964	835	854
1965	794	806
1966	745	754
1967	744	869

[1] Excludes bentonite.

Gypsum.—Deposits in the Nescatunga and Shimer Gypsum Members of the Permian Blaine Formation in Blaine, Canadian, and Jackson Counties were strip mined to provide raw material for manufacturing wallboard, plaster, other building materials, and as a retarder in portland cement. Gypsum deposits in the Cloud Chief Formation, also Permain in age in Caddo, Comanche, and Washita Counties, were strip mined for wallboard manufacture and as a soil conditioner.

Lime.—Much of the lime output was used by chemical plants in the Pryor area and in municipal water plants. Other uses included steel manufacture, oil refining, waste disposal, building material, and paper manufacture.

Salt.—Salt was recovered by solar evaporation of brine from springs near Elm Fork of the Red River in Harmon County and from surface encrustations on the Big Salt Plain of the Cimarron River in Woods County. Principal uses were in stock feed and water softening; other uses included herbicides and salinity control of oil well drilling fluid.

Sand and Gravel.—Over half of the quantity and value of sand and gravel produced in Oklahoma was supplied by operators in Johnston, Muskogee, Oklahoma, Pontotoc, and Tulsa Counties. Despite an upsurge in the value of building permits issued and the awarding of contracts by the Oklahoma State Highway Department and the U.S. Army Corps of Engineers the output and value of sand and gravel produced in 1967 was less than that of the previous year.

Stone.—Thirty-seven counties reported output of stone; Comanche, Kiowa, Murray, Sequoyah, and Tulsa Counties accounted for more than 45 percent of the quantity and value. Sandstone production increased 98 percent over that of 1966 as the State Highway Department and the U.S. Army Corps of Engineers continued the use of sandstone for riprap. Output of limestone increased as phases of construction requiring the use of limestone were reached.

Table 14.—Sand and gravel sold or used by producers [1]

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	4,644	$5,756	776	$360	5,420	$6,116
1964	5,032	6,031	1,648	972	6,680	7,003
1965	4,570	5,614	648	409	5,218	6,023
1966	4,329	6,151	1,711	1,414	6,040	7,565
1967	3,654	4,729	886	552	4,540	[1] 5,280

[1] Data does not add to total due to 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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,487	$1,437	1,534	$1,447
Paving	742	715	654	625
Fill	414	177	365	133
Other [1]	951	2,624	896	2,215
Total	3,594	4,953	3,449	4,420
Gravel:				
Building	430	785	126	222
Paving	181	241	77	86
Other [2]	124	172	2	1
Total	735	1,198	205	309
Total sand and gravel	4,329	6,151	3,654	4,729
Government-and-contractor operations:				
Sand:				
Building	12	16	----------	----------
Paving	704	665	465	247
Other	10	5	----------	----------
Total	726	686	465	247
Gravel:				
Building	203	215	26	29
Paving	782	513	395	275
Total	985	728	421	304
Total sand and gravel	1,711	1,414	886	[3] 552
Grand total	6,040	7,565	4,540	5,280

[1] Includes railroad ballast (1967), other construction sand, and industrial sand (unground and ground).
[2] Includes miscellaneous gravel (1966), railroad ballast (1966), fill (1966), and other gravel.
[3] Data does not add to total shown because of independent rounding.

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

(Thousand short tons and thousand dollars)

Year	Granite		Limestone		Sandstone		Miscellaneous stone		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1963	7	$832	12,437	$14,537	135	$214	1,238	$577	13,817	$16,160
1964	3	219	11,375	12,669	1,271	1,552	1,338	647	13,987	15,087
1965	6	503	13,121	14,771	2,057	2,092	1,233	705	16,417	18,071
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

METALS

Copper.—The Eagle-Picher Industries, Inc., increased the output of copper ore from Permian red beds near Creta in southwestern Jackson County. The ore was beneficiated at the company mill, and the concentrate shipped to El Paso, Texas, and foreign countries for smelting.

Germanium.—Reclaimed from residues accumulated in zinc smelting, germanium was produced from domestic and foreign ore concentrates by Eagle-Picher Industries, Inc., at Henryetta and by National Zinc Co. at Bartlesville. The residue was shipped to Eagle-Picher Industries. Inc., germanium processing plant north of Quapaw.

Lead.—Twenty-five producers conducted mining operations at 47 mines in the Century, Quapaw, and Picher-Cardin Districts in Ottawa County during 1967. More than one operator was active on the same lease in several instances. Output of lead decreased in 1967 as a result of a drop in the price of lead at New York to 14 cents per pound.

Silver.—Less silver was recovered from the concentrate of copper mined near Creta in 1967 than in the preceding year.

Uranium.— Kerr-McGee Corp. announced plans in October to construct a uranium conversion plant located at the confluence of the Arkansas and Illinois Rivers west of Sallisaw, Sequoyah County. Uranium oxide (U_3O_8) will be converted into uranium hexafluoride (UF_6) for enrichment at one of the Atomic Energy Commission's gaseous diffusion plants.

Zinc.—Thirty-two operators mined zinc ore from 61 operations at 47 mines in the Century, Quapaw, and Picher-Cardin Districts in Ottawa County. Zinc produced in 1967 was less than the previous year largely because of a drop in price to 13.5 cents per pound on June 20.

Custom Mills and Smelters.—Domestic and foreign ores and concentrates were treated in horizontal retort zinc smelters operated by American Metal Clmax, Inc., Eagle-Picher Industries, Inc., and National Zinc Co. at Blackwell, Henryetta, and Bartlesville, respectively. Federated Metals Division of the American Smelting and Refining Co. operated a secondary zinc plant in Sand Springs. Kaiser Aluminum & Chemical Corp. operated a secondary magnesium recovery smelter in Tulsa. Sulfuric acid was recovered as a byproduct from the zinc ores processed by National Zinc Co. at Bartlesville.

Tri-State District.—Late in December, Eagle-Picher Industries, Inc., announced plans to develop a lead-zinc deposit in the "sheetground" of Cherokee County, Kansas, on the Swalley and Paxton leases 5 miles northeast of Picher, Oklahoma. Output, scheduled to reach 3,000 rock tons per day, would be brought to the surface by conveyer and processed at the company's Central Mill at Cardin, Okla.

Table 17.—Mine production of lead and zinc, in terms of concentrate and recoverable metals [1]

Year	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content [2]			
					Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1963	4,317	$432	24,329	$1,757	3,192	$689	13,245	$3,046
1964	3,730	505	22,592	1,963	2,781	729	12,159	3,307
1965	3,896	651	23,668	2,277	2,813	878	12,715	3,713
1966	4,181	649	21,086	2,002	2,999	907	11,237	3,259
1967	3,935	536	19,764	1,812	2,727	764	10,670	2,954
1891–1967	1,700,390	166,080	9,874,067	494,104	1,302,890	199,079	5,207,683	791,888

[1] Based on Oklahoma ore (dirt) and old tailing treated at mills during calendar year indicated.
[2] In calculating metal content of the ores from assays, allowance made for smelting losses of both lead and zinc. In comparing values of concentrate (ore) and metal, it should be noted that value given for concentrate is that actually received by producer, whereas value of lead and zinc is calculated from average price for all grades.

Table 18.—Tenor of lead-zinc ore milled and concentrates produced

	1966	1967
Total material milled—short tons	549,313	442,858
Recovery of concentrate and metal from quantity milled:		
Galena—short tons	4,181	3,935
Sphalerite—do	21,086	19,764
Galena—percent	0.76	0.89
Sphalerite—do	3.84	4.46
Lead [1]—do	0.55	0.62
Zinc [1]—do	2.05	2.41
Average lead content of galena concentrate—do	73.16	70.70
Average zinc content of sphalerite concentrate—do	59.21	59.99
Average value per ton:		
Galena concentrate	$155.26	$136.27
Sphalerite concentrate	$94.94	$91.69

[1] Figures represent metal content of crude ore (dirt) as recovered in concentrate. Data on tailing losses not available.

Table 19.—Mine production of lead and zinc in 1967, by months, in terms of recoverable metals

(Short tons)

Month	Lead	Zinc
January	343	981
February	223	1,067
March	189	1,031
April	208	797
May	291	904
June	251	889
July	159	875
August	200	1,153
September	164	935
October	206	843
November	275	714
December	218	481
Total	2,727	10,670

Table 20.—Mine production of lead and zinc concentrates in Tri-State District, in terms of concentrate and recoverable metals

Year	Lead concentrate (galena)		Zinc concentrate (sphalerite)		Recoverable metal content			
					Lead		Zinc	
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)
1963	5,719	$604	30,762	$2,271	4,219	$911	16,753	$3,853
1964	5,333	733	31,228	2,732	3,966	1,039	16,824	4,576
1965	6,200	1,031	35,671	3,434	4,457	1,391	19,223	5,613
1966	5,755	891	29,997	2,851	4,108	1,242	16,006	4,642
1967:								
Kansas	1,486	209	8,832	817	1,031	289	4,765	1,319
Oklahoma	3,935	536	19,764	1,812	2,727	764	10,670	2,954
Total 1967 [1]	5,421	745	28,596	2,629	3,758	1,053	15,435	4,273

[1] Excludes southwest Missouri.

Table 21.—Tenor of lead and zinc ore milled and concentrates produced in the Tri-State District

	1963	1964	1965	1966 [1]	1967 [1]
Total material milled:					
Crude ore—short tons	612,862	691,798	905,973	818,410	693,753
Recovery of concentrate and metal from material milled:					
Galena—percent	0.93	0.77	0.68	0.70	0.78
Sphalerite—do	5.02	4.51	3.94	3.67	4.12
Lead [2]—do	0.69	0.57	0.49	0.50	0.54
Zinc [2]—do	2.73	2.43	2.12	1.96	2.22
Average lead content of galena concentrate—do	75.21	75.77	73.27	72.81	70.71
Average zinc content of sphalerite concentrate—do	60.52	59.86	59.91	59.29	59.98
Average value per ton:					
Galena concentrate	$105.68	$137.52	$166.32	$154.84	$137.46
Sphalerite concentrate	$73.82	$87.48	$96.28	$95.03	$91.95

[1] Excludes southwest Missouri; included in Missouri total.
[2] Metal content of the crude ore (dirt) as recovered in concentrate.

A decline in lead and zinc prices resulted in decreased output of lead and zinc concentrates produced from ore mined in the Tri-State District. Lead was priced at 14 cents per pound throughout the year and zinc at 13.5 cents per pound after June 20, and thus were below the 14.5 cent price at which payment is made to qualified producers of lead and zinc under the small mines stabilization program. Public Law 89–238, as emended October 5, 1965, made the producers eligible to receive payment.

Prices quoted in Metals Week on 60 percent zinc concentrates at Joplin, Mo., declined from $92 per ton to $86 per ton on May 15, to $84 per ton on July 3, and remained at that level for the remainder of the year.

Table 22.—Principal producers and processors of fuels, minerals, and metals

Commodity and company	Type of activity	County	Address
Cement:			
Dewey Portland Cement Co. [1]	Quarry and plant	Rogers	Tulsa, Okla.
Ideal Cement Co. [1]	do	Pontotoc	Denver, Colo.
Oklahoma Cement Co. [1]	do	Mayes	Dallas, Tex.
Clays:			
Acme Brick Co	Mine and plant	Custer	Fort Worth, Tex.
Do	do	Tulsa	Do
Chandler Materials Co. [2]	do	Rogers	Tulsa, Okla.
Do	do	Oklahoma	Do
Filtrol Corp. [3]	do	Dewey	Los Angeles, Calif.
Frankoma Pottery Co	do	Creek	Sapulpa, Okla.
Mangum Brick	do	Greer	Mangum, Okla.
Oklahoma Brick Corp	do	Canadian	Oklahoma City, Okla.
Sapulpa Brick & Tile Corp	do	Creek	Sapulpa, Okla.
Superior Clay Products Inc	do	Pontotoc	Ada, Okla.
Wewoka Brick & Tile Co	do	Seminole	Wewoka, Okla.
Coal:			
Bills Coal Co., Inc	Strip mine	Craig	Welch, Okla.
Briartown Coal Co	do	Muskogee	Stigler, Okla.
Carbon Hill Coal Co	do	Okmulgee	Okmulgee, Okla.
Evans Coal Co	Strip mine and auger.	Haskell	McCurtain, Okla.
Howe Coal Co	Strip mine	Haskell	Fort Smith, Ark.
McNabb Coal Co	do	Craig	Catoosa, Okla.
Do	do	Rogers	Do.
Sinclair Coal Co	do	do	St. Louis, Mo.
J. F. Turnipseed Coal Co	Underground mine	Le Flore	Poteau, Okla.
Copper and silver:			
Eagle-Picher Industries, Inc	Strip mine	Jackson	Miami, Okla.
Gypsum:			
Agricultural Gypsum Corp	Quarry	Washita	Colony, Okla.
Harrison Gypsum Co., Inc	do	Caddo	Lindsay, Okla.
Republic Gypsum Co	Quarry and plant	Jackson	Lubbock, Tex.
Raymond Schweitzer Gypsum	Quarry	Canadian	Okarche, Okla.
Texas Gypsum Co., Inc	do	Comanche	Irving, Tex.
United States Gypsum Co	Quarry and plant	Blaine	Southard, Okla.
Universal Atlas Cement, Co. Div. of United States Steel Corp.	Quarry	do	Pittsburgh, Pa.
Walton Gypsum Co	do	do	Homestead, Okla.
Lead and zinc:			
Eagle-Picher Industries, Inc.[4]	Underground mine	Ottawa	Miami, Okla.
Kenoyer Mining Co	do	do	Picher, Okla.
Marlene Ann Mining Co	do	do	Do.
The Quapaw Co	do	do	Do.
Lime:			
St. Clair Lime Co.[5]	Plant and quarry	Sequoyah	Oklahoma City, Okla.
Salt:			
Ezra S. Blackmon	Solar evaporation	Woods	Freedom, Okla.
Salton Salt Co	do	Harmon	Erick, Okla.
Sand and gravel:			
Bagby-Harris Sand Co	Dredge	Tulsa	Jenks, Okla.
Joe Brown Sand & Gravel Co	Portable	Murray	Sulphur, Okla.
The Dolese Co	Stationary	McClain	Oklahoma City, Okla.
Do	do	Logan	Do.
Do	do	Kingfisher	Do.
Do	do	Canadian	Do.
Do	do	Garfield	Do.
McMichael Concrete Co	Dredge	Tulsa	Tulsa, Okla.
Midcontinent Glass Sand Co.[6]	Stationary	Pontotoc	Roff, Okla.
Mohawk Rock & Sand Co	Portable and dredge	Tulsa	Tulsa, Okla.
Pennsylvania Glass Sand Corp.[5]	Stationary	Johnston	Hancock, W. Va.
Pitts Sand & Gravel Co	do	Jackson	Wichita Falls, Tex.
Sand Products, Inc	Stationary and dredge.	Oklahoma	Oklahoma City, Okla.
Shoffner Sand & Gravel Co	Portable	McCurtain	Salina, Kan.
Sober Bros. Sand & Gravel Co	Stationary and dredge.	Kay	Ponca City, Okla.
Yahola Sand & Gravel Co	Stationary	Muskogee	Fort Smith, Ark.
Stone:			
Anchor Stone Co	Quarry	Tulsa	Tulsa, Okla.
Arkhola Sand & Gravel	do	Cherokee	Fort Smith, Ark.
The Century Granite Co., Inc	do	Johnston	Frederick, Okla.
Chandler Materials Co	do	Tulsa	Tulsa, Okla.
Dolese Brothers Co	do	Carter	Oklahoma City, Okla.
Do	do	Coal	Do.
Do	do	Comanche	Do.
Do	do	Kiowa	Do.
Do	do	Murray	Do.
Do	do	Pittsburg	Do.
Do	do	Seminole	Do.

See footnotes at end of table.

Table 22.—Principal producers and processors of fuels, minerals, and metals—Continued

Commodity and company	Type of activity	County	Address
Stone—Continued			
Idabel Stone Co	Quarry	Choctaw	Idabel, Okla.
Do	do	McCurtain	Do.
The Quapaw Co	do	Creek	Drumright, Okla.
Roosevelt Materials Co	do	Caddo	Hobart, Okla.
Do	do	Kiowa	Do.
Sooner Rock and Sand Co	do	Murray	Davis, Okla.
Standard Industries, Inc	do	Kay	Tulsa, Okla.
Do	do	Mayes	Do.
Do	do	Osage	Do.
Do	do	Tulsa	Do.
Trinity Concrete Products Co	do	Atoka	Dallas, Tex.
Tulsa Rock Co	do	Tulsa	Tulsa, Okla.
Tripoli:			
The Carborundum Co., American Tripoli Division [7]	Open pit	Ottawa	Seneca, Mo.
Vermiculite:			
Texas Vermiculite Co	Exfoliating plant	Oklahoma	Dallas, Tex.
Volcanic ash:			
Axtell Mining Corp	Open pit	Beaver	Laverne, Okla.
Helium:			
U.S. Bureau of Mines	Keyes plant	Cimarron	Amarillo, Tex.
Smelters:			
American Metal Climax, Inc	Zinc	Kay	Blackwell, Okla.
American Smelting and Refining Company[8]	do	Tulsa	Sand Springs, Okla.
Eagle-Picher Industries, Inc	do	Okmulgee	Henryetta, Okla.
Kaiser Chemicals, Inc.[8]	Magnesium	Tulsa	Tulsa, Okla.
National Zinc Co.[9]	Zinc	Washington	Bartlesville, Okla.
Petroleum refineries:			
Allied Materials Corp	Refinery	Lincoln	Stroud, Okla.
Apco Oil Corp	do	Caddo	Cyril, Okla.
Bell Oil & Gas Co	do	Carter	Ardmore, Okla.
Champlin Petroleum Co	do	Garfield	Enid, Okla.
Continental Oil Co	do	Kay	Ponca City, Okla.
Kerr-McGee Corp	do	Payne	Cushing, Okla.
Do	do	Garvin	Wynnewood, Okla.
Midland Cooperative, Inc	do	Payne	Cushing, Okla.
Okmulgee Refining Co., Inc	do	Okmulgee	Okmulgee, Okla.
Sequoyah Refining Co	do	Kay	Ponca City, Okla.
Sunray DX Oil Co	do	Stephens	Duncan, Okla.
Do	do	Tulsa	Tulsa, Okla.
Texaco, Inc	do	do	Do.
Natural gas liquids:			
Champlin Petroleum Co	Natural gas liquids processing.	Garfield	Fort Worth, Tex.
Cities Service Oil Co	do	Kay	Bartlesville, Okla.
Humble Oil & Refining Co	do	Kingfisher	Tulsa, Okla.
Phillips Petroleum Co	do	Garvin	Bartlesville, Okla.
Do	do	Oklahoma	Do.
Shell Oil Co	do	Beckham	Oklahoma City, Okla.
Signal Oil & Gas Co	do	Carter	Ardmore, Okla.
Skelly Oil Co	do	Stephens	Tulsa, Okla.
Sun Oil Co	do	Harper	Tulsa, Okla.
Union Texas Petroleum, Division of Allied Chemical Corp.	do	Major	Do.
Warren Petroleum Corp	do	Beaver	Do.
Do	do	Garvin	Do.
Do	do	Grady	Do.

[1] Also limestone and clay.
[2] Also for lighweight aggregate.
[3] Bentonite.
[4] Also miscellaneous stone.
[5] Also limestone.
[6] Also silica sand.
[7] Mill located in Mo.
[8] Also secondary smelter.
[9] Also byproduct sulfuric acid.

The Mineral Industry of Oregon

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

By Ronald P. Collins,[1] Jerry J. Gray,[2] and Gary A. Kingston [2]

The 1967 value of Oregon's mineral production declined to $66.6 million from the record-setting $107.5-million figure of the previous year. This was the largest single decrease ever recorded in value and the first sizable downward adjustment since 1955, except for the relatively small declines in 1961 and 1962. Decreased requirements for sand and gravel and stone at large construction projects and closure of the Ideal Cement Co. plant in Jackson County accounted for the sharp dip in value. Construction materials, however, continued to be the dominant mineral commodities produced in the State, amounting to over 80 percent of the total value. Nickel and substantial mercury production gains were recorded. The value of mercury output scored the highest gain percentagewise (49 percent) of all the major mineral commodities produced in the State; the gain in production (35 percent) reflected the $47 increase in average price received per flask over that of 1966. The Glass Butte mercury mine (Lake County), opened in 1966 and operated by the Jackson Mountain Mining Co., had the second highest production in the State.

Gulf Oil Co. leased mineral rights to 82,644 acres of State land in central, southern, and eastern Oregon for uranium prospecting. Gulf, known primarily for its petroleum operations, purchased General Atomic, a General Dynamics Corp. division that manufactures and markets nuclear power reactors.

[1] Economist, Bureau of Mines, Albany, Oreg.
[2] Mineral specialist, Bureau of Mines, Albany, Oreg.

Table 1.—Mineral production in Oregon [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays—thousand short tons	361	$362	[2] 295	[2] $295
Diatomite—short tons	W	W	108	2
Gem stones	NA	750	NA	750
Gold (recoverable content of ores, etc.)—troy ounces	281	10	186	7
Lime—thousand short tons	116	2,283	99	2,059
Mercury—76-pound flasks	700	309	943	461
Nickel (content of ore and concentrate)—short tons	15,036	W	15,287	W
Peat—do	900	17	W	W
Perlite—do	W	W	8	([3])
Pumice and volcanic cinder—thousand short tons	714	1,256	834	1,195
Sand and gravel—do	35,327	34,986	19,630	25,250
Silver (recoverable content of ores, etc.)—troy ounces	343	([3])	31	([3])
Stone—thousand short tons	33,288	48,335	13,201	20,256
Value of items that cannot be disclosed: Cement, fire clay (1967), copper (1966), iron ore (1966), lead (1966), talc and soapstone (1967) and values indicated by symbol W	XX	19,176	XX	16,285
Total	XX	107,484	XX	66,560
Total 1957–59 constant dollars	XX	r 103,566	XX	64,114

r Revised. NA Not available. XX Not applicable.
W Withheld to avoid disclosing individual company confidential data.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes fire clay (1967); included with "Value of items that cannot be disclosed."
[3] Less than ½ unit.

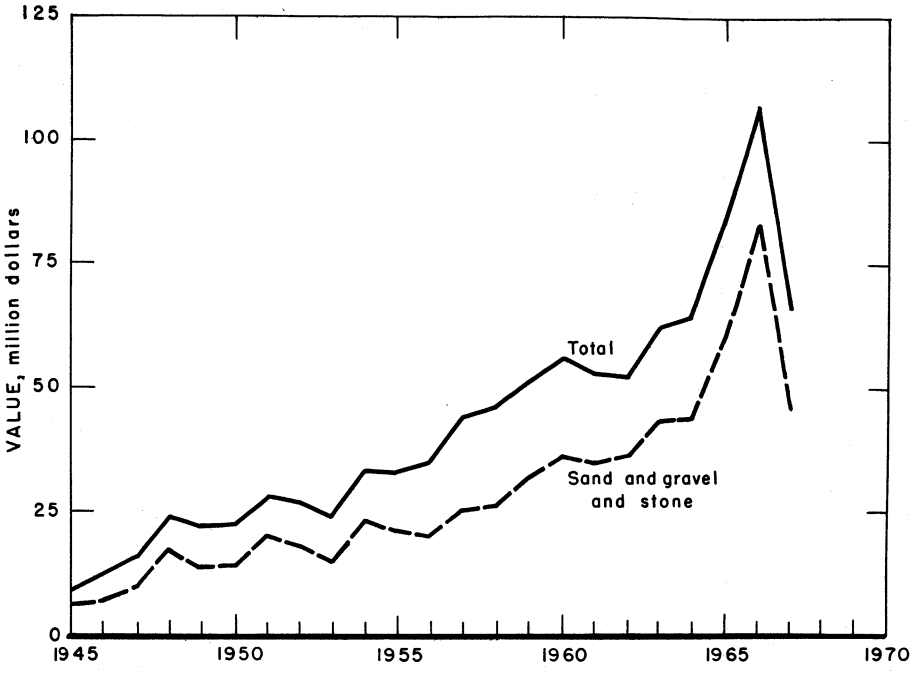

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Oregon.

Plans for a $130-million-kilowatt nuclear powerplant on the lower Columbia River were announced by Portland General Electric Co. The plant would be located in Columbia County and was expected to be ready for inclusion in the regional power grid by 1975.

Interest in exploration for copper and petroleum was exhibited. A copper search by Kennecott's Bear Creek Mining Co. was centered in Baker County where 38 claims were registered. Standard Oil Co. of California, Mobil Oil Co., and Texaco Inc., applied for leases in Columbia and Washington Counties for petroleum exploration. Mobil Oil was also interested in leases in Coos and Douglas Counties. Pan American Petroleum Corp., in conjunction with several other firms, drilled one offshore hole.

The growth of Oregon's metals industry was evidenced by two new entrants, Rem Metals Corp. and TiLINE, Inc. Both casting firms located in the Albany area.

A history of the metal industry centered at Albany was published [3]. It covered the history and development of the titanium, zirconium, columbium, and tantalum production processes employed by two Albany firms, Wah Chang Albany Corp. and Oregon Metallurgical Corp.

Construction started on a $35-million fully integrated steel plant at the Port of Portland's Rivergate Industrial District. Two firms, Gilmore Steel Corp. and Midland-Ross Corp., announced jointly that adjacent plants were to be constructed on the 150-acre Willamette River waterfront site.

Preliminary work began on Northwest Aluminum Co.'s $142-million plant, slated for completion in early 1970, at Warrenton, near Astoria. An alumina plant to process bauxite from Australia and a reduction plant to convert the alumina to aluminum were to be constructed. Northwest Aluminum is a combination of Japanese and American firms. Employment of 900 to 1,000 workers was expected to require a payroll of nearly $8 million when actual production commenced.

[3] DeWeese, R. W., and R. S. Mason. A Is For Albany, Z Is For Zirconium. Ore Bin, Oregon Dept. Geol. and Miner. Ind., October 1967, p. 185.

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

(Thousand dollars)

County	1966	1967	Minerals produced in 1967 in order of value
Baker	$6,499	$5,985	Cement, stone, sand and gravel, lime, clays, pumice, gold, perlite, diatomite, silver.
Benton	907	210	Sand and gravel, stone, clays.
Clackamas	7,474	7,574	Cement, sand and gravel, stone, clays.
Clatsop	900	19	Sand and gravel.
Columbia	258	W	Stone, sand and gravel.
Coos	1,112	686	Do.
Crook	247	237	Sand and gravel, stone, clays.
Curry	188	157	Sand and gravel, stone.
Deschutes	1,003	1,054	Pumice, sand and gravel, stone.
Douglas	9,929	9,730	Nickel, sand and gravel, stone, mercury.
Gilliam	31,950	171	Stone, sand and gravel, pumice.
Grant	367	857	Sand and gravel, stone, mercury, gold.
Harney	275	233	Stone, sand and gravel.
Hood River	1,465	364	Sand and gravel, stone.
Jackson	3,402	2,843	Stone, cement, sand and gravel, clays, gold, mercury, silver.
Jefferson	217	133	Pumice, stone, sand and gravel.
Josephine	1,146	298	Sand and gravel, stone, gold, silver, soapstone.
Klamath	2,124	1,716	Stone, sand and gravel, pumice, clays.
Lake	1,020	808	Stone, pumice, mercury, sand and gravel, diatomite.
Lane	8,500	7,890	Sand and gravel, stone, mercury, pumice.
Lincoln	W	484	Stone, sand and gravel.
Linn	3,429	534	Sand and gravel, stone.
Malheur	1,091	727	Lime, sand and gravel, gold, silver.
Marion	1,145	571	Sand and gravel, stone, clays.
Morrow	W	69	Stone.
Multnomah	6,200	6,748	Sand and gravel, lime, stone, clays.
Polk	482	1,129	Sand and gravel, stone, clays.
Sherman	1,424	236	Sand and gravel, stone.
Tillamook	753	263	Stone, sand and gravel, clays.
Umatilla	1,820	5,378	Sand and gravel, stone.
Union	461	445	Stone, sand and gravel, clays.
Wallowa	330	W	Peat, stone.
Wasco	374	146	Stone, sand and gravel.
Washington	2,466	2,441	Stone, sand and gravel, clays.
Wheeler	247	37	Stone, sand and gravel, mercury.
Yamhill	366	681	Stone, sand and gravel, clays.
Undistributed [1]	7,913	5,706	
Total	107,484	66,560	

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.

Bestwall Gypsum Co., third largest manufacturer of gypsum products in the Nation and a recently acquired division of Georgia-Pacific Corp., transferred its headquarters from Pennsylvania to Portland. A new $250,000 research and development facility for the division was to be constructed in the Tigard industrial area near the interstate freeway.

Consumption, Trade, and Markets.—According to figures published by the Oregon Department of Employment, an alltime record of 881,400 employed workers was reached in August 1967. Comparatively good weather and minimal rainfall held employment losses in construction and wood products industries (8.2 and 5.3 percent, respectively) to a low level in spite of both the continued tight money market and the curtailed general building activity. Indicative of the slowdown in the construction industry, heavy engineering awards were down 35 percent, expenditures on highway contract work were down 24 percent, and cement shipments to destinations within the State were off 27 percent. An encouraging note was a 15-percent increase in building permits. Any resurgence of the financially restrained activity in the residential and nonresidential building industry directly affects the lumber and wood products sector of the economy.

For 66 consecutive months, through the end of 1967, total employment for each individual month had been above the respective figure for that month in the prior year. However, the labor force in the State continued to increase faster than the economy was able to provide jobs for the additions. As a result, the rate of unem-

Table 3.—Indicators of Oregon business activity

		1966	1967 p	Change, percent
Personal income:				
Total	millions	$5,738.0	$6,106.0	+6.4
Per capita		$2,908.0	$3,055.0	+5.1
Construction activity:				
Building permits	millions	$233.8	$268.9	+15.0
Heavy engineering awards	do	$211.0	$137.8	−34.7
Value of highway contracts awarded	do	$78.5	$79.9	+1.8
Expenditures on highway contract work	do	$85.6	$65.2	−23.8
Cement shipments to and within Oregon	thousand 376-pound barrels	4,280.0	3,415.1	−20.2
Mineral production	millions	$107.5	$66.6	−38.0
Cash receipts from farm marketings	do	$513.6	$530.1	+3.2
Factory payrolls	do	$1,107.8	$1,133.8	+2.3
Annual average labor force and employment:				
Total labor force	thousands	843.4	858.9	+1.8
Unemployment	do	35.4	41.3	+16.6
Construction	do	33.0	30.3	−8.2
Lumber and wood products	do	73.0	69.1	−5.3
Food products	do	22.3	23.0	+3.1
All manufacturing	do	167.2	164.2	−1.8
All industries	do	807.3	817.3	+1.2

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	1966		1967	
	Employment	Payrolls (thousands)	Employment	Payrolls (thousands)
Mining	1,680	$12,901	1,647	$13,261
Stone, clay, and glass products:				
Glass products	419	3,112	455	3,321
Hydraulic cement	421	3,233	326	2,643
Structural clay products	132	696	125	727
Concrete, gypsum, and plaster products	2,159	16,109	2,063	15,763
Cut-stone, stone, and pottery products	84	443	67	397
Miscellaneous	102	615	102	590
Total	3,317	24,208	3,138	23,442
Primary metals:				
Blast furnaces, steelworks, rolling and finishing mills	1,101	10,185	1,134	10,208
Primary smelting and refining of nonferrous metals	2,619	20,834	2,868	23,692
Iron and steel foundries	2,211	16,537	2,157	16,620
Nonferrous foundries	707	4,983	585	4,131
Secondary smelting and refining of nonferrous metals and miscellaneous industries	184	1,353	271	2,121
Total	6,822	53,892	7,015	56,771
Industrial chemicals	568	4,102	549	4,339
Petroleum refining and related products	371	2,533	401	2,849
Grand total	12,758	97,636	12,750	100,662

Source: Oregon Employment Department. Industries may vary from those in the Bureau of Mines canvass.

ployment averaged around 4.9 percent for the year, well above the national average and the highest in 3 years.

Legislation and Government Programs.—A comprehensive report recommending a program to curb pollution of the Willamette River Basin was completed by the Federal Water Pollution Control Administration. Estimated cost of the proposed 20-year pollution reduction program would be about $105 million.

The State of Oregon was given $18,130 by the Federal Water Resources Council as an initial planning grant under the Water Resources Planning Act of 1966. A

Table 5.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal and peat	4	49	(1)	2	----	----	----	----
Metal	143	219	31	251	1	6	27.86	24,661
Nonmetal	181	177	32	256	----	13	50.86	865
Sand and gravel	4,463	218	973	7,815	----	166	21.24	641
Stone	1,840	233	428	3,428	----	86	25.09	475
Total [2]	6,631	221	1,465	11,751	1	271	23.15	1,111
1967:p								
Coal and peat	10	63	1	6	----	----	----	----
Metal	150	203	30	245	----	11	44.91	1,821
Nonmetal	145	165	24	194	----	2	10.29	1,425
Sand and gravel	2,145	206	441	3,384	----	74	21.87	441
Stone	1,115	237	265	2,102	1	59	28.54	3,426
Total [2]	3,570	213	761	5,931	1	146	24.78	1,588

p Preliminary.
[1] Less than ½ unit
[2] Data may not add to totals shown because of independent rounding.

total of $704,190 has been given to 38 States.

In October, the Office of Minerals Exploration (OME) approved a $34,440 contract for work on a gold-silver property (Argonaut claim) in Baker County. There were no other contracts active during the year.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives and Roofing Granules.—Pacific Abrasive Supply, Portland, and Mining Mineral Manufacturing Co., Riddle, continued to dry, screen, and bag granulated slag for airblasting purposes, especially for cleaning ship hulls. The unprocessed slag for the Portland plant was obtained from an abandoned copper smelter site at Grand Forks, British Columbia, Canada. The Riddle plant was supplied from the Hanna Nickel Smelting Co. operation. Production of roofing granules by Flintkote Co., Pioneer Division, declined slightly compared with the 1966 total.

Cement.—Cement production and shipments were 27 percent less than those of 1966 because of the April closure of the Ideal Cement Co. plant at Gold Hill, Jackson County. The plant was converted to a storage and distribution terminal for cement manufactured at the firm's new Seattle, Wash., plant. Oregon Portland Cement Co. continued production from its Lime, Baker County, and Lake Oswego, Clackamas County, plants. A $5.75-million construction and modernization program for the Lake Oswego plant started in 1966 was completed by midyear. The rated annual capacity was raised from 2.0 million to 3.5 million barrels, making it the largest cement operation in the Pacific Northwest.

Destinations of shipments were chiefly within the State; out-of-State shipments were made to Washington, Idaho, and northern California. Shipments of portland cement were distributed to ready-mixed concrete companies, 71.5 percent; to concrete-product manufacturers, 11.7 percent; to general contractors, 10.9 percent; to building material dealers, 3.6 percent; and to highway contractors and to Federal, State, and local government agencies, 2.3 percent. Trucking, the principal method of transportation, accounted for 88 percent of the portland cement shipped; the remainder went by rail. The ratio of bulk to paper-bag shipments was about 10:1.

Combined shipments from four plants in Oregon and Nevada were 3.5 million barrels (376 pounds each) of finished portland cement; the same plants shipped 4.5

million barrels in 1966. The average value of portland cement shipped from these plants was $3.61 per barrel, f.o.b. plant, the same as in 1966.

Clay and Shale.—Clay and shale production declined 18 percent from the 1966 level primarily because of a cement plant closure; also contributing to the decline was less mining of expandable shale. Production of heavy-clay-products clay remained about the same. Bentonite increased 24 percent, and fire clay production was initiated.

Expandable shale, for conversion to lightweight-concrete aggregate and pozzolan, was produced at the Empire Lite-Rock, Inc., Banks pit, Washington County. The Cloverleaf Mines, Ltd., Haydite quarry, Washington County, was idle; however, plant equipment was being renovated and remodeled.

Miscellaneous clay, for making heavy clay products, was produced at operations in Benton, Clackamas, Klamath, Marion, Multnomah, Polk, Tillamook, Union, Washington, and Yamhill Counties. Willamina Clay Products Co., Inc., one of Yamhill County's miscellaneous clay producers, also produced fire clay. Both clays were used for building brick. Material for two cement firms came from two shale quarries (Baker and Jackson Counties) and from one clay pit (Baker County).

Central Oregon Bentonite Co. increased production from its Silver Well and Sands pits, Crook County, because of greater demand for its use in rotary-drilling mud, a binder in stock-feed pellets, a sealer for irrigation projects, and as a carrier in insecticides. Crude bentonitic clay was trucked from the pit to a beneficiating plant at Bend, Deschutes County, owned by Anderson Mining & Development Co. Mandrones Mining Co., Inc., Clackamas County, mined, dried, processed, and packaged a carbonaceous shale 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 dryer.

Diatomite.—The doubling of diatomite production over that of 1966 was due to the entry of a new firm, Keating Diatomaceous Earth Co., which produced diatomite from a deposit near Keating, Baker County, for use as a fertilizer filler. A. M. Matlock continued to mine crude diatomaceous earth from a deposit near Silver Lake in Lake County and trucked it to Eugene for processing into pet litter.

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 materials output was by this large number of amateur miners. Production was concentrated in the Prineville, Nyssa, and Lebanon areas. Obsidian and cryptocrystalline varieties of quartz—thunder egg, moss agate, plume agate, jasper, silicified rhyolite, and petrified wood—were the most popular materials mined. The Bureau of Land Management removed obsidian and chalcedony from the list of mineral materials that could be appropriated under the general mining laws on 90,000 acres of public domain in central Oregon. The affected lands included the Glass Buttes obsidian area. The land would remain open for mining locations, but the obsidian and chalcedony deposits were specifically reserved for the gem and mineral collector or hobbyist.

A visitor's guide, by the Bureau of Mines, to mining and mineral operations and other points of mineral interest that can be visited or viewed was published.[4]

Gypsum.—Bestwall Gypsum Co., third largest manufacturer of gypsum products in the United States, moved its division headquarters from Paoli, Pa., to Portland. Basically a mining-manufacturing concern, Bestwall operates six mines and quarries and 10 manufacturing plants out of State to produce 1.5 billion square feet of wallboard, lath, plaster, and sheathing annually.

Perlite.—A small amount of perlite was mined by Del T. Harmon, Baker County, for market testing. Supreme Perlite Co., Portland, expanded crude perlite from Nevada. The expanded product was used chiefly as a building plaster aggregate and concrete aggregate; smaller quantities were used for soil conditioning and as loose-fill insulation.

Pumice and Volcanic Cinder.—Pumice and pumiceous material (volcanic cinder and scoria) sold or used by producers increased 17 percent over the 1966 total. The material was used, mainly unprocessed, for

[4] Staff, Bureau of Mines. Mining and Mineral Operations in the United States, A Visitor's Guide. 1967, 89 pp.

road construction and maintenance by governmental agencies; smaller amounts were processed and used for lightweight-concrete aggregate, concrete admixtures (pozzolan), and as an abrasive. All uses had gains. Road material (658,459 tons) was produced in Deschutes, Jefferson, Klamath, and Lake Counties. Central Oregon Pumice Co. and Graystone Corp. of Deschutes County produced pumice which was processed and sold to concrete-products plants in the Northwestern States, California, and Canada. Volcanic cinder from Baker County was mined and crushed by Oregon Portland Cement Co., and volcanic ash from Gilliam County was mined and processed by Kaiser Cement & Gypsum Corp. Both volcanic materials were mined for their pozzolanic properties. Output of volcanic material from these two operations was sharply curtailed because of completion of the John Day and Green Peter Dams by the Army Corps of Engineers.

Sand and Gravel.—Sand and gravel output fell 44 percent from that of 1966 owing to completion of the John Day road, railway, and town relocations and completion of the earth-filled Foster Dam by the U.S. Army Corps of Engineers. The commercial output increase of 5 percent helped to offset the 16.2-million-ton decline in Government-and-contractor production. Under this classification, output for Federal agencies decreased from 20.2 million tons (1966) to 4.2 million tons; output for State agencies increased from 3.1 million to 3.6 million tons; and output for counties decreased from 1.9 million tons to 1.3 million tons.

Production was reported from 35 of 36 counties; the exception was Morrow County. Output exceeding 6 million tons was reported from Lane County; over 3 million tons from Multnomah County; and over 1 million tons each from Douglas and Umatilla Counties.

The availability and quality of sand and gravel and stone within the Tualatin Valley area were reported in a State study.[5]

Stone.—Stone output fell 60 percent below that of 1966. The large decrease, as with sand and gravel, was due to reduced requirements for fill material at the John Day dam project. Stone output for the Government-and-contractor market decreased 68 percent from 29.6 million tons

[5] Schlicker, H. G., and R. J. Deacon. The Engineering Geology of the Tualatin Valley Region. Oregon Dept. Geol. and Miner. Ind., Bull. 60, 1967, 103 pp.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	3,006	$3,923	3,636	$4,706
Railroad ballast	145	116	W	W
Road material	5,617	7,309	5,931	7,178
Fill	1,081	790	804	530
Other [1]	205	314	180	186
Total	10,054	12,452	10,551	12,600
Government-and-contractor operations:				
Building	168	245	226	336
Road material	7,140	11,425	5,744	9,982
Fill	17,395	10,456	161	116
Other [1]	570	408	2,948	2,216
Total	25,273	22,534	9,079	12,650
All operations:				
Building	3,174	4,168	3,862	5,042
Railroad ballast	145	116	W	W
Road material	12,757	18,734	11,675	17,160
Fill	18,476	11,246	965	646
Other [1]	775	722	3,128	2,402
Grand total	35,327	34,986	19,630	25,250

[1] Includes special sands and sand and gravel used for miscellaneous purposes.

(1966) to 9.6 million tons. Commercial stone decreased 3 percent from 3.7 million tons (1966) to 3.6 million tons. Basalt, used for roadstone, ballast, riprap, concrete and asphalt aggregate, and fill, continued to be the principal stone quarried, accounting for 94 percent of total.

Bristol Silica Co. mined silica (quartz) from a quarry near Rogue River, Jackson County. The material was transported about 4 miles by truck to a screening plant at Gold Hill. The sized material was marketed for use in making ferrosilicon, silicon carbide, and cement. Stone was produced from operations in 34 of the 36 counties; output exceeded 1 million tons in Lane and Washington Counties.

The April closing of Ideal Cement Co. Gold Hill, Jackson County plant, was reflected in decreased limestone output which totaled 588,000 tons compared with 627,000 tons for 1966. The decrease would have been much greater except that the use of limestone for roadstone was initiated. The largest limestone industrial market was the cement industry, followed by the sugar, lime, paper, and agricultural industries. Limestone was quarried in Baker County by Chemical Lime Co. at its Baboon quarry and by Oregon Portland Cement Co. at its Durkee quarry; in Josephine County by Ideal Cement Co. at its Marble Mountain quarry; and in Polk County by Oregon Portland Cement Co. at its Dallas quarry. Limestone for roadstone was produced in Baker County by U.S. Forest Service and in Curry County by the Curry County road department.

Table 7.—Stone sold or used by producers by uses

(Thousand short tons and thousand dollars)

Use	1966		1967	
	Quantity	Value	Quantity	Value
Concrete and roadstone	14,277	$20,883	10,992	$16,115
Railroad ballast	244	349	237	343
Riprap	1,380	2,894	1,234	2,346
Other [1]	17,387	24,209	737	1,452
Total [2]	33,288	48,335	13,201	20,256

[1] Includes building stone (dimension), stone used at cement, paper, and chemical plants; sugar refineries; rock fill; dams; dikes; and for miscellaneous unspecified purposes.
[2] Data may not add to totals shown because of rounding.

Talc and Soapstone.—Soapstone for use as a carrier material in insecticides was ground at the Portland plant of Stauffer Chemical Co. The crude material was obtained from mines in Skagit County, Wash. Soapstone was mined and shipped by John C. Pugh from a deposit on Powell Creek, Josephine County. The material was used for sculpturing purposes by educational institutions.

Vermiculite (Exfoliated).—Output of expanded vermiculite was 14 percent higher than that of 1966. Crude vermiculite from the Republic of South Africa and Montana was exfoliated at Portland plants of Vermiculite-Northwest, Inc., and Supreme Perlite Co., respectively. Expanded material was marketed as loose-fill insulation, as a lightweight aggregate for plaster and concrete, and for soil conditioning.

METALS

Aluminum.—Northwest Aluminum Co. chose Warrenton, near Astoria, as the construction site for a $142-million plant with an aluminum capacity of 130,000 tons per year. Australian bauxite was to be processed to alumina at the plant and the alumina in turn reduced to aluminum. Three U.S. and three Japanese companies were announced partners in the project. Yawata Econ Steel, Shawa Denko KK, and Mitsui and Co., the Japanese companies involved, were to take an estimated 35 percent of the aluminum ingot produced. Bell Intercontinental Corp. of New York, Equity Corp., and American Export-Isbrandtsen Co. were the U.S. participants; Bell Intercontinental, a subsidiary of Equity Corp., was to be in charge of plant construction on the 840-acre site. The construction contract was let to Parsons-

Jurden Corp. Site selection was successfully concluded upon agreement with the Port of Astoria to finance the plant through the sale of revenue bonds; the Port was to lease the plant to Northwest Aluminum Co. Construction was expected to require 3 years and as many as 2,000 workmen. Production was to begin early in 1970 and would provide an annual payroll of $8 million with an additional local contribution of about $700,000 in county taxes. Access roads and site grading were completed.

The Reynolds Metals Co. Troutdale plant was operated at capacity throughout the year, and employment was near 800. Addition of a new potline, announced in 1966, remained under consideration.

Harvey Aluminum, Inc., The Dalles, received alumina from its new plant in the Virgin Islands. Capacity production continued through the year, and plant employment was approximately 500.

A metallurgical process for recovery of aluminum from Pacific Northwest ferruginous bauxites was reported by the Albany Metallurgy Research Center, Bureau of Mines, Albany. The research described applies to aluminum-bearing material such as that found in the Salem Hills area.[6]

Purchases of electricity from Bonneville Power Administration (BPA) by the Harvey and Reynolds companies totaled 3,076 million kilowatt-hours, 2.7 percent more than the previous year.[7]

Copper.—Bear Creek Mining Co., exploration subsidiary of Kennecott Copper Corp., located 38 claims in northeastern Baker County. The area was being explored by geologists from Bear Creek's district office in Spokane, Wash. Cyprus Mines Corp. also was doing exploration in the same area.

Ferroalloys.—The Union Carbide Corp. Portland plant strike, which began in August 1966, was settled in April after 8 months and 1 week. In addition to production of ferromanganese, silicomanganese, and ferrosilicon, output of low-iron manganese metal was begun. Manganese ore was imported from numerous foreign sources, and silica rock was shipped from Montana. Purchases of electricity from BPA declined 15.7 percent compared with that of the previous year.[8]

Gold and Silver.—Lode and placer mines yielded 186 ounces of gold and 31 ounces of silver, the lowest production since the Bureau of Mines began keeping records in 1902. Old tailings shipped from the Warner mine, Jackson County, to a California smelter accounted for most of the reported production; the remainder came from lode and placer operations in Baker, Grant, Jackson, Josephine, and Malheur Counties.

The idle Buffalo mine, Baker County, source of most of the gold produced in the State over the past several decades, was acquired by A. W. Brandenthaler through a lease-purchase-option agreement from the Union Pacific Railroad. Development work, consisting of drilling and drifting, was conducted.

A gold prospect, situated in an extensive mineralized zone of Josephine County, was the subject of a State publication.[9]

Iron and Steel.—Iron ore from the Tolman property, Jackson County, was being considered for use at the Hanna Nickel Smelting Co. Riddle plant, Douglas County, as an additive for refining ferronickel in an electric steelmaking furnace.

Peruvian iron ore was to be used to produce steel at a plant being constructed at Portland by Oregon Steel Mills, a division of Gilmore Steel Corp. Mildand-Ross Corp. began constructing for Oregon Steel a prereduced iron ore pellet plant with an initial annual capacity of 300,000 tons. The plant, scheduled to begin in early 1969, was to produce prereduced pellets containing a minimum of 95 percent metallic iron under a new and unique patented process developed by Midland-Ross. Electric steelmaking furnaces, with an annual capacity of 150,000 tons, were planned, with plant-design expansion capability up to 500,000 tons. Included in the construction program was a new rolling mill capable of forming up to 750,000 tons of steel plate per year with dimensions ranging from 3/16 to 3 inches in thickness and up to 96 inches in width. The $35-million facility would meet all government requirements for air- and water-pollution control.

[6] Blake, Henry E., Jr., Oliver C. Fursman, Arden D. Fugate, and Lloyd H. Banning. Adaptation of the Pedersen Process to the Ferruginous Bauxites of the Pacific Northwest. BuMines Rept. of Inv. 6939, 1967, 21 pp.

[7] Bonneville Power Administration, Branch of Customer Service.

[8] Bonneville Power Administration, Branch of Customer Service.

[9] Libbey, F. W. The Almeda Mine, Josephine County, Oregon. Oregon Dept. Geol. and Miner. Ind., Short Paper 24, 1967, 53 pp.

Mercury.—Production rose 35 percent over that of the previous year. The Black Butte Mining Inc., Black Butte mine (Lane County) and the Jackson Mountain Mining Co., Glass Butte mine (Lake County) accounted for 93 percent of the total output. Other producers, in descending order of production, were Alcona Mining, Inc., Elkhead mine (Douglas County), Canyon Creek Mercury Mines Canyon Creek mine (Grant County), Tooley, Quant & Brewer Mercury Queen mine (Wheeler County), and Fitzpatrick and Inman Doodle Bug mine (Jackson County). Robert Lyman continued to retort Alaskan cinnabar concentrate at a plant in Benton County.

Nickel.—Production of nickel contained in ore by Hanna Mining Co., Douglas County, was 15,287 tons (1,084,208 tons of ore averaging 1.41 percent nickel), an increase of 1.7 percent over that of the previous year. Ferronickel production, by the subsidiary Hanna Nickel Smelting Co., Riddle plant, was 25,978 tons containing 13,036 tons of nickel. Electric energy consumption was 7.5 percent greater than that of the previous year.[10]

Titanium.—Oregon Metallurgical Corp., Albany, began to construct a titanium ingot-melting complex that was to double the existing 6,000-ton annual ingot capacity. The new plant unit, with completion expected by early 1969, was designed to produce ingots up to 36 inches in diameter weighing 20,000 pounds. Further developments in prospect included the production of titanium tetrachloride and a magnesium recovery plant. Magnesium is used in reducing titanium tetrachloride to titanium metal sponge. In addition to magnesium metal, liquid chlorine, also used in the process, was to be recovered.

Rem Metals Corp., Albany, began construction on a $1.5-million precision casting plant for titanium, zirconium, and columbium metal.

TiLINE, Inc., Albany, began site preparation for a casting plant where castings, shaped around a preformed titanium lining, were to be produced.

Uranium.—Gulf Oil Corp., Nuclear Fuels Division, applied for a lease to 82,644 acres of State land in Malheur (43,452 acres), Harney (12,905 acres), Grant (400 acres), Lake (2,662 acres), Crook (11,316 acres), and Wheeler (11,909 acres) Counties for the purpose of uranium exploration. Ground exploration was to be preceded by aerial reconnaissance. The State Land Board proposed a lease contract calling for annual payments of 25 cents an acre for the first 2 years, then escalating the annual payments to 50 cents for the third and fourth years, and to $3 per acre thereafter. A 5- to 10-percent royalty would be assessed against production revenue. It was expected that Gulf would seek exploration rights to other lands adjacent to the leased State land.

The White King and Lucky Lass properties, Lake County, were examined by Western Nuclear, Inc.

Zirconium.—Teledyne, Inc., purchased the Albany plant of Wah Chang Corp.; the company name was changed to Wah Chang Albany Corp. Plans were announced to raise zirconium production from 1,000 tons to 1,750 tons per year. The expansion was to include pollution control measures that would meet State water-pollution standards.

MINERAL FUELS

Asphalt.—Union Oil Co. of California started constructing a $1-million asphalt refinery near its Portland marketing terminal. Completion of the facility was scheduled for late spring of 1968.

Carbon.—Carbon fly ash from a number of boiler plants in the Eugene-Springfield area was used by the Kingsford Co. to produce charcoal briquets. The firm, headquartered in Louisville, Ky., plans to serve the 11 Western States from its new $1.2-million Springfield plant. Productive utilization of carbonaceous fly ash has helped to solve an air-pollution problem.

Natural Gas.—William G. Craig, Tacoma, Wash., acquired leases, for a natural gas test, on more than 4,000 acres in the Buena Vista area south of Salem. The test site, on a farm 1 mile north of Buena Vista, was near a 3,600-foot dry hole drilled in 1933 by the Portland Gas & Coke Co. The test hole drilling was recessed after it reached 1,560 feet.

Peat.—Wes Cruikshank continued to develop and exploit a peat bog near Enterprise, Wallowa County.

[10] Bonneville Power Administration, Branch of Customer Service.

Petroleum.—Two companies filed application with the Bureau of Land Management to lease gas and oil rights on public domain. Both were approved. Standard Oil Co. of California applied for 11,000 acres of O & C lands in the south-central part of Columbia County and in northeastern Washington County. Mobil Oil Co. requested several thousand acres of land in Coos and Douglas Counties. Standard, Mobil, and Texaco, Inc., also were active in private leasing in Columbia and Washington Counties. Total acreage involved in the leasing was approximately 50,000.

The Oregon Department of Geology and Mineral Industries had four drilling permits in effect. Only the one issued in 1967 to William Craig of Tacoma, Wash., was active, and it was covered under the natural gas heading.

Offshore activity was limited to one hole drilled to a depth of 6,146 feet by Shell Oil Co. for Pan American Petroleum Corp. and others (Atlantic-Richfield, Sinclair, Superior, Canadian Superior, and J. Ray McDermott). The hole, located about 10 miles off Coos Bay, was tested and had a show of oil and gas.

Federal offshore acreage leased by oil companies dropped from 580,800 for 1965 to 385,000 for 1966 to 64,000 for 1967. The two offshore State lease parcels were also canceled in December.

Table 8.—Principal producers of metals and minerals

Commodity and company	Type of activity	County	Address
Nonmetals:			
Cement:			
Ideal Cement Co	Plant [1]	Jackson	Denver, Colo.
Oregon Portland Cement Co	do	Baker and Clackamas	Portland, Oreg.
Clay:			
Central Oregon Bentonite Co	Pit	Crook	Prineville, Oreg.
Columbia Brick Works	Pit and plant	Multnomah	Portland, Oreg.
Empire Lite-Rock, Inc	do	Washington	Do.
Ideal Cement Co	do [1]	Jackson	Denver, Colo.
McMinnville Brick Co	do	Yamhill	McMinnville, Oreg.
Monroe Clay Products Co	do	Benton	Monroe, Oreg.
Needy Brick and Tile Co	do	Clackamas & Marion	Hubbard, Oreg.
Oregon Portland Cement Co	Plant	Baker	Portland, Oreg.
Willamina Clay Products Co., Inc.	Pit and plant	Yamhill	Tigard, Oreg.
Diatomite:			
Keating Diatomaceous Earth Co.	Mine	Baker	Baker, Oreg.
A. M. Matlock	Mine and plant	Lake	Eugene, Oreg.
Lime:			
Ash Grove Lime & Portland Cement Co.	Plant	Multnomah	Portland, Oreg.
Chemical Lime Co	do	Baker	Baker, Oreg.
Pacific Carbide & Alloys Co	do	Multnomah	Portland, Oreg.
Peat: Jewell's Mother Earth	Mine	Wallowa	Enterprise, Oreg.
Perlite: Del T. Harmon	do	Baker	Stanfield, Oreg.
Pumice:			
L. V. Anderson	Mine and plant	Lane	Oakridge, Oreg.
Central Oregon Pumice Co	do	Deschutes	Bend, Oreg.
Graystone Corp	do	do	Do.
Kaiser Cement & Gypsum Corp.	do	Gilliam	Permanente, Calif.
Oregon Portland Cement Co	Mine	Baker	Portland, Oreg.
D. W. Parks	do	Klamath	Klamath Falls, Oreg.
Roofing Granules: Flintkote Co	Plant	Multnomah	Portland, Oreg.
Sand and Gravel:			
Baker Rock Crushing	Pit and plant	Washington	Hillsboro, Oreg.
Delta Sand & Gravel	do	Lane	Eugene, Oreg.
Eugene Sand & Gravel Co	do	do	Do.
Glacier Sand & Gravel	do	Multnomah	Portland, Oreg.
McKenzie Sand & Gravel	do	Lane	Eugene, Oreg.
M. P. Materials	do	Marion	Salem, Oreg.
Milwaukie Sand & Gravel Co	Dredge and plant	Clackamas	Milwaukie, Oreg.
Rich Valley Top Soil Co	Pit and plant	do	Oregon City, Oreg.
Roseburg Sand & Gravel	do	Douglas	Roseburg, Oreg.
Ross Island Sand & Gravel	Dredge and plant	Multnomah	Portland, Oreg.
Umpqua River Navigation Co.	do	Douglas	Reedsport, Oreg.
Valley Concrete & Gravel Co., Inc.	Pit and plant	Polk	Independence, Oreg.
Wildish Sand & Gravel	do	Lane	Eugene, Oreg.
Willamette Hi-Grade Concrete Co.	Dredge and plant	Multnomah	Portland, Oreg.

See footnotes at end of table.

Table 8.—Principal producers of metals and minerals—Continued

Commodity and company	Type of activity	County	Address
Nonmetals—Continued			
Stone:			
Ray Bohlman	Quarry	Jefferson	Madras, Oreg.
Anthony Brandenthaler	do	Baker	Baker, Oreg.
Bristol Silica Co	do	Jackson	Rogue River, Oreg.
Chemical Lime Co	do	Baker	Baker, Oreg.
L. H. Cobb	do	Washington	Beaverton, Oreg.
Dutton & Adkins	do	Clackamas	Molalla, Oreg.
Eckman Creek Quarries	do	Lincoln	Waldport, Oreg.
Fall Creek Gravel Co	do	Lane	Springfield, Oreg.
Germania Masonry, Inc	do	Multnomah	Portland, Oreg.
Ideal Cement Co	do [1]	Josephine	Denver, Colo.
E. H. Itschner Co	do	Umatilla	Molalla, Oreg.
Peter Kiewit Sons	do	Clackamas	Vancouver, Wash.
W. D. Miller Construction Co.	do	Klamath	Klamath Falls, Oreg.
S. S. Mullen, Inc	do	Umatilla	Seattle, Wash.
Oregon Portland Cement Co	do	Baker and Polk	Portland, Oreg.
Pioneer Construction Co	do	Multnomah	Do.
Quality Rock Co	do	Washington	Beaverton, Oreg.
Arthur Simonsen & Co	do	Baker, Grant, Umatilla.	Baker, Oreg.
Springfield Sand & Gravel	do	Lane	Springfield, Oreg.
L. P. Stubblefield	do	Benton, Lane, Linn	Eugene, Oreg.
W. W. D. Corp	do	Douglas	Drain, Oreg.
Yaquina Head Quarries	do	Lincoln	Newport, Oreg.
Talc and Soapstone:			
John H. Pugh	Mine	Josephine	Grants Pass, Oreg.
Stauffer Chemical Co	Plant	Multnomah	Portland, Oreg.
Exfoliated Vermiculite:			
Supreme Perlite Co	do [2]	do	North Portland, Oreg.
Vermiculite-Northwest, Inc	do	do	Auburn, Wash.
Metals:			
Aluminum:			
Harvey Aluminum Co	do	Wasco	The Dalles, Oreg.
Reynolds Metals Co	do	Multnomah	Troutdale, Oreg.
Ferroalloys:			
Hanna Nickel Smelting Co	do	Douglas	Riddle, Oreg.
Union Carbide Corp., Mining and Metals Division.[3]	do	Multnomah	Portland, Oreg.
Gold:			
M & B Logging Co	Mine (iode)	Jackson	Canyonville, Oreg.
Russell Mitchell	do	do	Medford, Oreg.
Osee Oden	do	Josephine	Wolf Creek, Oreg.
George Slade	do	do	Applegate, Oreg.
Mercury:			
Alcona Mining, Inc	Mine	Douglas	Springfield, Oreg.
Black Butte Mining Co	do	Lane	Cottage Grove, Oreg.
Canyon Creek Mercury Mine.	do	Grant	Canyon City, Oreg.
Jackson Mountain Mining	do	Lake	Winnemucca, Nev. (Hampton, Oreg.)
Nickel: Hanna Mining Co	do	Douglas	Riddle, Oreg.

[1] Closed April 1967.
[2] Also expands perlite.
[3] Produces ferromanganese, silicomangonese, ferrosilicon.

The Mineral Industry of Pennsylvania

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

By Charles C. Yeloushan [1]

Production reported by the mineral industry of Pennsylvania in 1967 was valued at $898.4 million, a $5 million decrease from that of 1966. Value of anthracite and bituminous coal fell $4.5 million and $5.8 million, respectively, from 1966 levels al-

[1] Mining engineer, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Pennsylvania

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland---376-pound barrels	40,003,833	$114,357	40,196,388	$114,592
Masonry---280-pound barrels	2,960,110	7,860	2,928,554	7,948
Clays [2]---short tons	3,293,114	17,033	2,994,091	16,703
Coal:				
Anthracite---do	12,941,264	100,663	12,256,063	96,160
Bituminous---do	81,442,801	425,168	79,411,968	419,345
Copper---do	3,178	2,299	4,401	3,365
Gem stones	NA	4	NA	4
Lime---short tons	1,585,088	22,816	1,719,089	24,715
Natural gas---million cubic feet	90,914	25,820	89,966	25,280
Natural gas liquids:				
Natural gasoline and cycle products thousand gallons	3,211	186	1,167	77
LP gases---do	1,863	121	1,757	114
Peat---short tons	52,912	562	39,505	437
Petroleum (crude) thousand 42-gallon barrels	4,337	19,300	4,387	19,701
Sand and gravel---short tons	17,567,000	29,562	17,479,000	29,614
Stone---do	59,087,000	99,233	60,155,000	103,157
Zinc [3] (recoverable content of ores, etc.) short tons	28,080	8,143	35,067	9,468
Value of items that cannot be disclosed: Clays, (kaolin), cobalt, gold, iron ore, mica, pyrites, sericite-schist, silver, and tripoli	XX	30,281	XX	27,718
Total	XX	903,408	XX	898,398
Total 1957-59 constant dollars	XX	931,980	XX	p899,195

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.

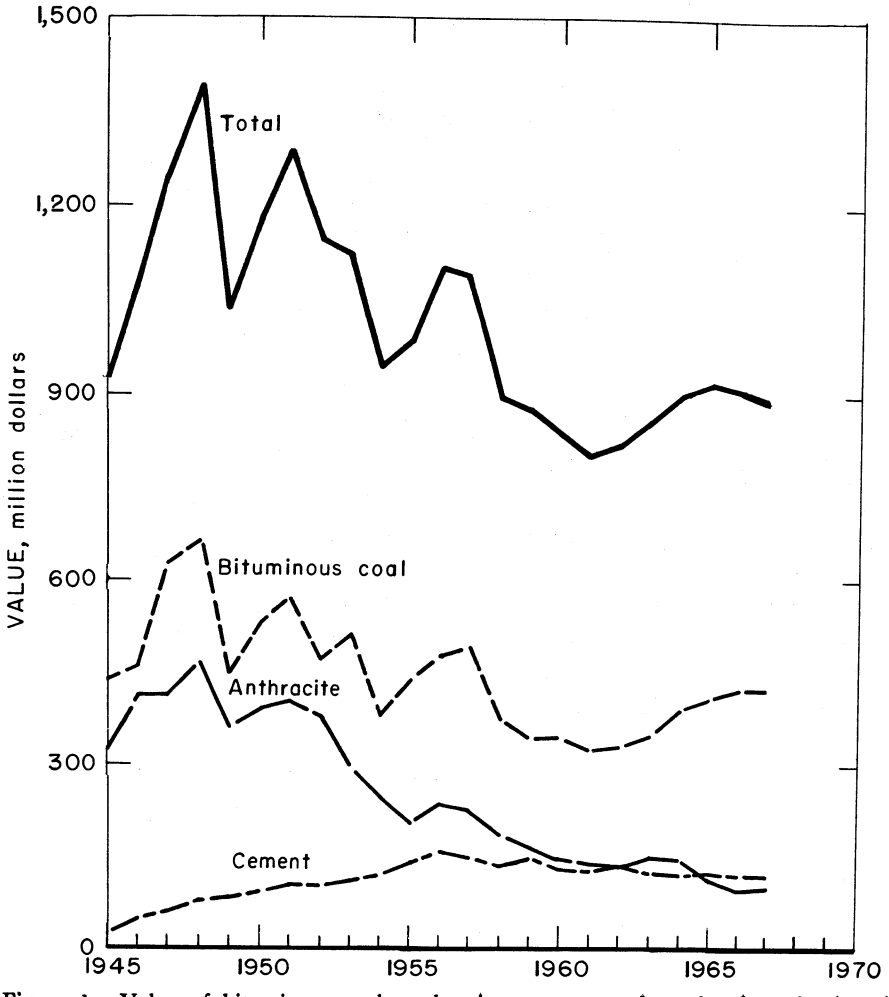

Figure 1.—Value of bituminous coal, anthracite, cement, and total value of mineral production in Pennsylvania.

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

County	1966	1967	Minerals produced in 1967 in order of value [2]
Adams	W	W	Stone, lime, sericite schist, clays.
Allegheny [3]	$32,983,953	$27,585,061	Coal, cement, clays, sand and gravel, stone, iron ore (pigment material).
Armstrong	25,138,199	28,875,472	Coal, sand and gravel, clays, stone, lime.
Beaver	3,639,419	2,435,184	Clays, coal, sand and gravel.
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	W	Stone, clays, coal.
Bradford	664,920	W	Sand and gravel.
Bucks	W	W	Sand and gravel, stone, clays.
Butler [4]	12,480,210	10,882,969	Coal, cement, stone, lime, sand and gravel.
Cambria	W	W	Coal, clays, stone, iron ore (pigment material).
Carbon	4,885,309	5,682,802	Coal, sand and gravel, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Pennsylvania by counties [1]—Continued

County	1966	1967	Minerals produced in 1967 in order of value [2]
Centre	$16,396,017	$18,825,018	Lime, stone, coal, sand and gravel, clays.
Chester [5]	5,036,388	4,007,661	Stone, lime, clays.
Clarion	13,745,918	12,878,323	Coal, stone, sand and gravel, clays.
Clearfield	29,232,088	29,630,420	Coal, clays.
Clinton	2,942,513	4,064,316	Coal, stone, clays.
Columbia	3,850,214	4,008,596	Coal, sand and gravel, lime, stone.
Crawford	429,000	395,000	Sand and gravel.
Cumberland	W	W	Stone, sand and gravel, clays.
Dauphin	3,611,118	3,099,161	Stone, coal, clays, sand and gravel.
Delaware	W	W	Stone.
Elk	W	W	Coal, stone.
Erie	W	W	Sand and gravel, peat.
Fayette	8,993,792	7,083,462	Coal, stone, clays.
Forest	310,000	W	Sand and gravel.
Franklin	1,636,365	1,606,688	Stone, sand and gravel.
Fulton	W	W	Do.
Greene	W	W	Coal, clays.
Huntingdon	W	W	Sand and gravel, stone, coal, clays.
Indiana	W	W	Coal, clays.
Jefferson	W	W	Coal, clays, stone, sand and gravel.
Lackawanna	W	W	Coal, sand and gravel, peat.
Lancaster	8,245,104	8,023,487	Stone, coal, clays, sand and gravel.
Lawrence	W	W	Cement, stone, coal, clays, sand and gravel, peat.
Lebanon	21,571,924	22,016,797	Iron ore, copper, lime, stone, cobalt, pyrites, gold, silver.
Lehigh	29,017,306	30,183,003	Cement, zinc, stone.
Luzerne	40,677,402	38,990,146	Coal, stone, sand and gravel, peat, clays.
Lycoming	W	W	Stone, sand and gravel, coal, tripoli.
McKean	407,675	302,186	Clays, stone, sand and gravel.
Mercer	2,476,343	1,929,694	Coal, sand and gravel, stone.
Mifflin	W	W	Sand and gravel, stone, lime.
Monroe	771,072	696,602	Stone, sand and gravel, clays.
Montgomery	W	W	Stone, cement, lime, clays.
Montour	W	W	Stone.
Northampton	57,326,162	59,169,193	Cement, stone, sand and gravel.
Northumberland	W	W	Coal, clays, stone, lime.
Perry	W	W	Stone.
Philadelphia	W	W	Sand and gravel.
Potter	W	124,861	Stone.
Schuylkill	37,123,723	36,016,832	Coal, stone, sand and gravel, clays.
Snyder	477,304	431,156	Stone, sand and gravel, coal.
Somerset	19,403,385	18,208,936	Coal, stone, clays, sand and gravel.
Sullivan	114,975	184,092	Coal.
Susquehanna	492,787	W	Stone, coal.
Tioga	2,504,665	3,113,296	Coal, sand and gravel.
Union	W	W	Stone.
Venanago	2,359,860	W	Coal, sand and gravel.
Warren	644,000	930,000	Sand and gravel.
Washington	W	W	Coal, stone, clays.
Wayne	W	W	Sand and gravel, stone, peat.
Westmoreland	W	W	Coal, stone, sand and gravel, lime.
Wyoming	720,319	W	Sand and gravel, stone.
York [4]	8,924,263	9,471,890	Cement, stone, lime, clays, sand and gravel, mica.
Undistributed [6]	r 504,174,000	507,546,640	
Total	903,408,000	[7] 898,398,000	

r Revised.
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] Excludes value of natural gas, natural gasoline, LP gases, petroleum, and gem stones unspecified by counties; included with "Undistributed."
[3] Excludes cement; included with "Undistributed."
[4] Excludes cement and lime; included with "Undistributed."
[5] Excludes lime; included with "Undistributed."
[6] Includes values indicated by symbol W.
[7] Data do not add to total due to rounding.

though collectively they accounted for 57 percent of the total State mineral value in 1967. Stone production continued to rise with a value increase of $3.9 million above that of 1966. Copper showed a substantial increase in both quantity and value. Cement, crude petroleum, sand and gravel, lime, kaolin clay, gold, pyrites, and silver also showed total value increases above those of 1966. Production of zinc increased considerably but the unit value fell slightly. Output of clays, natural gas, natural gas liquids, peat, cobalt, iron ore, mica, sericite-schist, and tripoli decreased from that of 1966.

Table 3.—Indicators of Pennsylvania business activity

	1966	1967 p	Change (percent)
Personal income:			
Total millions	$34,434	$36,624	+6.4
Per capita	$2,968	$3,149	+6.1
Construction activity:			
Construction contracts [1]	$2,239,440	$2,897,123	+29.4
Nonresidential buildings	$1,040,280	$1,128,902	+8.5
Residential buildings	$663,166	$680,836	+2.7
Nonbuilding construction	$535,994	$1,087,385	+102.9
Cement shipments into and within Pennsylvania thousand 376-pound barrels	16,781	17,527	+4.4
Mineral production millions	$903	$898	−.6
Civilian work force thousands	4,788.6	4,824.7	+.8
Total civilian employment do	4,625.4	4,659.3	+.7
Unemployment (percent of work force)	3.4	3.4	
Manufacturing employment thousands	1,555.8	1,540.6	−1.0
Durable goods do	925	918.1	−.7
Nondurable goods do	630.8	622.5	−1.3
Nonmanufacturing employment thousands	2,513.5	2,582.6	+2.7
Mining do	42.4	42.1	−.7

p Preliminary.
[1] F. W. Dodge Division, McGraw-Hill Information Systems Company.
Sources: U.S. Department of Labor; Pennsylvania Department of Employment Security; U.S. Department of Commerce.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1966:								
Bituminous coal	23,433	231	5,415	43,469	28	1,001	23.67	5,296
Anthracite	9,292	203	1,883	13,672	6	829	61.07	4,477
Metal	1,579	287	454	3,629	----	30	8.27	815
Nonmetal	1,731	252	436	3,545	----	140	39.50	769
Sand and gravel	1,205	232	280	2,384	1	50	21.39	3,766
Stone	8,286	269	2,226	18,285	7	315	17.61	3,356
Peat	60	225	14	109	----	----	----	----
Total [1]	45,586	235	10,706	85,092	42	2,365	28.29	4,318
1967: p								
Bituminous coal	22,800	234	5,329	42,820	27	925	22.23	5,123
Anthracite	7,750	219	1,701	12,359	9	609	50.00	5,511
Metal	1,600	280	448	3,586	2	31	9.20	3,663
Nonmetal	1,430	250	357	2,920	----	89	30.48	740
Sand and gravel	1,195	240	287	2,409	1	55	23.25	3,731
Stone	8,335	267	2,225	18,261	9	281	15.88	3,447
Peat	46	224	10	84	----	4	47.87	3,770
Total [1]	43,155	240	10,357	82,439	48	1,994	24.77	4,549

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

REVIEW BY MINERAL COMMODITIES

FUELS

Coal (Anthracite).—Anthracite production declined for the fifth consecutive year to a low of 12.3 million tons, a 700,000-ton decrease from that of 1966. The average value of anthracite was $7.85 per ton, an increase of $0.07 over that of 1966. Of the total production, 6.6 million tons was shipped by truck, 5.5 million tons was shipped by rail, and 143,000 was used as colliery fuel. Underground mining produced 3.3 million tons of which 2 million tons was mechanically loaded by 228 conveyors and pit-car loaders (including duck-bills and other self-loading conveyors), 119 scraper loaders, and 21 mobile

Table 5.—Coal (bituminous) production, by counties

County	Number of mines				Production, thousand tons	Average price per ton
	Underground	Strip	Auger	Total		
Allegheny	12	15	1	28	5,028	$5.28
Armstrong	31	45	11	87	5,899	4.24
Blair	1	1	------	2	5	5.51
Butler	8	32	5	45	2,023	3.82
Cambria	57	22	6	85	7,718	5.93
Centre	3	12	2	17	786	3.93
Clarion	1	60	------	61	2,828	3.91
Clearfield	25	57	9	91	6,910	3.73
Clinton	----	12	------	12	929	3.77
Elk	4	9	4	17	320	3.90
Fayette	7	24	------	31	527	5.42
Greene	19	3	------	22	11,898	6.89
Huntingdon	2	2	1	5	44	2.69
Indiana	45	30	7	82	7,669	4.50
Jefferson	18	41	12	71	1,771	4.01
Lawrence	----	19	------	19	925	3.38
Lycoming	----	5	------	5	113	3.26
Mercer	----	6	------	6	305	3.73
Somerset	41	60	2	103	4,061	4.16
Tioga	----	7	------	7	715	4.28
Venango	----	13	------	13	517	3.26
Washington	16	15	1	32	14,776	6.55
Westmoreland	16	22	1	39	3,333	5.53
Other counties [1]	6	5	------	11	313	3.69
Total	312	517	62	891	[2] 79,412	5.28

[1] Includes data for Beaver and Bedford Counties.
[2] Data do not add to total shown because of independent rounding.

loaders. Strip pits (the largest segment of the industry) supplied 4.7 million tons, culm banks 3.6 million tons, and river dredging 631,600 tons. Production of fresh-mined coal (underground and strip mines) continued to decrease, a 1.3-million-ton loss from that of 1966.

Daily employment in the anthracite industry averaged 7,750 men (1,542 less than in 1966). Productivity from all operations except dredges averaged 6.9 tons per man-day, while dredge operations reported 34.2 tons per man-day for an overall average of 7.21 tons per man-day (0.3 ton better than in 1966).

Luzerne County continued to be the leading producer with 4.3 million tons, followed by Schuylkill County with 4.2 million tons, and Northumberland with 1.5 million tons.

Retail dealer deliveries for the year increased by 200,000 tons while industrial consumption by electric utilities and coke plants remained virtually unchanged.

Nine deaths were reported in the anthracite industry for a frequency rate of 0.74 per million man-hours exposure, an increase of three deaths from 1966. Three of the fatalities occurred at a mine employing fewer than 15 persons underground, five at mines employing 15 or more persons underground, and one at a strip mine. There were 609 nonfatal lost-time injuries, a frequency rate of 50.00 per million man-hours.

Coal (Bituminous).—Bituminous coal production totaled 79.4 million tons at an average of $5.28 per ton. The 48.7 million tons sold in the open market averaged $4.30 per ton, and the 30.7 million tons not sold in the open market averaged $6.84 per ton. Of the total output, 62 million tons was shipped by rail or water, 15.1 million tons by truck, and 2.3 million tons by other means.

There were 891 mines, including 312 underground mines producing 56.5 million tons, 517 strip mines producing 22.0 million tons, and 62 auger mines producing 938,000 tons.

Pennsylvania is divided into two bituminous coal-producing districts. District 1 consists of Bedford, Blair, Bradford, Cambria, Cameron, Centre, Clarion, Clearfield, Clinton, Elk, Forest, Fulton, Huntington, Jefferson, Lycoming, McKean, Mifflin, Potter, Somerset, and Tioga Counties; that part of Armstrong County including mines served by the P. & S. R.R. on the west bank of the Allegheny River, and north of the Conemaugh di-

vision of the Pennsylvania Railroad; that part of Fayette County, including all mines on and east of the line of Indian Creek Valley branch of the Baltimore & Ohio Railroad; that part of Indiana County north of, but excluding the Saltsburg branch of, the Pennsylvania Railroad between, Edri and Blairsville, both exclusive; and that part of Westmoreland County including all mines served by the Pennsylvania Railroad, Torrance, and east. District 2 consists of Allegheny, Beaver, Butler, Greene, Lawrence, Mercer, Venango, and Washington Counties; that part of Armstrong County west of the Allegheny River and exclusive of mines served by the P. & S. R.R.; that part of Indiana County including all mines served on the Saltsburg branch of the Pennsylvania Railroad north of Conemaugh River; Fayette County, except all mines on and east of the line of Indian Creek Valley branch of the Baltimore & Ohio Railroad; and that part of Westmoreland County, including all mines except those served by the Pennsylvania Railroad from Torrance, east. District 1 had 226 underground mines and accounted for 21 million tons, of which 18 million tons was sold in the open market for $4.65 per ton; 220 cutting machines cut 2.9 million tons; 150 mines loaded 20.6 million tons mechanically with 241 continuous miners, 71 mobile loaders (15 of which were used with continuous miners), and 65 hand-loaded face conveyors. District 2 had 86 underground mines accounting for 35.5 million tons of which 8.1 million tons was sold in the open market for $5.05 per ton; 106 machines cut 6.9 million tons and 63 mines loaded 35.5 million tons mechanically with 208 continuous miners, 166 mobile loaders (85 of which were used with continuous miners), and five hand-loaded face conveyors.

Strip mines in district 1 totaled 347 and accounted for 16.4 million tons, almost all of which was sold in the open market for $3.77 per ton. Stripping was accomplished by 449 shovels, 238 draglines (10 of which had over 12 cubic yards of capacity), seven carryall scrapers (two of which had over 12 cubic yards of capacity), 455 bulldozers, 138 drills and 864 trucks. The 170 strip mines in district 2 recovered 5.6 million tons of coal with 178 shovels (two of which had the capacity of over 12 cubic yards), 104 draglines (three of which had over 12 cubic yards of capacity), eight carryall scrapers (four of which had over 12 cubic yards of capacity), 221 bulldozers, 68 power drills, and 365 trucks.

The 50 auger mines in district 1 produced 712,000 tons at an average of $4.17 per ton with 51 augers, seven bulldozers, 10 power drills, and 64 trucks. A total of 12 auger mines in district 2 produced 226,000 tons at $3.79 per ton with 11 augers, two bulldozers, four power drills, and 11 trucks.

Ninety-one preparation plants mechanically cleaned 51.7 million tons of coal, of which 44.6 million tons came from underground mines, 6.9 million tons from strip mines, and 194,000 tons from auger mines; 32.7 million tons was cleaned by wet-washing other than jigs, 10.4 million tons by jigs, and 8.6 million tons by pneumatic methods. Coal was crushed at 189 plants for a total of 38.4 million tons with 63 plants treating 12.4 million tons with calcium chloride, oil, or other materials. Thermal drying was conducted at 13 plants with a total of 18 thermal units drying 6.5 million tons.

During the year 27 fatal and 925 nonfatal lost-time injuries occurred. Of the fatalities, 20 occurred underground (nine from falls of roof, four on haulage, three on machinery, one on electricity, and three from falls of face, side, rib, or pillar) three on the surface (two haulage and one on machinery), and four on strip mines. Injury rates were 0.63 fatal and 21.60 nonfatal per million man-hours exposure and 0.34 fatal and 11.65 nonfatal per million short tons.

Trophy winner in the 1967 Pennsylvania National Safety Competition in the Underground Coal Group was Robena No. 3 mine, United States Steel Corp., for operating 703,906 man-hours without a disabling work injury. Newfield mine, Republic Steel Corp., also received a Certificate of Achievement for its outstanding safety record in the Underground Coal Group in 1967 with 365,861 man-hours worked without a disabling work injury.

Coke and Coal Chemicals.—Oven-coke production totaled 18.4 million tons, a 2-percent decrease from that of 1966. Beehive-coke production totaled 346,000 tons, a 43-percent decrease from that of 1966. Oven-coke had an average value

of $16.05 per ton at the ovens ($0.25 per ton more than in 1966); beehive coke average $14.21 per ton at the ovens ($0.70 per ton more than in 1966). Twelve oven-coke plants carbonized 26.2 million tons of coal and had 70.22 percent yield of coke from coal. Eight beehive-coke plants (one more than in 1966), carbonized 574,000 tons of coal and had 60.19 percent coke yield.

Of the total oven-coke output, producing companies used 16.7 million tons in blast furnaces and 22,000 tons for other purposes and sold 732,000 tons to blast-furnace plants, foundries, other industrial plants, and to retail dealers for residential heating both in and out of the State. Of the total beehive-coke production, 278,000 tons was sold to blast furnaces, 16,000 tons to foundries, and 52,000 tons to other industrial plants. Of the 14.5 million tons of oven and beehive coke distributed in Pennsylvania, 14.1 million tons went to blast-furnace plants, 239,000 tons to foundries, 175,000 tons to other industrial plants, and less than 500 tons for residential heating.

Breeze recovered at coke plants totaled 773,000 tons at an average of $6.46 per ton. Coke breeze yield per tons of coal was 2.94 percent. Of the breeze used by producers 549,000 tons was used in agglomerating plants, 81,000 tons in steam plants, and 94,000 tons for other industrial uses. Breeze sold on the open market totaled 120,000 tons at an average of $7.33 per ton. Stocks of breeze on hand at yearend totaled 210,000 tons.

Coal chemicals produced at the oven-coke plants included 243,000 tons of ammonium sulfate equivalent, 234.3 million gallons of tar, and 76.8 million gallons of crude light-oil, from which were derived 42.5 million gallons of benzene, 10.3 million gallons of toluene, 3.3 million gallons of xylene, and 1.7 million gallons of solvent naphtha.

Natural Gas Liquids.—Production of natural gas liquids totaled 2.9 million gallons of which 1.2 million gallons was natural gasoline and cycle products and 1.7 million gallons was liquefied petroleum (LP) gases and ethane. Natural gasoline and cycle products were listed at 6.6 cents per gallon (5.8 cents in 1966) and LP gases and ethane at 6.5 cents per gallon (same as in 1966). Natural gas processing plants were located in Elk, Venango, Warren, and Greene Counties. Estimated proved recoverable reserves of natural gas liquids totaled 1.2 million (42-gallon) barrels at yearend.

Underground-storage capacity for LP gas was 1.1 million barrels located in four mined granite caverns in Delaware County and a mined shale cavern in Westmoreland County. An inground frozen earth cavity is being constructed in Philadelphia County by Philadelphia Gas Works (completion 1970) with a capacity of 1.2 million barrels.

Peat.—Production of peat totaled 41,560 tons from eight operations located in five counties. Sales totaled 39,500 tons at an average price of $11.06 per ton. Of the total sold, 71 percent was reported as humus; 86 percent was sold in bulk for $11.03 per ton, and 14 percent packaged for $11.25 per ton. Peat producers reported working on deposits totaling 348 acres (average depth of 29 feet) with 2 million tons of reserves. Luzerne County was the leading producer; other counties producing peat were Erie, Lackawanna, Lawrence, and Wayne.

Petroleum and Natural Gas.—Crude oil production totaled 4.4 million 42-gallon barrels, a 1-percent increase over that of 1966. The average price per barrel increased $0.04 to $4.49. The number of producing oil and condensate wells decreased from 48,000 in 1966 to 42,000 in 1967. Estimated proved recoverable reserves of crude oil at yearend totaled 63.3 million barrels, a decrease of 9.1 million barrels from that of yearend 1966. Operating capacity of 13 crude oil refineries totaled 620,500 barrels per calendar day.

Natural gas production totaled 90 billion cubic feet, (Bcf), a 1-percent decrease from that of 1966. Average wellhead value was 28.1 cents per 1,000 cubic feet. Productive gas wells decreased from 17,800 in 1966 to 17,300 in 1967. Estimated proved recoverable reserves of natural gas including underground storage at yearend totaled 1,392 Bcf, an increase of 41 Bcf from that of yearend 1966. Natural gas held in underground reservoirs for storage purposes at yearend 1967 totaled 490 Bcf, a decrease of 11 Bcf. Total natural gas underground reservoir capacity at yearend totaled 696 Bcf.

According to the Oil and Gas Section, Pennsylvania Bureau of Topographic and Geologic Survey, 685 wells were drilled, including 274 oil wells, 271 gas wells, 79 dry holes, 57 service wells, three stratigraph tests, and one miscellaneous test. In addition, 22 wells were deepened, including 21 gas wells and one dry hole. The total footage of all wells drilled was 1,508,211 of which 1,245,324 was development footage, 164,451 was exploratory footage, and 98,436 feet were service-well, stratigraphic, and miscellanous drilling. Of the 624 deep and shallow well completions, 59 wells were exploratory (36 percent successful) and 565 were development (93 percent successful). Total deep footage drilled at 71 deep wells (Middle Devonian or older) was 350,693. Of the 71 deep wells, 61 were gas wells and 10 were dry holes. A total of 41.4 billion cubic feet of natural gas was produced from deep reservoirs. Shallow drilling (Upper Devonian or younger (totaled 614 wells, of which 274 were oil wells, 210 gas wells, 57 service wells, three stratigraphic tests, and 70 dry holes. Of the 274 oil wells, 65 were drilled in areas being waterflooded. Total shallow footage amounted to 1,157,518.

Warren County continued to be the most active oil area with 163 new wells drilled, of which 147 were successful oil wells, producing primarily from the Glade and Clarendon Sandstones and 16 were dry holes. Indiana County continued to be the most active gas area with 131 wells drilled, of which 43 wells were drilled in the Marchand field, and all but one well was successful. The Big Run field in Jefferson, Indiana, and Clearfield Counties had 37 new wells, of which 34 were gas wells and three were dry holes. Seismic crews logged 17 crew-weeks during the year compared with 68 crew-weeks in 1966. The steamflood project which has been active in the Venango "first sand" in the Franklin-Oak Forest field in Venango County during the last 3 years has recently been converted to a waterflood.

NONMETALS

Cement.—Shipments of portland cement were slightly above those of 1966 but the average price per 376-pound barrel decreased $0.01 to $2.85. Shipments of masonry cement decreased 1 percent from those of 1966 while the average price per 280-pound barrel increased $0.05 to $2.71. Portland cement was produced at 22 plants during 1967 which had a total annual production capacity of 50.9 million barrels, a decrease of 4.9 million barrels from that of 1966. Masonry cement was produced at 21 plants during 1967, five more plants than in 1966.

The dividing line between eastern and western Pennsylvania is along the eastern boundaries of Potter, Clinton, Centre, Huntingdon, and Franklin Counties. Portland cement shipments of all types from the five plants in western Pennsylvania totaled 10.6 million barrels at an average price of $3.10 per barrel, of which 91 percent was types I–II (general use and moderate heat), 3 percent was type III (high-early-strength), and 2 percent was portland-pozzolan; 52 percent was shipped to locations in western Pennsylvania, 38 percent to Ohio, and 6 percent to West Virginia. Of the total shipments from western Pennsylvania, 9.3 million barrels was shipped by truck in bulk, 743,000 barrels by truck in containers, 495,000 barrels by railroad in bulk, and 83,000 barrels by railroad in containers.

Portland cement shipments of all types from 17 plants in eastern Pennsylvania totaled 29.6 million barrels at an average price of $2.76 per barrel, of which 90 percent was types I–II, 6 percent type III, and 3 percent white cement; 34 percent was shipped to locations in eastern Pennsylvania, 28 percent to New Jersey, 14 percent to New York, 6 percent to Connecticut, and 6 percent to Maryland. Of the total shipments from eastern Pennsylvania, 15.6 million barrels was by truck in bulk, 9.4 million barrels by railroad in bulk, 3.4 million barrels by truck in containers, and 1.2 million barrels by railroad in containers.

Of the 10.5 million barrels of portland cement produced in western Pennsylvania, 4.9 million barrels was air-entrained; of 29.0 million barrels produced in eastern Pennsylvania, 5.6 million barrels was air-entrained. Portland cement stocks at year-end totaled 1.7 million barrels in western Pennsylvania and 2.9 million barrels in eastern Pennsylvania.

Ready-mixed concrete companies purchased 16.9 million barrels of portland cement shipped from eastern Pennsylvania and 6.4 million barrels from western

Pennsylvania; concrete product manufacturers purchased 6.6 million barrels from the east and 1.4 million barrels from the west, building material dealers purchased 3.1 million barrels from the east and 850,000 barrels from the west, and highway contractors purchased 2.2 million barrels from the east and 1.4 million barrels from the west.

Limestone and cement rock were the chief raw materials used for the manufacture of portland cement, 8.3 million tons in eastern Pennsylvania and 5.7 million tons in western Pennsylvania. Other raw materials include clay, sand, slag, gypsum, fluorspar, iron ore, and mill scale in eastern Pennsylvania and shale, sand, slag, gypsum, iron ore, and mill scale in western Pennsylvania. Eastern Pennsylvania cement plants purchased 677 million kilowatt-hours, western plants 271 million kilowatt-hours.

Prepared masonry cement shipped from 16 plants in eastern Pennsylvania totaled 1.9 million barrels at an average price of $2.62 per barrel, of which 21 percent was shipped to locations in eastern Pennsylvania, 29 percent to New Jersey, 18 percent to New York, 7 percent to Virginia, 6 percent to Maryland, 5 percent to Connecticut, and 5 percent to the District of Columbia. Shipments of prepared masonry cement from western Pennsylvania totaled 1 million barrels at $2.90 per barrel, of which 52 percent was shipped to locations in western Pennsylvania, 38 percent to Ohio, 4 percent to West Virginia, and 4 percent to Michigan.

The leading portland cement producer was Northampton County with 44 percent of the total production, followed by Lehigh County with 16 percent of the total. Other counties producing cement were Allegheny, Butler, and Lawrence in the west, and Berks, Montgomery, and York in the east. Northampton County was also the leading masonry cement producer with 30 percent of the total production.

Clays.—Total production of clays (excluding kaolin) decreased 9 percent in tonnage and 2 percent in value from that of 1966. Fire clay accounted for 48 percent of the total production, decreasing 11 percent in tonnage and increasing 5 percent in value over that of 1966. Miscellaneous clay and shale accounted for the remaining 52 percent of the total, decreasing 7 percent in tonnage and 13 percent in value from that of 1966.

Table 6.—Clays sold or used by producers, by kinds and uses [1]

(Short tons)

Use	Fire clay		Miscellaneous clay	
	1966	1967	1966	1967
Refractories:				
Firebrick and block	738,262	623,661	----------	----------
Fire clay mortar	W	W	----------	----------
Heavy clay products	627,370	556,018	1,404,763	1,343,447
Portland and other hydraulic cements	----------	----------	227,120	W
Undistributed	[2] 254,609	[2] 255,547	[3] 40,990	[3] 215,418
Total	1,620,241	1,435,226	1,672,873	1,558,865

W Withheld to avoid disclosing individual company confidential data.

[1] Excludes kaolin.

[2] Includes exports, art pottery, floor and wall tile, high-alumina brick, mortar, clay crucibles, foundries and steelworks (bulk), other refractories, insecticides and fungicides, other filler, absorbent uses (1966), and other uses (1966).

[3] Includes art pottery, flowerpots, and glaze slip; floor and wall tile; foundries and steelworks (bulk); lightweight aggregate; portland hydraulic cements (1967), and linoleum and oil cloth.

Clearfield County was the leading clay producer, followed by Lawrence, Beaver, and Berks Counties. Of the total fire clay produced, 43 percent was used for firebrick and block and 39 percent for building brick and other heavy clay products. Of the total miscellaneous clay and shale produced, 86 percent was used for building brick and other heavy clay products and 8 percent for portland and other hydraulic cements.

Kaolin was produced in Blair County

for firebrick and block and in Cumberland County for white cement.

Gem Stones.—Mineral specimens were collected chiefly by hobbyists and amateur lapidarists at scattered locations throughout the State.

Gypsum.—A gypsum-calcining plant was operated at Philadelphia using both domestic and imported crude gypsum.

Iodine.—One company in Lebanon County and one company in Washington County consumed crude iodine in the production of both inorganic and organic compounds.

Iron-Oxide Pigments.—Crude iron-oxide pigments were mined in the form of sulfur mud in Cambria County and extracted in the form of red iron oxide during the processing of bauxite to alumina in Allegheny County. Finished iron-oxide pigments were produced and shipped from two plants in Northampton County and one plant in Carbon County. Finished pigments included natural and manufactured black, brown, red, and yellow pigments, and mixtures of natural and manufactured red iron oxides.

Lime.—Production of lime (quicklime and hydrated lime) increased 8 percent in tonnage and value from that of 1966. Of the total production, 85 percent was quicklime and 15 percent hydrated lime. The average price per ton of quicklime increased from $13.86 to $14 while that of hydrated lime decreased from $16.92 to $16.44 per ton. The chemical and other industrial markets consumed 78 percent of the total lime production with the remaining 22 percent being distributed among refractory, agricultural, and construction markets. Sixteen plants were operated in 14 counties with Centre County ranking first in production with three large plants producing quicklime and hydrated lime accounting for 45 percent of the total lime tonnage and 39 percent of the total value. Of the 16 plants, three plants sold only quicklime, three plants sold only hydrated lime, one plant used quicklime, and nine plants sold and used quicklime and hydrated lime. Regenerated quicklime was consumed at a pulp and paper plant in Blair County. Of the total lime sold, 60 percent was consumed in Pennsylvania, 6 percent in New York, 7 percent in Ohio, and 5 percent in New Jersey. The remainder was shipped to 16 other States, or exported.

Mica.—Crude scrap mica was produced at a mine in York County. The processed mica was used in paint, roofing, rubber (mold lubricant), insulation (electric), welding rods, and textile coating. After the company changed hands on July 1, 1967, production stopped because the new owners, Micalith Mining Co., Inc., were installing new equipment.

Perlite (Expanded).—Crude perlite from out-of-State sources was expanded at one plant each in Allegheny, Delaware, Lehigh, Montgomery, and York Counties. The Panacalite Perlite Co., previously operating in Allegheny County discontinued business as of December 30, 1966. Lehigh County continued to lead the State in expanded perlite production, which was used chiefly for building plaster with substantial amounts for loose fill insulation, concrete aggregate, soil conditioning, fines, cryogenic applications, and other uses.

Pyrites.—Pyrite concentrate was recovered by flotation in the milling process for magnetite iron ore in Berks and Lebanon Counties. The concentrate was then shipped to Sparrows Point, Md., for further processing.

Sand and Gravel.—Production of commercial sand and gravel decreased slightly in tonnage from that of 1966, but the value was virtually the same. Of the total commercial sand and gravel output, 50 percent was sand for construction (building, paving, fill, and other uses), 42 percent was gravel for construction (building, paving, railroad ballast, fill, and other uses), and 7 percent was unground sand for industrial uses (glass, molding, grinding and polishing, blast, fire or furnace, engine, and other uses). A small amount of ground sand was used for abrasives, chemicals, filler, glass, pottery, porcelain, tile, foundry, and other uses.

Bucks County was again the leading producing county, followed by Erie, Armstrong, Wyoming, and Westmoreland Counties. Production was reported in 42 counties by 115 operations, of which almost 56 percent produced less than 100,000 tons each for 14 percent of the total tonnage; 21 percent of the operations produced be-

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Molding	185	$526	157	$461
Building	5,228	7,698	4,855	7,424
Paving	3,362	5,183	3,678	5,636
Fire or furnace	87	270	71	223
Fill	20	19	24	20
Undistributed [1]	1,490	5,054	1,292	4,336
Total	10,372	18,750	10,077	18,100
Gravel:				
Building	3,005	4,346	2,562	4,141
Paving	3,522	5,758	4,147	6,639
Fill	328	163	343	214
Undistributed [2]	292	472	298	441
Total	7,147	10,739	7,350	11,435
Total sand and gravel	17,519	29,489	17,427	29,535
Government-and-contractor operations:				
Sand:				
Paving	7	10	--------	--------
Other	------	--------	52	79
Gravel:				
Other	41	63	--------	--------
Total sand and gravel	48	73	52	79
All operations:				
Sand	10,379	18,760	10,129	18,179
Gravel	7,188	10,802	7,350	11,435
Grand total	17,567	29,562	17,479	29,614

[1] Includes glass, grinding and polishing, blast, engine, ground, and other sand.
[2] Includes railroad ballast, miscellaneous, and other gravel.

tween 100,000 and 200,000 tons each for 21 percent of the total tonnage; 20 percent of the operations produced between 200,000 and 500,000 tons each for 39 percent of the total tonnage; almost 3 percent of the operations produced between 500,000 and 1 million tons each for 11 percent of the total tonnage; and less than 1 percent of the operations produced over 1 million tons each for 15 percent of the total tonnage.

Of the total production, 98 percent was processed; 75 percent was trucked to markets, and the balance was transported by railroads and waterways.

Operations receiving Certificates of Achievement for outstanding safety records in the Sand and Gravel Pit Group of the 1967 Pennsylvania National Saftey Competition were Seidle Sand and Gravel, Inc., with 30,508 man-hours without a disabling work injury; Houdaille Construction Materials, Inc., with 28,355 man-hours; Tionesta Sand & Gravel, Inc., with 27,644 man-hours; Mahoning Valley Sand Co., with 24,413 man-hours; Shippingport Sand & Gravel Co., with 23,426 man-hours; and Atlas Sand and Gravel, Inc., with 22,854 man-hours. The General Concrete Products Corp., received a Certificate of Achievement in the Sand and Gravel Dredge Group with 30,246 man-hours without a disabling work injury.

Sericite-Schist.—Crude sericite-schist was produced from two mines in Adams County and processed for use as a carrier in insecticides, and as a filler in asphalt, enamel coating, and joint cement.

Stone.—Production of stone increased 2 percent in total tonnage and 4 percent in total value from that of 1966. Crushed stone totaled 60 million tons of which 84 percent was limestone, 7 percent basalt, 5 percent sandstone, and the remaining 4 percent granite, miscellaneous stone, and slate. Crushed stone was used for the fol-

lowing purposes: Concrete aggregate and roadstone (61 percent), furnace flux (10 percent), agricultural purposes (2 percent), railroad ballast (1 percent), and for other uses (26 percent) including cement and lime manufacture, riprap, and limestone dust for coal mines.

Dimension stone decreased 13 percent in tonnage but increased 13 percent in value over that of 1966 due to the greater value per ton placed on such items as blackboards, structural and sanitary ware, roofing slate, and building stone. Slate accounted for 31 percent of the dimension stone and 67 percent of its value with sandstone accounting for almost 50 percent of the tonnage and only a little less than 25 percent of the value. Northampton County was the leading stone producer in the State, followed by Montgomery, Adams, Centre, York, Lancaster, and Berks Counties.

Table 8.—Stone sold or used by producers, by uses

Use	1966		1967	
	Short tons	Value	Short tons	Value
Dimension stone:				
Building stone	108,023	$1,471,731	86,350	$1,417,097
Curbing and flagging	39,672	803,210	33,824	1,158,002
Other uses [1]	27,233	3,424,837	31,418	3,838,439
Total	174,928	5,699,778	151,592	6,413,538
Crushed and broken stone:				
Riprap	261,867	460,348	247,948	355,600
Concrete and roadstone	34,341,170	49,371,631	36,883,375	52,584,930
Furnace flux (limestone)	6,300,021	12,063,633	5,789,922	11,392,163
Railroad ballast	620,375	931,310	743,072	1,170,000
Agricultural	1,266,862	3,865,644	1,109,837	3,414,179
Other uses [2]	16,122,396	26,840,487	15,229.644	27,826,926
Total	58,912,691	93,533,053	60,003,798	96,743,798
Grand total	59,087,619	99,232,831	60,155,390	103,157,336

[1] Includes roofing slate and millstock.
[2] Includes refractory.

Table 9.—Stone sold or used by producers, by counties [1]

Counties	1966		1967	
	Short tons	Value	Short tons	Value
Allegheny, Clarion, Washington	505,685	$1,016,852	623,025	$1,267,141
Armstrong	374,865	783,240	443,466	926,233
Bedford, Franklin, Fulton	2,008,284	3,374,442	1,881,679	3,014,799
Berks	4,193,398	5,156,998	3,594,171	4,755,658
Blair	1,548,793	2,413,892	1,523,130	1,840,225
Bradford	622	14,130	----------	----------
Bucks	3,359,514	4,429,945	3,228,622	4,397,743
Butler	1,545,155	2,836,619	1,617,615	2,965,425
Cambria	13,000	29,750	W	W
Carbon, Monroe, Schuylkill	1,001,854	2,215,703	842,200	2,058,510
Centre	2,735,923	4,405,167	3,955,433	5,911,462
Chester	2,390,644	4,910,888	2,056,913	3,886,961
Clinton, Lycoming, Union	1,271,793	1,831,907	W	W
Cumberland	1,022,042	1,493,026	1,036,395	1,658,776
Dauphin	944,610	1,550,200	1,000,641	1,616,784
Elk, McKean, Potter	63,799	249,773	58,033	227,107
Fayette, Somerset	1,543,745	3,272,849	1,421,753	3,131,353
Jefferson	15,959	65,337	W	W
Lancaster	3,970,226	5,422,535	3,644,319	5,205,261
Lawrence	2,959,272	4,513,284	W	W
Lebanon	1,903,329	3,317,489	1,726,918	3,068,707
Lehigh	2,644,281	2,783,264	2,376,877	2,644,290
Luzerne	496,652	757,054	618,695	862,302
Mifflin, Snyder	460,357	650,542	620,758	810,185
Montgomery	4,896,509	8,552,323	5,374,449	8,908,142
Northampton	5,783,588	9,116,035	5,737,419	9,442,866
Northumberland	68,840	111,840	70,300	112,800
Susquehanna	184,710	483,622	W	W
Wayne	123,329	263,696	W	W
Westmoreland	683,264	1,164,874	1,440,369	2,825,337
York	3,734,221	7,625,364	3,772,434	8,281,017
Other counties [2]	6,639,356	14,420,191	11,489,776	23,338,252
Total	59,087,619	99,232,831	60,155,390	103,157,336

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Excludes counties with no stone production.
[2] Includes Adams, Columbia, Delaware, Huntingdon, Mercer, Montour, Perry, and Wyoming Counties and data indicated by symbol W.

Trophy winner in the 1967 Pennsylvania National Safety Competition in the Quarry Group was the Annville plant, Bethlehem Mines Corp. for operating 468,188 man-hours without a disabling work injury. Other operations competing in the Quarry Group received Certificates of Achievement for their outstanding safety record. The top runnerup was the Hanover quarry, Bethlehem Steel Corp. with 359,776 man-hours without a disabling work injury, followed by Charmian quarry, General Aniline & Film Corp. with 205,232 man-hours, and Hillsville quarry, United States Steel Corp. with 196,442 man-hours.

Sulfur.—Two refineries recovered sulfur in Delaware County, one using the Claus-type process and the other using single-stage catalytic oxidation of hydrogen sulfide. In Philadelphia County, one refinery recovered hydrogen sulfide by the Girdler system using diethanolamine and monethanolamine and molten sulfur by the improved Claus-type process, another refinery recovered sulfur by the Claus process.

Tripoli. (Rottenstone).—Tripoli was mined and processed by two companies in Lycoming County for use as an abrasive compound and filler material.

Vermiculite (Exfoliated).—Crude vermiculite was processed at two plants, one in Bucks County and one in Lawrence County, and the exfoliated product was sold for various uses, chiefly for insulation, concrete aggregate, and agriculture.

METALS

Cadmium.—Cadmium production decreased considerably from that of 1966. Cadmium was recovered by St. Joseph Lead Co. at its Josephtown plant in Beaver County and by The New Jersey Zinc Co. at its Palmerton plant in Carbon County.

Cobalt.—The cobalt content of pyrite concentrate shipments from the magnetic iron ore mines in Berks and Lebanon Counties showed a slight decrease from that of 1966.

Copper, Gold, and Silver.—Copper concentrate was recovered by flotation of magnetite iron ore mined in Lebanon County and shipped to western refineries for processing. The concentrate also contained gold and silver.

Ferroalloys.—Producers of ferroalloys in 1967 by type of product and furnace were ferromanganese by blast furnace, Bethlehem Steel Co. at Bethlehem, E. J. Lavino & Co. at Sheridan, and United States Steel Corp. at Clairton and Duquesne; ferromolybdenum by aluminothermic furnace, Climax Molybdenum Co. at Langeloth, and Molybdenum Corporation of America at Washington which also used electric furnaces; ferrocolumbium, Kawecki Chemical Co. at Easton; spiegeleisen by electric furnace, The New Jersey Zinc Co. at Palmerton; ferroboron, ferrocolumbium, ferrovanadium, ferromolybdenum, and nickel columbium by aluminothermic furnace, Reading Alloys Co., Inc. at Robesonia.

Iron Ore.—Usable iron ore production and shipments decreased 5 percent in quantity and 9 percent in value from those of 1966. Shipments were in the form of pellets produced at agglomerating plants located at the magnetite mines in Berks and Lebanon Counties. Crude magnetite was mined underground by block-caving methods. Most of the iron ore pellets were shipped to company-owned iron and steel plants in the State and in Maryland.

Iron and Steel.—Pig iron production totaled 20.5 million tons, of which 92 percent was basic pig iron, and the remainder Bessemer, malleable, foundry, and direct castings pig iron.

Receipts of iron ore totaled 26.8 million tons, 68 percent from foreign countries and 32 percent from domestic sources. Consumption of iron ore totaled 24.7 million tons, 53 percent by agglomerating plants, 41 percent by blast furnaces, and the remainder by steel furnaces. Iron ore stock at beginning of the year was 11.3 million tons and 12.2 million tons at yearend. Fluxes consumed by the iron and steel industry included 2.9 million tons of limestone, 2.5 million tons of dolomite, and 927,000 tons of other type fluxes. Other materials consumed included 1.6 million tons of mill cinder and roll scale, 889,000 tons of raw flue dust, 1.2 million tons of steel furnace slag, 13 million tons of coke, 336,000 tons of coke breeze, and 383,000 tons of anthracite. Steel furnaces consumed 19.8 million tons of pig iron and hot metal and 10.5 million tons of home and purchased scrap. Blast furnaces consumed 752,000 tons of home and purchased scrap,

290,000 tons of slag scrap, and 75,000 tons of pig iron and hot metal.

Agglomerates consumed in blast furnaces totaled 21.5 million tons, of which 55 percent was U.S. sinter (regular) and the remaining 45 percent was iron ore pellets (regular), semifluxing and self-fluxing sinter, and agglomerated foreign iron ore. Agglomerates consumed in steel furnaces totaled 266,000 tons, of which most were iron ore pellets (regular). Slag produced at blast furnaces totaled 5.9 million tons, scrap produced 159,000 tons, and flue dust recovered 825,000 tons.

Nine companies with 20 plants operated 46 blast furnaces at some time during the year, compared with 51 blast furnaces in 1966.

According to the American Iron and Steel Institute, steel production (ingots and steel for castings) totaled 29.9 million tons, of which 20.9 million tons were from open hearth and Bessemer, 5.9 million tons from basic oxygen process, and 3.2 million tons from electric furnaces. Production of hot-rolled steel products totaled 21.1 million tons, merchant bars and light shapes 2.4 million tons, concrete reinforcing bars 872,000 tons, wire rods 732,000 tons, and blanks, tube rounds or pierced billets for seamless tubing 1.7 million ton.

Zinc.—Production of zinc ore (based on the recoverable zinc metal tonnage) increased 25 percent over that of 1966, although unit value decreased. The zinc ore was concentrated at the mine in Lehigh County and the concentrates were shipped to the company's smelter in Carbon County.

Smelters—Zinc concentrates were shipped to smelters at Josephtown in Beaver County and Palmerton in Carbon County. Zinc concentrates shipped to the Josephtown smelter came from New York, Missouri, Illinois, and Tennessee, and from Canada, and Peru. Zinc concentrates and crude ore and residues shipped to the Palmerton smelter came from New Jersey, New York, Pennsylvania, Tennessee, Indiana, Virginia, Colorado, and several foreign countries. Products from the Josephtown smelter included zinc metal lead-free zinc oxide, cadmium metal, and sulfuric acid, which were used in such consumer items as galvanized ware, die castings, and brass in the case of zinc, paint, rubber, ceramics, and pharmaceuticals in the case of zinc oxide, and protective coatings, bearings and atomic uses in the case of cadmium. Products from the Palmerton smelter included slab zinc, zinc base die casting alloys, zinc oxide, rolled zinc, dry-battery shells, cadmium, and spiegeleisen.

Table 10.—Principal producers

Commodity and company	Type of activity	County	Address
Abrasives:			
Nonmetallic:			
Satellite Alloy Corp	Plant	Allegheny	9800 McKnight Rd. Pittsburgh, Pa.
Metallic:			
Abrasive Metals Co	Plant	----do	26th and B.&O. RR Pittsburgh, Pa.
Durastel Abrasive Co	----do	Westmoreland	2601 Smallman St. Pittsburgh, Pa.
Industeel Corp	----do	Allegheny	37th and A.V. RR Pittsburgh, Pa.
The Pangborn Corp., Roto-blast Abrasive Division.	----do	Butler	P.O. Box 280 Hagerstown, Md.
Clay and shale:			
Fire clay:			
C. Brant Mining Co	Open Cut	Somerset	R.D. 3 Somerset, Pa.
Continental Clay Products Co.	Underground	Armstrong	Kittanning, Pa.
Drexel Refractories	----do	----do	P.O. Box 50 Kittanning, Pa.
Eastvale Clay Products Co	----do	Beaver	Box 681 Beaver Falls, Pa.
Falls Creek Refractories Co	Open cut	Clearfield	Falls Creek, Pa.
Freeport Brick Co	Underground	Armstrong	Drawer F. Freeport, Pa.
Freeport Brick Co., Kittanning Brick Division.	----do	----do	R.D. 1 Adrian, Pa.
General Refractories Co	Open cut	Somerset	1520 Locust St. Philadelphia, Pa.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Clay and shale—Continued			
Fire—Continued			
Hanley Co	Underground	Jefferson	28 Kennedy St. Bradford, Pa.
Harbison-Walker Refractories Co.	do	Armstrong	2 Gateway Center Pittsburgh, Pa.
Do	Open cut	Cambria	Do.
Do	do	Clearfield	Do.
Do	Underground	do	Do.
Do	Open cut	Fayette	Do.
Kaiser Refractories, Division of Kaiser Aluminum & Chemical Corp.	Strip	do	P.O. Box 363 Frostburg, Md.
Narvon Mines Ltd	Open cut	Lancaster	Narvon, Pa.
The Negley Fire Clay Co	do	Lawrence	Box 264 New Galilee, Pa.
Standard Clay Manufacturing Co.	Underground	Beaver	Box 98 New Brighton, Pa.
Hiram Swank's Sons, Inc	Open cut	Clearfield	P.O. Drawer 630 Johnstown, Pa.
Ralph A. Veon, Inc	do	Lawrence	Darlington, Pa.
Kaolin:			
Grannas Brothers	Open cut	Blair	R.D. 2, Box 399 Hollidaysburg, Pa.
The Philadelphia Clay Co	do	Cumberland	236 West North St. Carlisle, Pa.
Miscellaneous:			
American Vitrified Products Co.	Open cut	Clearfield	700 National City Bank Building Cleveland, Ohio
Fenati Brick Co., Inc	do	Lawrence	New Castle, Pa.
Glen-Gery Shale Brick Corp	do	Berks	227 North 5th St. Reading, Pa.
Do	do	Dauphin	Do.
Do	do	Lancaster	Do.
Do	do	Northumberland	Do.
Do	do	York	Do.
Hanley Co	do	McKean	28 Kennedy St. Bradford, Pa.
Logan Clay Products Co. Worthington Ceramics Division.	do	Armstrong	Worthington, Pa.
McAvoy Vitrified Brick Co	do	Chester	Phoenixville, Pa.
Medusa Portland Cement Co	do	Lawrence	P.O. Box 5668 Cleveland, Ohio
Milliken Brick Co., Inc	do	Allegheny	2100 Montier St. Pittsburgh, Pa.
Quakertown Brick & Tile Co., Inc.	do	Bucks	Quakertown, Pa.
The Robinson Clay Product Co.	do	Montgomery	65 West State St. Akron, Ohio
Triangle Clay Products Co	do	Cambria	Sheridan St. Johnstown, Pa.
Universal Atlas Cement Division United States Steel Corp.	do	Monroe	Chatham Center Box 2969 Pittsburgh, Pa.
Watsontown Brick Co	do	Northumberland	Watsontown, Pa.
Cement:			
Allentown Portland Cement Co	Plant	Berks	7th St. at Thruway Allentown, Pa.
Do	do	Montgomery	Do.
Bessemer Cement Co., Division of Diamond Shamrock Corp.	do	Lawrence	800 Stambaugh Bldg. Youngstown, Ohio
Coplay Cement Manufacturing Co.	do	Lehigh	North 2d St. Coplay, Pa.
G. & W. H. Corson, Inc	do	Montgomery	Plymouth Meeting, Pa.
Dragon Cement Co., Division of Martin Marietta Corp.	do	Northampton	5A Joyce Kilmer Ave. New Brunswick, N.J.
Giant Portland Cement Co	do	Lehigh	1500 Chestnut St. Philadelphia, Pa.
Green Bag Cement Co., Division of Marquette Cement Manufacturing Co.	do	Allegheny	20 N. Wacker Dr. Chicago, Ill.
Hercules Cement Co., Division of American Cement Corp.	do	Northampton	555 City Line Ave. Bala-Cynwyd, Pa.
Keystone Portland Cement Co	do	do	1400 South Penn Square Philadelphia, Pa.
Lehigh Portland Cement Co	do	Lehigh	718 Hamilton St. Allentown, Pa.
Lone Star Cement Corp	do	Northampton	P.O. Box 6237 Richmond, Va.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Cement—Continued			
Medusa Portland Cement Co	Plant	Lawrence	P.O. Box 5668 Cleveland, Ohio
Do	----do	York	Do.
National Portland Cement Co	----do	Northampton	170 East Post Rd. White Plains, N.Y.
Nazareth Cement Co	----do	do	Easton Rd. Nazareth, Pa.
Penn-Dixie Cement Corp	Plant	Butler	P.O. Box 152 Nazareth, Pa.
Do	----do	Northampton	Do.
Universal Atlas Cement Division United States Steel Corp.	----do	Allegheny	Chatham Center Pittsburgh, Pa.
Do	----do	Northampton	Do.
The Whitehall Cement Manufacturing Co.	----do	Lehigh	123 South Broad St. Philadelphia, Pa.
Coal:			
Anthracite:			
Blue Coal Corp	Strip mine	Luzerne	101 South Main St. Ashley, Pa.
Carbondale Coal Co., Inc	----do	Lackawanna	78 Cottage St. Carbondale, Pa.
Gangloff Brothers	Bank operation	Northumberland	New Ringgold, Pa.
Glen Nan Coal Co., Inc	Deep mine	Luzerne	Wilkes Barre, Pa.
Greenwood Stripping Corp	Stripmine	Schuylkill	One Venice St. Nesquehoning Pa.
Honeybrook Mines, Inc	----do	----do	109 East 1st St. Hazleton, Pa.
Jeddo-Highland Coal Co	----do	Luzerne	800 Exeter Ave. West Pittston, Pa.
Kerris & Helfrick, Inc	----do	Northumberland	Lehigh & Poplar St. Mount Carmel, Pa.
Lehigh Valley Anthracite, Inc	----do	Columbia	800 Exeter Ave. West Pittston, Pa.
Do	----do	Schuylkill	Do.
George Racho	Bank operation	Luzerne	371 Church St. Hazleton, Pa.
Reading Anthractie Co	Strip mine	Northumberland	200 Mahantango St. Pottsville, Pa.
State Coal Co., Inc	Bank operation	----do	109 E. 1st St. Hazleton, Pa.
Bituminous:			
Barnes & Tucker Co	Underground	Cambria	357 Lancaster Ave. Haverford, Pa.
Do	----do	Indiana	Do.
Bethlehem Mines Corp. [1]	----do	Cambria	701 E. 3rd St. Bethlehem, Pa.
Do [1]	----do	Washington	Do.
Buckeye Coal Co	----do	Greene	P.O. Box 900 Youngstown, Ohio
Gateway Coal Co. for J & L	----do	----do	Box 608 California, Pa.
Harmar Coal Co	----do	Allegheny	Box 500 Library, Pa.
Jones & Laughlin Steel Corp	----do	Greene	Box 608 California, Pa.
Mathies Coal Co	----do	Washington	Box 500 Library, Pa.
Pittsburgh Coal Co	----do	----do	Do.
United States Steel Corp	----do	Greene	525 Wm. Penn Place Pittsburgh, Pa.
Graphite (synthetic):			
Stackpole Carbon Co	Plant	Elk	St. Marys, Pa.
Gypsum (calcined):			
United States Gypsum Co.[2]	----do	Philadelphia	101 South Wacker Dr. Chicago, Ill.
Iron Ore:			
Bethlehem Mines Corp.[3]	Underground	Berks	Bethlehem, Pa.
Do.[4]	----do	Lebanon	Do.
Iron oxide pigments:			
Crude:			
Allegheny Ludlum Steel Corp	Plant	Allegheny	2000 Oliver Bldg. Pittsburgh, Pa.
Lanzendorfer Minerals Co	Open pit	Cambria	Twin Rocks, Pa.
Finished:			
Minerals, Pigments, & Metals Division Chas. Pfizer & Co., Inc.	Plant	Northampton	640 North 13th St. Easton, Pa.
The Prince Manufacturing Co	----do	Carbon	Bowmanstown, Pa.
Reichard-Coulston, Inc	----do	Northampton	15 East 26th St. New York, N.Y.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Lime:			
Primary:			
Baker Stone Co	Plant	Columbia	R.D. 5 Bloomsburg, Pa.
The J. E. Baker Co	do	York	P.O. Box 1189 York, Pa.
Bethlehem Mines Corp	do	Adams	701 East 3rd St. Bethlehem, Pa.
Do	do	Lebanon	Do.
G. & W. H. Corson, Inc	do	Montgomery	Plymouth Meeting, Pa.
Mercer Lime & Stone Co	do	Butler	Branchton, Pa.
National Gypsum Co	do	Centre	325 Delaware Ave. Buffalo, N.Y.
Standard Lime & Refrac. Co., Division Martin Marietta Corp.	do	do	2000 First National Bank Building Baltimore, Md.
Warner Co	do	do	1721 Arch St. Philadelphia, Pa.
Do	do	Chester	Do.
Regenerated:			
West Virginia Pulp & Paper Co.	Plant	Blair	Tyrone, Pa.
Mica (crude):			
General Mining Associates	Pit	York	700 Cathedral St. Baltimore, Md.
Peat:			
Blue Ridge Soil Pep Co	Bog	Luzerne	R.D. 2 White Haven, Pa.
D. M. Boyd Co	do	Lawrence	226 Francis St. New Wilmington, Pa.
Corry Peat Products Co	Bog	Erie	515 West Columbus Ave. Corry, Pa.
Lake Linda Peat Co., Inc	do	Lackawanna	Dalton, Pa.
Pennsylvania Peat Moss, Inc	do	Luzerne	21st & Laurel Sts. Hazelton, Pa.
Stillers Blue Ridge Peat Co	do	do	R.D. White Haven, Pa.
Wayne Peat Humus Co	do	Wayne	P.O. Box 315 Gouldsboro, Pa.
Welker Greenhouses, Inc	do	Lawrence	New Castle, Pa.
Perlite (expanded):			
Insul-Fil Manufacturing Co	Plant	Delaware	Box 325 Primos, Pa.
Pennsylvania Perlite Corp	do	Lehigh	P.O. Box 2002 Lehigh Valley, Pa.
Do	do	York	Do.
Perlite Manufacturing Co	do	Allegheny	P.O. Box 478 Carnegie, Pa.
Refractory & Insulation Co	do	Montgomery	Port Kennedy, Pa.
Petroleum refineries:			
Atlantic Richfield Co	Plant	Philadelphia	
Franklin Refinery, Division of Sonneborn Sons, Inc.	do	Venango	
Gulf Oil Corp	do	Erie	
Kendall Refining Co., Division of Witco Chemical Co.	do	McKean	
Pennsylvania Refining Co	Plant	Butler	
Pennzoil Company	do	Venango	
Quaker State Oil Refining Corp	do	McKean	
Do	do	Venango	
Sinclair Refining Co	do	Delaware	
Sun Oil Company	do	do	
United Refining Co	do	Warren	
Valvoline Oil Co., Division of Ashland Oil and Refining Co.	do	Beaver	
Wolf's Head Oil Refining Co., Inc	do	Venango	
Sand and gravel:			
Davison Sand & Gravel Co	Dredge	Westmoreland	3rd Ave. & 4th St. New Kensington, Pa.
Emlenton Limestone Co	Pit	Armstrong	Box 67 Emlenton, Pa.
Erie Sand Steamship Co	Dredge	Erie	Erie, Pa.
Glacial Sand & Gravel Co	Pit	Armstrong	P.O. Box 10 Kittanning, Pa.
Do	do	Clarion	Do.
Lycoming Silica Sand Co	do	Lycoming	401 Broad St. Box 159 Montoursville, Pa.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Sand and gravel—Continued			
Mt. Cydonia Sand Co., Inc	Pit	Franklin	R.D. 1 Fayetteville, Pa.
Oil City Sand & Gravel Co	----do	Venango	Wyllis & Front Sts. Oil City, Pa.
Pennsylvania Glass Sand Corp	----do	Huntingdon	Hancock, W. Va.
Do	----do	Mifflin	Do.
Pennsy Supply, Inc	----do	York	1001 Paxton St. Harrisburg, Pa.
State Aggregates, Inc	----do	Bradford	635 Lucknow Lane Harrisburg, Pa.
The Liberty Corp	Dredge	Philadelphia	No. 2 Penn Center Plaza Philadelphia, Pa.
Tionesta Sand & Gravel, Inc	Pit	Forest	Hawthorne, Pa.
Warner Co	----do	Bucks	1721 Arch St. Philadelphia, Pa.
Wyoming Sand & Stone Co	----do	Wyoming	Falls, Pa.
Smelters (zinc):			
The New Jersey Zinc Co	Plant	Carbon	Palmerton, Pa.
St. Joseph Lead Co	----do	Beaver	Josephtown, Pa.
Stone:			
Basalt (crushed):			
Bradford Hills Quarries, Inc	Quarry	Berks	Box 231 Easton, Pa.
Bucks County Crushed Stone, Inc,	----do	Bucks	Ottsville, Pa.
V. Di Francesco & Sons	----do	Chester	17 Mifflin Ave. Havertown, Pa.
Do	----do	Delaware	Do.
The John T. Dyer Quarry Co	Quarry	Berks	Box 188 Birdsboro, Pa.
Faylor Lime & Stone Co	----do	Dauphin	Winfield, Pa.
General Aniline & Film Corp. The Ruberoid Division.	----do	Adams	140 West 51st St. New York, N.Y.
The General Crushed Stone Co.	----do	Bucks	712 Drake Bldg. Easton, Pa.
Do	----do	Delaware	Do.
Vernon B. Horn	----do	Bucks	R.D. Chalfont, Pa.
Keystone Trappe Rock Co	----do	Chester	Glenmoore, Pa.
Kibblehouse Quarries, Inc	----do	Montgomery	Perkiomenville, Pa.
Montgomery Stone Co., Inc	----do	----do	Montgomeryville, Pa.
Pottstown Trap Rock Quarries, Inc.	----do	Berks	R.D. 1 Douglasville, Pa.
Do	----do	Montgomery	Do.
Tohickon Quarry Co	----do	Bucks	Quakertown, Pa.
Basalt (Dimension):			
Coopersburg Granite Co	----do	Bucks	Coopersburg, Pa.
French Creek Granite Co	----do	Chester	St. Peters, Pa.
Montgomery Stone Co., Inc. [5]	----do	Montgomery	Montgomeryville, Pa.
Granite (crushed):			
Mignatti Constr. Co., Inc	----do	----do	2310 Terwood Ave. Bethayres, Pa.
Granite (dimension):			
Carl Galantino, Inc	Quarry	Delaware	42 Hirst Ave. E. Lansdowne, Pa.
Marcolina Bros., Inc	----do	Montgomery	133 E. Mermaid Lane Chestnut Hill, Pa.
Limestone (crushed):			
Appalachian Stone Division Martin Marietta Corp.	Quarry	Fayette	Box 120 Mercersburg, Pa.
The J. E. Baker Co	----do	York	P.O. Box 1189 York, Pa.
Bethlehem Mines Corp	----do	Adams	701 E. 3rd St Bethlehem, Pa.
Do	----do	Lebanon	Do.
Do	----do	Montgomery	Do.
Bradford Hills Quarries, Inc	----do	Chester	Box 231 Easton, Pa.
G. & W. H. Corson, Inc	----do	Montgomery	Plymouth Meeting, Pa.
Eureka Stone Quarry, Inc	----do	Bucks	Lower State and Pickertown Rds. Eureka, Pa.
National Gypsum Co	Underground	Centre	325 Delaware Ave. Buffalo, N.Y.
Do	Quarry	York	Do.
New Hope Crushed Stone & Lime Co.	----do	Bucks	New Hope, Pa.
Nittany Materials, Inc	----do	Centre	P.O. Box 138 State College, Pa.
Thomasville Stone & Lime Co	Underground and quarry.	York	Thomasville, Pa.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Stone—Continued			
Limetone crushed—Continued			
Warner Company	Underground	Centre	1721 Arch St. Philadelphia, Pa.
United States Steel Corp	Quarry	Lawrence	Hillsville, Pa.
Miscellaneous (crushed):			
Better Materials Corp	----do	Bucks	Route 232 & Swamp Rd. Penns Park, Pa.
Gill Quarries, Inc	----do	----do	P.O. Box 187 Fairview Village, Pa.
Do	----do	Montgomery	Do.
M & M Stone Co	----do	----do	Harleysville, Pa.
Miscellaneous (dimension):			
Burdo & Burdo	----do	Montgomery	29 Washington Ave. Belmont Heights Philadelphia, Pa.
F. Cantono & Sons	----do	Delaware	1749 Rowan St. Philadelphia, Pa.
Di Bonaventura Quarries, Inc.	----do	----do	4989 W. Thompson St. Philadelphia, Pa.
Oystershell (crushed):			
Reading Poultry Food Co	Plant	Berks	Orrton & Noble Sts. Reading, Pa.
Sandstone (crushed):			
American Asphalt Paving Co.	Quarry	Luzerne	Box 95, R. D. 5 Shavertown, Pa.
Connellsville Bluestone Co	----do	Fayette	Box 20 Scottdale, Pa.
Coolbaugh Sand & Stone, Inc	----do	Luzerne	32 Railroad Ave. Scranton, Pa.
Detwilers Industries, Inc	----do	Bedford	New Enterprise, Pa.
Eidemiller Enterprises, Inc	----do	Westmoreland	Greensburg, Pa.
Hall's Bluestone, Inc	----do	----do	Murrysville, Pa.
Harbison Walker Refractories Co.	----do	Huntingdon	2 Gateway Center Pittsburgh, Pa.
Do	----do	Schuylkill	Do.
Latrobe Construction Co	Underground	Westmoreland	P.O. Box 150 Latrobe, Pa.
North American Refractories Co.	Quarry	Carbon	6th Street Bldg. Cleveland, Ohio
Do	----do	Huntingdon	Do.
No. 1 Contracting Corp. of Delaware.	----do	Luzerne	Box 460 Pittston, Pa.
Do	----do	Northampton	Do.
Summit Quarries, Inc	----do	Schuylkill	P.O. Box 637 Pottsville, Pa.
Wayne Crushed Stone, Inc	----do	Wayne	Lake Ariel, Pa.
Sandstone (dimension):			
Delaware Quarries	----do	Bucks	Lumberville, Pa.
Firestone Products Co., Inc	----do	Montgomery	300 Willow Grove Ave. Glenside, Pa.
Lynn's Quarry	----do	Westmoreland	R.D. 3 Belle Vernon, Pa.
Media Quarry Co	----do	Delaware	131 E. 2d St. Media, Pa.
Mitchell Stone Co	----do	Susquehanna	Box 133 Springville, Pa.
Penn Kress Flagstone Co., Inc.	----do	Potter	Bridge St. Pittsburgh, Pa.
Powers Bros, Quarries	----do	Susquehanna	R.D. 5 Montrose, Pa.
J. G. Robinson, Inc	----do	Wyoming	P.O. Box 6 Fort Washington, Pa.
Paul Tompkins Estate	----do	Wayne	Hancock, N.Y.
Valley Forge Building Stone	----do	Chester	P.O. Box 195 Morgantown, Pa.
Slate (crushed):			
General Aniline & Film Corp. The Ruberoid Div.	----do	York	140 West 51st St. New York, N.Y.
Keystone Filler & Manfacturing Co.	----do	Lycoming	Muncy, Pa.
North Bangor Slate Co	----do	Northampton	Bangor, Pa.
Pennsylvania Lightweight Aggregate, Inc.	Plant	----do	Do.
Slate (dimension):			
Albion Vein Slate Co	Quarry	----do	Do.
Capitol Slate Co., Inc	----do	----do	P.O. Box 281 East Bangor, Pa.
Anthony Dally & Sons, Inc	----do	----do	Robinson Ave. Pen Argyl, Pa.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Stone—Continued			
Slate (dimension)—Continued			
Diamond Slate Co	Quarry	Northampton	P.O. Box 598 Pen Argyl, Pa.
Doney Slate Co	----do	----do	Pen Argyl, Pa.
Emerald Slate Corp	----do	----do	Alpha Road Wind Gap, Pa.
North Bangor Slate Co	----do	----do	Bangor, Pa.
Penn Big Bed Slate Co., Inc	----do	Lehigh	446 Main St. Slatington, Pa.
Stephens-Jackson Co	----do	Northampton	Main St. and Schanck Ave. Pen Argyl, Pa.
D. Stoddard & Sons, Inc	----do	----do	Bangor, Pa.
Sulfur:			
Atlantic Richfield Co.[7]	Plant	Philadelphia	260 S. Broad St. Philadelphia, Pa.
Gulf Oil Corp.[8]	----do	----do	P.O. Box 7408 Philadelphia, Pa.
Sinclair Refining Co	----do	Delaware	600 Fifth Ave. New York, N.Y.
Sun Oil Co	----do	----do	1608 Walnut St. Philadelphia, Pa.
Talc (sericite schist):			
Summit Industries, Inc.[9]	Pit	Adams	Drawer C Aspers, Pa.
Tripoli (rottenstone):			
Keystone Filler & Manufacturing Co.	----do	Lycoming	Muncy, Pa.
Penn Paint & Filler Co	----do	----do	Antes Fort, Pa.
Vermiculite (exfoliated):			
Hyzer & Lewellen	Plant	Bucks	P.O. Box 155 Southampton, Pa.
Zonolite Division, W. R. Grace & Co.	----do	Lawrence	62 Whittemore Ave. Cambridge, Mass.
Zinc:			
The New Jersey Zinc Co.[10]	Underground	Lehigh	160 Front St. New York, N.Y.

[1] 3 mines.
[2] Also expanded perlite.
[3] Also byproduct cobalt and pyrites.
[4] Also byproduct gold, silver, copper, cobalt, and pyrites.
[5] Also crushed basalt.
[6] Also a quarry in Somerset.
[7] Byproduct recovered in gas purification.
[8] Byproduct gas purification.
[9] 2 mines.
[10] Also byproduct limestone.

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 Minereralogy and Geology Section, Industrial Research, Economic Development Administration, Commonwealth of Puerto Rico, for collecting information on all minerals.

By Harry F. Robertson,[1] José F. Cadilla,[2] and Roy Y. Ashizawa [3]

PUERTO RICO [4]

Mineral production value in Puerto Rico reached a record high of $63 million. Increased construction activity was directly responsible because cement, sand and gravel, and stone accounted for most of the value.

[1] Supervisory mining engineer, Bureau of Mines, Bartlesville, Okla.
[2] Director, Program of Geology and Mineral Resources, Administration De Fomento Economico, Commonwealth of Puerto Rico.
[3] Mineral specialist, Bureau of Mines, San Francisco, Calif.
[4] Prepared by Harry F. Robertson and José F. Cadilla.

Table 1.—Mineral production in Puerto Rico [1]

Mineral		1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Cement	thousand 376-pound barrels	7,603	$24,277	8,447	$27,397
Clays	thousand short tons	350	271	291	244
Lime	do.	30	960	35	1,106
Salt	do.	11	183	12	195
Sand and gravel	do.	9,879	14,554	14,101	21,633
Stone	do.	5,732	10,541	7,269	12,795
Total		XX	50,786	XX	63,370
Total 1957–59 constant dollars		XX	49,207	XX	61,815

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

Senatorial district	1966	1967	Minerals produced in 1967, in order of value
Aguadilla	$1,481,400	$1,583,050	Stone, sand and gravel.
Arecibo	1,303,750	1,424,000	Do.
Guayama	2,725,250	4,697,900	Sand and gravel, stone.
Humacao	999,300	993,400	Stone, sand and gravel.
Mayaguez	3,059,522	4,112,511	Sand and gravel, stone, salt.
Ponce	17,345,659	22,107,874	Cement, sand and gravel, stone, lime, clay.
San Juan	23,871,119	28,451,265	Cement, sand and gravel, stone, clay.
Total	50,786,000	63,370,000	

The Puerto Rico Water Resources Authority was considering the Yabucoa area on the southeast corner of the Island as the site for a 500,000-kilowatt-per-day nuclear powerplant. Electric power requirements were increasing most rapidly in that area with the growth of industry. A seawater desalting plant may be included in the project.

Negotiations relating to the proposed copper mining in the Utuado-Lares-Adjuntas area continued. The Puerto Rico Economic Development Administration (PREDA) considered different versions of a suitable contract to mine the copper resource with minimal air, land, and water pollution.

The Geologic Division of the U.S. Geological Survey, working under a cooperative agreement with PREDA, mapped 7½-minute quadrangles at various locations on the Island as part of the program of preparing geologic maps and advising the Puerto Rican Government on geologic problems. Reports were published on the geology of the Quebradillas, Corozal, and Utuado quadrangles[5] and the stratigraphy of west-central Puerto Rico.[6]

The Water Resources Division of the U.S. Geological Survey, in cooperation with the Commonwealth of Puerto Rico, conducted water resource investigations in various areas of the Island. A map delineating the boundaries of record floods at Humacao was published.[7]

A study of minerals on the ocean floor around Puerto Rico was planned as a joint project by the Federal Geological Survey and the Commonwealth Government. The study will begin by sampling the ocean floor in Mona Passage south and west of the Island.

The Soils and Geology Division of the Puerto Rican Department of Public Works continued work on reports of construction material resources in the Rio Grande, Barceloneta, and Arecibo quadrangles. Responsibility for continuing the series of reports was assigned to the Highway Authority.

REVIEW BY MINERAL COMMODITIES

Nonmetals.—*Cement.*—Increased shipments of portland cement followed the upward trend of the construction industry. Domestic production gained while imported cement—principally from Colombia, Belgium, and Japan—decreased to 555,000 barrels.

[5] Monroe, W. H. Geologic map of the Quebradillas Quadrangle, Puerto Rico. Miscellaneous Geological Investigations Map No. I-498. U.S. Geol. Survey, 1967. Nelson, Arthur E. Geologic map of the Corozal Quadrangle, Puerto Rico. Miscellaneous Geological Investigations Map No. I-473. U. S. Geol. Survey, 1967. Nelson, Arthur E. Geologic map of the Utuado Quadrangle, Puerto Rico. Miscellaneous Geological Investigations Map No. I-480, U.S. Geol. Survey, 1967.

[6] Mattson, P. H. Cretaceous and lower Tertiary stratigraphy in west-central Puerto Rico. U.S. Geol. Survey Bull. 1254-B, 1967, 35 pp.

[7] Lopez, M. A. Floods at Humacao, Puerto Rico. Hydrologic Investigations Atlas No. HA-245. U.S. Geol. Survey, 1967.

Table 3.—Portland cement production and shipments

Year	Production (376-pound barrels)	Shipments		
		376-pound barrels	Value	
			Thousands	Average per barrel
1963	7,171,302	7,217,417	$22,090	$3.06
1964	7,910,624	7,925,781	23,879	3.01
1965	7,268,773	7,284,219	23,415	3.21
1966	8,071,343	7,602,641	24,277	3.19
1967	7,963,096	8,446,616	27,397	3.24

The Puerto Rican Cement Co. installed a new dust control system at its Ponce plant in a continuing effort to reduce air pollution. Electrostatic precipitators designed to eliminate 98 percent of the dust were installed in the smokestacks.

Clay.—Most of the clay production was used in making cement. Sandy clay, used for fill on various construction projects, was not included as mineral production. The value of land in Puerto Rico permits usage of pit-run fill selling for as much as $1 per cubic meter.

Diazlite, Inc. operated its lightweight aggregate plant near Trujillo Alto, and Puerto Rico Ceramics Corp. mined clay near Caguas for making hollow structural tile.

Lime.—Puerto Rican Cement Co., Inc., processed limestone into quicklime and hydrated lime at Ponce. Most of the hydrated lime was used as mason's lime in construction work. Other uses for the quicklime and hydrated lime were for steel (electric furnaces), soil conditioning, sugar refining, leather tanning, and water purification and softening.

Salt.—Evaporated salt was recovered from ponds and processed by Ponce Salt Industries, Carlos Ramirez, and other producers along the southwest coast. Users of the salt included nearby chemical plants and seafood processors and canners.

Sand and Gravel.—The gain in construction activities accounted for a corresponding increase in concrete aggregates. The greatest increases were in highway construction and industrial facilities such as petrochemical plants. Silica sand from inland beds west of San Juan was used in the nearby cement and glass plants, in foundries, in sandblasting, and in marble polishing. Puerto Rico Glass Corp. used white, high-grade silica sand in making bottles and jars.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,409	$4,495	3,065	$5,982
Paving	1,884	2,130	2,360	3,249
Fill	634	547	960	817
Total	4,927	7,172	6,385	10,048
Gravel:				
Building	2,245	4,074	2,779	5,108
Paving	1,214	1,934	3,006	4,428
Fill	458	381	577	490
Total	3,917	6,389	6,362	10,026
Total sand and gravel	8,844	13,561	12,747	20,074
Government-and-contractor operations:				
Sand:				
Building	------	--------	8	15
Paving	279	303	413	604
Fill	586	539	485	410
Total	865	842	906	1,029
Gravel:				
Building	------	--------	9	13
Paving	27	36	265	371
Fill	143	115	174	146
Total	170	151	448	530
Total sand and gravel	1,035	993	1,354	[1]1,558
Grand total	9,879	14,554	14,101	[1]21,633

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

Stone.—Andesite, tuffaceous siltstone, and miscellaneous volcanic stone were produced in all districts except Arecibo. Granite was produced in Humacao and Guayama Districts, and limestone was produced in all districts. Crushed limestone, used principally in making cement, comprised 77 percent of the total stone output. The limestone was quarried near the cement plants at Ponce and San Juan. Crushed marble was used in making terrazzo.

Table 5.—Stone sold or used by producers

(Thousand short tons and thousand dollars)

Year	Dimension limestone		Crushed limestone [1]		Miscellaneous stone [2]		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1963	65	$152	3,918	$5,306	1,351	$2,779	5,334	$8,237
1964	75	191	4,347	6,009	1,082	2,386	5,504	8,586
1965	74	180	4,236	6,607	1,034	2,324	5,344	9,111
1966	88	231	4,416	7,555	1,228	2,755	5,732	10,541
1967	101	293	5,578	8,767	1,590	3,735	7,269	12,795

[1] Includes limestone for cement and lime.
[2] Includes granite, marble, and miscellaneous stone.

Mineral Fuels.—Crude and unfinished oil imported from Venezuela and the Netherlands Antilles averaged 157,500 barrels per day, up 5 percent from the 1966 total. The oils were refined at the Cataño plant of Caribbean Gulf Refining Corp. and the Guayanilla plant of Commonwealth Oil Refining Co.

Phillips Puerto Rico Core, Inc. began construction of an orthoxylene plant at Guayama. Annual capacity of the plant, scheduled for completion in late 1968, will be 120 million pounds. Feedstock for the new plant will be mixed xylenes from the new chemical facilities of the company.

Union Carbide Caribe announced plans to build an olefins plant near its core plant at Peñuelas. The new plant will produce more than 1 billion pounds of ethylene and propylene gases, "building blocks" in the petrochemical process. Commonwealth Oil Refining Co. and Phillips Puerto Rico Core would supply some of the raw materials, with the bulk coming from Venezuela.

Metals.—Industrial Siderúrgica, Inc. produced various sizes of steel reinforcing rods for concrete construction at its steel mill near Cataño. Domestic and imported iron and steel scrap was melted in two 20-ton electric furnaces.

Contract revisions were being considered pertaining to the proposed mining, concentrating, smelting, and refining Puerto Rican copper ores. Ponce Mining Co., Cobre Caribe, and PREDA continued negotiations.

Renewed interest was reported in nickel and cobalt-bearing rocks in western Puerto Rico.

PANAMA CANAL ZONE [8]

The overall value of mineral production in the Panama Canal Zone remained at about the same level as that of 1966. Sand and gravel and stone used as construction aggregates comprised the entire mineral output.

VIRGIN ISLANDS [9]

Basalt was mined and crushed for concrete aggregate, roadstone, and riprap.

A new water desalting plant, described as the world's largest, was being constructed by Baldwin-Lima-Hamilton Corp. on St. Thomas. The complex will convert Caribbean sea water to 2.5 million gallons of fresh water daily for the municipal water district of Charlotte Amalie, principal city of St. Thomas. The unit will consist of a 41-stage flash distillation facility with a 15,500-kilowatt powerplant and will augment production of two existing desalting units on St. Thomas. Completion was scheduled for mid-1968.

The alumina plant of Harvey Aluminum, Inc., on St. Croix was in operation during the year. Imported bauxite was processed.

[8] Prepared by Harry F. Robertson.
[9] Prepared by Harry F. Robertson.

Table 6.—Mineral production in the Panama Canal Zone and Virgin Islands [1]

Mineral	1966		1967	
	Short tons	Value	Short tons	Value
Canal Zone:				
Sand and gravel	72,000	$91,000	56,000	$94,000
Stone [2]	113,520	266,685	100,476	245,010
Total	XX	357,685	XX	339,010
Total 1957–59 constant dollars	XX	348,961	XX	330,741
Virgin Islands:				
Stone (basalt)	87,541	303,358	182,974	850,906
Total 1957–59 constant dollars	XX	295,959	XX	830,152

XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Includes basalt.

The U.S. Department of the Interior approved a plant by Hess Oil and Chemical Corp. to establish a petrochemical complex on St. Croix, to be built in conjunction with a refinery. Hess operates on St. Croix and will export to the mainland a maximum of 15,000 barrels of finished products per day.

PACIFIC ISLAND POSSESSIONS [10]

REVIEW BY ISLANDS

American Samoa.—Beach sand, basalt rock, coral, and volcanic cinders were produced by crews of the Government of American Samoa for use in various building and paving projects. A rock crusher and concrete and asphalt batch plants were operated at the Tafuna Public Works Compound. Production of volcanic cinders increased during 1967 after tests proved it to be an economical substitute for basalt rock which had to be drilled and blasted. Cinder aggregate was used in about 80 percent of the concrete and concrete products and for all of the asphalt paving.

Table 7.—Mineral production in the Pacific Island Possessions

Area and mineral	1966		1967	
	Short tons	Value	Short tons	Value
American Samoa:				
Pumice (volcanic cinder)	16,580	$21,816	27,899	$23,714
Sand	20,000	18,000	7,000	7,000
Stone (crushed)	11,860	11,860	28,306	49,536
Total	XX	51,676	XX	80,250
Guam: Stone (crushed)	899,849	1,396,203	511,517	820,407
Wake: Stone (crushed)	11,638	66,500	31,500	150,000

XX Not applicable.

Guam.—Crushed coral limestone and coral fines were processed by commercial producers and government construction crews and used as base material and concrete aggregate. Much of the year's total output was consumed in building roads for residential subdivisions and in construction of typhoon-resistant homes.

Wake.—Fingerlike coral was dredged at Wake Island and processed in a 300-ton-per-day portable crusher. The crushed coral aggregate was used in several construction projects, the largest of which was the addition of a new taxiway paralleling the existing airfield runway.

Other Pacific Island Possessions.—No mineral production was reported on the islands of Canton, Enderbury, Jarvis, Johnston, Midway, and Palmyra. The National Aeronautics and Space Administration closed its small Gemini tracking station on Canton. Mineral material requirements for construction and rehabilitation projects on Johnston and Midway were obtained from stockpiles of previously quarried coral or supplied by contractors from Hawaii and the U.S. mainland.

TRUST TERRITORY OF THE PACIFIC ISLANDS [11]

The Trust Territory of the Pacific Islands consists of more than 2,100 islands and atolls in the Western Pacific, scattered over an ocean area roughly the size of the continental United States. Mineral production was confined to the quarrying of volcanic rock and coral used mainly for construction of medical and educational buildings, housing units, and maintenance of roads. Although deposits of phosphate rock and bauxite exist on several of the islands, neither of these minerals was mined during 1967. Inhabitants continued to oppose large-scale mining operations, fearing that such operations might contaminate ground water and destroy land used for subsistence farming.

[10] Prepared by Roy Y. Ashizawa.
[11] Prepared by Roy Y. Ashizawa.

The Mineral Industry of Rhode Island

By Meherwan C. Irani [1]

Sand and gravel, stone, and miscellaneous gem stone specimens accounted for the total mineral production in Rhode Island in 1967. Value of sand and gravel accounted for 60 percent of the total; miscellaneous stone, dimension granite, and crushed limestone contributed most of the remainder.

Producers of sand and gravel, in aggregate, reported a slight increase in output from 1966. Stone producers reported a decrease of 10 percent in quantity and 7 percent in value from the previous year.

[1] Metallurgist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Value of mineral production in Rhode Island, by counties [1]

(Thousands)

County	1966	1967	Minerals produced in 1967, in order of value
Kent	W	W	Sand and gravel.
Newport	$28	$52	Sand and gravel, stone.
Providence	2,086	1,900	Stone, sand and gravel.
Washington	W	W	Do.
Undistributed [2]	1,833	2,083	
Total	3,947	4,035	
Total in 1957–59 constant dollars	3,825	p 3,937	

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

		1966	1967 p	Change (percent)
Personal income: [1]				
Total	millions	$2,730	$2,914	+6.7
Per capita		$3,047	$3,328	+9.2
Construction activity:				
Building permits		110	118	+7.3
Contract construction awards [2]	millions	$234	$235	+.4
Residential	do	$83	$74	−10.9
Nonresidential	do	$88	$87	−1.1
Public works and utilities	do	$63	$74	+17.5
Cement shipments to Rhode Island	thousand 376-pound barrels	1,169	1,225	+4.8
Mineral production	thousands	$3,947	$4,035	+2.2
Annual average labor force and employment: [3]				
Civilian work force	do	379.3	387.8	+2.2
Total civilian employment	do	365.2	373.2	+2.2
Manufacturing	do	129.6	127.2	−1.9
Durable goods	do	52.2	50.2	−3.8
Nondurable goods	do	77.4	77.0	−.5

p Preliminary.
[1] Bureau of Census, U.S. Department of Commerce.
[2] F. W. Dodge Co., Division of McGraw-Hill, Inc.
[3] Bureau of Employment Security, U.S. Department of Labor.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Sand and gravel	167	190	32	252	--	2	7.92	812
Stone	61	239	15	127	--	4	31.61	1,636
Total	228	203	46	379	----	6	15.83	1,087
1967: p								
Sand and gravel	205	191	39	312	--	3	9.60	189
Stone	45	234	11	98	--	4	41.02	728
Total	250	199	50	410	--	7	17.08	317

p Preliminary.

REVIEW BY MINERAL COMMODITIES

Gem Stones.—Miscellaneous gem stone specimens recovered included actinolite, agate, fluorescent calcite, and pegmatite minerals. Most of the minerals were collected from mine dumps and quarries at various sites, located chiefly in the northern part of the State.

Sand and Gravel.—Sand and gravel continued to be the principal mineral produced in the State. Total production was 2.3 million short tons, about the same as in 1966, but slightly higher in value. Kent County accounted for more than half of the output and replaced Providence County as the largest producer of sand and gravel in the State. Washington and Newport Counties produced only small quantities. Production was reported by 15 companies, one less than in 1966, all with stationary processing plants. Seventy-six percent was washed and screened.

Sand accounted for 38 percent of tonnage and 35 percent of value of the total sand and gravel produced. A total of 884,000 tons of sand was sold in 1967 compared with 921,000 tons in 1966. About 49 percent of the production was used for building purposes, 33 percent for paving, and the remainder for drainage, ice control, foundry sand, etc. The average value per short ton increased from $0.94 in 1966 to $0.95 in 1967. Values ranged from $0.98 to $1 for building and paving sand to $0.42 for fill. Most of the sand for building and paving use was processed. Virtually all the sand was shipped by truck.

Gravel production was 1.5 million tons, compared with 1.4 million tons in 1966. The gravel was chiefly used for building, paving, highway construction, and fill. Average value of gravel, f.o.b. plant, was $1.09 per ton, compared with $1 per ton in 1966. Price range for washed gravel was $1.21 to $1.34 per ton, and unprocessed gravel was $0.53 per ton. Transportation to consumer was mainly by truck.

Stone.—The output of stone was 481,000 tons, compared with 535,000 tons in 1966. The total value was $1.6 million, compared with $1.7 million in 1966. Dimension granite was quarried in Washington County. Crushed limestone, miscellaneous stone consisting of granitized schist, and a small quantity of dimension limestone were produced in Providence County. Crushed limestone was used as fertilizer filler; miscellaneous stone was used for concrete aggregate, riprap, and roadstone. Newport County produced some crushed miscellaneous stone for use as concrete aggregate.

Table 4.—Principal producers

Commodity and company	Type of activity	County	Address
Petroleum: Mobil Oil Co	Refinery	Providence	
Sand and gravel:			
A. Cardi Construction Co., Inc	Pit	Kent	451 Arnold Rd., Coventry, R.I.
Forte Brothers, Inc	do	Providence	14 Whipple St., Berkeley, R.I.
Lapham Sand & Gravel Co	do	do	R.F.D. 2, Greenville Rd., Woonsocket, R.I.
Rhode Island Sand & Gravel Co., Inc	do	Kent	Kilvert St., Hillsgrove, R.I.
South County Sand & Gravel Co., Inc	do	Washington	North Rd., Peace Dale, R.I.
Luigi Vallone, Inc	do	Kent	420 Bald Hill Rd., Apponaug, R.I.
Stone:			
Granite, dimension:			
Providence Granite Co	Quarry	Washington	210 Kingsley Ave., Providence, R.I.
Westerly Granite Corp	do	do	Westerly, R.I.
Limestone, crushed: The Conklin Limestone Co., Inc.[1]	do	Providence	R.F.D. 1, Lincoln, R.I.
Miscellaneous stone, crushed:			
M. A. Gammino Construction Co	do	do	875 Phenix Ave., Cranston, R.I.
Peckham Brothers Co., Inc	do	Newport	Paradise Ave., Newport, R.I.

[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 Henry S. Johnson, Jr.[2]

Mineral production value in 1967 increased $2.7 million over that of 1966, setting a new record of $48.3 million. The gain was due mainly to increased production of masonry and portland cement, kaolin, feldspar, peat, crushed limestone, and crushed and dimension granite.

Record production was reported for masonry and portland cement, kaolin, crushed limestone and crushed granite. Leading mineral producers in South Carolina were Giant Portland Cement Co. (cement, miscellaneous clay, and crushed limestone), Campbell Limestone Co. (crushed granite and crushed limestone), Becker County Sand & Gravel Co. (sand and gravel), J. M. Huber Corp. (kaolin), Santee Portland Cement Co. (cement, miscellaneous clay, and crushed limestone), and Palmetto Quarries Co. (crushed granite).

South Carolina continued to rank second among the States in the production of kaolin, kyanite, and vermiculite.

Business activity in the State expanded in 1967, generally paralleling the Nation's economic growth. Although both the total work force and unemployment rose, the total number employed remained constant. Total personal income advanced 6 percent, compared with an increase of 6.9 percent for the Nation. Per capita income increased 5.6 percent to $2,167, but was below the national average of $3,137 for 1967. Construction activity rose 25 percent, reflecting the high performance level of the South Carolina

[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]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays thousand short tons	2,139	$8,830	1,733	$8,048
Sand and gravel do	6,016	7,668	5,248	7,178
Stone do	8,129	12,510	8,310	[2] 12,366
Value of items that cannot be disclosed: Barite (1966), cement, feldspar, kyanite, scrap mica, peat, pyrite, stone (dimension granite 1967), and vermiculite	XX	16,585	XX	20,682
Total	XX	45,593	XX	48,274
Total 1957–59 constant dollars	XX	[r] 43,910	XX	[p] 46,652

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

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

County	1966	1967	Minerals produced in 1967 in order of value
Aiken	W	$6,678,451	Kaolin, sand and gravel.
Cherokee	$1,216,150	1,275,400	Limestone, miscellaneous clay, sand and gravel.
Chesterfield	129,000	W	Sand and gravel.
Colleton	W	W	Peat.
Dorchester	W	W	Cement, limestone, sand and gravel, miscellaneous clay.
Edgefield	W	W	Miscellaneous clay.
Fairfield	W	W	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	929,624	660,839	Sand and gravel, granite, kaolin, miscellaneous clay.
Lancaster	W	599,997	Mica, sand and gravel, miscellaneous clay.
Laurens	W	W	Vermiculite.
Lexington	W	W	Granite, kaolin, miscellaneous clay, sand and gravel.
Marion	170,000	W	Miscellaneous clay, sand and gravel.
Marlboro	W	W	Sand and gravel, miscellaneous clay.
Orangeburg	W	W	Cement, limestone, miscellaneous clay.
Pickens	W	W	Granite, sand and gravel.
Richland	W	W	Granite, kaolin, miscellaneous clay, sand and gravel.
Spartanburg	W	W	Granite, feldspar, sand and gravel.
Sumter	W	W	Sand and gravel, kaolin, miscellaneous clay.
York	W	W	Kyanite, pyrites.
Undistributed	43,148,226	39,059,313	
[3] Total	45,593,000	48,274,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] The following counties are not listed because no production was reported: Abbeville, Allendale, Anderson, Bamberg, Barnwell, Beaufort, Berkeley, Calhoun, Charleston, Chester, Clarendon, Darlington, Dillon, Georgetown, Hampton, Lee, McCormick, Newberry, Oconee, Saluda, Union, and Williamsburg.

Table 3.—Selected indicators of South Carolina business activity

	1966	1967	Change, percent
Personal income:			
Total—millions	$5,310	$5,631	+6.0
Per capita	$2,052	$2,167	+5.6
Construction activity:			
Total construction projects—thousands	14.7	18.3	+24.5
State Highway Department:			
Value of contracts, construction awards—millions	$61.8	$64.9	+5.0
Cash receipts from farm marketings—do	$396.5	$414.7	+4.5
Mineral production—do	$45.6	$48.3	+6.0
Annual average work force and employment:			
Total work force—thousands	997.4	1,002.4	+.5
Unemployment—do	41.8	46.9	+12.2
All employment—do	955.6	955.5	−.001
Wage and salary employment:			
Mining—do	1.7	1.7	0.0
Contract construction—do	48.5	47.6	−1.9
Manufacturing—do	313.9	319.4	+1.8
Transportation, communications, and public utilities—thousands	30.3	31.5	+4.0
Trade—do	120.6	123.5	+2.4
Finance, insurance and real estate—do	24.7	25.9	+4.9
Services—do	74.2	74.8	+.8
Government—do	121.0	128.4	+6.1

Sources: S. C. Employment Security Commission, S. C. State Highway Department, U. S. Department of Commerce, U. S. Bureau of Mines.

economy during most of the year. Mineral production value rose 6 percent, an increase comparable with other marketed products and the general growth of the State's economy.

Government Programs.—The Division of Geology, State Development Board,[3]

[3] Johnson, H. S., Jr., Geologic Activities in South Carolina During 1967. Geologic Notes. Division of Geology, State Development Board, v. 12, No. 1, April 1968, pp. 1–8.

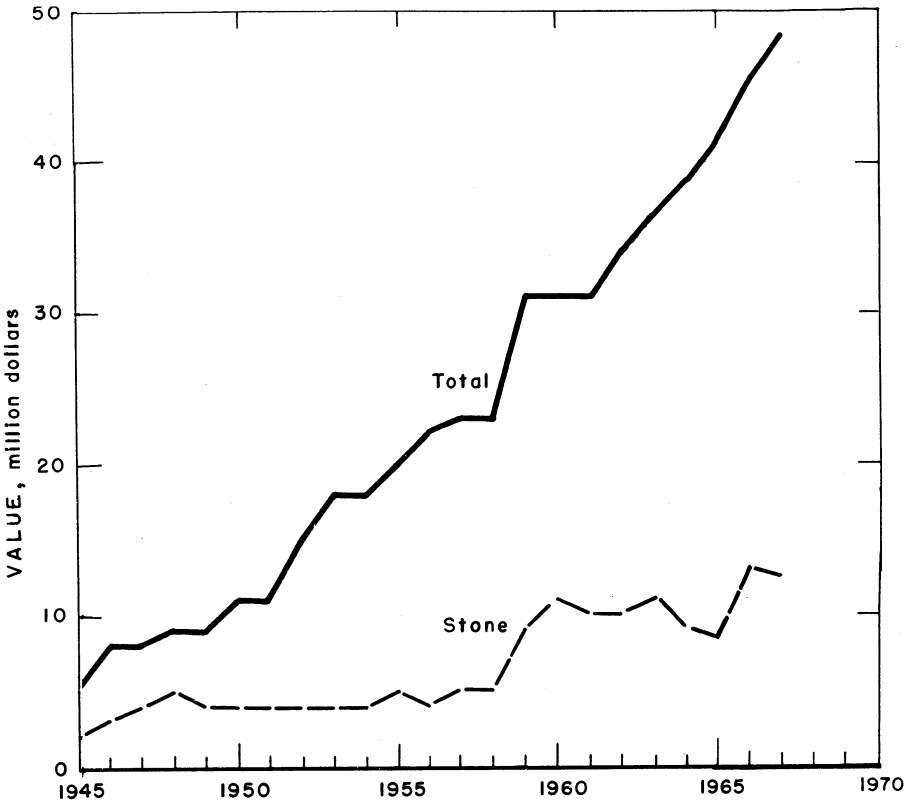

Figure 1.—Value of stone, and total value of mineral production in South Carolina.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1966:								
Nonmetal and peat	952	265	253	2,073	----	48	23.16	501
Sand and gravel	391	250	98	793	----	17	21.44	518
Stone	817	256	209	1,712	----	28	16.35	7,759
Total [1]	2,160	259	559	4,578	----	93	20.31	3,219
1967: [p]								
Nonmetal and peat	1,005	250	251	2,008	----	35	17.43	2,655
Sand and gravel	385	246	94	769	----	14	18.22	403
Stone	840	268	225	1,870	1	42	23.00	3,582
Total	2,230	256	570	4,647	1	91	19.80	2,656

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

continued its basic studies of the geology and mineral resources in Edgefield, McCormick, Newberry, Oconee, Orangeburg, and Pickens Counties. At yearend, 19 projects were active, and 11 reports were published. Geologic mapping was in progress on the following 7½-minute quadrangles: Sumter West, Irmo NE, Wampee, Myrtle Beach (15 minute), James Island, Lake View, Winnsboro (15 minute), Dongola, Dovesville, Tamassee, Owdoms, Fair Play, Holly Springs, Whetstone, Old Pickens, Seneca, and Walhalla.

Reports published by the Division of Geology during 1967 were as follows: "Heavy Minerals in South Carolina," Bulletin 35; "Geology of the Eutawville Quadrangle, South Carolina," MS–12; "Geology of the Six Mile Quadrangle, South Carolina," MS–14; and "Geologic Notes," Volume 10, Number 4, and Volume 11, Numbers 1, 2, and 3. Other activities reported included the magnetometer surveys of mafic volcanics and iron-bearing quartzite beds and a sampling program of bedload sediments along the Lynches River drainage system. It was also reported that nine other investigations were in progress or recently completed by the Department of Geology, University of South Carolina.

At yearend, 372 miles, or 55 percent, of the State's total designated Interstate Highway System was open to traffic. Work was in progress on the remaining 310 miles.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Barite.—Industrial Minerals, Inc., located at Kings Creek, Cherokee County, ground imported barite for use as a rubber filler.

Cement.—Two companies, Giant Portland Cement Co., near Harleyville, Dorchester County, and Santee Portland Cement Corp., near Holly Hill, Orangeburg County, produced cement in South Carolina. Record production was established for both masonry and portland cement. Masonry cement shipments increased 13 percent, and value increased 15 percent. Portland cement increased 27 percent in output and 29 percent in value. The cement industry in South Carolina has shown continued substantial yearly growth since 1957, the first year of production.

Clays.—Clay production in 1967 accounted for 17 percent of the State's total mineral value. South Carolina continued to rank second among the States in kaolin production; output increased slightly, but value declined 6 percent from 1966. Ten companies operated 20 mines in five counties during 1967; leading counties were Aiken and Richland. Six companies operated 11 mines in Aiken County, and three companies operated four mines in Richland County. Leading producers in Aiken County were J. M. Huber Corp., Dixie Clay Co., National Kaolin Products Corp., Southeastern Clay Co., Cyprus Mines Corp., and Bell Kaolin Co. Richland County producers were Eastern Brick & Tile Co., D. T. Duncan, and Columbia Pipe Co. Kaolin was used primarily as rubber filler and in the manufacture of paper, paint, fertilizers, whiteware, saggers, insecticides, firebrick, and plaster.

Miscellaneous clay production decreased 25 percent in quantity to 1.2 million tons, and 23 percent in value, to $1.1 million, from 1966 figures. Fourteen companies operated 18 mines in 14 counties; leading counties were Cherokee, Dorchester, Greenwood, and Richland. Miscellaneous clay was used principally in the manufacture of cement, brick, drain tile, and sewer pipe.

Feldspar.—Spartan Minerals Co. continued production of a feldspar-silica mixture from the granite fines at the Campbell Limestone Co. Pacolet quarry in Spartanburg County. The material was ground and shipped out of State for use as a rubber filler and in the manufacture of glass and pottery.

Kyanite.—Commercialores, Inc., continued production of kyanite at the Henry Knob mine in York County. The material was used in the manufacture of refractories.

Lime.—Regenerated or recirculated lime was produced by four companies for use in paper manufacture and pulp processing. Production in 1967 was 314,000 tons

Table 5.—Kaolin sold or used by producers, by uses

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Rubber	235,311	$2,843,792	$12.09	261,974	$3,832,652	$14.63
Firebrick and block	51,471	449,500	8.73	10,291	115,387	11.21
Insecticides and fungicides	18,751	233,000	12.43	W	W	W
Architectural terracotta	3,702	26,700	7.21	W	W	W
Other uses [1]	229,191	3,880,800	16.93	268,170	3,022,432	11.27
Total	538,426	7,433,792	13.81	540,435	6,970,471	12.90

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."
[1] Includes whiteware, stoneware (1967), floor and wall tile (1967), foundries and steelworks, kiln furniture other refractories (1967), paper filling and coating, linoleum and oilcloth, paint, fertilizers, mortar, plaster and plaster products (1967), exports, other uses, and uses indicated by symbol W.

valued at $3.2 million, reflecting a slight decrease from the 1966 unit price.

Mica.—Mineral Mining Corp. produced scrap and ground mica from mica schist in Kershaw, Lancaster County. The ground mica was used in the manufacture of pipeline enamel, paint, plastics, welding rods, and electrical products.

Pyrite.—Commercialores, Inc., York County, recovered pyrite as a byproduct of milling kyanite ore. The pyrite was shipped out of State.

Sand and Gravel.—Sand and gravel production in South Carolina declined to 5.2 million tons valued at $7.2 million, decreases of 12.8 percent and 6.4 percent respectively from the record in 1966. Sand and/or gravel was produced by 23 companies from 27 mines in 17 counties. Sand accounted for 66 percent of total production and 54 percent of total value. All sand and gravel was commercial production, and 94 percent was processed before shipment. Fifty-three percent was shipped by truck, and 47 prcent by rail. Leading counties in output of sand and gravel were, in order of decreasing amount, Marlboro, Sumter, Lexington, Chesterfield, Dorchester, and Lancaster. Leading producers, in order of decreasing rank, were Becker County Sand & Gravel Co., with mines in Chesterfieild, Dorchester, Marlboro, and Sumter Counties; Columbia Silica Sand Co. in Lexington County; Brewer Sand Co. in Lancaster County; Pennsylvania Glass Sand Corp. in Lexington County; and Foster Bros. Dixiana Sand Co. in Lexington County.

Table 6.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1966			1967		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Sand:						
Structural	2,978	$1,848	$ .62	2,833	$1,857	$0.66
Fill	277	171	.62	135	W	W
Blast	11	45	4.09	10	50	5.00
Paving	383	230	.60	W	W	W
Glass	240	968	4.03	W	W	W
Other sands	249	W	W	504	W	W
Total	4,138	W	W	3,482	W	W
Gravel	1,878	W	W	1,766	W	W
Total sand and gravel [1]	6,016	7,668	1.27	5,248	7,178	1.37

W Withheld to avoid disclosing individual company confidential data; included with "Total sand and gravel."
[1] Includes molding, fire or furnace, engine, filtration, chemical, filler, pottery, abrasive, and other sands; structural, paving, and railroad ballast gravel; and uses indicated by symbol W.

Table 7.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1966			1967		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Aiken	2	W	W	1	114	$114
Cherokee	1	12	W	1	W	W
Chesterfield	3	169	$129	3	470	W
Dorchester	2	302	W	2	373	W
Greenville	3	118	72	3	93	51
Horry	1	86	W	1	95	275
Jasper	1	W	W	1	123	W
Lancaster	1	736	368	1	320	W
Lexington	4	964	1,588	5	915	1,566
Marion	1	7	7	1	W	W
Marlboro	1	1,507	W	1	1,228	W
Spartanburg	1	113	W	1	W	W
Sumter	1	1,067	W	1	986	W
Other counties [1]	9	935	5,504	5	530	5,172
Total	31	6,016	7,668	27	5,248	7,178

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Florence, Greenwood (1966), Kershaw, Pickens, and Richland Counties, and counties indicated by symbol W.

Stone.—The production and value of crushed granite, dimension granite, and crushed limestone increased in 1967.

Crushed granite was produced in seven counties by four companies from 10 quarries; leading counties were Lexington, Pickens, Greenville, Richland, and Spartanburg. Producters in order of descending rank were Palmetto Quarries Co., Campbell Limestone Co., Weston & Brooker Co., and Superior Stone Co. Seventy-one percent of the crushed granite was transported by truck, and the remainder by railroad.

Dimension granite was produced by Winnsboro Granite Co., Fairfield County, and Kershaw Granite Co. and Comolli Granite Co., both in Kershaw County. All dimension granite produced was rough monumental stone.

Four companies quarried and crushed limestone; producers were Giant Portland Cement Corp. (Harleyville quarry, Dorchester County), Campbell Limestone Co. (Blacksburg quarry, Cherokee County), Ideal Cement Co. (Carolina quarry, Dorchester County), and Santee Portland Cement Corp. (Holly Hill quarry, Orangeburg County). Crushed limestone was used in cement, roadstone, agricultural stone, and fluxing material for foundries. Ninety-three percent of the crushed limestone was transported by truck and the remainder by rail.

Vermiculite.—Production of vermiculite declined slightly in 1967. South Carolina continued to rank second to Montana in output. The leading producer was W. R. Grace & Co., with mines in Laurens and Spartanburg Counties and processing plants near Enoree and Traveler's Rest, South Carolina. Patterson Vermiculite Co. mined crude vermiculite and operated an exfoliating plant in Laurens County. American Vermiculite Co. operated an exfoliating plant in Laurens County. The vermiculite was used as loose fill insulation, in concrete, in building plaster, and for other uses.

METALS

Ferroalloys.—Mobil Oil Corp., Charleston, continued production of ferrophosphorus as a byproduct of elemental phosphorus furnace operations. Pittsburgh Metallurgical Co., also located in Charleston, produced ferrosilicon, ferrochromium, and ferrochromium-silicon.

Zirconium.—M & T Chemicals, Inc., located near Andrews, Georgetown County, continued operation of a grinding plant for production of dry-milled and granular zircon for foundry, refractory, ceramic, and glass industry applications.

MINERAL FUELS

Peat.—Reed-sedge peat was produced by Ti-Ti Peat Humas Co., Colleton County. Output of peat for use as a soil conditioner increased.

Table 8.—Principal producers

Commodity and company	Name of operation	County	Address
Cement:			
Giant Portland Cement Co	Harleyville plant	Dorchester	1500 Chestnut St. Philadelphia, Pa. 19102
Santee Portland Cement Co	Holly Hill plant	Orangeburg	Holly Hill, S.C. 29059
Clay:			
Kaolin:			
Cyprus Mines Corp	No. 47 mine	Aiken	Box 1201 Trenton, N. J. 08618
Dixie Clay Co	McNamee mine	do	230 Park Ave. New York, N.Y. 10017
J. M. Huber Corp	Barden mine	do	630 Third Ave. New York, N.Y. 10017
Do	Paragon mine	do	Do.
National Kaolin Products Co.	Aiken County mine	do	Box 431 Aiken, S.C. 29803
Southeastern Clay Co	Flock mine	do	Box 1022 Aiken, S.C. 29801
Do	Johnson mine	do	Do.
Do	Rogers mine	do	Do.
Do	Seigler mine	do	Do.
Do	Toole mine	do	Do.
Miscellaneous:			
Ashe Brick Co	Van Wyck mine	Lancaster	Van Wyck, S.C. 29744
Broad River Brick Co	Broad River mine	Cherokee	Box 681 Gaffney, S.C. 29340
Columbia Brick & Tile Co	Columbia mine	Richland	Box 4126 Columbia, S.C. 29204
Giant Portland Cement Co	Harleyville Shale mine.	Dorchester	1500 Chestnut St. Philadelphia, Pa. 19102
Southern Brick Co	Ninety Six mine	Greenwood	Ninety Six, S.C. 29666
Feldspar, crude:			
Spartan Minerals Co. [1]	Pacolet plant	Spartanburg	Pacolet, S.C. 29342
Iodine, crude:			
Columbia Organic Chem. Co., Inc.	Cedar Terrace plant	Richland	Box 5273 Columbia, S.C. 29205
West Virginia Pulp & Paper Co.	N. Charleston plant	Charleston	Box 5207 N. Charleston, S.C. 29406
Kyanite:			
Commercialores, Inc.[2]	Henry Knob mine	York	Box 156 Clover, S.C. 29710
Lime, regenerated:			
Bowater Carolina Corp	Catawba limekiln	York	Catawba, S.C. 29704
International Paper Co	Georgetown limekiln	Georgetown	Georgetown, S.C. 29440
South Carolina Industries, Inc	Florence limekiln	Florence	Florence, S.C. 29501
West Virginia Pulp & Paper Co.	Charleston limekiln	Charleston	Charleston, S.C. 29406
Mica, scrap:			
The Mineral Mining Corp.[3]	Kershaw strip mine	Lancaster	Kershaw, S.C. 29067
Peat: Ti-Ti Peat Humus Co., Inc	Green Pond mine	Colleton	Box 425 Charleston, S.C. 29402
Pyrite: *See* Kyanite			
Sand and gravel:			
Becker County Sand & Gravel Co.	Cash mine	Chesterfield	Box 729 Cheraw, S.C. 29520
Do	Summerville mine	Dorchester	Box 848 Cheraw, S.C. 29520
Do	Marlboro mine	Marlboro	Do.
Do	Camden mine	Sumter	Do.
Brewer Sand Co	Brewer mine	Lancaster	Box 267 Lancaster, S.C. 29720
Columbia Silica Sand Co	Dixiana mine	Lexington	Box 1519 Columbia, S.C. 29202
Do	Edmund mine	do	Box 509 Columbia, S.C. 29202
Foster Bros. Dixiana Sand Co	Dixiana mine	do	Box 5442 Columbia, S.C. 29205
Pennsylvania Glass Sand Corp.	Columbia mine	do	Gen. Operations Dept. Hancock, W.Va. 25424

See footnotes at end of table.

Table 8.—Principal producers—Continued

Commodity and company	Name of operation	County	Address
Stone:			
Granite, crushed:			
Campbell Limestone Co	Lakeside quarry	Greenville	Piedmont Hwy. Greenville, S.C. 29601
Do	Beverly quarry	Pickens	Liberty, S.C. 29657
Do	Pacolet quarry	Spartanburg	Route 1 Pacolet, S.C. 29372
Do	Pelham quarry	do	Route 1, Liberty Plant Liberty, S.C. 29657
Palmetto Quarries Co	Blair quarry	Fairfield	Drawer 5185 Columbia, S.C. 29205
Do	Coronaca quarry	Greenwood	Do.
Do	Stoney Point quarry	do	Do.
Do	Columbia quarry	Richland	Do.
Superior Stone Co	Rion quarry	Fairfield	Box 2568 Raleigh, N.C. 27602
Weston & Brooker Co	Cayce quarry	Lexington	650 Knox-Abbott Ave. Cayce, S. C. 29033
Granite, dimension:			
Comolli Granite Co	Carolina Mahogany quarry	Kershaw	Box 898 Elberton, Ga. 30635
Kershaw Granite Co., Inc	Kershaw quarry	do	Box 250 Elberton, Ga. 30635
Winnsboro Granite Co	Anderson quarry	Fairfield	Rion, S.C. 29132
Limestone, crushed:			
Campbell Limestone Co	Blacksburg quarry	Cherokee	Box 188 Blacksburg, S.C. 29702
Giant Portland Cement Co	Harleyville quarry	Dorchester	1500 Chestnut St. Philadelphia, Pa. 19102
Ideal Cement Co	Carolina quarry	Dorchester	620 Denver National Bldg. Denver, Colo. 80202
Santee Portland Cement Corp	Holly Hill quarry	Orangeburg	Holly Hill, S.C. 29059
Other stone, crushed:			
Bird & Son, Inc	Roofing granules plant	Charleston	Stark Island Park, Box 4336 Charleston Heights, S.C. 29405
Vermiculite:			
Crude:			
Patterson Vermiculite Co	Laurens County mine	Laurens	Route 1 Enoree, S.C. 29335
W. R. Grace & Co	Enoree mines	Laurens, Spartanburg	62 Whitmore Ave. Cambridge, Mass. 01109
Exfoliated:			
American Vermiculite Co	Exfoliating plant	Laurens	Rona Mountain, Tenn. 37687
Patterson Vermiculite Co	do	do	Route 1 Enoree, S.C. 29335
W. R. Grace & Co	Travelers Rest plant	Greenville	Cambridge, Mass. 02138
Do	Enoree plant	Laurens	Do.

[1] Also feldspar grinders. [2] Also byproduct pyrite. [3] Also mica grinders.

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 Franklin H. Persse [1] and William C. Henkes [2]

Mineral production in South Dakota during 1967 was valued at $52.6 million, essentially the same as in 1966. The record high for the State was $54.1 million in 1963.

The value of metals produced declined 5 percent, whereas the value of nonmetals increased 2 percent. However, this decline in the value of metals produced did not prevent South Dakota from leading the Nation in gold output for the 19th consecutive year. All but 2 ounces of the total State output was produced at the Homestake mine at Lead.

[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	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Beryllium concentrate—short tons, gross weight	124	$40	W	W
Cement:				
Masonry—thousand 280-pound barrels	51	170	54	$178
Portland—thousand 376-pound barrels	1,974	6,367	1,406	4,815
Clays—thousand short tons	231	870	199	799
Coal (lignite)—do	10	45	5	27
Feldspar—long tons	r 53,810	r 369	61,411	420
Gem stones	NA	20	NA	30
Gold (recoverable content of ores, etc.)—troy ounces	606,467	21,226	601,785	21,062
Gypsum—thousand short tons	17	68	12	49
Petroleum (crude)—thousand 42-gallon barrels	239	479	211	502
Sand and gravel—thousand short tons	13,630	13,585	13,463	13,737
Silver (recoverable content of ores, etc.) thousand troy ounces	110	142	121	188
Stone—thousand short tons	2,186	7,995	1,866	9,694
Value of items that cannot be disclosed: Columbium-tantalum (1967), lime, lithium minerals, mica (scrap), molybdenum, tin (1966), uranium [2] (recoverable content U_3O_8), vanadium, and value indicated by symbol W	XX	r 1,796	XX	1,117
Total	XX	r 53,172	XX	52,618
Total 1957–59 constant dollars	XX	r 49,228	XX	47,545

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] Method of reporting changed from short tons of ore and f.o.b. mine value (AEC Circular 5, Revised, price schedule) to recoverable pounds of uranium oxide and f.o.b. mill value.

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

County	1966	1967	Minerals produced in 1967 in order of value
Aurora	$366,000	$69,000	Sand and gravel.
Beadle	107,000	145,000	Do.
Bennett	3,000	----------	
Bon Homme	198,000	232,000	Sand and gravel.
Brookings	303,000	753,000	Do.
Brown	602,000	576,000	Do.
Brule	86,000	274,000	Do.
Buffalo	82,300	27,420	Sand and gravel, stone.
Butte	W	842,561	Clays, sand and gravel.
Campbell	124,000	222,000	Sand and gravel.
Charles Mix	374,000	113,100	Sand and gravel, stone.
Clark	187,000	320,000	Sand and gravel.
Clay	69,000	64,000	Do.
Codington	367,000	808,000	Do.
Corson	233,000	153,000	Do.
Custer	471,538	672,039	Feldspar, sand and gravel, stone, petroleum, lime, beryllium concentrate.
Davison	817,000	424,000	Sand and gravel.
Day	298,000	495,000	Do.
Deuel	127,000	105,000	Do.
Dewey	94,125	37,486	Coal, sand and gravel.
Douglas	110,000	278,000	Sand and gravel.
Edmunds	18,000	92,000	Do.
Fall River	W	W	Uranium, sand and gravel, vanadium.
Faulk	153,000	152,000	Sand and gravel.
Grant	4,549,927	6,335,018	Stone, sand and gravel.
Gregory	122,000	104,000	Sand and gravel.
Haakon	56,000	41,000	Do.
Hamlin	30,000	276,000	Do.
Hand	272,000	231,000	Do.
Hanson	1,089,239	701,529	Stone, sand and gravel.
Harding	r 1,082,193	W	Petroleum, sand and gravel, molybdenum.
Hughes	110,350	127,430	Sand and gravel, stone.
Hutchinson	167,000	176,000	Sand and gravel.
Hyde	46,000	68,000	Do.
Jackson	76,000	322,000	Do.
Jerauld	229,000	21,000	Do.
Jones	39,000	189,000	Do.
Kingsbury	95,000	127,000	Do.
Lake	95,000	88,000	Do.
Lawrence	21,696,095	22,348,029	Gold, sand and gravel, stone, silver.
Lincoln	95,000	81,000	Sand and gravel.
Lyman	199,000	62,000	Do.
Marshall	131,000	103,000	Do.
McCook	131,000	160,000	Do.
McPherson	244,000	98,000	Do.
Meade	155,015	287,000	Do.
Mellette	28,000	437,000	Do.
Miner	71,000	----------	
Minnehaha	1,191,069	1,036,975	Stone, sand and gravel.
Moody	338,000	593,000	Sand and gravel.
Pennington	r 10,005,080	8,150,077	Cement, stone, lime, sand and gravel, clays, feldspar, gypsum, columbium-tantalum, mica(scrap), beryllium concentrate, lithium minerals.
Perkins	555,000	39,000	Sand and gravel.
Potter	140,000	305,000	Do.
Roberts	143,000	292,724	Sand and gravel, stone.
Sanborn	57,000	203,000	Sand and gravel.
Shannon	73,000	2,000	Do.
Spink	94,000	149,000	Do.
Stanley	----------	73,000	Do.
Sully	87,000	122,000	Do.
Todd	80,000	34,000	Do.
Tripp	W	W	Stone, sand and gravel.
Turner	303,000	123,000	Sand and gravel.
Union	149,000	341,000	Do.
Walworth	295,000	115,000	Do.
Washabaugh	55,000	31,000	Do.
Yankton	W	189,000	Do.
Ziebach	75,000	133,000	Do.
Undistributed [1]	r 3,533,005	1,448,808	
Total	r 53,172,000	52,618,000	

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

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

Table 3.—Indicators of South Dakota business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$1,643	$1,719	+4.6
Per capita		$2,420	$2,550	+5.4
Bank debits (for 17 principal reporting cities)	millions	$5,422.5	$5,584.9	+3.0
Total State revenue (fiscal 1965–66 & fiscal 1966–67)	do	$185.3	$202.0	+9.0
Cash receipts from farm marketing	do	$180.1	NA	
Mineral production	do	$53.2	$52.6	−1.0
Ordinary life insurance sales	do	$295.9	$303.9	+2.7
Gross postal receipts (based on nine reporting cities)	do	$6.4	$6.8	+5.3
New truck registrations	number	8,504	8,332	−2.0
New car registrations	do	25,604	23,430	−8.5
Work force (mid-June):				
Total labor force	thousands	286.8	284.1	−.9
Total employment	do	276.1	273.3	−1.0
Total unemployment	do	10.7	10.8	+.9
Unemployment rate	percent	3.7	3.8	
Employment (mid-June):				
Total agricultural	thousands	82.3	74.0	−10.1
Total non-agricultural	do	158.3	166.8	+5.4
Mining	do	2.3	2.4	+4.3
Contract construction	do	8.2	8.9	+8.5
Manufacturing	do	14.4	15.3	+6.2
Finance, insurance, real estate	do	7.0	7.2	+2.9
Transportation and utilities	do	10.2	10.1	−1.0
Trade	do	42.8	44.3	+3.5
Services and miscellaneous	do	26.2	28.3	+8.0

NA Not available.

Source: Business Research Bureau, University of South Dakota, Vermillion, S. Dak.

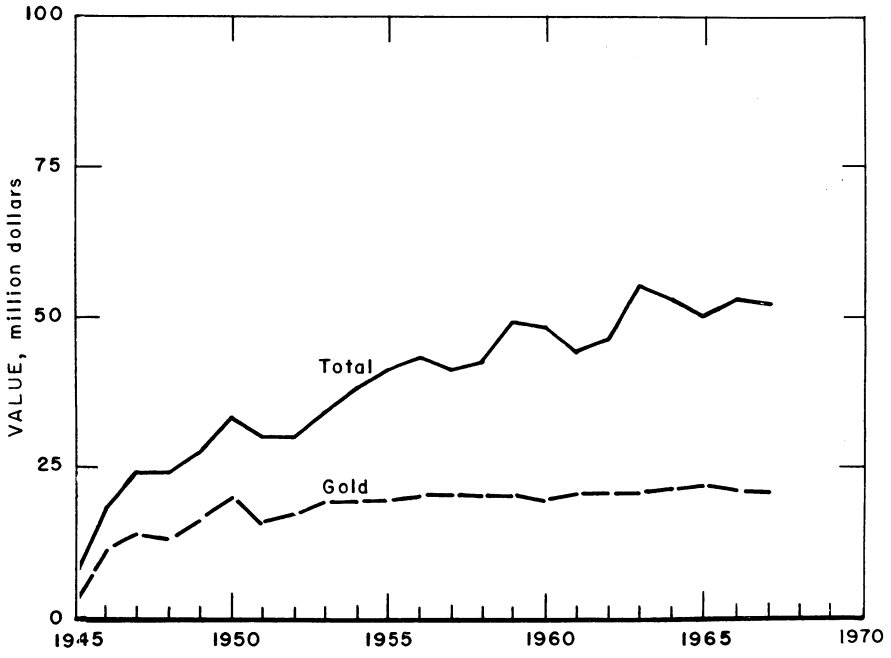

Figure 1.—Value of gold and total value of mineral production in South Dakota.

The overall increase in value of nonmetals production, attributed mainly to gains in stone, lime, sand and gravel, and feldspar, more than offset the decreased values of portland cement, clays, gypsum, and mica.

Two publications on resources of the State were released during the year.[3]

Employment and Injuries.—The extent of employment and injuries in the mineral industry, exclusive of the petroleum industry is presented in table 4. Information for 1966 represents final data; that given for 1967 is preliminary.

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

Year and industry	Average men Working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Nonfatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1966:								
Coal	4	119	(1)	4	----	----	----	----
Metal	1,740	306	533	4,246	1	81	19.31	2,262
Nonmetal	259	232	60	489	----	9	18.41	168
Sand and gravel	995	170	169	1,421	1	23	16.89	4,922
Stone	389	244	95	790	----	16	20.25	1,228
Total [2]	3,387	253	858	6,950	2	129	18.85	2,540
1967: [p]								
Coal	5	83	(1)	3	----	----	----	----
Metal	1,695	311	528	4,222	----	114	27.00	2,729
Nonmetal	295	211	63	519	----	11	21.21	137
Sand and gravel	975	154	150	1,358	----	25	18.41	445
Stone	465	227	105	894	----	15	16.78	302
Total [2]	3,435	246	846	6,995	----	165	23.59	1,782

[p] Preliminary.
[1] Less than ½ unit.
[2] Data may not add to totals shown because of independent rounding.

Government Programs.—The Office of Coal Research, U. S. Department of the Interior, announced in April that Secretary Stewart L. Udall signed an $8.5 million amendment to the contract with Consolidation Coal Co. (Consol), a wholly owned subsidiary of Continental Oil Co., for further development of lignite gasification through the construction of a pilot plant at Rapid City. Plans for the facility were being developed by Consol at Library, Pa. Construction is to begin in the fall of 1968 on 10 acres of land provided by Rapid City Industries.

The Office of Minerals Exploration (OME) of the U.S. Geological Survey loaned $234,135 to Double Rainbow Mines, Inc., for exploration of silver-bearing ore at its Double Rainbow mine near Galena. This loan, the only OME loan made in South Dakota during the year, was for 75 percent of the cost. The work was being done by Homestake Mining Co.

Highway construction contracts awarded during the year amounted to $48.3 million, an increase of $2 million over those of last year.[4] The increase was for contracts awarded for Interstate highway construction and for improvements to meet standards adequate for present traffic. Contracts awarded for other highway construction were essentially the same as those for 1966. As of December 31, 415.1 miles of Interstate highway in the State was open to traffice, an increase of 38.4 miles from the corresponding date last year. Of this total 18.1 miles was completed to full or acceptable standard; 20.3 miles was improved to meet standards adequate for present traffic.[5]

[3] U.S. Department of the Interior. Natural Resources of South Dakota. 1967, 72 pp.
U.S. Department of the Interior and U.S. Department of Agriculture. Black Hills Area Resources Study. February 1967, 225 pp.
[4] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1968 . . . and Budgets for Maintenance: Highway Spending Goes for a New Record Despite Federal Aid Cuts. V. 180, No. 14, 1968, pp. 86–87.
[5] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 13, 1967. Press Release FHWA–118, Feb. 14, 1968.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—The South Dakota Cement Commission produced at its Rapid City plant (the only State-owned cement plant in the United States, and the only cement plant in South Dakota), 45,000 barrels of masonry cement and 1.4 million barrels of portland cement. Production of masonry cement was 31 percent above that of last year; output of portland cement decreased 30 percent. To manufacture this amount of cement, approximately 352,500 tons of limestone, 98,200 tons of shale, 11,900 tons of gypsum, 8,500 tons of sand, and 3,750 tons of iron ore were required. With the exception of the iron ore, obtained from a stockpile, all of these nonmetallics were quarried in Pennington County during the year.

The decrease in the production of portland cement was caused by the cutback in the use of cement in highway construction. In 1966 highway contractors purchased 819,300 barrels; in 1967, however, they accounted for only 244,200 barrels. Sales to other users were essentially unchanged.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	404	$493	621	$677
Paving	165	206	56	56
Fill	73	65	43	21
Other	[1] 3	[1] 12	--------	--------
Industrial: Glass	(1)	(1)	--------	--------
Total	645	776	720	754
Gravel:				
Construction:				
Building	214	317	472	672
Paving	1,459	1,700	1,384	1,596
Railroad ballast	12	9	4	3
Fill	44	35	78	64
Other	30	20	1	1
Miscellaneous	18	18	31	37
Total	1,777	2,099	1,970	2,373
Total sand and gravel	2,422	2,875	2,690	3,127
Government-and contractor operations:				
Sand:				
Paving	2,246	2,258	1,967	1,964
Fill	------	--------	11	11
Other	9	9	10	5
Total	2,255	2,267	1,988	1,980
Gravel:				
Building	135	100	--------	--------
Paving	8,818	8,343	8,774	8,620
Fill	------	--------	10	9
Other	------	--------	1	1
Total	8,953	8,443	8,785	8,630
Total sand and gravel	11,208	10,710	10,773	[2] 10,616
All operations:				
Sand	2,900	3,043	2,708	2,734
Gravel	10,730	10,542	10,755	11,003
Total	13,630	13,585	13,463	13,737

[1] Glass sand combined with "Other (construction)" sand to avoid disclosing individual company confidential data.

[2] Data do not add to total shown because of independent rounding.

Installation of electrostatic precipitators capable of removing 99 percent plus of the solids from the kiln emission was begun late in 1967. By this approximately $1 million addition to the cement plant, the State has set an example for air-pollution control in the Rapid City area. Although the micron-size particles collected have little or no commercial value, the investment should pay off in improved public relations.

Clays.—Bentonite and common clays were produced in Butte County and shale in Pennington County. Bentonite was mined by American Colloid Co. and International Minerals & Chemical Corp. (IMC). The only processing plant in the State, operated by American Colloid Co. at Belle Fourche, processed bentonite mined in Butte County, S. Dak., and Crook County, Wyo.; the processed bentonite was marketed under the trade name Volclay. The bentonite mined by IMC was processed at its new plant at Colony, Wyo.

Black Hills Clay Products Co. at Belle Fourche, the only brick manufacturer in South Dakota, mined common clays from two locations for manufacturing building brick. Shale mined near Rapid City was used as an ingredient for manufacturing cement at the State-owned cement plant and for making lightweight aggregate by Light Aggregates, Inc.

Feldspar.—Feldspar production increased in Custer and Pennington Counties, even though the number of operating mines decreased by one in each county. The two plants processing feldspar were the IMC grinding plant at Custer, the principal processor of potash-type feldspar, and the Northwest Beryllium flotation mill at Keystone, which produced soda-type feldspar.

Gypsum.—South Dakota Cement Commission, the only producer and consumer of gypsum in the State, produced 12,221 tons from its open-pit mine in Pennington County. Of this output, 11,907 tons were used for manufacturing cement; the remainder was stockpiled.

Lime.—The continued increase in lime production was attributed to a vertical kiln installed late in 1966 at the Pete Lien & Sons lime plant at Rapid City. According

Table 6.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value	County	Quantity	Value
Aurora	58	$69	Jerauld	21	$21
Beadle	149	145	Jones	189	189
Bon Homme	252	232	Kingsbury	120	127
Brookings	740	753	Lake	98	88
Brown	453	576	Lawrence	587	603
Brule	271	274	Lincoln	79	81
Buffalo	14	14	Lyman	61	62
Butte	173	173	McCook	159	160
Campbell	207	222	McPherson	95	98
Charles Mix	112	111	Marshall	90	103
Clark	320	320	Meade	287	287
Clay	89	64	Mellette	437	437
Codington	707	808	Minnehaha	547	478
Corson	186	153	Moody	578	593
Custer	259	239	Pennington	600	572
Davison	398	424	Perkins	31	39
Day	475	495	Potter	305	305
Deuel	103	105	Roberts	239	279
Dewey	10	10	Sanborn	201	203
Douglas	262	278	Shannon	2	2
Edmunds	91	92	Spink	147	149
Fall River	120	120	Stanley	73	73
Faulk	152	152	Sully	122	122
Grant	218	218	Todd	34	34
Gregory	102	104	Tripp	80	79
Haakon	41	41	Turner	105	123
Hamlin	253	276	Union	333	341
Hand	258	231	Walworth	94	115
Hanson	118	118	Washabaugh	31	31
Harding	164	164	Yankton	182	189
Hughes	78	74	Ziebach	133	133
Hutchinson	180	176			
Hyde	68	68	Total	13,463	13,737
Jackson	322	322			

to a paper presented by Bruce H. Lien, this vertical kiln, designed by Development Engineering, Inc., and built by a local steel fabricator, has an even greater output potential than that attained this year. Lime manufactured by Pete Lien & Sons was used mainly as construction lime. Black Hills Lime Co., near Pringle, produced only chemical lime.

Lithium.—South Dakota was one of four States reporting production of lithium minerals. Keystone Chemical Co., near Keystone, shipped a small amount of hand-sorted lepidolite ore.

Mica.—The only scrap mica produced in South Dakota came from the Peerless mine operated by Northwest Beryllium Corp. It was one of six minerals recovered from pegmatite ore at the corporation's flotation mill at Keystone.

Sand and Gravel.—Production of sand and gravel was reported in all but Bennett and Miner Counties. The total quantity of 13.5 million tons, valued at $13.7 million, remained essentially the same as that for 1966. The major use was for highway construction, improvement, and maintenance.

Government-and-contractor sand and gravel was produced for the U.S. Army Corps of Engineers, Federal Bureau of Indian Affairs, U.S. Bureau of Public Roads, U.S. Forest Service, Iowa State Highway Commission, South Dakota Cement Commission, South Dakota Department of Highways, and county and municipal highway departments. This output was reported by 62 respondents from 256 operations. Commercial sand and gravel production was reported by 87 respondents from 136 operations.

Stone.—Stone sold or used in South Dakota was classified as crushed and broken granite, limestone, sandstone, and miscellaneous stone; and dimension granite, limestone, and sandstone. Compared with 1966 shipments, an increase of $1.7 million in total value was noted in 1967 along with a decrease of 320,000 tons in total tonnage. This condition occurred because of an increase in the price of monumental stone and in the quantity of architectural stone, whereas the shipments of crushed and broken limestone and sandstone decreased. The value of the increase in dimension stone shipped more than offset the value of the decrease in crushed and broken limestone and sandstone, because of the greater value per unit of dimension stone. Again the leading counties were Grant and Pennington, with production values of $6.1 million and $1.6 million, respectively. Output in Grant County was "Mahogany Granite" dimension stone from six quarries; that from Pennington County included crushed granite; crushed, broken, and dimension limestone; crushed quartz; and dimension sandstone. As the result of the installation of an atomic absorption tester, Northwest Beryllium Corp. was able to increase the quality and output of crushed quartz, a high-grade optical silica sold under the trade name Kesil.

In August, Texas Mining Co. purchased South Dakota Sand Co. at Pringle, Custer County. Soon after this transaction, construction was begun to double the size of the plant. Manufactured industrial-silica sand was produced by South Dakota Sand Co.

Table 7.—Stone sold or used by producers, by kinds

Year	Granite		Limestone		Sandstone [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1963	24,630	$2,761,546	1,652,571	$2,427,016	1,033,749	$2,070,837
1964	17,803	2,807,851	1,179,551	1,734,812	920,361	1,702,349
1965	20,129	2,944,586	868,726	1,411,917	650,847	1,006,609
1966	23,806	4,066,853	1,100,575	1,793,263	983,897	1,997,291
1967	48,024	6,160,368	[2]882,273	[2]1,398,984	[2]780,710	[2]1,622,592

Year	Other stone		Total	
	Short tons	Value	Short tons	Value
1963	82,618	$79,310	2,793,568	$7,338,709
1964	-------	----------	2,117,715	6,245,012
1965	14,068	24,117	1,553,770	5,387,229
1966	77,800	137,349	2,186,078	7,994,756
1967	155,447	511,664	1,866,454	9,693,608

[1] Includes quartz and quartzite.
[2] Excludes dimension stone, included with "Other stone."

Table 8.—Stone sold or used by producers, by uses

Use	1966		1967	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction and rubble short tons	W	W	W	W
Rough architectural cubic feet	[1] 136,764	[1] $1,741,591	[1] 181,680	[1] $3,114,910
Dressed architectural do				
Rough monumental do				
Dressed monumental do	157,177	2,330,462	147,386	3,008,358
Curbing and flagging do	W	W	W	W
Total (approximate, in short tons)	28,800	4,079,553	31,200	6,130,108
Crushed and broken stone:				
Refractory short tons	37,462	74,924	38,750	77,500
Riprap do	75,335	127,753	184,547	548,492
Railroad ballast do	279,494	378,945	345,066	487,385
Concrete and roadstone do	1,235,485	2,294,570	834,946	1,479,763
Cement do	451,115	812,007	352,519	616,908
Other do	[2] 78,391	[2] 227,004	[3] 79,417	[3] 353,452
Total do	2,157,282	3,915,203	1,835,245	3,563,500
Total stone (approximate, in short tons)	2,186,100	7,994,756	1,866,500	9,693,608

W Withheld to avoid disclosing individual company confidential data; included in "Totals."
[1] Combined to avoid disclosing individual company confidential data.
[2] Includes stone used for decorative use, filler, landscaping, lime, precasting, and roofing granules.
[3] Includes stone used for abrasives, architectural panels, foundry, lime, filler, precasting, and stone sand.

METALS

Beryllium.—Shipments of beryl concentrate declined considerably in 1967. The hand-cobbed concentrates were produced from the Scott mine in Custer County operated by William Fitzner, and from various mines in Pennington County, one of which was the Hugo, operated by L. W. Judson. Purchasers of the beryl concentrates included Beryl Ores Co. of Arvada, Colo.

Ore from the Peerless mine of Northwest Beryllium Corp. in Pennington County was treated at its flotation mill at Keystone. Beryl concentrate, one of the six minerals recovered, was stockpiled.

Gold and Silver.—Except for 2 ounces of placer gold produced by Marvin Kenoyer at his 3 W's mine in Custer County, all gold and silver came from the Homestake mine in Lawrence County. This represented the largest single source of revenue from mineral production in the State. According to the annual report of Homestake Mining Co., gold and silver worth $21,200,375 were recovered from 1,896,311 tons of ore mined, compared with $21,309,115 worth of gold and silver recovered from 2,002,239 tons of ore in 1966. This reduction of 105,928 tons of ore mined resulted in only a $108,740 loss of recovered value. Ore from the Nineteen Ledge, below the 4,850-foot level, was substantially above average grade and thus helped to raise the grade of ore milled to the highest level since 1959. The recovered value was $11.18 per ton, compared with $10.64 in 1966. Improvements made by Homestake during the year included automation of the number four winze ore hoist between the 6,800- and 4,850-foot levels, automation of the two hydroelectric plants, and installation of a computer system.

Molybdenum.—Kerr-McGee Corp. reported a small shipment of molybdenum recovered as a byproduct from uraniferous lignites previously mined in Harding County.

Tin.—Tin concentrate (cassiterite) recovered from pegmatite ore processed at Northwest Beryllium Corp.'s mill at Keystone was stockpiled.

Uranium.—Uranium output decreased substantially in 1967. No uraniferous lignite was mined in Harding County. Production of uraniferous sandstone ore was reported from eight operations in Fall River County. All of the uranium ore produced in the State was processed at the Edgemont plant of Mines Development, Inc., a subsidiary of The Susquehanna Corp. A small quantity of uranium ore from three operations in Wyoming was also processed.

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)
1963	3	1	1,909	576,726	$20,185	117	$150
1964	1	1	2,033	616,913	21,592	133	172
1965	1	------	2,032	628,259	21,989	129	167
1966	1	------	2,002	606,467	21,226	110	142
1967	1	1	1,896	601,785	21,062	121	188
1876–1967	NA	NA	NA	32,416,144	916,162	12,369	9,616

NA Not available.
[1] Excludes placer gravel.

Table 10.—Homestake mine ore milled, receipts, and dividends [1]

Year	Ore milled (thousand short tons)	Receipts for bullion product		Dividends (thousands)
		Total (thousands)	Per ton	
1963	1,909	$20,278	$10.62	$3,265
1964	2,033	21,703	10.68	3,288
1965	2,032	22,094	10.88	3,445
1966	2,002	21,309	10.64	3,937
1967	1,896	21,200	11.18	[2] 4,087

[1] From 1876 to 1967, inclusive, this mine yielded bullion and concentrates that brought a net return of $844.5 million and paid $236.1 million in dividends.
[2] Consists of dividends as follows:

Cash—$0.80 per share	$1,995,721
Stock—market value of 45,331 shares of capital stock issued as a 2 percent stock dividend and $164,988 paid in lieu of fractional shares	2,091,555
Total	4,087,276

Source: Homestake Mining Co. annual report.

Exploration for uranium increased because of the increased demand for the commodity. Among those involved in the activity were Susquehanna-Western, Inc., a subsidiary of The Susquehanna Corp., which performed extensive drilling, drifting, and trenching, and Hells Canyon Mining Co. which accomplished 2,000 feet of rotary drilling.

Vanadium.—At its Edgemont plant Susquehanna-Western, Inc., recovered vanadium pentoxide from uranium-sandstone ore tailings from the adjacent mill of Mines Development, Inc., and from fly ash from California. The expansion of the vanadium mill was virtually completed in 1967 at an approximate cost of $500,000.

MINERAL FUELS

Coal.—Early in the year Dewey County Coal Co., near Firesteel, was purchased by Herbert H. Davis of Timber Lake, who operated it as Firesteel Coal Co.

Petroleum.—Output of crude oil from the Buffalo field, Harding County, declined 12 percent to 194,049 barrels; the decline resulted from normal depletion of the field reservoir, the Red River Formation (Ordovician). Associated natural gas, 12 million cubic feet, was used as field fuel or flared. The four-well Barker Dome field, Custer County, also had a decline in production—to 16,838 barrels; output was from the Leo sandstone (Pennsylvanian). The net decrease in production for the State was 28,450 barrels (12 percent).

Drilling activity was 25 percent below the level of the previous year. All of the nine exploratory wells were unsuccessful; no development wells were drilled. Gulf Oil Corp. continued its interest in the south-central part of the State with three wildcat wells drilled; this operator drilled a fourth well in Dewey County. Miami Oil Producers, Inc., drilled an 8,600-foot Ordovician test about 10 miles west of the Buffalo field; Amerada Petro-

leum Corp. drilled an Ordovician test to 6,410 feet, about 90 miles southeast of Buffalo field. No shows of oil or gas were reported from any of the wells.

Table 11.—Oil and gas well [1] drilling in 1967, by counties

County	Dry [2]	Total	Footage
Exploratory completions:			
Custer	1	1	2,918
Dewey	1	1	4,600
Haakon	1	1	4,827
Harding	1	1	8,600
Jones	1	1	3,181
Lyman	1	1	1,950
Tripp	1	1	3,000
Washabaugh	1	1	6,000
Ziebach	1	1	6,410
Total	9	9	41,486

[1] No development wells were drilled during the year.
[2] All exploratory wells were unsuccessful.

Source: Petroleum Information Corp., 1967, Résumé, Oil and Gas Operations in the Rocky Mountain Region.

Three State oil and gas lease sales involved 224,210 acres for which bonuses totaling $325,881 were received. The first State sale, in April, covered 31,303 acres; most of the acreage, in Tripp and Mellette Counties, was purchased by Gulf Oil Corp. The third sale, in mid-December, reflected the interest aroused by the discovery of Bell Creek oilfield in southeastern Montana; the sale involved 189,707 acres, chiefly in the northwestern counties, for which bonuses of $325,759 were paid.

Three Indian agency oil and gas lease sales, for lands in the Cheyenne River, Pine Ridge, and Rosebud Reservations, involved 147,864 acres. The Cheyenne River leases, totaling 84,314 acres, brought bonuses of $22,764; the Pine Ridge Agency leased 51,030 acres for a total bonus of $13,778; the Rosebud Reservation leased 12,520 acres for bonuses of $3,037.

Table 12.—Principal producers and processing plants in 1967

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Cement:					
South Dakota Cement Commission	Drawer 351 Rapid City, S. Dak. 57701	Plant	Pennington	Clay (shale), gypsum, limestone.	Wet process portland cement.
Clays:					
American Colloid Co	5100 Suffield Court, Skokie, Ill. 60076	Open-pit mine and plant.	Butte		Drying, grinding, screening, and air separation plant.
Black Hills Clay Products Co	Bell Fourche, S. Dak 57717	Two open-pit mines	do		
Lightweight Aggregates, Inc	Rapid City, S. Dak 57701	Open-pit mine and plant.	Pennington		Expanding plant.
South Dakota Cement Commission	Drawer 351 Rapid City, S. Dak. 57701	Open-pit mine	do	*See* Cement.	
Coal:					
Firesteel Coal Co	Timber Lake, S. Dak. 57656	Strip mine	Dewey		Crushing and oil treatment plant.
Feldspar:					
International Minerals & Chemical Corp., Industrial Minerals Division.	Administration Center Old Orchard Road Skokie, Ill. 60079	Two open-pit mines and mill.	Custer		Processed company and custom ores in dry-grinding mill at Custer.
L. W. Judson	Custer, S. Dak. 57730	Open-pit mine	Pennington	Beryllium concentrate	
Northwest Beryllium Corp	218-219 American National Bank Bldg. Rapid City, S. Dak. 57701	Underground mine	do	Beryllium concentrate, columbium-tantalum, mica (scrap), glass sand (quartz), tin.	Flotation mill.
Gold:					
Homestake Mining Co	Lead, S. Dak. 57754	do	Lawrence	Silver	Amalgamation-cyanidation mill, refinery.
Gypsum:					
South Dakota Cement Commission	Drawer 351 Rapid City, S. Dak. 57701	Open-pit mine	Pennington	*See* Cement.	
Lime:					
Pete Lien & Sons	Box 3124 P.O. Annex Rapid City, S. Dak. 57703	Plant	do	Stone	Rotary and vertical kiln, continuous lime plant.
Petroleum:					
The Ozark Corp	Box 2491 Casper, Wyo. 82601	Crude oil wells	Custer (Barker Dome field)		
Pennzoil Co	900 Southwest Tower, Houston, Tex. 77002	do	Harding (Buffalo field)		
Phillips Petroleum Co	Bartlesville, Okla. 74003	do	do		
Sand and gravel (commercial):					
Birdsall Sand & Gravel Co	Box 767 Rapid City, S. Dak. 57701	Pit and two plants	Pennington		Two stationary crushing and screening plants.
Concrete Materials Co	3000 W. Madison Street Sioux Falls, S. Dak. 57104	do	Minnehaha		One stationary and one portable crushing and screening plants.
Robert Fuller	Flandreau, S. Dak. 57028	Pit and plant	Moody		Portable crushing and screening plant.
Hallett Construction Co	Crosby, Minn. 56441	do	Codington		Stationary crushing and screening plant.

Table 12.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Silver:					
Homestake Mining Co	Lead, S. Dak. 57754	Underground mine	Lawrence	*See* Gold.	
Stone:					
Concrete Materials Co	3000 W. Madison St., Sioux Falls, S. Dak. 57104	Quarry and plant	Minnehaha		Stationary crushing and screening plant.
Hills Materials Co	1311 St. Joseph Street Rapid City, S. Dak. 57701	do	Pennington		Do.
Pete Lien & Sons	Box 3124 Rapid City, S. Dak. 57703	do	do	*See* Lime.	Do.
South Dakota Cement Commission	Drawer 351 Rapid City, S. Dak. 57701	do	do	*See* Cement.	Do.
Uranium:					
Susquehanna-Western, Inc	Edgemont, S. Dak. 57735	Two open-pit and five underground mines.	Fall River	Vanadium	Ore to Mines Development, Inc., mill for uranium extraction.
Mines Development, Inc	do	Mill	do		Processed uranium ores from S. Dak. and Wyo. by acid leach.
Vanadium:					
Susquehanna-Western, Inc	do	do	do		Recovered vanadium pentoxide from uranium tailings from Mines Development, Inc., mill.

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 William D. Hardeman[2]

Record production of pyrite, crushed limestone, miscellaneous clay, and silver highlighted the mineral industry of Tennessee in 1967. Significant increases were also made in bituminous coal and zinc production. Tennessee led the Nation in production of ball clay, pyrite and zinc, ranked third in production of phosphate rock and dimension marble, fourth in production of fuller's earth, fifth in production of masonry cement, and sixth in dimension sandstone. Total value of mineral production increased 4 percent over that of 1966.

Leading mineral industries, which together furnished 80 percent of the total value of mineral production, were as follows: Stone, zinc, cement, coal, and phosphate rock. Leading companies were Tennessee Copper Co. (copper, gold, pyrite, silver, and zinc), American Zinc Co. (zinc, limestone), Monsanto Co. (phosphate rock), Vulcan Materials Co. (limestone, sand and gravel), Penn-Dixie Cement Corp. (cement, limestone, clay), Marquette Cement Manufacturing Co. (cement, limestone, clay), Ideal Cement Co. (cement, limestone), and General Portland Cement Co. (cement, limestone).

[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	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite—short tons	29,206	$412	14,862	$235
Cement:				
Portland—thousand 376-pound barrels	8,177	25,718	8,062	25,548
Masonry—thousand 280-pound barrels	1,095	2,822	1,092	2,992
Clays [2]—thousand short tons	1,359	4,909	1,574	5,152
Coal (bituminous)—do	6,309	23,763	6,832	26,974
Copper (recoverable content of ores, etc.)—short tons	15,410	11,148	14,600	11,162
Gold (recoverable content of ores, etc.)—troy ounces	141	5	181	6
Lead (recoverable content of ores, etc.)—short tons	181	55	-----	-----
Natural gas—million cubic feet	-------	-------	58	11
Petroleum (crude)—thousand 42-gallon barrels	7	W	7	W
Phosphate rock—thousand short tons	3,125	23,886	2,992	22,571
Sand and gravel—do	8,628	11,142	7,975	10,679
Silver (recoverable content of ores, etc.) thousand troy ounces	101	130	130	202
Stone [3]—thousand short tons	31,260	41,432	31,463	41,958
Zinc (recoverable content of ores, etc.)—short tons	103,117	29,904	113,065	31,303
Value of items that cannot be disclosed: Clay (fuller's earth), lime, pyrite, stone (crushed sandstone), and values indicated by symbol W	XX	7,258	XX	10,779
Total	XX	182,584	XX	189,572
Total 1957–59 constant dollars	XX	r 171,836	XX	p 175,006

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] Excludes crushed sandstone; included with "Value of items that cannot be disclosed."

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

County	1966	1967	Minerals produced in 1967 in order of value [2]
Anderson	W	W	Coal, limestone, miscellaneous clay.
Bedford	W	W	Limestone.
Benton	$1,707,000	W	Sand and gravel, limestone.
Bledsoe	10,000	$107,115	Coal.
Blount	W	W	Limestone, marble.
Bradley	W	W	Limestone.
Campbell	W	W	Coal, limestone, sandstone.
Cannon	W	W	Limestone.
Carroll	W	W	Sand and gravel.
Carter	W	W	Limestone.
Claiborne	W	W	Coal, limestone.
Clay	W	W	Limestone.
Cocke	96,000	W	Do.
Coffee	W	W	Do.
Cumberland	W	W	Limestone, sandstone, sand and gravel, coal.
Davidson	11,251,112	13,679,183	Limestone, cement, phosphate rock, sand and gravel, miscellaneous clay.
Decatur	W	W	Limestone, sand and gravel.
De Kalb	----------	W	Limestone.
Fayette	74,000	77,000	Sand and gravel.
Fentress	447,358	383,921	Limestone, coal, sandstone.
Franklin	5,412,757	5,236,514	Cement, limestone, sandstone, sand and gravel, miscellaneous clay.
Gibson	W	W	Sand and gravel.
Giles	W	W	Phosphate rock, limestone, sand and gravel.
Grainger	W	W	Limestone, marble.
Greene	W	W	Limestone, sand and gravel.
Grundy	W	W	Coal, sand and gravel, limestone.
Hamblen	W	W	Limestone.
Hamilton	9,699,483	9,268,855	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	Limestone.
Haywood	48,000	61,000	Sand and gravel.
Henderson	W	W	Do.
Henry	W	W	Ball clay, fuller's earth.
Hickman	W	557,000	Phosphate rock.
Humphreys	W	W	Limestone, sand and gravel.
Jefferson	22,809,454	24,224,807	Zinc, limestone.
Johnson	W	W	Limestone.
Knox	15,077,976	16,434,879	Cement, limestone, zinc, lime, marble, sand and gravel, miscellaneous clay.
Lauderdale	92,000	107,000	Sand and gravel.
Lincoln	W	W	Limestone.
Loudon	W	521,643	Limestone, miscellaneous clay, marble, barite, sand and gravel.
Macon	182,000	W	Limestone.
Marion	W	W	Coal, cement, limestone.
Marshall	W	W	Limestone.
Maury	W	W	Phosphate rock, limestone.
McMinn	W	W	Limestone, barite, sand and gravel.
McNairy	W	W	Sand and gravel.
Meigs	W	W	Limestone.
Monroe	W	W	Limestone, sand and gravel, barite.
Montgomery	W	W	Limestone.
Morgan	1,450,334	1,351,312	Coal.
Obion	273,000	W	Sand and gravel.
Overton	W	W	Coal, limestone.
Perry	249,000	----------	
Pickett	29,460	62,000	Limestone.
Polk	W	W	Copper, pyrites, zinc, silver, gold.
Putnam	765,000	W	Limestone, sand and gravel, coal.
Rhea	W	220,320	Limestone, coal.
Roane	268,326	W	Limestone.
Robertson	W	W	Do.
Rutherford	W	1,203,000	Do.
Scott	1,432,699	1,775,008	Coal, limestone.
Sequatchie	W	W	Do.
Sevier	W	W	Limestone, sand and gravel.
Shelby	W	W	Sand and gravel, miscellaneous clay.
Smith	W	149,000	Limestone.
Stewart	----------	W	Limestone, sand and gravel.
Sullivan	W	W	Cement, limestone, miscellaneous clay.
Sumner	W	W	Phosphate rock, limestone.
Tipton	W	W	Sand and gravel.
Unicoi	W	W	Sand and gravel, limestone.

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

County	1966	1967	Minerals produced in 1967 in order of value
Union	W	W	Marble, limestone.
Van Buren	$765,647	$1,254,887	Coal.
Warren	W	W	Limestone.
Washington	W	W	Limestone, miscellaneous clay.
Wayne	W	W	Sand and gravel, limestone.
Weakley	2,097,117	2,227,000	Ball clay.
White	W	W	Limestone.
Williamson	W	W	Phosphate rock, limestone.
Wilson	W	W	Limestone.
Undistributed [3]	108,346,277	110,670,556	
Total	182,584,000	189,572,000	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] The following counties are not listed because no production was reported: Cheatham, Chester, Crockett, Dickson, Dyer, Houston, Jackson, Lake, Lawrence, Lewis, Madison, Moore, and Trousdale.
[2] Excludes petroleum and natural gas; included with "Undistributed."
[3] Includes value of petroleum, natural gas (1967), and values indicated by symbol W.

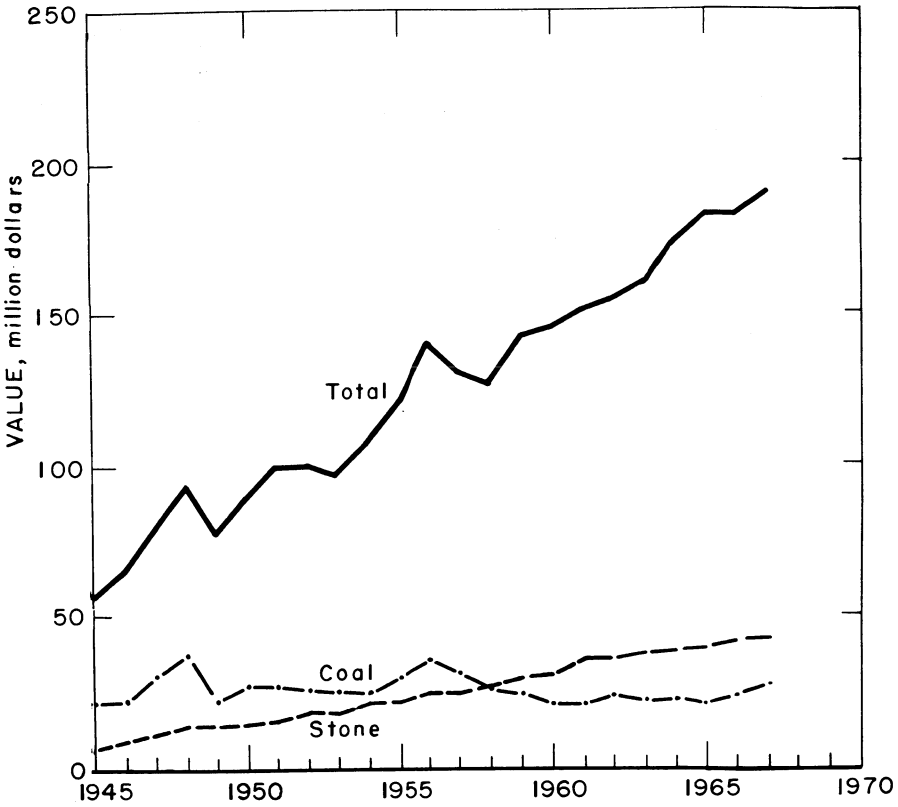

Figure 1.—Value of stone, coal, and total value of mineral production in Tennessee.

Although there was an increase in most sectors of the economy, with personal and per capita incomes reaching record highs, the agricultural sector was generally depressed. Cash receipts from farm marketings declined 3.0 percent in Tennessee, whereas the Nation as a whole declined only 1.7 percent. Tennessee River freight traffic increased for the sixth consecutive year, setting new records in stone, sand and gravel, coal, and coke. Of the total traffic using the Tennessee River in 1967, 70 percent either originated or terminated outside of the Tennessee Valley area.

Government Programs.—The Tennessee Division of Geology, Department of Conservation, published 30 geologic and mineral resource maps providing detailed information on Tennessee's mineral resources, bringing the total published to date to 146.

Tennessee Valley Authority (TVA) placed in operation the new 950,000-Kilowatt Bull Run steam plant near Oak Ridge. Coal consumption is expected to be 2.2 million tons per year. Construction was started on an active storage silo for coal to alleviate a coal dust problem.

TVA announced plans late in the year for construction of a $325 million coal-fired generating plant to be located at Cumberland City. The plant scheduled to begin operations by 1973, will contain two 1.3 million kilowatt generating units, and will have more capacity than any other coal-fired plant in the TVA system.

TVA also announced it will construct a second nuclear generating plant. The plant, to be located in eastern Tennessee, will have two 1.2-million-kilowatt nuc'ear units, and is scheduled to begin operation by 1974.

At yearend, 562 miles of Tennessee's total interstate highway system mileage was open to traffic; 53 percent of the system is now complete. Work was in progress on the remaining mileage of interstate highway designated for the State.

Table 3.—Indicators of Tennessee business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$8,611	$9,222	+7.1
Per capita		$2,227	$2,369	+6.3
Construction activity:				
Total private construction	millions	$330	$358	+8.5
Residential:				
Number of units		16,055	20,971	+30.6
Value of construction	millions	$147	$198	+34.7
Industrial growth (new and expansions):				
Number of units		338	374	+10.6
Investment	millions	$221	$497	+124.9
Employment		29,898	41,688	+39.4
Cash receipts from farm marketings	millions	$603	$585	−3.0
Mineral production	do	$183	$190	+3.8
Employment:				
Nonagricultural	thousands	1,223	1,243	+1.6
Manufacturing	do	432	437	+1.2
Sales of electric energy	million kilowatt-hours	47,472	47,974	+1.1
Tennessee River freight traffic:				
Total	thousand tons	19,709	21,628	+9.7
Stone, sand and gravel	do	6,126	6,442	+5.2
Petroleum products	do	780	1,096	+40.5
Iron and steel	do	481	316	−34.3
Coal and coke	do	7,893	8,075	+2.3

Sources: Tennessee Valley Authority; Tennessee Executive Department, Staff Division for Industrial Development; U.S. Department of Agriculture; U.S. Department of Commerce; and U.S. Department of Labor.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	2,166	178	385	3,087	6	115	39.20	12,919
Metal	1,687	243	410	3,301	2	98	30.30	6,623
Nonmetal	956	267	255	2,124	-------	37	17.42	1,661
Sand and gravel	708	261	185	1,574	-------	33	20.97	460
Stone	2,647	278	736	6,002	2	150	25.33	3,014
Total [1]	8,164	241	1,971	16,087	10	433	27.54	5,227
1967: [p]								
Coal	2,075	178	370	3,033	4	112	38.25	9,168
Metal	1,670	262	439	3,523	3	107	31.23	7,062
Nonmetal	730	244	178	1,464	-------	36	24.60	535
Sand and gravel	600	251	151	1,324	1	18	14.35	4,961
Stone	2,830	259	734	6,023	-------	102	16.93	2,749
Total [1]	7,910	237	1,873	15,367	8	375	24.92	4,985

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

REVIEW BY MINERAL COMMODITIES

NONMETALS

Production of nonmetals accounted for 63 percent of the total value of mineral production in the State, a 1-percent decrease from that of 1966. The principal nonmetal commodities produced in order of value were stone, cement, phosphate rock, and sand and gravel.

Barite.—Continuing a 3-year declining trend, production of barite in Tennessee dropped considerably below that of 1966. Barite was mined by three companies from five mines in the eastern part of the State.

Cement.—Tennessee ranked fifth in the Nation in the production of masonry cement, accounting for 5 percent of the national total. Production decreased slightly from that of 1966. Masonry cement was produced by four companies operating six plants in six counties. Three plants are in eastern Tennessee and three in central Tennessee. Of the masonry cement produced, 66 percent was shipped to Tennessee consumers. Other consumers, by State, were Georgia (12 percent), North Carolina (8 percent), Kentucky (4 percent), Alabama (3 percent), and South Carolina (3 percent). Indiana, Florida, and West Virginia each received less than 1 percent of the total shipped.

Production of portland cement decreased 115,000 barrels, 2 percent less than in 1966. Fifty-one percent of the cement shipments were within Tennessee. Out-of-State shipments went to North Carolina (19 percent), Georgia (19 percent), Virginia (4 percent), Kentucky (3 percent), and Alabama (3 percent). Other States receiving shipments were South Carolina, West Virginia, Indiana, Mississippi, and Florida.

Approximately 3 million tons of raw material was used in the manufacture of portland cement. This material consisted of limestone (64 percent), cement rock (24 percent), clay and shale (7 percent), gypsum (3 percent), sand (1 percent), and slag and iron-rich residues (1 percent).

During 1967, portland cement produced in Tennessee was used as follows: In ready-mix concrete (63 percent), in concrete products (20 percent), by building materials dealers (7 percent), by highway contractors (6 percent), and miscellaneous (4 percent).

Clays.—Tennessee again led in the production of ball clay, accounting for 67 percent of the Nation's total. Nine mines were operated by five companies in Henry and Weakley Counties. H. C. Spinks Clay Co. was the leading producer. Production was 3 percent less than in 1966.

The State ranked fourth in the production of fuller's earth with 4 percent

Table 5.—Ball clay sold or used by producers, by uses

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Whiteware, etc.	223,421	$3,008,173	$13.46	206,992	$2,811,422	$13.58
Floor and wall tile	66,600	664,092	9.97	64,200	846,266	13.18
Other uses [1]	95,220	873,205	9.17	101,031	961,624	9.52
Total	385,241	4,545,470	11.80	372,223	4,619,312	12.41

[1] Includes art pottery, firebrick and block, kiln furniture, other refractories, heavy clay products, enameling, fillers, and other uses.

of the national total. Production increased silghtly over that of 1966. Two companies operated mines in Henry County. Southern Clay Co., Inc., which purchased Tennessee Absorbent Clay Co., announced plans for a $500,000 expansion at the Paris plant; the addition of three new dryers will more than double plant capacity.

Miscellaneous clay production increased 24 percent, a new record. Ten companies mined clay in nine counties for use in lightweight aggregate, brick, cement, and heavy clay products. General Shale Products Corp., the State's leading producer, completed construction of a new facility at Knoxville, the first fully automatic kiln in the United States. The new kiln will produce 90,000 bricks in an 8-hour shift—100 million bricks per year.

Graphite.—Great Lakes Carbon Co. announced plans for a $13.5 million expansion of its graphite electrode plant at Dyersburg, Tenn.

Lime.—The production of quicklime and hydrated lime for building and chemical use increased 11 percent in 1967. Lime produced at the Knoxville plants of Williams Lime Manufacturing Co. and Foote Mineral Co. was shipped as follows: North Carolina (43 percent), Tennessee (41 percent), South Carolina (11 percent), and other States (5 percent).

Perlite.—Chemrock Corp. expanded perlite for aggregate, filler, and filter aids at Nashville. Production decreased 1 percent from that of 1966.

Phosphate Rock.—Tennessee ranked third in the production of phosphate rock with 8 percent of the Nation's total. However, State production decreased 10 percent from that of 1966. Six companies mined and processed phosphate rock in six counties in the central part of the State. The leading producers were Hooker Chemical Corp. and Monsanto Co.

Pyrite.—The State continued to lead the Nation in output of pyrite, establishing a new record high. Tennessee Copper Co. recovered pyrite concentrate from sulfide ore mined in Polk County in the southeastern part of the State.

Sand and Gravel.—Sand and gravel output decreased 8 percent from that of 1966, the record year. Most of the sand and gravel produced was used for construction purposes and the remainder for industrial uses. Production was by 43 companies at 47 operations in 31 counties, with 22 commercial operations, led by Ingram Materials, Inc., each producing over 100,000 tons. Transportation was by truck (80 percent), rail (17 percent), and waterway (3 percent).

Stone.—Tennessee ranked third in the Nation in production of dimension marble, and sixth in dimension sandstone.

Quarrying and crushing of limestone increased 1 percent over that of 1966, establishing a new industry record. Crushed limestone was utilized in concrete and roads (81 percent), agricultural stone (8 percent), cement (7 percent), stone sand (1 percent), and other uses (3 percent). Crushed limestone was produced by 76 operators at 122 locations. Lambert Brothers Division of Vulcan Materials Co. announced plans for constructing a $1 million, 300-ton-per-hour limestone quarry and crushing plant in Goodletts-

Table 6.—Sand and gravel sold or used by producers, by counties

(Thousand short tons and thousand dollars)

County	1966			1967		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Benton	6	931	$1,707	6	871	$1,576
Carroll	1	284	W	1	182	W
Cumberland	1	110	181	1	W	W
Davidson	1	748	1,320	1	W	W
Fayette	1	65	74	1	69	77
Franklin	1	86	W	1	68	W
Gibson	1	585	W	1	323	W
Giles	1	291	141	1	316	156
Grundy	1	193	338	1	154	W
Hamilton	1	406	626	1	W	W
Hardeman	2	76	W	2	105	W
Haywood	1	56	48	1	69	61
Henderson	1	54	W	1	34	W
Humphreys	1	499	564	1	W	W
Lauderdale	1	106	92	1	122	107
Loudon	1	17	20	1	15	W
McMinn	1	67	152	1	W	W
Monroe	1	30	45	1	33	W
Obion	2	225	273	2	222	W
Perry	1	182	249	---	---	---
Polk	1	18	33	---	---	---
Putnam	1	84	141	1	114	W
Shelby	7	1,875	1,685	7	1,758	1,603
Other counties [1]	13	1,640	3,453	13	3,520	7,099
Total	49	8,628	11,142	47	7,975	10,679

W Withheld to avoid disclosing individual company confidential data; included with "Other counties."
[1] Includes Decatur, Greene, Hardin, Knox, McNairy, Sevier, Stewart (1967), Tipton, Unicoi, and Wayne Counties, and counties indicated by symbol W.

Table 7.—Sand and gravel sold or used by producers, by uses

(Thousand short tons and thousand dollars)

Use	1966			1967		
		Value			Value	
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Sand:						
Structural	2,195	$2,752	$1.25	2,347	$3,145	$1.34
Paving	1,135	1,815	1.60	1,029	1,707	1.66
Molding	340	1,039	3.06	319	992	3.11
Fill	59	42	.71	W	W	W
Railroad ballast	24	41	1.71	---	---	---
Fire or furnace	10	22	2.20	---	---	---
Engine	1	2	2.00	W	W	W
Other sands [1]	534	1,015	1.90	435	902	2.07
Total sand	4,298	6,728	1.57	4,130	6,746	1.63
Gravel:						
Paving	2,740	2,424	.88	2,560	2,353	.92
Structural	965	1,203	1.25	876	1,084	1.24
Fill	115	80	.70	117	79	.68
Other gravel [2]	510	707	1.39	292	417	1.43
Total gravel	4,330	4,414	1.02	3,845	3,933	1.02
Total sand and gravel	8,628	11,142	1.29	7,975	10,679	1.34

W Withheld to avoid disclosing individual company confidential data.
[1] Includes glass, grinding and polishing, fill (1967), engine (1967), and other sands.
[2] Includes railroad ballast (1966), miscellaneous and other gravel.

ville. The crushed stone will be used in highway construction, ready-mix, and concrete block.

The quarrying of marble for crushed and dimension stone was limited to a four-county area in eastern Tennessee. The production of crushed and dimension marble decreased 14 percent and 38 percent, respectively. The crushed marble was used for terrazzo, and as extenders and fillers; the dimension marble was used in structural and monumental work.

Table 8.—Crushed limestone sold or used by producers, by counties

County	1966			1967		
	Number of quarries	Short tons	Value	Number of quarries	Short tons	Value
Anderson	2	405,407	W	2	500,820	W
Bedford	1	351,500	W	1	W	W
Blount	1	652,510	W	1	W	W
Bradley	2	503,559	W	2	W	W
Campbell	2	420,000	W	3	W	W
Cocke	1	108,000	$96,000	2	W	W
Coffee	2	899,656	W	2	909,136	W
Davidson	6	4,060,089	4,611,056	7	4,176,209	$4,816,400
Fentress	1	183,983	255,082	1	156,781	222,762
Franklin	4	830,379	1,197,786	4	910,521	1,359,910
Giles	1	248,000	W	2	W	W
Grainger	1	32,000	40,000	1	33,013	41,266
Greene	5	421,589	W	5	286,500	399,375
Hamilton	2	1,991,590	W	2	W	W
Jefferson	8	1,698,108	1,722,684	7	1,845,929	1,847,874
Knox	7	2,096,145	3,084,533	8	2,175,488	3,100,055
Macon	1	121,000	182,000	1	W	W
Marion	4	2,243,295	2,696,199	4	1,757,213	2,059,279
McMinn	2	387,182	512,283	2	W	W
Monroe	2	W	W	2	301,087	373,253
Pickett	1	19,640	29,460	1	50,000	62,000
Putnam	2	452,000	462,000	3	852,783	1,045,783
Rhea	1	W	W	1	124,000	167,400
Roane	1	195,810	268,326	1	W	W
Scott	1	29,994	40,491	1	30,000	37,000
Sevier	2	343,016	W	2	W	W
Smith	2	196,765	W	1	120,000	149,000
Sullivan	1	892,988	W	1	W	W
Unicoi	1	125,000	158,000	1	4,508	5,600
Union	3	227,200	W	1	81,600	101,000
Warren	1	260,500	W	2	W	W
Washington	5	186,942	233,676	5	296,828	371,040
White	2	273,000	W	2	249,000	W
Other counties [1]	36	10,343,311	23,645,585	41	16,567,710	23,797,616
Total	114	31,200,158	39,235,161	122	31,429,126	39,956,613

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

[1] Includes Benton (1967), Cannon Carter, Claiborne, Clay, Cumberland, Decatur, De Kalb (1967), Grundy, Hamblen, Hancock, Hardin, Hawkins, Humphreys, Johnson, Lincoln, Loudon (1967), Marshall, Maury, Meigs, Montgomery, Overton, Robertson, Rutherford, Sequatchie, Stewart (1967), Sumner, Wayne, Williamson, and Wilson Counties, and counties indicated by symbol W.

Table 9.—Crushed limestone sold or used by producers, by uses

Use	1966			1967		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Concrete and roads	25,901,618	$32,162,897	$1.24	25,530,828	$31,929,229	$1.25
Agstone	1,906,539	2,300,860	1.21	2,467,255	2,998,425	1.22
Cement	2,235,045	2,775,502	1.24	2,207,358	2,754,075	1.25
Stone sand	189,500	275,759	1.46	247,270	364,508	1.47
Other uses [1]	967,456	1,720,143	1.78	976,415	1,910,376	1.96
Total	31,200,158	39,235,161	1.26	31,429,126	39,956,613	1.27

[1] Includes riprap, fluxing stone, railroad ballast, glass, paper, asphalt filler, fertilizer filler, other fillers, rock dust for coal mines, mineral food (1967), lime, and other uses.

Crushed and dimension sandstone were quarried in the Cumberland Plateau section of central Tennessee. Crushed sandstone for abrasives, construction, glass, and other uses was produced by three companies at operations in three counties. Production increased for the fifth straight year and was 2 percent higher than in 1966. Dimension sandstone for rough architectural use, flagging, and sawed and dressed building stone was produced by six companies from operations in seven counties. Production decreased 32 percent from that of the preceding year.

METALS

Metals accounted for 23 percent of the total value of mineral production, the same as in 1966. Zinc production accounted for nearly 73 percent of this value and copper for 27 percent.

Aluminum.—The Aluminum Company of America (Alcoa) announced plans for an expansion and modernization program which will include new smelting facilities at the aluminum reduction and fabrication complex at Alcoa. Completion date has been set for 1969.

Consolidated Aluminum Corp. (Conalco), continued work on a fourth potline scheduled for completion in 1968, which will increase production by 34,000 tons per year. Plant output with the new potline is expected to be 140,000 tons annually.

Copper.—Tennessee Copper Co. recovered copper concentrate from sulfide ore in Polk County in the southeastern part of the State. Production was down 5 percent from that of the record year 1966. Because of the copper strike in the Western States, Tennessee Copper Co. was the leading copper producer for part of the year. Tennessee Copper Co. discovered additional reserves of sulfide ore as a result of its continuing exploration program.

Ferroalloys.—Shipments of ferroalloys totaled 111,353 tons valued at $16,585,000. Tonnage and value decreased 66 and 63 percent, respectively.

Gold.—Tennessee Copper Co. recovered gold as a byproduct in blister copper. Production increased 22 percent over that of 1966.

Manganese.—Foote Mineral Co. continued construction on an electrolytic manganese plant at New Johnsonville, with 1968 as the planned completion date. Production from this facility combined with manganese produced by the company's plant at Knoxville will provide an annual capability approaching 50 million pounds.

Silver.—The recovery of silver, a byproduct in refining copper by the Tennessee Copper Co., increased 29 percent, a record recovery.

Zinc.—Tennessee continued to be the leading zinc-producing State with 21 percent of the national production. Production increased approximately 1 percent over that of 1966. A 5-month strike which ended in February lowered production figures in both years.

Total crude ore milled in the State was 5,468,100 tons, an increase of 10 percent from that of 1966. Zinc concentrates were shipped to Illinois, Missouri, Ohio, Oklahoma, and Pennsylvania for smelting and refining.

Table 10.—Mine production of recoverable gold, silver, copper, lead, and zinc

Commodity	1966			1967			Earliest record to date	
	Number of producers	Quantity	Value (thousands)	Number of producers	Quantity	Value (thousands)	Quantity	Value (thousands)
Gold, troy ounces	1	141	$5	1	181	$6	24,896	$614
Silver, do	1	100,716	130	1	130,078	202	4,494,071	3,686
Copper, short tons	1	15,410	11,148	1	14,600	11,162	605,817	244,795
Lead, do	1	181	55	------	------	------	27,324	3,240
Zinc, do	5	103,117	29,904	5	113,065	31,303	2,147,373	472,906
Total	XX	XX	41,242	XX	XX	42,673	XX	725,241

XX Not applicable.

Work continued on American Zinc Co.'s Immel mine, scheduled for production early in 1968. The main shaft and ventilation shaft have been bottomed at 1,600 feet, 600 feet below sea level. Mine output, at full production, will be between 2,000 and 3,000 tons of ore per day.

New Jersey Zinc Co. continued exploration in middle Tennessee near Carthage. Work continued on New Jersey Zinc Co.'s Idol mine in Hancock County, approximately 15 to 20 miles southwest of the company's Flat Gap mine in the Copper Ridge District. The shaft was completed and underground development begun; no date has been set for production.

MINERAL FUELS

Production of mineral fuels accounted for 14 percent of the total value of mineral production in Tennessee, a 1-percent increase over that of 1966.

Coal (Bituminous).—The production of bituminous coal increased 8 percent in tonnage and 14 percent in value above that of 1966. Coal was produced at 193 mines, including 47 new mines, in 16 counties compared with 205 mines in 16 counties in 1966.

In District 8 (northern Tennessee), 4,970,000 tons of coal was produced from 137 mines in nine counties for an average of 36,000 tons per mine, an increase of 900 tons per mine over 1966 figures. Underground mines produced 59 percent of the total tonnage, strip mines 37 percent, and auger mines 4 percent. Of the coal, 63 percent was shipped by rail and 37 percent by truck.

In southern Tennessee (District 13), 1,862,200 tons of coal was produced from 56 mines in seven counties. Average production per mine was 33,300 tons, an increase of 10,000 tons per mine over 1966 figures. Of the coal, 54 percent was mined underground and 46 percent was produced by strip mining. Coal shipments were by rail and barge (83 percent) and truck (17 percent).

Table 11.—Coal (bituminous) production [1] in 1967, by counties

(Thousand short tons and thousand dollars)

County	Number of mine operations			Production [2]				
	Underground	Strip	Auger	Underground	Strip	Auger	Total	
							Quantity	Value
Anderson	23	9	2	1,692	574	67	2,333	$9,552
Bledsoe		2			27		27	107
Campbell	19	15	4	286	564	68	917	3,320
Claiborne	6	3	1	364	249	5	618	2,002
Cumberland	1	2		1	25		26	103
Fentress	7	3		38	19		56	158
Grundy		3			245		245	979
Hamilton	3	1		28	28		56	236
Marion	28			918			918	4,625
Morgan	11	9	1	112	236	59	407	1,351
Overton	6			57			57	222
Putnam	1			50			50	200
Rhea	2			12			12	53
Scott	10	3	1	352	151	3	506	1,738
Sequatchie	9	3		45	242		287	1,072
Van Buren		5			318		318	1,255
Total [2]	126	58	9	3,954	2,677	203	6,832	26,974
Earliest record to date							437,606	NA

NA Not available.
[1] Excludes mines producing less than 1,000 short tons.
[2] Data may not add to totals shown because of independent rounding.

The Tennessee Valley Authority (TVA) purchased 49 percent of the coal mined in the State, a decrease of 4 percent from 1966 level.

Consolidation Coal Co. and Georgia Power Co. signed a 20-year contract for delivery of 1.5 million tons of coal annually. The coal will be shipped by unit

train from the company's Matthews mine in Claiborne County to a steam-electric generating plant of the Georgia Power Co. in Milledgeville, Ga. Initial coal delivery is scheduled for early in 1968.

Coke.—Woodward Iron Co. was the only coke producer in the State. Coke and breeze were produced by 44 coke ovens; coke was used in foundries and blast furnaces, and breeze was used and sold. Coal chemicals produced included coke oven gas, ammonium sulfate, tar, and crude light oil (converted to industrial-grade benzene), toluene, and crude naphtha.

Natural Gas.—State production of natural gas in 1967 was 53 million cubic feet valued at $11,000. One gas-producing well was completed in Macon County.

Petroleum.—Cumulative production of crude petroleum in Tennessee since 1916 is 699,000 barrels. Crude petroleum was produced from 33 wells in the north-central part of the State. Pemberton Oil and Lumber Co. and David Law & Mack Petroleum Co. were the principal producers.

During the year, exploration drilling for petroleum was conducted in 18 counties and resulted in three commercial producers.

Table 12—Oil and gas will drilling in 1967

County	Exploratory wells			
	Oil	Gas	Dry	Footage
Bledsoe	--	--	1	2,030
Clay	--	--	7	6,335
Fentress	--	--	1	855
Henry	--	--	1	1,008
Jackson	--	--	2	2,407
Macon	2	1	7	6,029
Marshall	--	--	2	1,577
Morgan	--	--	1	1,401
Obion	--	--	5	14,263
Overton	--	--	1	930
Robertson	--	--	4	3,465
Rutherford	--	--	1	5,616
Scott	1	--	2	4,888
Smith	--	--	1	305
Stewart	--	--	2	1,445
Sumner	--	--	2	600
White	--	--	2	1,302
Wilson	--	--	1	5,534
Total	3	1	43	59,990

Source: American Association of Petroleum Geologists.

Table 13.—Principal producers

Commodity and company	Name of operation	County	Address	Remarks
Aluminum smelters:				
Consolidated Aluminum Corp	Conalco plant	Madison	1100 Richmond St. Jackson, Tenn. 38310	
Aluminum Company of America	Alcoa plant	Blount	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	
Barite:				
Godsey Mines, Inc	Athens mine	McMinn	Box 227 Sweetwater, Tenn. 37874	
Do	Niota mine	do	do	
Do	Forkner mine	Monroe	do	
National Lead Co	Ballard mine	McMinn	Box 1675 Houston, Tex. 77001	
B. C. Wood	Cedar Forks mine	Loudon	Box 284 Sweetwater, Tenn. 37874	
Cement:				
General Portland Cement Co	Chattanooga mill	Hamilton	305 Maclellan Bldg. Chattanooga Tenn. 37402	Masonry and portland cement, limestone.
Ideal Cement Co	Knoxville plant	Knox	Denver National Bldg. Denver, Colo. 80202	Masonry and portland cement, limestone, clays.
Marquette Cement Manufacturing Co	Nashville plant	Davidson	20 N. Wacker Dr. Chicago, Ill. 60606	Do.
Do	Cowan plant	Franklin	do	Do.
Penn-Dixie Cement Corp	Richard City mill	Marion	Box 152 Nazareth, Pa. 18064	Do.
Do	Kingsport mill	Sullivan	do	Do.
Clay:				
Ball:				
Bell Clay Co	Bynum mine	Weakley	Gleason, Tenn. 38229	
Do	Collins mine	do	do	
Do	Dresden mine	do	do	
Do	Stallcup mine	do	do	
Cyprus Mines Corp	No. 60 mine	do	Box 1201 Trenton, N. J. 08618	
Kentucky-Tennessee Clay Co	Tennessee mine	Henry	Box 77 Mayfield, Ky. 42066	
Laird Brick Co., Inc	Puryear mine	do	Puryear, Tenn. 38251	
H. C. Spinks Clay Co., Inc	Henry County mine	do	Box 829 Paris, Tenn. 38242	
Do	Gleason mine	Weakley	do	
Fuller's earth:				
Southern Clay Co., Inc	Henry County mine	Henry	Box 838 Paris, Tenn. 38242	
Tennessee Absorbent Clay Co	do	do	do	
Miscellaneous:				
W. G. Bush & Co., Inc	Nashville mine	Davidson	1136 2d Ave. North Nashville, Tenn. 37208	
John A. Denie's Sons Co	Denlite plant	Shelby	Box 247 Memphis, Tenn. 38101	
General Shale Products Corp	Chattanooga mine	Hamilton	Box 60 Johnson City, Tenn. 37601	

Do	Knoxville mine	Knox	----do	
Do	Kingsport mine	Sullivan	----do	
Do	Johnson City mine	Washington	----do	
Old Hickory Brick Co., Inc	Greenback mine	Loudon	Greenback, Tenn. 37742	
Shalite Corp	Shalite mine	Knox	Box 441 Knoxville, Tenn. 37901	
Coal:				
Consolidated Coal Co	Morco mine	Anderson	Devonia, Tenn. 37728	All underground mines.
Grundy Mining Co., Inc	No. 21 mine	Marion	Tracy City, Tenn. 37387	
Oliver Springs Mining Co., Inc	Dean mine	Anderson	Box 350 Oliver Springs, Tenn. 37840	
Do	Windrock mine	----do	----do	
Tennco, Inc	Grays Gap mine	Anderson	Box 498 Lake City, Tenn. 37769	Strip.
Do	Premium mine	----do	----do	Auger.
Do	Tennco mine	----do	----do	Do.
Do	No. 1 mine	----do	----do	Strip.
Do	No. 3-A mine	----do	----do	Do.
Tennessee Auger Co., Inc	Graves Gap mine	----do	----do	All underground mines.
Do	Walnut Mountain No. 2 mine	----do	----do	
Do	Walnut Mountain No. 3 mine	----do	----do	
Do	Walnut Mountain No. 4 mine	----do	----do	
Coke:				
Woodward Iron Co	Chattanooga plant	Hamilton	Woodward, Ala. 35189	
Copper:				
Tennessee Copper Co	Boyd mine	Polk	General Office Copper hill, Tenn. 37317	Also gold, silver, zinc, pyrites.
Do	Calloway mine	----do	----do	
Do	Cherokee mine	----do	----do	
Do	Eureka mine	----do	----do	
Do	Mary mine	----do	----do	
Graphite, artificial:				
Union Carbide Corp	Columbia plant	Maury	270 Park Ave. New York, N. Y. 10017	
Lime				
Bowaters Southern Paper Co	Calhoun limekiln	McMinn	Calhoun, Tenn. 37309	Regenerated lime.
Foote Mineral Co	Asbury limekiln	Knox	Rt. 8, Asbury Rd. Knoxville, Tenn. 37914	Hydrated and quicklime, limestone.
The Mead Corp	Kingsport limekiln	Sullivan	Kingsport, Tenn. 37660	Regenerated lime.
Tennessee River Pulp & Paper Co	Counce limekiln	Hardin	Counce, Tenn. 38326	Do.
Williams Lime Mfg. Co	Knoxville limekiln	Knox	Box 2286 Knoxville, Tenn. 37901	Hydrated and quicklime, limestone.
Natural gas:				
Citizens Gas Utility District	----------	Morgan	Oneida, Tenn. 37841	18 wells.
		Scott	----do	3 wells.
Oil:				
Allen Boles	----------	Clay	1726 N. Washington Cookeville, Tenn. 38501	
J. Fred Landers	----------	Sumner	6424 Bresslyn Rd. Nashville, Tenn. 37205	3 wells.
David Law	----------	Scott	Box 1751, Garrity Bldg. Parkersburg, W. Va. 26101	
Mack Petroleum Co	----------	Morgan	Box 629 Knoxville, Tenn. 37901	4 wells.
Pemberton Oil & Lumber Co	----------	----do	Oneida, Tenn. 37841	10 wells.
		Scott	----do	3 wells.

Table 13.—Principal producers—Continued

Commodity and company	Name of operation	County	Address	Remarks
Perlite, expanded:				
Chemrock Corp	Nashville plant	Davidson	Osage St. Nashville, Tenn. 37208	
Petroleum refinery:				
Delta Refinery Co		Shelby	543 W. Mallory Ave. Memphis, Tenn. 38106	
Phosphate rock:				
Hooker Chemical Corp	Columbia mine	Maury	Box 591 Columbia, Tenn. 38402	
Monsanto Co	Davidson County mine	Davidson	800 North Lindbergh Blvd St. Louis, Mo. 63141	
Do	Giles County mine	Giles	do	
Do	Monsanto mine	Maury	do	
Do	Sumner County mine	Sumner	do	
Do	Williamson County mine	Williamson	do	
Presnell Phosphate Co., Inc	Columbia mine	Maury	Presnell Bldg. Columbia, Tenn. 38401	
Stauffer Chemical Co	Mt. Pleasant mine	do	299 Park Ave. New York, N. Y. 10017	
Do	Southport mine	do	do	
M. C. West, Inc	Highland mine	Hickman	Box 381 Columbia, Tenn. 38402	
Sand and gravel:				
Dixie Sand & Gravel Co	Dixie mine	Hamilton	515 River St. Chattanooga, Tenn. 37402	
Hardy Sand Co	Camden mine	Benton	Box 629 Evansville, Ind. 47702	
Do	Silica mine	do	do	
Do	Bruceton mine	Carroll	do	
Ingram Materials, Inc	Nashville mine	Davidson	Box 5278 Nashville, Tenn. 37206	
Mid-South Aggregates, Inc	Ellis mine	Shelby	8600 Ellis Rd. Memphis, Tenn. 38128	
Do	Holmes mine	do	do	
Sangravel Co., Inc	Johnsonville mine	Humphreys	1136 2d Ave. North Nashville, Tenn. 37208	
Stone:				
Limestone:				
American Zinc Co	Coy mine	Jefferson	20 South Fourth St. St. Louis, Mo. 63102	Crushed limestone, zinc.
Do	Grasselli mine	do	do	
Do	North Friends Station mine	do	do	
Do	Young mine	do	do	
Do	Immel mine	Knox	do	
Do	Mascot No. 2 mine	do	do	
Do	Midway quarry	do	do	Limestone only.
Hoover, Inc	Nashville quarry	Davidson	Box 7201 Nashville, Tenn. 37210	Crushed limestone.
Do	Giles quarry	Giles	do	

Do	Marshall quarry	Marshall	do	
Do	Putnam quarry	Putnam	do	
Do	Rutherford quarry	Rutherford	do	
Lambert & Lambert Stone Co., Inc	Shelbyville quarry	Bedford	Box 2098 Chattanooga, Tenn. 37409	Do.
Do	Tiftonia quarry	Hamilton	do	
Do	Murfreesboro quarry	Rutherford	do	
Do	McMinnville quarry	Warren	do	
Ralph Rogers & Co., Inc	Oak Ridge quarry	Anderson	720 Argyle Ave. Nashville, Tenn. 37203	Do.
Do	Coffee County quarry	Coffee	do	
Do	Pilot Knob mine	Sumner	do	
Vulcan Materials Co	Benton quarry	Benton	Box 7 Knoxville, Tenn. 37901	Do.
Do	Maryville quarry	Blount	do	
Do	Tazewell quarry	Claiborne	do	
Do	Cocke quarry	Cocke	do	
Do	Danley quarry	Davidson	do	
Do	Hermitage quarry	do	do	
Do	River Road quarry	do	do	
Do	Goodlettsville quarry	do	do	
Do	Parsons quarry	Decatur	do	
Do	Chattanooga quarry	Hamilton	do	
Do	Savannah quarry	Hardin	do	
Do	McCloud quarry	Hawkins	do	
Do	Rock Hill quarry	Humphreys	do	
Do	City quarry	Knox	do	
Do	Lenoir City quarry	Loudon	do	
Do	Marion quarry	Marion	do	
Do	Nickajack Dam quarry	Marion	do	
Do	Sevierville quarry	Sevier	do	
Do	New Kingsport quarry	Sullivan	do	
Do	Waynesboro quarry	Wayne	do	
Do	Franklin quarry	Williamson	do	
Marble, crushed:				
Appalachian Marble Co	Appalachian quarry	Knox	2607 Middlebrook Pike Knoxville, Tenn. 37921	
Do	Bond quarry	do	do	
John J. Craig Co	Hamil quarry	Blount	Box 9300 Knoxville, Tenn. 37920	
Do	Marmor quarry	do	do	
Do	Alexander quarry	Loudon	do	
Knoxville Crushed Stone Co	Stone Road quarry	Knox	121 Stone Rd. Knoxville, Tenn. 37920	
Marble, dimension:				
Appalachian Marble Co	Appalachian quarry	Knox	2607 Middlebrook Pike Knoxville, Tenn. 37921	
Do	Bond quarry	do	do	
John J. Craig Co	Hamil quarry	Blount	Box 9300 Knoxville, Tenn. 37920	
Do	Lee quarry	do	do	
Do	Marmor quarry	do	do	
Do	Alexander quarry	Loudon	do	
Georgia Marble Co	Eagle quarry	Knox	Box 1550 Knoxville, Tenn. 37901	
Do	Luttrell quarry	Union	do	

Table 13.—Principal producers—Continued

Commodity and company	Name of operation	County	Address	Remarks
Stone—Continued				
Marble, dimension—Continued				
Imperial Black Marble Corp	Thornhill quarry	Grainger	801 Bluff Dr. Knoxville, Tenn. 37919	
Sandstone, crushed:				
Gamble Asphalt Materials Co	Gamble quarry	Cumberland	Crossville, Tenn. 38555	
Sewanee Silica Co	Monteagle quarry	Franklin	Box 215 Sewanee, Tenn. 37375	
White Silica Sand Co., Inc	Silica quarry	Campbell	Box 6056 Knoxville, Tenn. 37914	
Sandstone, dimension:				
Bowman Stone Co	Crab Orchard quarry	Cumberland	Crab Orchard, Tenn. 37723	
Ross L. Brown Cut Stone Co., Inc	Brown quarry	do	do	
Crab Orchard Stone Co., Inc	Peck quarry	do	Box 238 Crossville, Tenn. 38555	
Cumberland Mtn. Stone Co	Cumberland Mtn. quarry	do	Crab Orchard, Tenn. 37723	
Turner Bros. Stone Co., Inc	Turner Bros. quarry	do	Crossville, Tenn. 38555	
Zinc:				
American Zinc Co	Coy mine	Jefferson	20 South Fourth St. St. Louis, Mo. 63102	Also limestone.
Do	Grasselli mine	do	do	
Do	North Friends Station mine	do	do	
Do	Young mine	do	do	
Do	Mascot No. 2 mine	Knox	do	
Do	Immel mine	do	do	
New Jersey Zinc Co	Flat Top mine	Hancock	160 Front St. New York, N. Y. 10038	Do.
	Jefferson City mine	Jefferson	do	
New Market Zinc Co	New Market mine	Jefferson	Box 66 New Market, Tenn. 37820	
Tennessee Copper Co	Boyd mine	Polk	General Office Copperhill, Tenn. 37317	Also gold, silver, copper, pyrites.
Do	Calloway mine	do	do	
Do	Cherokee mine	do	do	
Do	Eureka mine	do	do	
Do	Mary mine	do	do	
U.S. Steel Corp	Zinc Mine works	Jefferson	Box 599 Fairfield, Ala. 35064	Also limestone.

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 F. F. Netzeband [1] and Roselle Girard [2]

Texas, with a $5.4 billion value of mineral production in 1967, led the Nation for the 33d consecutive year. The 1967 total value was about 8 percent greater than that of 1966. The State was the largest domestic producer of crude oil, natural gas, natural gas liquids, and magnesium metal. Substantial quantities of cement, clay, gypsum, iron ore, lime, salt, sand and gravel, stone, and sulfur were also produced. Minerals and mineral fuels were produced in 236 of the State's 254 counties; crude oil in 199 counties; natural gas in 192; natural gas liquids in 123; nonmetallic minerals in 168; and metallic minerals in eight.

[1] Mining engineer, Bureau of Mines, Dallas, Tex.
[2] Geologist, Bureau of Economic Geology, The University of Texas at Austin, Austin, Texas.

Table 1.—Mineral production in Texas [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland—thousand 376-pound barrels	30,827	$97,188	31,944	$99,329
Masonry—thousand 280-pound barrels	884	2,872	888	2,847
Clays—thousand short tons	4,516	7,187	4,497	8,081
Gem stones	NA	150	NA	150
Gypsum—thousand short tons	899	3,258	984	3,419
Helium:				
Refined—thousand cubic feet	364,100	12,744	335,900	9,900
Crude—do	1,030,500	10,605	977,600	10,246
Lime—thousand short tons	1,473	18,696	1,564	20,713
Natural gas—million cubic feet	6,953,790	903,993	7,188,900	948,935
Natural gas liquids:				
Natural gasoline and cycle products—thousand gallons	3,890,267	269,332	4,031,589	277,105
LP gases—do	6,359,870	260,755	7,449,439	320,326
Petroleum (crude)—thousand 42-gallon barrels	1,057,706	3,141,387	1,119,962	3,375,565
Salt—thousand short tons	7,724	33,797	8,344	36,435
Sand and gravel—do	26,222	31,313	31,398	39,170
Stone (includes basalt and shell)—do	43,578	56,659	49,424	61,577
Sulfur (Frasch process)—thousand long tons	3,703	96,820	3,448	111,931
Talc—short tons	102,399	367	90,836	356
Value of items that cannot be disclosed: Asphalt (native), barite (1966), bromine, coal (lignite), graphite, iron ore (usable), magnesium chloride (for metal), magnesium compounds (except for metal), mercury, perlite, pumicite, sodium sulfate, uranium (recoverable content U_3O_8), and crude vermiculite (1967)	XX	r 74,918	XX	80,286
Total	XX	r 5,022,041	XX	5,406,371
Total 1957–59 constant dollars	XX	4,885,240	XX	p 5,200,941

p Preliminary. r Revised. XX Not applicable. NA Not available.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

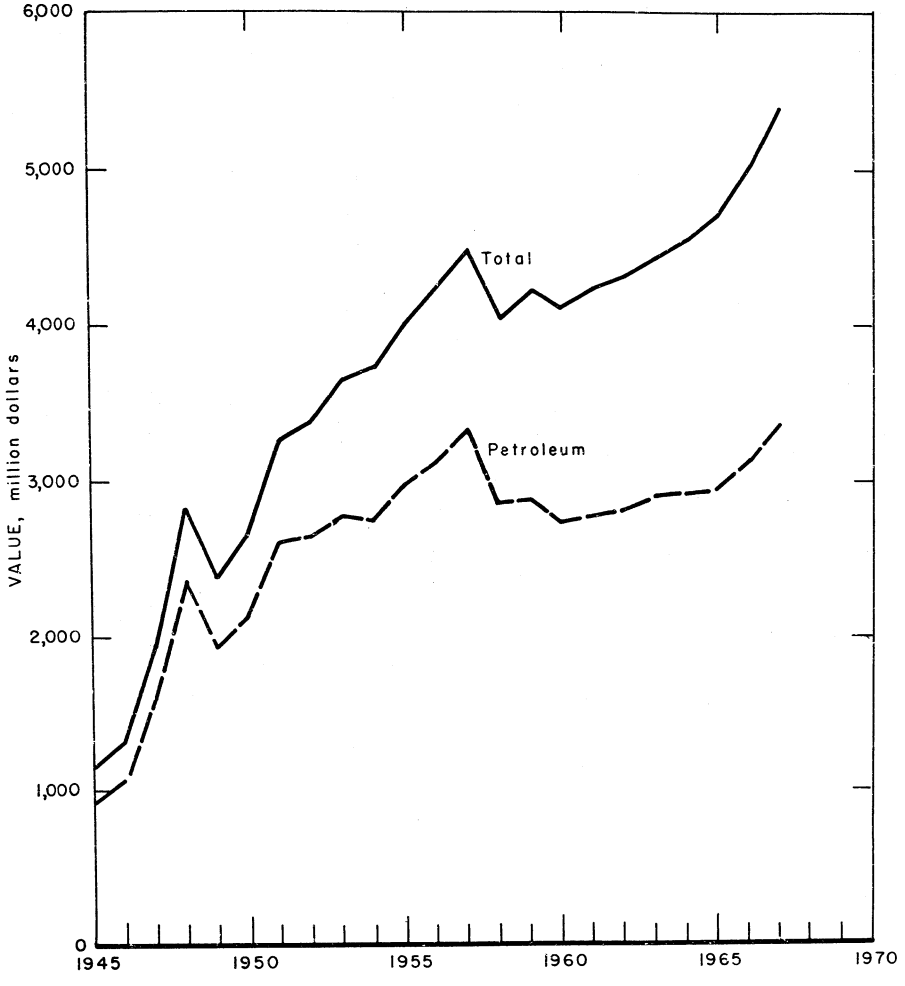

Figure 1.—Value of petroleum and total value of mineral production in Texas.

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

County	1966 [r]	1967	Minerals produced in 1967 in order of value
Anderson	$32,002,460	$34,561,270	Petroleum, natural gas, natural gas liquids, stone.
Andrews	270,683,309	285,795,701	Petroleum, natural gas liquids, natural gas.
Angelina	474,691	328,319	Clays, natural gas, petroleum.
Aransas	10,796,921	11,717,299	Natural gas, petroleum, natural gas liquids, shell.
Archer	31,069,514	33,352,608	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Atascosa	18,877,110	20,061,624	Petroleum, natural gas, natural gas liquids, sand and gravel.
Austin	6,387,115	6,839,600	Do.
Bastrop	963,837	957,210	Clays, petroleum, stone, sand and gravel, natural gas.
Baylor	4,977,300	5,294,630	Petroleum, sand and gravel, stone, natural gas.
Bee	24,317,235	25,066,592	Natural gas, petroleum, natural gas liquids, stone.
Bell	102,087	227,298	Sand and gravel, stone.

See footnotes at end of table.

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

County	1966 [r]	1967	Minerals produced in 1967 in order of value
Bexar	$25,158,381	$26,753,560	Cement, stone, sand and gravel, petroleum, natural gas liquids, clays.
Blanco	W	133,560	Stone, sand and gravel.
Borden	26,224,960	28,149,823	Petroleum, natural gas, sand and gravel.
Bosque	117,000	W	Stone, sand and gravel.
Bowie	111,770	150,938	Petroleum, clays.
Brazoria	188,170,805	214,036,422	Petroleum, natural gas, natural gas liquids, magnesium chloride, bromine, salt, lime, magnesium compounds, sulfur, sand and gravel.
Brazos	17,530	W	Sand and gravel, stone, natural gas, petroleum.
Brewster	W	W	Mercury, clays.
Brooks	38,358,273	40,593,035	Natural gas, petroleum, natural gas liquids.
Brown	2,227,172	2,417,107	Stone, petroleum, natural gas, clays.
Burleson	W	6,953	Petroleum.
Burnet	4,412,650	5,112,451	Stone, graphite, sand and gravel.
Caldwell	15,469,870	16,636,687	Petroleum, stone.
Calhoun	20,577,846	22,314,928	Natural gas, petroleum, natural gas liquids, shell, lime.
Callahan	6,262,393	6,650,163	Petroleum, natural gas, natural gas liquids.
Cameron	1,341,400	1,408,760	Natural gas, petroleum.
Camp	2,942,450	3,161,651	Petroleum, natural gas.
Carson	16,854,600	17,714,143	Petroleum, natural gas liquids, natural gas.
Cass	14,842,324	15,965,086	Natural gas liquids, petroleum, natural gas, iron ore.
Chambers	83,203,425	87,776,346	Petroleum, natural gas, shell, salt, natural gas liquids.
Cherokee	3,379,037	3,533,733	Petroleum, natural gas, natural gas liquids, clays, iron ore.
Childress	266,390	309,241	Petroleum, sand and gravel, natural gas.
Clay	12,827,750	13,750,894	Petroleum, natural gas, stone, sand and gravel.
Cochran	25,038,112	26,809,051	Petroleum, natural gas, natural gas liquids.
Coke	28,969,850	32,017,641	Petroleum, natural gas liquids, natural gas, sand and gravel.
Coleman	7,346,363	7,385,816	Petroleum, natural gas, natural gas liquids, clays, stone.
Collin	120,302	612,150	Stone.
Collingsworth	3,917,630	4,202,877	Natural gas, petroleum, sand and gravel.
Colorado	39,590,350	44,827,733	Natural gas, natural gas liquids, sand and gravel, petroleum.
Comal	W	W	Stone, lime.
Comanche	205,172	229,377	Natural gas, petroleum, natural gas liquids, stone, clays, sand and gravel.
Concho	1,681,765	1,787,704	Petroleum, natural gas, natural gas liquids.
Cooke	33,155,669	35,595,328	Petroleum, natural gas liquids, natural gas, stone.
Coryell	115,304	----------	
Cottle	40,110	43,093	Petroleum, natural gas.
Crane	175,010,413	219,097,510	Petroleum, natural gas liquids, natural gas.
Crockett	29,748,540	32,026,047	Petroleum, natural gas, natural gas liquids.
Crosby	360,340	1,386,180	Sand and gravel, petroleum, natural gas.
Culberson	3,508,293	3,748,236	Petroleum, natural gas.
Dallam	50,400	52,905	Natural gas.
Dallas	18,667,190	16,548,489	Cement, sand and gravel, stone, clays.
Dawson	30,055,526	32,228,387	Petroleum, natural gas, natural gas liquids, stone.
Denton	296,382	187,659	Petroleum, sand and gravel, natural gas, clays.
De Witt	13,854,445	14,561,212	Natural gas, petroleum, natural gas liquids, sand and gravel, stone.
Dickens	89,950	104,631	Petroleum, sand and gravel. natural gas.
Dimmit	884,860	948,846	Petroleum, natural gas.
Donley	----------	380,000	Sand and gravel.
Duval	37,577,495	39,451,641	Petroleum, natural gas, salt, natural gas liquids, sand and gravel.
Eastland	4,737,152	5,077,123	Natural gas liquids, petroleum, natural gas, clays, stone.
Ector	254,562,279	272,868,409	Petroleum, natural gas liquids, natural gas, cement, stone, sand and gravel.
Edwards	137,070	134,200	Petroleum.
Ellis	14,596,778	18,903,400	Cement, stone, clays, sand and gravel.
El Paso	5,466,905	5,589,947	Cement, stone, sand and gravel.
Erath	1,832,785	1,844,381	Natural gas, natural gas liquids, petroleum, sand and gravel.
Falls	308,721	57,234	Stone, sand and gravel, petroleum.
Fayette	1,533,145	1,924,611	Petroleum, sand and gravel, clays, natural gas, stone.
Fisher	20,329,546	21,854,966	Petroleum, natural gas liquids, natural gas, gypsum, stone, clays.
Floyd	W	W	Sand and gravel.
Foard	2,885,940	3,186,079	Petroleum, sand and gravel, natural gas.
Fort Bend	42,135,238	47,970,759	Petroleum, sulfur, natural gas, salt, natural gas liquids, clays, sand and gravel.
Franklin	13,781,085	14,201,111	Petroleum, natural gas liquids, natural gas.
Freestone	2,797,061	2,749,556	Natural gas, stone, petroleum, natural gas liquids, clays, sand and gravel.
Frio	5,092,722	5,375,187	Petroleum, natural gas, natural gas liquids.
Gaines	110,398,436	118,362,024	Petroleum, natural gas, natural gas liquids, sodium sulfate, stone.

See footnotes at end of table.

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

County	1966 [r]	1967	Minerals produced in 1967 in order of value
Galveston	$55,099,057	$57,142,820	Petroleum, natural gas, natural gas liquids, shell, clays, sand and gravel.
Garza	15,552,080	16,661,127	Petroleum, sand and gravel, natural gas.
Gillespie	222,009	W	Gypsum, sand and gravel, stone, soapstone.
Glasscock	4,423,120	4,738,875	Petroleum, natural gas.
Goliad	12,086,594	12,647,984	Natural gas, petroleum.
Gonzales	1,339,478	1,259,849	Natural gas, petroleum, clays, sand and gravel.
Gray	50,731,566	53,124,785	Petroleum, natural gas liquids, natural gas.
Grayson	27,798,085	28,560,407	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Gregg	89,832,715	96,901,155	Petroleum, natural gas liquids, natural gas.
Grimes	32,100	72,481	Stone, sand and gravel, natural gas.
Guadalupe	9,354,146	10,043,211	Petroleum, sand and gravel, clays, natural gas.
Hale	7,614,318	8,161,312	Petroleum, natural gas, natural gas liquids.
Hall	------	6,000	Sand and gravel.
Hamilton	93,266	117,668	Natural gas, stone, petroleum.
Hansford	28,051,078	29,295,528	Natural gas liquids, natural gas, petroleum, helium.
Hardeman	7,508,124	8,824,140	Petroleum, gypsum, natural gas liquids, sand and gravel, natural gas.
Hardin	26,559,031	28,163,209	Petroleum, natural gas, natural gas liquids, sand and gravel.
Harris	116,284,279	121,186,568	Petroleum, cement, natural gas liquids, natural gas, lime, salt, sand and gravel, clays.
Harrison	18,630,930	19,608,857	Petroleum, natural gas, natural gas liquids, coal, clays.
Hartley	154,760	166,292	Petroleum, natural gas.
Haskell	10,113,840	10,879,504	Petroleum, natural gas, stone.
Hays	53,864	W	Sand and gravel, stone.
Hemphill	2,491,660	2,640,025	Natural gas, petroleum.
Henderson	10,569,901	11,543,556	Natural gas, petroleum, natural gas liquids, clays, sand and gravel.
Hidalgo	36,946,131	38,511,982	Natural gas, natural gas liquids, petroleum, sand and gravel, stone, clays.
Hill	963,102	1,583,223	Lime, stone, sand and gravel, petroleum.
Hockley	58,150,761	62,368,610	Petroleum, natural gas liquids, natural gas.
Hood	62,500	50,513	Natural gas, sand and gravel.
Hopkins	8,916,700	9,504,225	Natural gas, petroleum, natural gas liquids, clays.
Houston	6,783,268	7,001,778	Petroleum, natural gas liquids, natural gas, sand and gravel.
Howard	55,055,438	59,148,365	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Hudspeth	553,930	501,123	Talc, stone, gypsum.
Hunt	150,900	160,507	Natural gas, stone.
Hutchinson	43,626,996	45,957,384	Petroleum, natural gas liquids, natural gas, sand and gravel, salt, stone.
Irion	3,414,160	3,637,305	Petroleum, natural gas liquids, natural gas.
Jack	13,766,145	15,031,201	Petroleum, natural gas, stone, natural gas liquids.
Jackson	56,090,464	59,804,290	Petroleum, natural gas, natural gas liquids, sand and gravel.
Jasper	2,087,865	2,257,087	Petroleum, natural gas, clays, lime, sand and gravel.
Jefferson	69,381,289	78,838,440	Petroleum, sulfur, natural gas, natural gas liquids, salt, sand and gravel, clays.
Jim Hogg	20,890,048	22,273,583	Petroleum, natural gas, natural gas liquids.
Jim Wells	84,585,018	88,963,440	Do.
Johnson	W	2,644,377	Lime, stone, sand and gravel.
Jones	11,800,305	12,498,491	Petroleum, natural gas liquids, natural gas, stone.
Karnes	18,780,425	22,350,617	Petroleum, uranium, natural gas, natural gas liquids.
Kaufman	2,190,625	1,879,394	Petroleum, stone, sand and gravel, natural gas.
Kenedy	12,062,854	12,794,368	Natural gas, petroleum, natural gas liquids.
Kent	40,196,975	43,215,433	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kerr	W	W	Sand and gravel.
Kimble	58,280	W	Sand and gravel, natural gas, petroleum.
King	3,797,760	4,077,183	Petroleum, natural gas.
Kleberg	123,625,376	127,445,460	Petroleum, natural gas, natural gas liquids, stone.
Knox	5,843,270	6,290,466	Petroleum, natural gas, sand and gravel.
Lamb	520,326	554,486	Petroleum, stone, natural gas.
Lampasas	74,019	43,320	Sand and gravel, stone.
La Salle	1,146,430	1,224,979	Petroleum, natural gas.
Lavaca	9,911,017	10,181,783	Natural gas liquids, natural gas, petroleum.
Lee	39,300	161,546	Stone, petroleum, sand and gravel, natural gas.
Leon	5,660,478	6,020,798	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Liberty	39,616,107	42,516,591	Petroleum, sulfur, natural gas, sand and gravel, natural gas liquids.
Limestone	2,548,488	3,166,479	Sand and gravel, natural gas, petroleum, clays, stone.
Lipscomb	11,991,780	12,764,047	Petroleum, natural gas.
Live Oak	22,611,621	23,881,305	Natural gas, natural gas liquids, petroleum.
Llano	353,167	514,319	Stone, vermiculite.
Loving	10,510,720	11,272,067	Petroleum, natural gas.
Lubbock	989,620	1,026,211	Petroleum, sand and gravel, natural gas.

See footnotes at end of table.

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

County	1966 r	1967	Minerals produced in 1967 in order of value
Lynn	$1,670,820	$1,795,144	Petroleum, natural gas.
McCulloch	1,468,635	W	Sand and gravel, stone.
McLennan	6,546,707	7,096,735	Cement, sand and gravel, natural gas liquids, stone, clays, petroleum.
McMullen	9,569,379	9,774,938	Natural gas, petroleum, natural gas liquids.
Madison	4,610,529	5,032,231	Natural gas, petroleum, sand and gravel, natural gas liquids, stone.
Marion	5,037,156	5,370,907	Petroleum, natural gas, natural gas liquids.
Martin	6,239,370	6,719,446	Petroleum, natural gas, stone.
Mason	48,000	26,440	Stone, sand and gravel.
Matagorda	57,764,195	60,638,874	Petroleum, natural gas, natural gas liquids, sulfur, shell, sand and gravel, clays.
Maverick	4,428,446	4,795,095	Petroleum, natural gas liquids, natural gas.
Medina	941,573	1,007,360	Petroleum, clays, natural gas.
Menard	329,690	354,099	Petroleum, natural gas.
Midland	58,847,974	63,126,264	Petroleum, natural gas liquids, natural gas, sand and gravel.
Milam	W	W	Coal, petroleum, sand and gravel.
Mills	345,526	56,200	Stone.
Mitchell	6,033,630	6,376,173	Petroleum, natural gas, sand and gravel.
Montague	20,886,539	22,028,741	Petroleum, natural gas liquids, natural gas, stone, sand and gravel.
Montgomery	31,983,735	33,880,105	Petroleum, natural gas liquids, natural gas, sand and gravel.
Moore	45,746,393	44,096,184	Natural gas liquids, helium, natural gas, petroleum.
Morris	W	W	Iron ore.
Motley	1,032,160	1,045,234	Petroleum, sand and gravel, natural gas.
Nacogdoches	5,693,157	6,060,674	Natural gas, iron ore, natural gas liquids, clays, petroleum.
Navarro	6,324,346	6,804,216	Petroleum, natural gas, clays, stone, sand and gravel.
Newton	5,433,088	5,704,258	Petroleum, natural gas, natural gas liquids.
Nolan	29,079,263	28,678,490	Petroleum, cement, natural gas liquids, natural gas, gypsum, stone, sand and gravel.
Nueces	85,408,029	94,378,093	Natural gas, petroleum, natural gas liquids, cement, shell, lime, sand and gravel.
Ochiltree	26,076,964	27,540,605	Petroleum, natural gas, natural gas liquids.
Oldham	W	W	Sand and gravel, clays.
Orange	11,346,716	13,101,498	Petroleum, natural gas, cement, natural gas liquids, clays.
Palo Pinto	4,071,236	4,393,696	Natural gas, natural gas liquids, stone, petroleum, clays, sand and gravel.
Panola	40,890,855	43,576,863	Natural gas, natural gas liquids, petroleum.
Parker	3,206,130	3,194,251	Natural gas liquids, natural gas, stone, clays, petroleum, sand and gravel.
Pecos	74,991,333	81,960,595	Petroleum, natural gas, natural gas liquids, sulfur, sand and gravel.
Polk	5,498,400	5,984,289	Petroleum, natural gas, stone.
Potter	62,648,304	64,036,246	Natural gas, cement, helium, natural gas liquids, stone, sand and gravel, petroleum.
Presidio	W	W	Mercury, perlite.
Rains	779,600	1,966,987	Natural gas liquids, natural gas.
Reagan	43,373,042	45,967,339	Petroleum, natural gas liquids, natural gas.
Red River	94,320	101,351	Petroleum.
Reeves	12,136,759	12,795,820	Petroleum, natural gas, natural gas liquids, sand and gravel.
Refugio	84,547,196	90,706,330	Petroleum, natural gas, natural gas liquids.
Roberts	6,237,550	6,617,665	Natural gas, petroleum.
Robertson	27,640	217,428	Sand and gravel, stone, petroleum.
Rockwall	----------	164,674	Stone.
Runnels	12,470,946	12,888,744	Petroleum, natural gas, natural gas liquids.
Rusk	65,783,524	70,976,741	Petroleum, natural gas liquids, natural gas, clays.
San Augustine	1,280	3,300	Sand and gravel, petroleum.
San Jacinto	2,077,890	2,389,355	Petroleum, natural gas, sand and gravel, stone.
San Patricio	45,998,722	50,483,723	Petroleum, natural gas, natural gas liquids, sand and gravel, stone, clays.
San Saba	----------	21,290	Stone.
Schleicher	13,766,797	14,722,642	Petroleum, natural gas, natural gas liquids.
Scurry	117,251,930	128,405,980	Petroleum, natural gas liquids, natural gas, stone, clays.
Shackelford	9,198,907	9,995,502	Petroleum, natural gas, stone, natural gas liquids.
Shelby	785,660	824,903	Natural gas, petroleum.
Sherman	16,364,590	17,179,336	Do.
Smith	10,718,645	11,427,797	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Somervell	W	W	Sand and gravel.
Starr	31,750,370	33,709,314	Petroleum, natural gas, natural gas liquids, pumicite, clays.
Stephens	8,755,595	9,145,013	Petroleum, natural gas, natural gas liquids, stone.
Sterling	8,145,010	8,751,732	Petroleum, natural gas.
Stonewall	20,859,859	22,495,680	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.

See footnotes at end of table.

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

County	1966 [r]	1967	Minerals produced in 1967 in order of value
Sutton	$952,900	$1,006,147	Natural gas, petroleum, sand and gravel.
Tarrant	7,189,650	7,231,674	Cement, sand and gravel, stone, sodium sulfate.
Taylor	17,062,528	17,894,216	Petroleum, natural gas liquids, natural gas, stone, sand and gravel, clays.
Terrell	5,174,080	5,425,048	Natural gas, petroleum.
Terry	21,294,823	22,587,159	Petroleum, sodium sulfate, natural gas liquids, natural gas.
Throckmorton	7,156,690	7,689,591	Petroleum, natural gas, sand and gravel.
Titus	11,851,160	12,734,473	Petroleum, natural gas.
Tom Green	7,559,650	8,088,094	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Travis	3,938,885	5,041,181	Lime, stone, sand and gravel, petroleum.
Trinity	126,000	165,819	Natural gas, stone, clays.
Tyler	2,471,560	2,640,710	Petroleum, natural gas.
Upshur	10,188,780	10,956,385	Petroleum, natural gas, sand and gravel.
Upton	66,672,969	69,778,193	Petroleum, natural gas liquids, natural gas, sand and gravel.
Uvalde	3,651,038	W	Asphalt, basalt, sand and gravel, natural gas, stone.
Val Verde	356,690	370,387	Natural gas, petroleum.
Van Zandt	31,703,117	34,151,382	Petroleum, natural gas liquids, salt, natural gas.
Victoria	24,841,413	26,330,591	Petroleum, natural gas, natural gas liquids, sand and gravel.
Walker	144,640	148,780	Natural gas, clays, petroleum.
Waller	37,687,764	37,943,819	Natural gas, natural gas liquids, petroleum, sand and gravel.
Ward	81,621,076	87,318,493	Petroleum, natural gas, natural gas liquids, sodium sulfate, salt, sand and gravel.
Washington	871,522	1,007,308	Petroleum, stone, sand and gravel, natural gas.
Webb	9,651,716	10,411,060	Petroleum, natural gas, natural gas liquids, stone, sand and gravel, clays.
Wharton	84,981,938	94,897,943	Sulfur, petroleum, natural gas, natural gas liquids, sand and gravel.
Wheeler	9,905,544	10,784,740	Petroleum, natural gas, natural gas liquids, sand and gravel.
Wichita	35,274,841	38,558,881	Petroleum, natural gas liquids, sand and gravel, stone, natural gas.
Wilbarger	16,207,981	17,447,671	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Willacy	12,113,430	12,888,562	Petroleum, natural gas, natural gas liquids.
Williamson	8,195,403	8,073,803	Stone, lime, sand and gravel, petroleum.
Wilson	2,369,738	2,498,830	Petroleum, natural gas.
Winkler	85,882,861	91,911,783	Petroleum, natural gas, natural gas liquids.
Wise	34,925,339	37,673,112	Natural gas, natural gas liquids, petroleum, stone, clays, sand and gravel.
Wood	60,638,377	64,455,959	Petroleum, natural gas liquids, natural gas, clays, sand and gravel.
Yoakum	67,758,319	72,425,974	Petroleum, natural gas liquids, natural gas, salt.
Young	13,189,199	14,177,446	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Zapata	5,540,960	5,890,888	Petroleum, natural gas.
Zavala	1,220,700	1,297,906	Do.
Undistributed	21,697,021	24,903,141	
Total	5,022,041,000	5,406,371,000	

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

[1] The following counties were not listed because no production was reported in 1966 or 1967: Armstrong, Bailey, Bandera, Briscoe, Castro, Deaf Smith, Delta, Fannin, Jeff Davis, Kendall, Kinney, Lamar, Parmer, Randall, Real, Sabine, and Swisher.

An important and varied metals-extractive industry was active in Texas at 18 installations: Two alumina plants; three aluminum, two magnesium, one manganese reduction works; one antimony, one copper, one lead, one tin, and three zinc smelters; one copper refinery; and two integrated iron and steel plants. Cadmium was recovered as a byproduct of smelter dust collection, zinc was recovered at a fuming plant, and gold and silver were recovered from base metal smelter residues.

The Mideast crisis of June 1967 revealed several important facts about the State and the Nation's oil industry. It proved that the Texas oil industry, together with that of Louisiana, could make up for oil supplies cut off by an international crisis, that the State's oil industry could increase production and pipeline movements in a minimum of time, and that established world transport routes were flexible and bottlenecks such as the Suez Canal were

Table 3.—Indicators of Texas business activity

		1966	1967 p	Change (percent)
Personal income:				
Total	millions	$27,319	$29,385	+7.6
Per capita		$2,542	$2,704	+6.4
Construction activity:				
Building permits	millions	$1,226.4	$1,461.3	+19.2
State highway commission:				
Value of construction started	do	$424.3	$452.9	+6.7
Value of construction completed	do	$321.6	$341.8	+6.3
Cement shipments to and within Texas	thousand 376-pound barrels	26,995	26,955	−.1
Cash receipts from farm marketings	millions	$2,698.6	$2,521.8	−6.6
Mineral production	do	$5,022.0	$5,406.4	+7.7
Factory payrolls	do	$11,825.9	$13,076.7	+10.6
Annual average labor force and employment:				
Total labor force	thousands	4,164.0	4,269.7	+2.5
Unemployment	do	133.2	123.8	−7.1
Employment:				
Construction	do	201.4	208.4	+3.5
Mining	do	107.2	106.0	−1.1
All manufacturing	do	624.3	663.7	+6.3
All industries	do	4,030.8	4,145.9	+2.9

p Preliminary.

Sources: Survey of Current Business, Construction Review, Texas Highway Department, The Farm Income Situation, Texas Employment Commission, and Bureau of Mines.

not as important as they had been in the past.

More of the State's oil and gas industry diversified into other minerals fields during 1967. A large number of oil and gas companies expanded geological, exploration, and leasing staffs in order to explore for other minerals. Many new oil and gas leases included the "all other minerals" clause; in addition, the clause was renegotiated into existing oil and gas leases. The policy change resulted in the increased exploration and leasing activity for radioactive minerals, especially in a wide belt extending from Gonzales and Fayette Counties on the north to Starr and Hidalgo Counties on the Rio Grande.

Texas remained one of the Nation's leaders in petrochemical output and capacity. The State was the major source of ethylene and acetic acid, both stock materials for many petrochemical intermediates and products.

Three aluminum reduction plants operated at or near capacity in 1967 as demand for this metal increased.

Employment and Injuries.—Although total employment reached a record 4.3 million persons in December 1967, and nonfarm employment attained a record 3.9 million persons, mining employment declined from 107,200 to 106,000 according to the Texas Employment Commission. Nearly all of the loss was attributed to the oil and gas industry. The average work week of factory workers dropped about 30 minutes to 41.6 hours, while that of mine workers averaged 42.7 hours. Average weekly earnings of mine workers (including oil and gas) advanced $5.86, to $137.07, compared with average factory workers' increase of $3.55, to $111.49. Workers in petroleum refining maintained a weekly salary of $159.80 and chemical workers, $149.39.

Consumption, Trade, and Markets.—The expansive character of the State's 1967 economy, evident from most economic indicators, was the result of expanding productivity and increased capacity of its raw materials (nonmanufacturing) sector. A major part of manufacturing in Texas is oriented toward raw materials. According to the Federal Reserve Bank of Dallas, all major industries advanced nearly 20 points over the record 1966. The same industries on a national basis advanced an average of 1 to less than 4 points.

Because of the magnitude of production, many of the mineral industries were dependent upon national and international markets rather than intrastate markets. Among the major industries dependent upon national markets were petroleum refining, natural gas liquids extraction, natural gas distribution, nonferrous and

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	98	275	27	215	-------	3	13.93	325
Metal	1,252	292	366	2,927	-------	45	15.37	1,272
Nonmetal and native asphalt	3,484	289	1,007	8,171	2	169	20.93	3,026
Sand and gravel	1,976	273	540	4,854	2	155	32.35	3,115
Stone	4,555	307	1,399	11,677	5	179	15.76	3,384
Total [1]	11,365	294	3,340	27,844	9	551	20.11	2,987
1967: [p]								
Coal	95	284	27	214	-------	3	14.02	322
Metal	1,570	306	481	3,852	1	54	14.28	2,343
Nonmetal and native asphalt	3,405	292	993	8,042	3	170	21.51	2,726
Sand and gravel	2,115	264	559	5,126	1	155	30.43	2,111
Stone	4,605	312	1,436	12,052	3	211	17.76	1,959
Total [1]	11,795	296	3,497	29,285	8	593	20.52	2,235

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

Table 5.—Employment data in mining and related industries
(Thousand employees)

Industry	Employment		Weekly hours worked		Weekly earnings	
	1966	1967	1966	1967	1966	1967
Manufacturing	624.3	663.7	42.0	41.6	107.94	111.49
Primary metals	32.2	32.3	41.8	41.4	126.24	128.75
Stone, clay, and glass products	28.3	27.5	43.6	42.2	95.48	95.79
Chemicals	55.8	59.6	42.8	42.2	146.80	149.39
Petroleum and related industries	36.3	36.0	41.9	42.5	152.10	159.80
Transportation equipment	68.2	81.3	43.0	42.3	143.19	140.01
Nonmanufacturing	2,476.8	2,606.7	------	------	--------	--------
Mining	107.2	106.0	42.6	42.7	131.21	137.07
Crude petroleum and natural gas	101.3	99.7	42.5	42.5	133.45	138.55
Other mining	6.0	6.3	------	------	--------	--------
Construction	201.4	208.4	------	------	--------	--------

Source: Texas Employment Commission; U.S. Bureau of Labor Statistics.

light metal extraction, bromine, graphite, natural salines, and sulfur. One of the major problems of the economy has been the relatively small development of consumer-oriented industries within the State.

Several industries were integrated to convert raw materials into intermediates or finished products for both State and national markets. Such industries included oil refineries processing domestic and foreign crude oil; cement plants using local limestone, shell, and clay; and building materials manufacturers using gypsum to prepare wallboard, sheathing, and plaster. The petrochemical industry of the gulf coast produced a major portion of the domestic feedstocks—ethylene, propylene, and butylene—for numerous synthetic chemical plastics, fibers, and solvents. The feedstocks were derived from natural gas, natural gas liquids, and refinery off-gases. Nearly 300 chemical plants operated in Texas in 1967, producing over 500 chemical intermediates and other synthetic products.

Legislative and Government Programs.—The State of Texas' claim to about 30,000 acres of potentially valuable oil land in the Gulf of Mexico was denied by the Supreme Court. The State's position was that the 3-league (9 nautical miles) distance should be measured from the tip of manmade jetties rather than the natural coastline of 1845, the year Texas joined the Union, as contended by the Government. The Texas contention would have

extended the coastline a mile or more beyond the 1845 shoreline. Potentially rich oil and gas deposits are in the disputed area. The dispute originated from a 1960 Supreme Court decision which vested to the Federal Government title to all lands, minerals, and other natural resources underlying the Gulf of Mexico more than 3 nautical miles seaward from the coastlines of Louisiana, Mississippi, and Alabama, and more than 9 nautical miles seaward from the coastlines of Texas and Florida. At that time, the Court made no decision as to the exact position of the Texas coastline.

A milestone in proration regulations was being considered by the Texas Railroad Commission relative to applying oil allowables on a lease basis in flush fields rather than on a per-well basis. This principle would permit an operator to shut in low-producing and expensive wells and transfer the allowables to high producing wells on the same lease. The same principle of lease allowables was used by the Commission in stripper oilfields and unitized waterfloods.

An appraisal of oil pipeline capacities and terminal capability of the gulf coast oil industry was made by the Railroad Commission. The study headlined the logistical situation of the State's and Nation's petroleum industry and problems resulting from the Mideast crisis.

State and Federal agencies continued flood and water pollution control projects and research studies on the conservation of mineral resources.

The Air Quality Act of 1967 became Public Law 90-148 on November 21, 1967. The law requires States to develop air quality standards and enforcement programs. The law obligated $428.3 million over the next 3 years for research and operating costs of the pollution and control program with $125 million allocated to research on fuels.

The General Land Office collected $5.1 million in offshore oil and gas leases at a bid opening held April 4, 1967. At a November 7 bid letting, the Office collected $2.5 million for offshore oil and gas leases and $1.7 million for sulfur leases in Culberson County in West Texas. One sulfur lease of 555 acres drew a high bid of $1.06 million.

The Texas Legislature modified the mining act of 1913 relating to leases on coal, lignite, sulfur, and potash. The State's portion of bonuses, rentals, and royalties was increased to 60 percent with a royalty fee of not less than one-sixteenth of the value of minerals produced. The General Land Office reserved the right to approve proposed mineral leases on State lands.

The University of Texas System received over $766,000 in bonuses at a December 1967 sulfur lease sale. University Lands offered 20 tracts involving 13,430 acres, with 15 offers involving 10,007 acres being accepted. This was the University's first sulfur lease offering.

New emphasis was placed on water in Texas and along the gulf coast; studies were started of resources and quality for industrial purposes, as a mode of transportation for ocean freight via the Intracoastal Waterway, and for potential barge traffic via a number of rivers entering the gulf.

The U.S. Army Corps of Engineers completed or was building several dams on Texas rivers or on boundary rivers between Texas and adjoining States. Pat Mayse Dam and Reservoir, 10 miles north of Paris, was completed in 1967. The multipurpose Bardwell Dam and Reservoir near Ennis will provide water supply for municipal and industrial purposes for Ennis and surrounding communities and will control floods on the Richland-Chambers Creek segment of the Trinity River Basin. The Big Fossil Creek Dam, a flood-control project for residents in the Richland Hills section of Tarrant County, was completed. San Antonio Floodway project, to control flooding of the San Antonio River and three tributaries flowing through the City, was over 50 percent complete in 1967. Somerville Dam and Reservoir on Yegua Creek, 2 miles south of Somerville, was completed during 1967. Wallisville Dam and Reservoir on the Lower Trinity River, 44 miles east of Houston in Liberty and Chambers Counties, was scheduled for completion in 1970. The project provides a multipurpose dam and reservoir for navigation, salinity control, water conservation, fish and wildlife, and recreation. An enlargement project of the Lavon Dam and Reservoir began in 1967. The project will furnish storage space for supply water for communities served by the North Texas Municipal Water District.

The U.S. Army Corps of Engineers coastal and harbor projects included improvement of Galveston Harbor and Channel, extending a 42-foot-deep entrance channel from the Gulf to near Galveston North Jetty, and a 40-foot-deep channel to the junction with the Houston ship channel. The navigation channel of the Sabine-Neches Waterway was being deepened to 40 feet from the Gulf of Mexico to terminals at Sabine Pass, Port Arthur, and Beaumont. A 12-foot channel in the Sabine River from Orange, Tex., to Echo was being dredged. Other coastal projects included deepening the Houston ship channel to 40 feet, the Matagorda ship channel to 36 feet, the Texas City channel to 40 feet, and completion of a 9-foot channel from the Gulf Intracoastal Waterway to Victoria, Tex., with a connecting side channel to Seadrift.

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Texas remained the Nation's leading producer of crude oil, natural gas, and natural gas liquids. Petroleum production advanced for the seventh consecutive year. For the second time in 10 years, the domestic oil industry helped compensate for Middle East supplies that were cut off by the war between Israel and Arab nations. An alltime production record of

Table 6.—Production and value of mineral fuels

Year	Crude petroleum		Natural gas[1]	
	Thousand barrels	Value (thousands)	Million cubic feet	Value (thousands)
1963	977,835	$2,908,380	6,205,034	$775,629
1964	989,525	2,928,994	6,490,202	809,180
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

Year	Natural gasoline and cycle products		Natural gas liquids			
			LP gas		Total	
	Thousand gallons	Value (thousands)	Thousand gallons	Value (thousands)	Thousand gallons	Value (thousands)
1963	3,320,416	$218,975	5,366,831	$169,695	8,687,247	$388,670
1964	3,512,460	232,245	5,521,236	167,492	9,033,696	399,737
1965	3,772,471	256,959	5,847,601	204,666	9,620,072	461,625
1966	3,890,267	269,332	6,359,870	260,755	10,250,137	530,087
1967	4,031,589	277,105	7,449,439	320,328	11,481,028	597,431

[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
1963	978	1,108	151	2,237	43.7	49.5	6.8	3.7	2.0	5.6	3.0
1964	990	1,159	157	2,306	42.9	50.3	6.8	1.2	4.6	4.0	3.1
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

[1] 1 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				Percent of fuels				Texas percent of United States		Change from 1966 (percent)	
	Texas		United States		Texas		United States					
	1966	1967	1966	1967	1966	1967	1966	1967	1966	1967	Texas	United States
Crude oil	1,058	1,120	3,028	3,216	42.7	43.0	47.0	47.0	34.9	34.8	+5.9	+6.2
Natural gas	1,242	1,284	3,073	3,245	50.1	49.3	47.7	47.5	40.4	39.6	+3.4	+5.6
Natural gas liquids	179	199	343	375	7.2	7.7	5.3	5.5	52.2	53.1	+11.2	+9.3
Total equivalent	2,479	2,603	6,444	6,836	100.0	100.0	100.0	100.0	38.5	38.1	+5.0	+6.1

[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 1966		Texas		United States	
	1966	1967	1966	1967	1966	1967	Texas	United States	1966	1967	1966	1967
Crude oil	14,077	14,494	31,452	31,377	44.8	46.2	+3.0	−0.2	13.3	12.9	10.4	9.8
Natural gas	22,073	22,396	51,667	52,305	42.7	42.8	+1.5	+1.2	17.8	17.4	16.8	16.1
Natural gas liquids	3,001	2,992	6,094	6,281	49.2	47.6	−.3	+3.1	16.8	15.0	17.8	16.7
Total oil equivalent	39,151	39,882	89,213	89,963	43.9	44.3	+1.9	+.8	15.8	15.3	13.8	13.2

[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 in 1967 by railroad districts [1]

(Million cubic feet)

Railroad district	Proved reserves, Dec. 31, 1966	Extensions and revisions	New fields and new pools	Production	Proved reserves,[2] Dec. 31, 1967	Change [2] from Dec. 31, 1966
1	2,600,611	−52,567	14,939	133,138	2,429,936	−170,675
2	11,957,186	+272,094	238,053	728,151	11,739,786	−217,400
3	27,420,032	+276,248	662,594	1,414,058	26,946,816	−473,216
4	32,548,396	+675,853	1,218,261	1,536,725	32,905,785	+357,389
5	1,487,183	−52,909	126,452	107,316	1,451,981	−35,202
6	6,870,453	+108,471	23,019	482,336	6,519,607	−350,846
7B	889,207	−39,889	7,269	108,071	747,870	−141,337
7C	3,126,254	+863,979	124,670	220,221	3,894,530	+768,276
8	17,206,882	+2,904,440	213,582	866,641	19,458,263	+2,251,381
8A	3,769,843	−139,086	3,358	179,611	3,454,504	−315,339
9	2,768,762	+149,457	5,296	230,784	2,695,677	−73,085
10	12,964,517	+1,215,902	111,328	1,121,530	13,170,309	+205,792
Total	123,609,326	+6,181,993	2,748,821	7,128,582	125,415,064	+1,805,738

[1] Committee on Natural Gas Reserves of American Gas Association.
[2] Change reflects production and net additions and withdrawals in storage.

3,334,730 barrels per day for the State was established in August. An additional 800,000 barrels per day of natural gas liquids was also recovered. This response showed the oil industry capability to meet a national crisis on relatively short notice. The industry achieved the record production in a little over 2 months with the State market-demand factor rising from 33.8 percent in June to 54 percent in August. The previous record high, under similar Mideast war conditions in 1956, was 3,280,078 barrels per day when operators were producing at an allowable

Table 11.—Estimated proved recoverable reserves of natural gas liquids in 1967 by railroad districts [1]

(Thousand barrels)

Railroad district	Proved reserves, Dec. 31, 1966	Extensions and revisions	New fields and new pools	Production	Proved reserves, Dec. 31, 1967	Change from Dec. 31, 1966
1	40,983	+307	66	3,106	38,250	−2,733
2	194,091	+1,043	1,586	17,006	179,714	−14,377
3	824,299	+75,671	19,613	54,976	864,607	+40,308
4	769,953	+22,445	22,223	53,103	761,518	−8,435
5	84,330	+10,277	4,216	7,808	91,015	+6,685
6	510,215	−2,432	406	23,862	484,327	−25,888
7B	45,278	−8,060	237	5,005	32,450	−12,828
7C	151,951	+36,686	4,337	18,306	174,668	+22,717
8	519,718	+183,659	1,624	59,123	645,878	+126,160
8A	504,645	−106,164	49	18,049	380,481	−124,164
9	76,195	−3,714	220	8,443	64,258	−11,937
10	379,964	+32,524	3,301	29,960	385,829	+5,865
Total	4,101,622	+242,242	57,878	298,747	4,102,995	+1,373

[1] Committees on natural gas liquid reserves of American Petroleum Institute and American Gas Association.

Table 12.—Estimated proved recoverable reserves of crude oil in 1967 by railroad district [1]

(Thousand barrels)

Railroad district	Proved reserves, Dec. 31, 1966	Extensions and revisions	New fields and new pools	Production	Proved reserves, Dec. 31, 1967	Change from Dec. 31, 1966
1	140,560	36,115	1,253	18,493	159,435	+18,875
2	938,151	81,223	3,758	56,713	966,419	+28,268
3	2,100,318	74,326	11,116	140,479	2,045,281	−55,037
4	749,145	4,905	24,644	87,116	691,578	−57,567
5	163,508	1,262	1,756	11,496	155,030	−8,478
6	2,807,347	55,670	2,633	101,010	2,764,640	−42,707
7B	279,792	20,247	2,729	38,884	263,884	−15,908
7C	403,937	26,078	5,119	53,001	382,133	−21,804
8	3,059,630	836,157	10,496	276,787	3,629,496	+569,866
8A	2,725,041	166,481	2,802	166,195	2,728,129	+3,088
9	418,137	79,618	2,233	67,374	432,614	+14,477
10	291,568	15,825	1,060	32,983	275,470	−16,098
Total	14,077,134	1,397,907	69,599	1,050,531	14,494,109	+416,975

[1] Committees on crude oil reserves of the American Petroleum Institute and American Gas Association.

rate of 18 days, or the equivalent of 58 percent of the market-demand factor. At that time, the larger Texas fields were at flush production according to Jim C. Langdon, Texas Railroad Commission Chairman, and now many of these same fields are being waterflooded. Nearly every railroad district showed some response to the 103,259,933 barrel August production record. The greatest volume—26,459,118 barrels—was recorded in District 8 of West Texas followed by 17,212,757 barrels from District 8A, with gulf coast District 3 reporting 14,116,285 barrels. The crisis showed 1,473 fields out of a total 8,680 fields with possible surplus capacity at the 54-percent factor. The Railroad Commission study showed 10,880 flowing wells that could produce more and 14,639 pumping wells with surplus capacity. The East Texas field, with more than 17,000 wells, was not included in the Commission's study.

The Mideast crisis resulted in two important temporary rulings by the Texas Railroad Commission. On June 23, 1967, the Commission abandoned its per-well basis for allowable production, substituting instead a lease allowable. It also suspended gas-oil ratio tests until December 31. Under the lease allowable, an operator could produce from any well or group of wells on any given lease. Thus, operators could use better producing wells to

make up underproduction from poor wells on the same lease. Suspension of the gas-oil ratio tests permitted operators to produce extra casinghead gas under temporary high oil allowables without being penalized for the excess gas.

Carbon Black.—Carbon black was recovered from natural gas and natural gas liquids at 18 plants in 13 counties. There were three channel plants, 14 furnace plants, and one combination channel-furnace plant. The plants consumed 42,869 million cubic feet of gas and 240.3 million gallons of hydrocarbon liquids in producing 1,214.3 million pounds of carbon black. Annual capacity of the Borger carbon black plant of J. M. Huber Corp. was being expanded by 30 million pounds, with completion scheduled for 1968.

Coal (Lignite).—Lignite was mined in two counties, Milam and Harrison, by two producers. The 1967 output decreased. Most of the lignite was used as fuel for electric power generation; a substantial amount was processed into activated carbon.

Helium.—Helium production comprised Grade A helium (purity 99.995 percent) produced for consumer sale, and crude helium (purity 50 to 80 percent) produced for the Government's conservation program.

Grade A helium was produced at two plants owned and operated by the Federal Bureau of Mines. The plants, located at Amarillo and Exell, produced a combined total of 334.5 million cubic feet. An additional 1.4 million cubic feet of helium, purified in a privately owned plant at Amarillo, was obtained in crude form from private sources. Thus, the total Grade A helium production was 335.9 million cubic feet, having a value of $9.9 million. This compares with the 1966 production of 364.1 million cubic feet.

Crude helium for the Government's long-range helium conservation program was recovered at two privately owned and operated plants. The plants, both owned by Phillips Petroleum Co. and located at Dumas and in Hansford County, produced 977.6 million cubic feet during the year, a slight decrease from the 1,030.5 million cubic feet produced in 1966. The total output was purchased by the Bureau of Mines for storage in a partially depleted underground natural gas reservoir in the Cliffside gasfield near Amarillo. When needed, the crude helium will be withdrawn from the reservoir, purified, and sold.

Natural Gas.—Texas retained its rank as the leading natural gas producing State. Principal gas-producing counties in the order of value were Potter, Kleberg, Brazoria, Nueces, and Jim Wells.

Industrial uses accounted for 50 percent of the production, field use for 25 percent, electric utilities for 17 percent, residential use for 5 percent, commercial use for 2 percent, with the remainder for carbon black or to storage.

An important development in the gas industry included the world's deepest production record which was established in the Gomez-Ellenburger gasfield, 10 miles north of Fort Stockton in Pecos County, where Humble Oil & Refining Co. completed 11 Wilbanks, Titus County School Land Survey 1, A–3175. Production was reported from perforations at 21,883 to 22,610 feet. Proved reserves at depths below 20,000 feet total 4 trillion cubic feet.

Mobil Oil Corp. completed a new discovery gas well 8 miles off Matagorda Island in Blocks 481–L and 487–L. Daily output was 3.7 million cubic feet of gas and 30 barrels of liquids through perforations at 7,000 feet. Three more wells were completed to confirm the discovery. A multipay gas discovery was made by E. Allday and J. P. Owens with completion of No. 1 O. H. Acom in Chambers County of southeast Texas. The well gauged 31 million cubic feet on open flow from an 8-foot section of *Nodosaria* sand at 11,202 feet, with a second prolific showing below 12,400 feet being investigated. One of the largest gas wells in the Delaware Basin of West Texas was completed by Sinclair Oil & Gas Co. Open flow potential of 435 million cubic feet was reported on the No. 1 Absher Unit lease in the Lockridge field, Ward County. Sinclair, the operator, reported production from selective perforations between 19,074 and 19,862 feet.

A sulfur-rich gas discovery was made on the West Shelf of the Smackover trend with completion of the No. 1 A. C. Bryant, 3 miles southeast of Streetman in Freestone County. An apparent new gasfield was discovered 3 miles off Mustang Is-

land opposite Corpus Christi Bay with the completion of two dual gas producers in Block 773–L by Texas Gas Exploration Co. and the CSSG Group (Cities Service, Skelly, Sunray, Getty).

The Katy gasfield, the largest single uncommitted gas reservoir in the Nation, will have its 6.1 trillion cubic feet of gas reserve committed to markets in Houston, Dallas, and Texas City by five purchasers. Gas volumes involved in the 20-year contracts include 1.6 trillion cubic feet for Lone Star Gas Co., 1.1 trillion cubic feet for Humble Oil & Refining Co., 1.9 trillion cubic feet for United Gas Co., 1 trillion cubic feet for Pan American Gas Co., and 500 billion cubic feet for Houston Pipe Line Co. The Katy gasfield, located 30 miles west of Houston, covers 31,000 acres in Harris, Fort Bend, and Waller Counties. The field is owned by 37 companies and individuals, all participating in a field-wide gas unit which is operated by Humble Oil & Refining Co. Of 122 wells in the field, 97 will be used for production and 25 for injection. To move the gas to the market areas, Lone Star Gas Co. completed a 219-mile pipeline to its Dallas station near Mesquite to serve residential and industrial customers in that metropolitan area. United Gas Pipe Line Co. was building an 18-mile, 30-inch line to connect into the Houston distribution system on the west side of the city. The company could also supplement the gas supply to its Beaumont and Port Arthur customers. Humble Oil & Refining Co. completed a 20-mile, 20-inch line to connect into its own Houston system at a point northwest of that city. Pan American Gas Co. will build 68 miles of 20-inch line to connect into its Texas City delivery system. Houston Pipe Line Co. will build a short 20-inch line to connect into its own distribution system near the field.

Gas production from the 55,000-acre J. M. gasfield in the Val Verde Basin of West Texas began with the completion of 10 miles of gathering pipelines and 15 miles of field lines by El Paso Natural Gas Co.

Natural Gas Liquids.—Texas remained the Nation's principal producer of natural gas liquids in 1967, supplying 53 percent of the total domestic output. Natural gasoline plants processed an average of 21,442 million cubic feet of gas daily to recover 36.9 million gallons of liquids. The number of gasoline plants operated declined to 404 plants, four less than in 1966. Installed plant capacity increased 7 percent to 28,898 billion cubic feet daily over 1966. LP gas accounted for 65 percent of the recovered liquids; natural gasoline and other cycle products for the remainder.

Texas had the largest underground storage capacity for natural gas liquids in the Nation in 1967. This capacity totaled 74 million barrels, including a 150,000-barrel-capacity facility under development. Another storage facility was planned in a salt dome in Wood County by Enterprise Petroleum Co. Thirty-eight companies operated 97 underground facilities in 35 counties. The five largest storage sites and their capacities (in millions of barrels) follow: Warren Petroleum Corp., Chambers County, salt dome, 12.3; Texas Eastern Transmission Corp., Chambers County, salt dome, 9.1; Phillips Petroleum Co., Brazoria County, salt dome with 12 caverns, 7.4; Hutchison County, salt layer with 13 caverns, 3.7; and Tenneco Oil Co., Chambers County, salt dome with seven caverns, 4.2.

The two major divisions of the natural gas liquid industry—LP gas and natural gasoline—had widely divergent experiences in 1967. Whereas supply and demand for natural gasoline was in approximate balance with stocks, declining less than 1 percent, the LP gas industry again faced a serious over supply situation due to the imbalance of excessive production to demand. While domestic LP gas output advanced 17 percent over that of 1966, there was little change in demand for refineries and fuels. The net result was a 50-percent rise in LP gas stocks to 2,376 million gallons. In retrospect, natural gas liquids output increased 4 percent in 1967, refinery demand rose more than 4 percent, and fuel and chemical demands increased 7 percent, while total stocks advanced nearly 65 percent. Fuel and chemical use composed 74 percent of the LP gas market; refineries and other uses constituted the remaining 26 percent.

The industry was building or completing 12 new gasoline plants with a daily input capacity of 1.8 billion cubic feet to recover 591,000 gallons of combined liquids, according to The Oil & Gas Journal. The industry also expanded capacities of nine

existing plants, increasing installed capacity by 468 million cubic feet per day of gas input to recover 448,000 gallons of combined liquids. Six gasoline plants were inactive or were dismantled during the year.

Emerald Oil Co. completed a refrigeration plant to recover 6,085 gallons per day of combined liquids in the Panhandle field of West Texas. Atlantic Richfield completed a refrigeration plant to recover 2,500 gallons per day of liquids. Cities Service Oil Co. built a gas-processing plant near Corpus Christi in Nueces County to recover approximately 3,000 barrels per day of combined liquids, and a refrigeration plant at Waco in McLennan County to recover approximately 41,000 gallons of liquids. Continental Oil Co. began construction of an adsorption facility in Reeves County to recover nearly 10,000 gallons of liquids per day and expanded refrigeration capacity of its Chittim Ranch plant. Houston Natural Gas Production Co. completed a refrigeration-adsorption plant near Alvin in Brazoria County to recover 22,000 barrels of combined liquids per day and increased capacity of its Bammel plant in Harris County to recover 27,000 gallons of liquids per day. Humble Oil & Refining Co. added new low-temperature absorption units and new fractionation facilities to the King Ranch gasoline plant in Kleberg County for a total daily recovery of 75,700 barrels of products. Mobil Oil Corp. completed a refrigeration-absorption plant in the Coyanosa field in Pecos County, Tex., to recover 260,000 gallons per day of deethanized products.

Shell Oil Co. replaced its Bryan No. 17 plant in the West Panhandle field of Carson County with a refrigeration plant and added capacity to its Conley plant in Hardeman County, its Tippett plant in Crockett County, and its Wasson plant in Yoakum County, Tex. Sun Oil Co. was modernizing its Starr County gasoline plant and added capacity to the Tijerina-Canales plant in Jim Wells County. Texaco Inc., completed a refrigeration plant in Rains County and a refrigeration-absorption plant at Tijerina in Jim Wells County.

Petroleum.—The State's oil industry entered 1967 with excessive stocks of crude oil and some refined products in spite of a nearly 4-percent gain in domestic crude demand. The net result was continued gasoline price wars in the midcontinent region, a continued cutback in drilling projects, and increased competition in the refinery markets of the eastern seaboard.

The Texas oil industry has produced nearly 31 billion barrels of crude oil or 36 percent of the U.S. total since oil was discovered at Spindletop in 1902. The output of oil was 1,120 million barrels in 1967, 35 percent of the Nation's total, and 9 percent of the world total. There were 8,500 fields with 192,001 producing oil wells in 200 Texas counties. Texas oil reserves, at 15 million barrels, represented 46 percent of the United States total reserves. The State's oil industry drilled 9,470 wells in 1967, totaling nearly 44.7 million feet of hole. More than 26 percent were exploratory wells drilled in 200 of the State's 254 counties. There were 48 oil refineries located in Texas in 1967, with installed capacity of 2.7 million barrels.

The 315-well, 20-square-mile Pegasus field near Midland in West Texas, will be put under computer control by Mobil Oil Corp. by 1968. This field accounted for 15,000 barrels of oil per day, and the Pegasus gasoline plant of Mobil Oil Corp. processes 77 million cubic feet of gas per day to recover 7,500 barrels of combined liquids. The computer was being programed to turn on wells, start tests and record results, regulate injection volume for water or gas, and correct ordinary operational problems. Field data from the monitors and control points will be fed by lease telephone line to a computer located in the Mobil division office in Midland. The computer will digest all reported information and immediately relay instructions back to the field control devices.

Considerable exploratory drilling with 50 active tests were being made in the Smackover and Cotton Valley formations in East Texas. Eight tests have proved productive. Three new fields have been discovered in Hopkins County, two new fields in Freestone County, and one each in Bowie and Henderson Counties.

The oil industry continued expansion of secondary recovery projects according to the 1966 biennial study by the Texas Petroleum Research Committee. This study revealed a total of 3,178 projects initiated since the beginning of secondary recovery

Table 13.—Oil and gas wells drilled in 1967, by counties and offshore

Producing area	Proved field wells			Exploratory wells				Geophysical crew-weeks		
	Oil	Gas	Dry	Oil	Gas	Dry	Total	Reflection seismograph method	Gravity meter method	Total
County:										
Anderson	68	2	4	4	2	25	105	21	-----	21
Andrews	91	4	7	8	-----	7	117	-----	-----	-----
Angelina	-----	-----	-----	-----	-----	4	4	7	-----	7
Aransas	5	7	5	3	4	7	31	-----	-----	-----
Archer	109	-----	79	1	-----	12	201	-----	-----	-----
Armstrong	-----	-----	-----	-----	-----	1	1	-----	-----	-----
Atascosa	9	-----	2	-----	-----	4	15	17	-----	17
Austin	3	-----	-----	-----	-----	2	5	29	-----	29
Bastrop	-----	-----	1	-----	-----	6	7	4	1	[2] 6
Baylor	6	1	3	-----	-----	2	12	-----	-----	-----
Bee	6	8	13	3	5	17	52	-----	-----	-----
Bell	-----	-----	-----	-----	-----	-----	-----	9	-----	9
Bexar	30	7	7	-----	-----	3	47	-----	-----	-----
Borden	5	-----	3	1	-----	4	13	-----	-----	-----
Bowie	-----	2	-----	1	-----	10	13	15	-----	15
Brazoria	27	11	8	5	10	20	81	26	4	30
Brazos	-----	-----	-----	-----	-----	5	5	-----	4	4
Brewster	-----	-----	1	-----	-----	3	4	-----	-----	-----
Briscoe	-----	-----	-----	-----	-----	1	1	14	-----	14
Brooks	27	3	10	-----	3	8	51	-----	-----	-----
Brown	21	5	8	-----	1	3	38	-----	-----	-----
Burleson	-----	-----	2	1	-----	6	9	-----	-----	-----
Caldwell	133	7	22	-----	-----	9	171	-----	-----	-----
Calhoun	6	9	4	4	2	21	46	-----	-----	-----
Callahan	33	3	41	-----	-----	14	91	-----	-----	-----
Cameron	-----	-----	-----	-----	-----	8	8	-----	-----	-----
Camp	4	-----	2	-----	1	3	10	9	-----	9
Carson	36	3	3	-----	-----	-----	42	-----	-----	-----
Cass	5	-----	1	2	-----	9	17	29	-----	29
Castro	-----	-----	-----	-----	-----	1	1	15	-----	15
Chambers	12	6	3	-----	4	18	43	16	-----	16
Cherokee	3	-----	1	-----	-----	14	18	34	-----	34
Childress	-----	-----	-----	-----	-----	4	4	12	-----	12
Clay	100	-----	37	5	2	12	156	-----	-----	-----
Cochran	79	-----	1	2	1	6	89	-----	-----	-----
Coke	20	1	1	3	-----	11	36	-----	-----	-----
Coleman	21	4	14	-----	2	11	52	-----	-----	-----
Colorado	2	12	-----	1	2	8	25	32	-----	32
Comanche	-----	-----	-----	1	-----	-----	1	-----	-----	-----
Concho	1	3	2	-----	-----	5	11	-----	-----	-----
Cooke	65	-----	26	2	-----	25	118	-----	-----	-----
Cottle	-----	1	1	2	1	5	10	13	-----	13
Crane	69	5	16	4	-----	12	106	-----	-----	-----
Crockett	39	44	15	3	5	12	118	-----	-----	-----
Crosby	1	-----	-----	-----	-----	3	4	-----	-----	-----
Culberson	5	-----	1	1	1	2	10	-----	-----	-----
Dallam	-----	-----	-----	-----	-----	1	1	-----	-----	-----
Dawson	41	-----	4	-----	-----	10	55	-----	-----	-----
Delta	-----	-----	-----	-----	-----	-----	-----	1	-----	1
Denton	-----	-----	1	-----	1	1	3	-----	-----	-----
DeWitt	1	7	7	-----	5	15	35	-----	-----	-----
Dickens	1	-----	1	1	-----	2	5	-----	-----	-----
Dimmit	-----	1	1	-----	1	4	7	9	-----	9
Duval	31	4	4	12	3	33	87	-----	-----	-----
Eastland	10	1	3	1	-----	1	16	-----	-----	-----
Edwards	2	-----	-----	-----	-----	-----	2	-----	-----	-----
Ector	131	2	6	2	-----	3	144	-----	-----	-----
Ellis	-----	-----	-----	-----	-----	1	1	-----	-----	-----
Erath	-----	2	1	1	-----	2	6	-----	-----	-----
Falls	1	-----	-----	1	-----	1	3	2	-----	2
Fannin	-----	-----	-----	-----	-----	-----	-----	8	-----	8
Fayette	3	-----	2	-----	-----	4	9	-----	5	5
Fisher	15	4	6	-----	-----	15	40	-----	-----	-----
Floyd	-----	-----	-----	-----	-----	1	1	7	-----	7
Foard	-----	-----	1	-----	-----	2	3	-----	-----	-----
Ft. Bend	44	7	7	1	3	14	76	33	-----	33
Franklin	7	1	-----	-----	-----	5	13	27	-----	27
Freestone	3	2	-----	-----	4	5	14	56	-----	56
Frio	4	-----	2	1	1	6	14	-----	-----	-----
Gaines	29	5	11	1	-----	7	53	-----	-----	-----
Galveston	14	2	2	-----	2	7	27	39	-----	39
Garza	21	-----	5	3	-----	5	34	-----	-----	-----

See footnotes at end of table.

Table 13.—Oil and gas wells drilled in 1967, by counties and offshore—Continued

Producing area	Proved field wells			Exploratory wells			Total	Geophysical crew-weeks		
	Oil	Gas	Dry	Oil	Gas	Dry		Reflection seismograph method	Gravity meter method	Total
County:—Continued										
Glasscock	57	1	6	-----	-----	5	69	-----	-----	-----
Goliad	5	10	11	4	5	24	59	-----	-----	-----
Gonzales	2	1	2	-----	-----	26	31	1	-----	1
Gray	39	9	7	-----	2	4	61	65	-----	65
Grayson	13	-----	3	2	-----	8	26	-----	-----	-----
Gregg	19	1	2	-----	-----	-----	22	-----	-----	-----
Grimes	-----	-----	-----	-----	-----	2	2	10	-----	10
Guadalupe	114	5	16	1	1	9	146	-----	-----	-----
Hale	-----	-----	-----	-----	-----	2	2	4	-----	4
Hamilton	-----	-----	-----	-----	-----	1	1	-----	-----	-----
Hansford	-----	7	5	-----	-----	-----	12	-----	1	1
Hardeman	2	-----	7	-----	-----	15	24	-----	-----	-----
Hardin	44	4	21	1	1	3	74	13	19	32
Harris	36	3	13	-----	7	15	74	55	-----	55
Harrison	2	6	1	4	2	11	26	-----	-----	-----
Haskell	26	1	20	4	-----	32	83	-----	-----	-----
Hartley	-----	-----	1	-----	-----	-----	1	27	-----	27
Hemphill	5	9	4	3	2	2	25	114	-----	114
Henderson	2	2	1	1	-----	6	12	29	-----	[1] 30
Hidalgo	-----	14	7	-----	6	13	40	-----	-----	-----
Hill	-----	-----	-----	-----	-----	-----	-----	3	-----	3
Hood	-----	1	1	-----	1	1	4	-----	-----	-----
Hockley	79	22	5	3	-----	18	127	-----	-----	-----
Hopkins	6	3	3	1	3	6	22	47	-----	[1] 50
Houston	13	2	2	8	-----	14	39	36	-----	36
Howard	83	-----	4	5	-----	15	107	-----	-----	-----
Hudspeth	-----	-----	-----	-----	-----	1	1	-----	-----	-----
Hunt	-----	-----	-----	-----	-----	3	3	11	-----	11
Hutchinson	15	8	5	-----	1	2	31	3	22	25
Irion	21	1	6	4	1	14	47	-----	-----	-----
Jack	78	16	24	2	-----	17	137	-----	-----	-----
Jackson	30	14	8	2	3	27	84	-----	-----	-----
Jasper	1	-----	-----	3	1	7	12	11	-----	11
Jefferson	44	4	11	1	2	19	81	15	5	20
Jim Hogg	9	7	8	-----	5	18	47	-----	-----	-----
Jim Wells	6	9	9	1	2	17	44	-----	-----	-----
Jones	29	-----	15	3	-----	33	80	-----	-----	-----
Karnes	2	1	2	1	1	14	21	-----	-----	-----
Kaufman	1	-----	-----	-----	-----	8	9	10	-----	10
Kenedy	6	6	4	-----	5	7	28	-----	-----	-----
Kent	5	-----	4	2	-----	14	25	-----	-----	-----
King	2	-----	1	1	-----	6	10	-----	-----	-----
Kleberg	34	4	8	2	5	19	72	-----	-----	-----
Knox	7	-----	4	1	-----	12	24	-----	-----	-----
LaSalle	1	-----	-----	1	5	4	11	17	-----	17
Lamar	-----	-----	-----	-----	-----	-----	-----	5	-----	5
Lamb	-----	-----	-----	1	-----	5	6	-----	-----	-----
Lavaca	2	3	1	-----	-----	5	11	-----	-----	-----
Lee	-----	-----	-----	-----	-----	5	5	-----	-----	-----
Leon	3	1	1	2	3	10	20	11	-----	11
Liberty	124	11	30	-----	-----	9	174	20	15	35
Limestone	1	5	-----	-----	-----	9	15	31	-----	31
Lipscomb	33	25	10	1	2	5	76	21	-----	21
Live Oak	19	6	6	-----	1	31	63	-----	-----	-----
Loving	8	-----	4	1	1	7	21	-----	-----	-----
Lubbock	2	-----	1	-----	-----	5	8	-----	-----	-----
Lynn	-----	-----	1	-----	-----	3	4	-----	-----	-----
Madison	7	3	-----	1	-----	5	16	1	-----	1
Marion	17	-----	1	4	1	6	29	-----	-----	-----
Martin	27	1	6	4	-----	3	41	-----	-----	-----
Matagorda	4	1	1	-----	2	17	25	32	-----	32
Maverick	5	-----	14	-----	-----	2	21	-----	-----	-----
McCulloch	-----	-----	3	-----	-----	-----	3	-----	-----	-----
McLennan	-----	-----	-----	-----	-----	-----	-----	9	-----	9
McMullen	12	2	5	-----	1	21	41	39	3	42
Medina	3	2	1	-----	-----	5	11	9	-----	9
Menard	4	-----	4	3	-----	7	18	-----	-----	-----
Midland	24	5	-----	3	2	2	36	-----	-----	-----
Milam	19	1	8	-----	-----	11	39	1	-----	[2] 3
Mitchell	23	-----	1	-----	-----	2	26	-----	-----	-----
Montague	30	-----	14	7	1	19	71	-----	-----	-----
Montgomery	2	-----	1	-----	-----	4	7	59	-----	59

See footnotes at end of table.

Table 13.—Oil and gas wells drilled in 1967, by counties and offshore—Continued

Producing area	Proved field wells			Exploratory wells			Total	Geophysical crew-weeks		
	Oil	Gas	Dry	Oil	Gas	Dry		Reflection seismograph method	Gravity meter method	Total
County:—Continued										
Moore	1	3	-----	-----	-----	-----	4	-----	-----	-----
Morris	-----	-----	-----	-----	-----	1	1	19	-----	19
Motley	-----	-----	-----	-----	-----	1	1	-----	-----	-----
Nacogdoches	5	4	-----	1	-----	-----	10	37	-----	37
Navarro	58	-----	2	-----	1	6	67	26	-----	26
Newton	1	-----	-----	1	1	7	10	22	-----	22
Nolan	15	1	8	3	1	14	42	-----	-----	-----
Nueces	45	45	27	14	20	49	200	-----	-----	-----
Ochiltree	80	9	1	2	-----	-----	92	9	-----	9
Oldham	-----	-----	-----	-----	-----	-----	-----	21	-----	21
Orange	12	-----	2	1	-----	9	24	-----	-----	-----
Palo Pinto	6	27	9	1	4	6	53	-----	-----	-----
Panola	1	10	1	-----	-----	3	15	4	-----	4
Parker	-----	5	2	-----	-----	2	9	-----	-----	-----
Pecos	40	20	20	6	8	37	131	-----	-----	-----
Polk	7	1	7	-----	-----	8	23	8	-----	8
Potter	-----	9	3	-----	-----	-----	12	22	-----	22
Rains	-----	1	-----	-----	1	2	4	35	-----	35
Randall	-----	-----	-----	-----	-----	-----	-----	19	-----	19
Reagan	227	2	6	1	-----	4	240	-----	-----	-----
Red River	1	-----	1	-----	-----	8	10	-----	-----	-----
Reeves	10	20	6	2	1	12	51	-----	-----	-----
Refugio	8	5	2	2	-----	17	34	-----	-----	-----
Roberts	7	6	5	1	1	2	22	59	-----	59
Robertson	-----	-----	1	-----	-----	2	3	28	-----	28
Rockwall	-----	-----	-----	-----	-----	-----	-----	3	-----	3
Runnels	38	1	17	9	1	37	103	-----	-----	-----
Rusk	41	7	7	3	5	9	72	19	-----	19
San Augustine	-----	-----	-----	-----	-----	2	2	-----	-----	-----
San Jacinto	-----	1	-----	-----	-----	-----	1	22	-----	22
San Patricio	18	16	18	2	4	35	93	-----	-----	-----
Sabine	-----	-----	-----	-----	-----	5	5	-----	-----	-----
Schleicher	5	10	8	1	1	13	38	-----	-----	-----
Scurry	18	-----	10	1	-----	8	37	-----	-----	-----
Shackelford	78	4	54	5	-----	36	177	-----	-----	-----
Shelby	1	-----	1	-----	1	2	5	44	-----	44
Sherman	-----	1	-----	-----	-----	2	3	-----	-----	-----
Smith	5	-----	3	-----	-----	5	13	17	-----	17
Starr	43	26	43	1	2	30	145	-----	-----	-----
Stephens	12	4	16	-----	1	9	42	-----	-----	-----
Sterling	33	-----	11	1	1	11	57	-----	-----	-----
Stonewall	12	-----	14	1	-----	24	51	-----	-----	-----
Sutton	11	3	3	-----	1	9	27	-----	-----	-----
Swisher	-----	-----	-----	-----	-----	-----	-----	17	-----	17
Taylor	53	2	34	-----	1	30	120	-----	-----	-----
Terrell	-----	-----	-----	-----	-----	4	4	-----	-----	-----
Terry	14	1	2	1	-----	5	23	-----	-----	-----
Throckmorton	55	-----	17	5	-----	41	118	-----	-----	-----
Titus	4	-----	2	-----	-----	4	10	13	-----	13
Tom Green	7	-----	9	1	-----	6	23	-----	-----	-----
Travis	-----	-----	-----	-----	-----	-----	-----	2	-----	2
Trinity	-----	-----	-----	-----	-----	1	1	9	-----	9
Tyler	13	2	4	2	-----	6	27	19	-----	19
Upshur	1	1	2	-----	2	2	8	5	-----	5
Upton	22	5	3	3	2	10	45	-----	-----	-----
Uvalde	-----	-----	-----	-----	-----	-----	-----	20	-----	20
Van Zandt	1	2	2	-----	1	2	8	67	-----	67
Victoria	7	20	8	3	8	28	74	-----	-----	-----
Walker	-----	-----	-----	1	-----	3	4	4	-----	4
Waller	2	5	1	-----	-----	1	9	19	-----	19
Ward	105	11	15	5	2	12	150	-----	-----	-----
Washington	3	1	6	-----	-----	3	13	2	7	9
Webb	8	11	7	2	7	28	63	-----	-----	-----
Wharton	20	16	11	4	9	20	80	24	-----	24
Wheeler	16	3	5	-----	-----	1	25	137	-----	137
Wichita	244	1	62	3	-----	13	323	-----	-----	-----
Wilbarger	81	-----	78	1	-----	16	176	-----	-----	-----
Willacy	6	2	3	-----	2	7	20	-----	-----	-----
Williamson	1	-----	1	-----	-----	6	8	14	-----	14
Wilson	8	-----	7	-----	-----	41	56	-----	-----	-----
Winkler	42	5	16	5	-----	7	75	-----	-----	-----

See footnotes at end of table.

Table 13.—Oil and gas wells drilled in 1967, by counties and offshore—Continued

Producing area	Proved field wells			Exploratory wells			Total	Geophysical crew-weeks		
	Oil	Gas	Dry	Oil	Gas	Dry		Reflection seismograph method	Gravity meter method	Total
County:—Continued										
Wise	12	34	4	2	2	3	57	-----	-----	-----
Wood	18	2	5	-----	-----	22	47	21	7	28
Yoakum	31	2	1	2	-----	5	41	-----	-----	-----
Young	73	11	45	6	1	19	155	-----	-----	-----
Zapata	5	11	6	-----	-----	21	43	-----	-----	-----
Zavala	-----	3	1	1	2	3	10	-----	-----	-----
Offshore area:										
Brazos	-----	2	-----	-----	14	10	26	25	-----	25
Brazos S. addition	-----	-----	-----	-----	-----	-----	-----	7	-----	7
Galveston	10	14	7	2	3	6	42	54	-----	54
Galveston S. addition	-----	-----	-----	-----	-----	-----	-----	21	-----	21
High Island	-----	5	3	1	5	8	22	47	-----	47
High Island E. addition	-----	-----	-----	-----	-----	-----	-----	26	-----	26
High Island S. addition	-----	-----	-----	-----	-----	-----	-----	29	-----	29
Matagorda Island	-----	-----	-----	-----	2	8	10	8	-----	8
Total	4,307	836	1,447	278	259	2,009	9,136	2,197	93	2,297

[1] Includes vibroseis method.
[2] Includes magnetometer method.

Source: American Association of Petroleum Geologists.

Table 14.—Crude petroleum production, indicated demand, and stocks in 1967, by months

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	Stocks originating in Texas
January	93,106	91,418	100,900
February	83,372	82,707	101,565
March	90,891	88,845	103,611
April	86,750	85,053	105,308
May	88,151	90,095	103,364
June	87,256	89,195	111,425
July	102,215	101,520	102,120
August	107,200	102,114	107,206
September	96,693	98,355	105,544
October	97,570	96,764	106,350
November	92,318	94,474	104,194
December	94,440	101,874	96,760
Total:			
1967	1,119,962	1,122,414	XX
1966	1,057,706	r 1,052,576	XX

r Revised. XX Not applicable.

Table 15.—Petroleum daily average production and runs to stills

(Thousand 42-gallon barrels)

Month	1966		1967	
	Crude production	Runs to stills	Crude production	Runs to stills
January	2,821	2,837	3,003	2,961
February	2,864	2,764	2,977	2,960
March	2,912	2,705	2,931	2,981
April	2,902	2,744	2,891	2,853
May	2,944	2,755	2,843	2,864
June	2,938	2,795	2,908	3,052
July	2,876	2,842	3,297	3,115
August	2,864	2,921	3,458	3,205
September	2,859	2,883	3,223	3,039
October	2,894	2,887	3,147	3,206
November	2,921	2,883	3,077	3,212
December	2,977	2,971	3,047	3,288

practices in the early 1930's. Of this total, 2,144 projects, which included a limited number of pressure maintenance operations, were active in 1967. The projects included 1,854 waterfloods, 100 gasfloods, 68 water and gasfloods combined, 14 thermal projects, and 122 unreported projects. Railroad Districts with the greatest number of active projects were District 9, 850 projects; District 8, 566 projects; District 7B, 394 projects; and District 4, 114 projects. Waterflooding was the most accepted practice with over 85 percent of the active total. The industry increased its fireflood and steam projects to 35 to improve the recovery of the heavy oil reserves known in the State.

Table 16.—Runs to stills and output of refineries in 1967, by months

(Thousand 42-gallon barrels)

Month	Runs			Output					
	Crude	Products	Rerun	Gasoline [1]	Kerosine	Fuel oil		Jet fuel	Miscellaneous
						Distillate	Residual		
January	76,711	11,764	−1,691	41,322	4,152	19,495	3,831	5,491	12,493
February	72,900	10,035	−2,828	37,061	3,410	18,178	3,527	5,855	12,076
March	77,960	11,124	−485	40,672	2,929	20,502	4,042	6,673	13,781
April	78,932	9,812	−3,674	41,349	2,791	18,191	3,017	6,157	13,565
May	82,328	10,733	−6,642	41,685	2,750	18,295	3,178	7,105	13,406
June	78,949	10,885	−1,194	43,029	2,274	19,299	3,817	6,979	13,242
July	80,902	11,091	−2,206	43,622	2,707	20,087	3,872	6,686	12,813
August	82,222	11,098	−1,219	44,916	3,024	20,328	3,780	6,730	13,323
September	79,168	10,129	1,788	44,385	2,977	19,975	4,292	6,358	13,098
October	82,754	11,735	−2,549	44,637	3,893	19,588	3,533	6,600	13,689
November	81,366	11,613	−3,196	42,492	3,839	19,266	3,676	7,062	13,448
December	86,703	11,538	−1,389	44,841	3,854	22,701	3,927	6,667	14,862
Total:									
1967	960,895	131,557	−25,285	510,011	38,600	235,905	44,492	78,363	159,796
1966	921,619	126,977	−14,520	507,466	45,890	223,924	40,682	61,617	154,497

[1] Includes special naphthas.

Table 17.—Stocks of crude petroleum at refineries, tank farms, and gathering systems in 1967, by months

(Thousand 42-gallon barrels)

Month	Refineries	Tank farms and pipelines	Lease tanks	Total
January	16,448	62,165	10,544	89,157
February	15,992	64,213	9,612	89,817
March	16,601	68,943	6,554	92,098
April	15,511	70,931	6,733	93,175
May	14,520	69,021	6,604	90,145
June	15,031	65,301	6,497	86,829
July	15,894	67,675	6,777	90,346
August	16,375	70,263	6,774	93,412
September	14,918	69,576	7,099	91,593
October	16,648	69,217	7,045	92,910
November	16,067	66,976	7,192	90,235
December	15,005	60,226	7,841	83,072

Table 18.—Stocks of refined products by refineries with plants and pipelines in 1967, by months

(Thousand 42-gallon barrels)

Month	Gasoline [1]	Kerosine	Fuel oil		Jet fuel	Natural gas liquids	Miscellaneous products
			Distillate	Residual			
January	36,286	2,730	15,747	8,056	3,725	848	30,954
February	36,733	2,599	12,080	8,092	4,110	997	32,790
March	35,180	2,317	11,511	6,836	4,119	932	32,007
April	34,013	2,665	12,851	6,855	4,079	914	32,686
May	34,038	2,954	13,143	7,513	4,071	1,041	36,456
June	33,838	3,432	17,517	6,187	4,621	1,135	35,210
July	34,448	3,511	19,693	7,887	4,157	1,149	34,189
August	31,643	3,566	22,957	7,281	4,836	1,251	32,873
September	32,816	3,574	25,433	7,906	4,403	1,227	30,505
October	33,880	3,955	26,661	7,242	4,550	1,066	31,608
November	33,647	3,211	23,746	7,310	4,932	1,028	32,936
December	37,263	3,350	20,520	7,083	4,717	1,347	33,454

[1] Includes naphtha.

Significant secondary recovery projects initiated in 1967 included Mobil Oil Corp's waterflood of a large portion of the Shafter Lake field in Andrews County, with 15 to 19 million barrels of oil added to ultimate recovery; a miscible flood, comprising a gas propane mix, in the University Waddell field in Crane County; and a significant fireflood in a thin section of the West Casa Blanca field in northwestern Duval County. An interesting pilot project, using a polymer-additive process, was being tested by Standard Oil Co. of Texas in the Westbrook field of Mitchell County. A pilot fireflood in a 10-foot sand section of the Glen Hummel field in Wilson County was operated by Sun Oil Co. A 12,000-acre tract in the Norris McElroy unit in Crane and Upton Counties was under waterflood by Tidewater Oil Co. A thermal belt appeared to be developing in a 47-county area in Railroad Commission Districts 1 and 4. The area contains 23 thermal recovery operations, 13 of which are firefloods.

Humble Oil & Refining Co. installed the Nation's largest crude still, a 210,000-barrel unit, at its Baytown refinery. The huge unit, which processes lube and fuel crudes at the same time, will form the core of the Baytown facility's crude-distillation complex. The company also added a 13,500-barrel-per-day hydrocracker to its Baytown operation. The new unit will produce 124 barrels of gasoline for every 100 barrels of aromatic feedstock.

A major expansion program, which included a 40,000-barrel hydrocracking unit, began at the Texas City refinery of American Oil Co. Other unit expansions included a 40,000-barrel-per-day ultraformer, a catalytic reformer in which naphthas are reformed into high-octane motor fuel components, a 50,000-barrel-per-day sulfolane unit to produce high-purity aromatics, additional electric-power-generating units to serve the new facilities, and new blending and shipping units to expedite product delivery. A 47,000-barrel-per-day, two stage crude distillation unit was added to the Big Spring refinery of Cosden Oil & Chemical Co. The new unit will replace distillation facilities at the Colorado City refinery. Sunray DX Oil Co. installed a 6,500-barrel-per-day hydrocracker at its Corpus Christi refinery. The hydrocracker upgrades low value, heavy hydrocarbons to profitable petroleum products by adding hydrogen. Mobil Oil Corp. installed a 120,000-barrel-per-day crude distillation unit at the Beaumont refinery in a modernization program which included a 42,000-barrel-per-day catalytic reformer, a 60-million-cubic-foot-per-day hydrogenerating unit, and a 29,000-barrel-per-day hydrocracker. The expansion project will raise refinery capacity from 220,000 to 280,000 barrels per day.

Ft. Worth Refining Co. purchased the 13,000-barrel-per-day oil refinery of Premier Oil Refining Co. The plant, located in the northeast part of Ft. Worth, was built in 1919 and serves markets in a 130-mile radius around Ft. Worth. Celanese Corp. purchased the 54,000-barrel-per-day oil refinery of Pontiac Refining Corp. located at Corpus Christi, Tex. The refinery will be operated by Champlin Petroleum Co., a Celanese subsidiary. The refinery has a 19,000-barrel-per-day catalytic reforming capacity to produce benzene, cyclohexane, orthoxylene, toluene, and mixed xylenes. Marathon Oil Co. planned to expand its Texas City refinery with a new catalytic reformer, a naphtha hydrotreater and treating facilities to permit processing of high-sulfur crudes. Sinclair Refining Co. added a 22,000-barrel-per-day catalytic reformer and a 4,450-barrel-per-day benzene-toluene recovery and purification unit to its Houston refinery. The reformer and extraction units will produce 32 million gallons per year of high-grade benzene and 36 million gallons per year of petroleum-grade toluene. The capacity of the paraxylene unit will be raised to 300 million pounds per year and the orthoxylene capacity to 200 million pounds per year.

Petrochemicals.—The petrochemical industry continued a growth through 1967 and was a major contributor to value-added category in the manufacturing sector of the economy. Texas was a major producer of first-generation petrochemical products derived from natural gas, and select oil refinery products and aromatics. The U.S. Department of Commerce reported chemical shipments to exceed $41 billion in 1967 with much of the shipment value originating in Texas. Most of the petrochemical industry was concentrated along the gulf coast from Corpus Christi through Freeport, Bay City, Houston, and Beaumont, Tex., into Lake Charles, Baton Rouge, and New Orleans, La.

The petrochemical industry added about 4.5 billion pounds of new ethylene capacity in 1967, a gain of about 38 percent over the existing 12-billion-pound capacity. The industry likewise showed interest in xylene isomers, particularly orthoxylene and paraxylene. Output of orthoxylene was 333 million pounds in 1966 and paraxylene a record 513 million pounds, according to latest data of the U.S. Tariff Commission.

Important petrochemical construction projects in 1967 were as follows: American Oil Co. raised the aromatics capacity of its Texas City refinery to 47,500 barrels per day with a BTX unit and began construction of a new 500-million-pound-per-year styrene monomer unit to be completed in 1969. Amoco Chemicals Corp. was building a 23-million-gallon-per-year polybutenes unit at the Texas City complex. Celanese Chemical Co., the world's largest producer of formaldehyde, was expanding the Bishop, Tex., formaldehyde plant capacity by 150 million pounds per year, raising the output potential to 720 million pounds per year. U.S. formaldehyde capacity was estimated at 4 billion pounds per year. The company also completed a 175-million-pound-per-year ethylene unit at the new Bay City complex. The latter was the first of two units to have a capacity of 1 billion pounds per year with production scheduled for 1969. The company likewise expanded 2-ethyl hexanol capacity of its Bay City operation by 80 million pounds per year with completion scheduled for early 1968.

Coastal States Petrochemical Co. boosted benzene capacity of the Corpus Christi plant by 3,000 barrels per day. A 150-million-pound-per-year expansion of perchloroethylene and trichloroethylene will double the capacity of the Deer Park chemical complex of Diamond Alkali Co. The Dow Chemical Co. began construction of a new chemical complex at Oyster Creek with construction of a 600-million-pound-per-year vinyl chloride monomer plant. The new plant was scheduled to go onstream in 1969. The company was also planning an 800-million-pound-per-year ethylene oxide plant to be built on the gulf coast with no definite location specified. E. I. du Pont de Nemours & Co., Inc., began constructing the world's largest methanol plant, a 200-million-gallon-per-year facility. This installation would more than double the company's methanol capacity. Enjay Chemical Co., a unit of Standard Oil Co., New Jersey, was expanding polypropylene capacity of its Baytown plant to a total of 150 million pounds per year. Goodrich-Gulf Chemicals, Inc., will become the second U.S. company to make polyisoprene rubber with construction of a 60,000-ton-per-year unit adjacent to its polybutadiene rubber plant at Orange, Tex., and a new isoprene monomer plant at Port Neches.

Goodyear Tire & Rubber Co. will increase polybutadiene capacity of its Beaumont plant to a total of 56,000 long tons per year and expand polyisoprene capacity to 60,000 tons. Both expansions, including new processing facilities for isoprene, and a new finishing line, were scheduled for completion in early 1968. Gulf Oil Corp. was building a 100-million-pound-per-year high-density polyethylene plant at Orange and planned a 900-million-pound-per-year ethylene plant at Port Arthur. The company operated a 200-million-pound-per-year low-density polyethylene unit at Orange and a new 200-million-pound-per-year unit at Cedar Bayou. FMC Corp. will build a 50-million-pound per-year synthetic glycerine plant in the Bayport area, southeast of Houston. Hill Chemical, Inc., will build a 1,000-ton-per-day anhydrous ammonia plant at Borger, the first phase of a project which will include associated terminals and storage facilities in the Midwest. The plant will be the first to distribute its product by pipeline to farm markets in the Midwest through the planned Mid-America Pipeline Co. system. Jefferson Chemical Co., a jointly owned subsidiary of Texaco, Inc., and American Cyanamid Co., began construction of an ethylene oxide unit at its Port Neches, Tex., plant. The new unit will use the direct oxidation process with output scheduled to begin in mid-1968.

A 30-million-pound-per-year orthoxylene unit was added to the Alvin complex of Monsanto Co. The company also expanded styrene monomer capacity of its Texas City plant to 750 million pounds per year. A 160-million-pound-per-year propylene oxide plant will be built near Houston by Oxirane Chemical Co. Propylene oxide is used to make urethane foams, polyester resins, glycols, synthetic elastomers, and other products. Oxirane Chemical Co., a joint venture of Atlantic Richfield and Halcon International, Inc., purchased a 5-acre

site in the Bayport industrial district, 20 miles southeast of Houston. Mayco Oil & Chemical Co., a new entry in the Gulf Coast chemical industry, will build a plant in the Bayport area. The company, headquartered in Philadelphia, produces sulfurized fatty bases, oils, additives, and leaded compounds. Mobil Chemical Co. added a metatoluic acid unit to its Beaumont complex. The acid is a petrochemical intermediate used in the manufacture of pharmaceuticals, plasticizers, and coatings. Petro-Tex Chemical Corp. completed a 45-million-pound-per-year neoprene rubber unit and was building a 45-million-pound-per-year chloroprene monomer unit at its Houston chemical complex. Rohm & Haas Co. was expanding acrylate monomers capacity of its Deer Park unit by 70 percent. Shell Chemical Co. was adding to its Deer Park chemical complex with a 1-billion-pound-per-year ethylene plant and a 150-million-pound-per-year isopropyl alcohol and acetone plant.

Sinclair Petrochemicals Corp. was installing a new unit at its Channelview plant to produce 35 million pounds of isophthalic acid and 35 million pounds of metaxylene. Isophthalic acid is used to make polyester plastics, fibers, film, and vinyl plasticizers. Metaxylene is used to make isophthalic and metatoluic acids, polymers, and perfume musks. Sinclair-Koppers Co. completed a 500-million-pound-per year ethylene plant at its Houston complex. The unit will assure adequate feedstock for expanded polyethylene resins and ethylbenzene production at its Port Arthur plant where a 350-million-pound-per-year ethylbenzene unit was added. The new ethylene unit is adjacent to the company's styrene-monomer plant and a Sinclair Refining Co. refinery. A 100-million-pound-per-year paraxylene unit and a 50-barrel-per-day orthoxylene unit were being built at the Corpus Christi refinery of Suntide Refining Co.; production was scheduled for early 1968. Tenneco Manufacturing Co. was raising acetylene capacity of its Houston petrochemical complex from 85 million to 110 million pounds per year, vinyl chloride monomer capacity from 200 to 255 million pounds per year, ammonia capacity from 365 to 600 tons per day, and methanol capacity from 38 to 60 million gallons per year. A 1,500-ton-per-day ammonia plant was being built at Texas City by Tuloma Gas Products Co. Union Carbide Corp. was building a 1.2-billion-pound-per-year ethylene plant, a 700-million-pound-per-year ethylene-oxide plant, and a 50-million-pound-per-year vinyl acetate unit at its Texas City complex and expanded polyethylene capacity of the Seadrift plant by 125 million pounds per year.

Pipelines.—A number of important gas pipelines were built or under construction in 1967. A 164-mile pipeline from Houston to Nacogdoches County will deliver 200–250 million cubic feet of gas per day from Humble's King Ranch gas plant to industrial customers along its Trawick pipeline system in East-Central Texas. A 369-mile, 30-inch pipeline from Kermit, Tex., to Beaver, Okla., was completed by Northern Natural Gas Co. The line will connect reserves of the Coyanosa, Gomez, and Reeves fields with the company's main pipeline at Beaver. The company will also build a 260-mile pipeline connecting New Mexico reserves to its Amarillo-Chicago main line at a point in Moore County. Houston Natural Gas Corp., through its subsidiary Houston Pipe Line Co., completed a transportation agreement with Mobil Oil Corp. to deliver in excess of 100 million cubic feet per day to Mobil's Beaumont operation. A 98-mile, 20-inch pipeline from Falfurrias in Jim Wells County to Normanna in Bee County will increase gas deliveries of South Texas Natural Gas Gathering Co. with Transcontinental Gas Pipe Line Corp. (Transco) by 115 million cubic feet of gas daily for a 16-year period. This contract raises South Texas deliveries to Transco to 65 million cubic feet, with peak deliveries of 385 million cubic feet.

A 238-mile, 8-inch pipeline between the King Ranch and Clear Lake gas plants of Humble Oil & Refining Co. will carry 200,000 barrels per day of ethane from these operations to a 6-inch line to the ethylene units of Phillips Petroleum Co. at Sweeny, Tex. A second 30-mile products pipeline and a gas-extraction unit at Alvin, Tex., will be built by Humble Oil & Refining Co. in conjunction with the Sweeny operation of Phillips Petroleum Co. and Houston Natural Gas Corp. Mobil Pipe Line Co. was building a 134-mile, 3-, 4-, and 8-inch gas liquids pipeline between its 10-inch products line at Corsicana and its Chitwood, Okla., gas plant. Suntide Pipeline Co. began construction of a 10-mile,

4-inch crude oil and condensate pipeline from the new Mobil-David field south of Corpus Christi to the Suntide refinery at Corpus Christi. A 4-mile, 4-inch crude oil pipeline connecting the Frost and Carbondale oilfields in Cass County with the company's Bryans Mill processing plant was begun by Shell Pipe Line Corp. Design capacity was estimated at 3,500 barrels daily. Black Lake Pipe Line Co., jointly owned by Sinclair Oil Corp. and Placid Oil Co., completed a 192-mile, 8-inch crude oil and gas liquids line to Sinclair's Houston refinery from the Black Lake oilfield near Natchitoches, La.

Two major pipelines to carry ammonia from Texas to midwestern markets were planned by Mid-America Pipeline Co. and by Gulf Central Pipeline Co. Mid-America will build an 850-mile line from Borger, Tex., to northwestern Iowa. The line will deliver ammonia from the 1,000-ton-per-day plant that Hill Chemicals, Inc., was building at Borger to Iowa for fertilizer markets. Gulf Central Pipeline Co. planned a $65 million, 2,000-mile ammonia transmission system from gulf coast ammonia producers to midwest fertilizer markets. The proposed system will include a 10-inch trunk line from a gulf coast location to a northern Missouri location with laterals to gulf coast ammonia plants and to ammonia-consuming areas in Illinois, Indiana, Iowa, and Nebraska. Initial pipeline capacity was estimated at 1.5 million tons per year with construction to begin early in 1969. The first pipeline to deliver industrial gas from a production facility to a consumer was under contract by Air Products & Chemicals, Inc. A major chemical company contracted with Air Products to receive hydrogen gas by pipeline directly from a new industrial gas facility that Air Products was building in Houston. Nitrogen and argon will also be produced for gulf coast markets at the Houston facility.

NONMETALS

The nonmetallic mineral industry of Texas registered new gains. Total value of output was up 10 percent, and accounted for 8 percent of the State's total 1967 mineral production value. Record highs were set in the production of portland cement, lime, salt, and combined stone-shell, reflecting the increased demand by construction, chemical, and other industrial users. Production was up during the year for ethylene dibromide, miscellaneous clay, ball clay, kaolin, fuller's earth, gypsum, magnesium chloride, sand and gravel, basalt, dimension granite, crushed marble, dimension and crushed sandstone, crushed limestone, crushed marl, shell, and sulfur. Declines were noted in production of fire clay, bentonite graphite, magnesium compounds, natural sodium sulfate, perlite, crushed granite, miscellaneous stone, dimension limestone, talc, and pumicite. New production reported in 1967 included crude vermiculite and dimension marble.

Barite.—No production of crude barite was reported—the open-pit barite mine in the Seven Heart Gap area of Culberson County was inactive during the year. Crude barite, mined outside of Texas, was processed at the Brownsville plant of Dresser Minerals Division of Dresser Industries, Inc.; at the Corpus Christi and Houston plants of Baroid Division of National Lead Co.; and at the Houston plant of Milwhite Co., Inc. Output of the ground barite declined 25 percent during 1967.

Bromine.—Texas continued as the Nation's second largest producer of bromine. Elemental bromine was extracted from sea water at the Freeport plant of Ethyl-Dow Chemical Co. on the Gulf Coast. Most of the output was consumed in production of ethylene dibromide, used chiefly as an additive in antiknock compounds in leaded gasolines. Total output and value of ethylene dibromide were up slightly from 1966 levels.

Cement.—The portland cement industry in Texas attained record highs in production, shipments, and total value. The increases followed a rise in construction activity in the State during the year. Production of portland cement was up about 3 percent from that of 1966. Shipments from plants in Texas, which accounted for approximately 9 percent of the Nation's total, were up almost 4 percent. Slightly more than 77 percent of the portland cement shipments were moved by truck, 21 percent by rail, and 1 percent by water.

Thirteen companies operated the State's 19 cement plants, located in Bexar, Dallas, Ector, Ellis, El Paso, Harris, McLennan, Nolan, Nueces, Orange, Potter, and Tarrant Counties. The 49 kilns at the plants

Table 19.—Portland cement production, shipments, and consumption

(Thousand 376-pound barrels and thousand dollars)

Year	Production	Shipments		Consumption
		Quantity	Value	
1963	29,150	29,104	$92,734	24,618
1964	29,792	30,030	94,492	26,156
1965	30,771	30,820	97,598	26,371
1966	31,487	30,827	97,188	26,995
1967	32,277	31,944	99,329	26,955

had a combined annual production capacity of 47,499,000 barrels. The plants purchased a total 616,756,573 kilowatt-hours and generated 71,205,300 kilowatt-hours of electrical energy during 1967.

Sixteen of the cement plants also manufactured masonry cement. Production and shipments of masonry cement increased less than 1 percent; value of shipments declined slightly.

The counties leading in cement production in order of output were Harris, Ellis, Bexar, and Dallas. Limestone was quarried by 13 of the cement operations and used as the basic raw material. In plants along the gulf coast, shell dredged from shallow bays was used in cement processing.

At Orange, Alpha Portland Cement Co. completed its 2.4-million-barrel-per-year plant equipped with an automatic control system. General Portland Cement Co., with plants at Dallas, Fort Worth, and Houston, announced that its main office would be moved from Chicago to Dallas. Ideal Cement Co., following modification of its No. 1 plant at Houston, began the manufacture of white cement. Universal Atlas Cement Co. was constructing a new white cement plant at Waco. Texas Industries, Inc., began the production of expansive cement, termed "chemically controlled compensating cement," at its plant in Midlothian.

Clays.—Texas ranked third in the Nation in tital clay output with 67 companies reporting production from 48 counties. Although the value of clay produced showed an increase in 1967, the tonnage dropped slightly. Declines were noted in the output of fire clay and bentonite, but production of ball clay, fuller's earth, kaolin, and miscellaneous clay was higher than that of 1966.

One producer mined ball clay in the Troup district of Cherokee County. The clay was used in the manufacture of ceramic products such as floor and wall tile.

Bentonite output was down 10 percent from that of 1966. Production was reported by five producers at six operations in Angelina, Fayette, Gonzales, and Walker Counties. Slightly more than 26 percent of the bentonite was used in rotary-drilling muds. Bentonite also was used as a filtering and decolorizing agent, animal feed filler, foundry sand binder, in insecticide carrier, and as a solution absorbent.

Fire clay production, which declined about 13 percent, was reported from operations in Bastrop, Bexar, Bowie, Brewster, Cherokee, Eastland, Harrison, Henderson, Hopkins, Limestone, Rusk, and Wood

Table 20.—Clays sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Bentonite		Fire clay		Miscellaneous clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1963	120	$1,366	808	$2,054	3,271	$3,429	[1] 4,199	[1] $6,849
1964	111	1,294	666	1,815	3,379	3,586	[1] 4,156	[1] 6,695
1965	114	829	735	1,999	3,605	3,832	[2] 4,469	[2] 6,865
1966	107	876	859	2,057	3,523	3,934	[2] 4,516	[2] 7,187
1967	97	660	748	1,862	3,598	4,882	[2] 4,497	[2] 8,081

[1] Incomplete total excludes kaolin (1964) and fuller's earth (1963–64).
[2] Includes ball, kaolin, and fuller's earth.

Counties. More than 87 percent of the output was used in the manufacture of building brick. Fire clay also was used in making stoneware, art pottery, firebrick and block, mortar, vitrified sewer pipe, and fertilizer products.

Fuller's earth production was reported from two operations in Fayette and Trinity Counties. Principal uses were as an absorbent and as a soil conditioner.

Kaolin, mined from open pits southeast of Kosse in Limestone County by one producer, was used in processing fertilizer, rubber, and cement.

Miscellaneous clay, which accounted for 80 percent of total 1967 clay output, was produced in 38 counties. Chief production was from Bexar, Eastland, Galveston, and Harris Counties. Almost 28 percent of the miscellaneous clay was used to make building brick, and slightly more than 35 percent was expanded for use as lightweight aggregate. Miscellaneous clay also was used in making art pottery, floor and wall tile, vitrified sewer pipe, other heavy clay products, and portland and masonry cement.

Following a change in ownership, the Leesburg Brick Co. in Pittsburg (Camp County) was renamed Saville-Baker Brick Co. The plant was remodeled and plans were made to produce a new line of sand-molded brick. A new plant, Teague Pottery, Inc., opened in Teague (Freestone County) for making dinnerware, ovenware, and floral and garden pottery.

Gem Stones.—Gem stones and mineral specimens produced in Texas during the year included agate, calcite, fluorite, jasper, fossiliferous limestone, opal, petrified wood, and topaz.

Graphite.—Southwestern Graphite Co., subsidiary of Joseph Dixon Crucible Co., produced crystalline-flake graphite from an open-pit mine in western Burnet County. The graphite was processed at the company mill adjacent to the mine. Output was down slightly from that of 1966. The graphite was used for lubricants, refractories, pencils, crayons, and other products.

Gypsum.—Crude gypsum was mined from open pits operated by seven companies in Fisher, Gillespie, Hardeman, Hudspeth, and Nolan Countries. The output was 9 percent greater than in 1966, but 28 percent lower than the record high production of 1959.

More than 73 percent of the crude gypsum was calcined for use in products such as plaster, plasterboard, tile, and building blocks. Most of the uncalcined gypsum was used as a retarder in portland cement.

Crude gypsum, mined outside of Texas, was calcined at a plant in Irving (Dallas County) and at a plant in Galena Park (Harris County) for use in manufacturing gypsum wallboard.

A. P. Green Refractories Co., a producer of Texas fire clay and manufacturer of refractories, merged with United States Gypsum Co.; A. P. Green will operate as a subsidiary of the United States Gypsum Co.

Attention centered on West Texas gypsum deposits during the year when Elcor Chemical Corp. of Midland, Tex., announced plans for construction of a facility in Culberson County to extract sulfur from gypsum. The gypsum, mined by open-pit methods, will be treated by a "unique process."

Table 21.—Crude gypsum mined

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	1,099	$3,999
1964	1,131	4,049
1965	1,045	3,794
1966	899	3,258
1967	984	3,419

Lime.—Lime production was reported from 15 plants in Brazoria, Calhoun, Comal, Harris, Hill, Jasper, Johnson, Nueces, Travis, and Williamson Counties. Output exceeded the record high of the previous year by 6 percent. The amount of lime sold for construction was up 16 percent, and lime sold or used for chemical and other industrial purposes increased 4 percent. An increased tonnage of lime was sold for refractory use in 1967, but a drop was noted in the amount used for treating soils.

Most of the construction lime was used as a soil stabilization agent for roads, foundation sites, parking lots, and similar applications. Rapid growth of the soil stabilization market was demonstrated by the 19-percent increase in tonnage of lime sold for this purpose during the year.

Other construction uses included mason's lime and finishing plaster. In agriculture, the lime was used as a soil conditioner and neutralizer.

Two-thirds of the 1967 lime output was sold or used for chemical and other industrial purposes. Such uses included applications in production of aluminum, chemicals, glass, magnesium, pulp, paper, and steel (as fluxing agent); and in softening and purifying water.

Approximately 1.4 million tons of limestone was used in the preparation of lime during 1967. Lime plants located on the gulf coast utilized shell as the raw material.

Of the 1967 Texas lime output, 98 percent was used within the State. Other markets included those located in Arkansas, Colorado, Louisiana, Mississippi, New Mexico, Oklahoma, and Wyoming.

During the year, United States Gypsum Co. began operating a 300-ton-per-day preheater-type rotary kiln in its lime plant at New Braunfels.

Mica.—No production of mica from Texas deposits was reported during 1967. Mica mined outside of Texas was processed at the Fort Worth grinding plant of Western Mica Co., Division of United States Gypsum Co., for use in paint.

Natural Sodium Sulfate.—Ozark-Mahoning Co. produced natural sodium sulfate from shallow brines in West Texas alkali-lake beds. The company operated facilities near Seagraves in Gaines County, Brownfield in Terry County, and Monahans in Ward County. Most of the production was processed to salt cake which is used in making kraft paper, glass, ceramics, and other products.

In Fort Worth, American Cyanamid Co. recovered sodium sulfate as a byproduct at its chemical and fertilizer plant.

Perlite.—Crude perlite was mined in Texas by one company, Perlite Producers, Inc. Production was from the open-pit Shely Ranch mine, located in the Pinto Canyon area of west-central Presidio County. Output, which was down 20 percent from that of 1966, was processed at the company drying and grinding plant adjacent to the mine.

Six plants expanded perlite in Dallas, Fort Worth, Houston, Irving, LaPorte, and Midland. The expanded product was used as loose-fill insulation, concrete aggregate, soil conditioner, filter aid, additive in building plaster, and for other purposes.

Pumicite (Volcanic Ash).—Pozzolana, Inc., was the only producer of pumicite in Texas during 1967. Production was from an open-pit mine in Tertiary strata located near Rio Grande City in Starr County. The pumicite was processed in the company plant at Rio Grande City for use as a concrete admixture.

Salt (Sodium Chloride).—With an increase of 8 percent in tonnage and value, salt production exceeded the record high of 1966. Most of the output was consumed by the chemical and petrochemical industries in the State. Some of the many other applications included use in animal feed, canning, and meat packing.

Nine companies reported salt production at 11 operations. Most of the salt was produced from brine wells drilled into salt domes in Brazoria, Chambers, Duval, Harris, and Jefferson Counties, and from wells drilled into Permian salt strata in Hutchinson, Ward, and Yoakum Counties. Seven companies produced salt brine at eight operations and two companies produced both evaporated and rock salt.

Rock salt was mined from the Grand Saline salt dome in Van Zandt County by Morton Salt Co. and from the Hockley salt dome in Harris County by United States Salt Corp.

Table 22.—Lime sold or used by producers

Year	Quicklime (short tons)	Hydrated lime (short tons)	Total	
			Short tons	Value (thousands)
1963	571,515	559,690	1,131,205	$13,026
1964	764,250	586,115	1,350,365	17,201
1965	716,574	621,377	1,337,951	19,663
1966	802,214	671,015	1,473,229	18,696
1967	853,607	710,843	1,564,450	20,713

A new salt-producing facility was under construction in Deaf Smith County about 5 miles southeast of Hereford. Plans called for Hereford Salt, Inc., to extract brine by pumps from a 2,000-foot shaft and then dehydrate it in tank-type basins. The output would supply salt for cattle.

Table 23.—Salt sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	5,965	$22,355
1964	6,410	28,797
1965	6,964	30,771
1966	7,724	33,797
1967	8,344	36,435

Sand and Gravel.—The sand and gravel industry had a marked recovery from the slump of the previous year, as output increased 20 percent and value increased 25 percent. Although the number of commercial operations dropped from 176 in 1966 to 156 in 1967, commercial output increased 10 percent. The number of Government-and-contractor operations increased from 89 in 1966 to 165 in 1967. Commercial operations accounted for 81 percent of the total production and 86 percent of the value in 1967.

The average value per ton of all sand and gravel produced was $1.25 compared with $1.19 in 1966 and $1.09 in 1963.

Sand and gravel processing included washing, screening, and crushing. Commercial operators processed 96 percent of their output before use; Government-and-contractor operators processed 93 percent of their production.

During the year, 42 percent of the total gravel output was used for building, and 54 percent for paving; the remainder was used for fill, railroad ballast, and other construction. Of the sand, 50 percent was used for building, 39 percent for paving; and 11 percent for fill and other construction.

Some industrial sands were ground for use as abrasives, chemicals, and foundry and pottery sands. Unground industrial sands were marketed as blast, engine, fire-furnace, glass, molding, and oil-frac sands, and for a variety of other uses.

Of the commercial sand and gravel, 60 percent was moved by truck, 36 percent by rail, and 4 percent by water.

Results of studies of Lower Cretaceous sands in 17 counties in central, north-central, north, and west-central Texas, and of Cenozoic sands in 26 counties in south and southeast Texas, were published.[3]

Stone.—Stone production reached a new high during 1967. Total quantity was 13 percent greater and value was almost 9 percent greater than in 1966. The 121 commercial operations, including shell producers, that were active during the year accounted for 82 percent of the quantity and 89 percent of the value. Limestone constituted 73 precent of total stone output and shell made up 22 percent. Also produced were basalt, granite, marble, marl, miscellaneous stone, and sandstone.

Basalt was quarried in Uvalde County by Trinity Concrete Products and crushed for use as concrete aggregate and roadstone.

Although an increase was recorded in the production of dimension granite, a sharp decline occurred in crushed granite

[3] Bureau of Economic Geology, The University of Texas at Austin. Lower Cretaceous Sand of Texas: Stratigraphy and Resources. Rept. of Inv. 59, 1967. Bureau of Economic Geology, The University of Texas at Austin. Sand Resources of Texas Gulf Coast. Rept. of Inv. 60, 1967.

Table 24.—Sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Year	Commercial		Government-and-contractor		Total sand and gravel	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	27,511	$32,085	5,745	$4,226	33,256	$36,311
1964	25,249	30,896	3,906	2,498	29,155	33,394
1965	27,488	33,572	5,161	2,503	32,649	36,075
1966	23,089	28,947	3,133	2,366	26,222	31,313
1967	25,397	33,630	6,001	5,539	31,398	[1] 39,170

[1] Data do not add to this total because of independent rounding.

Table 25.—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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	7,455	$6,896	6,073	$6,059
Paving	2,906	2,900	3,726	3,597
Fill	510	260	865	514
Other [1]	848	3,310	1,278	4,921
Total	11,719	13,366	11,942	15,091
Gravel:				
Building	6,809	9,566	7,726	11,462
Paving	4,045	5,457	5,084	6,212
Fill	244	130	302	186
Other [2]	272	428	343	679
Total	11,370	15,581	13,455	18,539
Total sand and gravel	23,089	28,947	25,397	33,630
Government-and-contractor operations:				
Sand:				
Building	10	17	61	33
Paving	404	247	1,107	697
Total	414	264	1,168	730
Gravel:				
Building	3	5	10	14
Paving	2,716	2,097	4,817	4,793
Fill	--	--	6	3
Total	2,719	2,102	4,833	4,810
Total sand and gravel	3,133	2,366	6,001	[3] 5,539
Grand total	26,222	31,313	31,398	[3] 39,170

[1] Includes other construction sand and industrial sand (unground and ground).
[2] Includes railroad ballast, miscellaneous, and other construction gravel.
[3] Data do not add to this total because of independent rounding.

Table 26.—Stone sold or used by producers, by kinds

(Thousand short tons and thousand dollars)

Year	Limestone		Sandstone		Shell		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1963	31,375	$34,682	1,412	$1,756	9,804	$14,026	43,142	$54,007
1964	28,263	31,950	1,304	1,753	9,990	15,077	40,240	52,070
1965	27,882	31,095	881	1,423	9,689	15,356	39,520	53,659
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

[1] Includes other stone to avoid disclosing individual company confidential data.

production and total granite output was less than that of the previous year. Dimension granite was quarried in Burnet County by Texas Granite Corp. and in Llano County by Premier Granite Quarries and Texas Crushed Stone Co. The output was used as rough construction stone, dressed architectural stone, and dressed monumental stone. Crushed granite, for use as riprap, was produced by one company in Burnet County.

During 1967, limestone was quarried in more than 74 counties. The three principal producing counties, in order of out-

put, were Bexar, Wise, and Williamson. Total production increased nearly 12 percent over that of 1966.

Crushed limestone production was up 11 percent. Ninety-three commercial operations accounted for 79 percent of the total output and 87 percent of the total crushed limestone value. Average value of crushed limestone produced by commercial operators was $1.23 per ton. Government-and-contractor production, at 86 operations, had an average value of 69 cents per ton.

Almost 70 percent of the total crushed limestone production was used for roadstone and concrete aggregate. Crushed limestone also was used as agricultural stone, flux, riprap, paint and asphalt filler, mineral food; and in filter beds; in the manufacture of cement and lime; in preparing sugar; and in glass manufacture. Refractory dolomite was prepared in Williamson County.

Approximately 82 percent of the commercially produced crushed limestone, including that used for cement and lime, was transported by truck in 1967 and 18 percent was moved by rail.

The new Mont Belvieu Corp. announced that a plant would be opened near Belton to process limestone obtained from the nearby quarry of Temple Crushed Stone Co. The limestone was to be prepared for use in livestock and poultry feed, fertilizers, floor tile, roofing, glass, paint, and absorbents. In Taylor County, White's Mines, Inc., opened a permanent plant near its limestone quarry about 6 miles northwest of View to process limestone for use as base material on roads and highways.

Dimension limestone output decreased during 1967. Production was reported from two operations in Gillespie County and one operation in Williamson County. The quarried material was used as rough construction stone, rubble, rough architectural stone, dressed stone, and for curbing and flagging.

Output of marble showed an increase during 1967. Crushed marble was produced in Llano County by Bilbrough Marble Co., a subsidiary of Marble Products Co. of Georgia, and in Burnet County by a new operation near Marble Falls—Cactus Canyon Quarries, Inc., a subsidiary of San Jacinto Stone Co. The marble was used as terrazzo chips, roofing aggregate and for other purposes. Cactus Canyon Quarries, Inc., also quarried dimension marble in Burnet County; the output was used for rough exterior building stone.

Marl, an argillaceous, calcareous sedimentary material, was produced in Bexar County for use in cement manufacture.

Production of miscellaneous stone, including rhyolite and graphitic schist, was less than that of 1966. Rhyolite was quarried in Hudspeth County by Gifford-Hill & Co., Inc., for use as concrete aggregate, railroad ballast, riprap, road metal, roofing granules, and for other purposes. Graphilter Corp. of Llano produced Precambrian graphitic schist in Llano County for use as filter material.

Total production of crushed and dimension sandstone was greater than in 1966. The crushed sandstone was produced in 19 counties at 27 operations, including two commercial operations—one in El Paso County and one in Freestone County. Most of the crushed sandstone was produced for various districts of the Texas Highway Department to use as road metal and as aggregate in concrete.

Dimension sandstone was quarried by H & H Materials Co. in El Paso County and by Ben Roy Gholson in Parker County for use as rough construction stone and rubble.

Shell was dredged from shallow bays in Aransas, Calhoun, Chambers, Galveston, Matagorda, and Nueces Counties along the Texas Gulf Coast. The production, by nine companies at 10 operations, was 15 percent greater than in 1966. The shell was used chiefly as aggregate for concrete and as a source of calcium carbonate in the manufacture of cement and lime; it also was used as asphalt filler and poultry grit.

Sulfur.—Continued demand and short supply for sulfur spurred the search for new sources and resulted in price increases during 1967. At yearend, domestic producer prices f.o.b. Gulf ports were $39 per ton for bright sulfur and $38 per ton for dark sulfur. The price rise was reflected in the total value of 1967 Frasch sulfur shipments, which showed a 16 percent increase over the 1966 value. Average per-ton value of Frasch shipments was $32.46 compared with $26.15 in 1966.

Production of Frasch sulfur increased slightly more than 1 percent in 1967, but shipments by producers declined 7 per-

cent. By the end of the year, producer stocks had declined more than 53 percent.

Five companies produced sulfur from 10 Frasch operations in Brazoria, Fort Bend, Jefferson, Liberty, Matagorda, Pecos, and Wharton Counties. New Frasch operations reporting production in 1967 were the Hooker Chemical Co. plant at Freeport (Bryan Mound salt dome) in Brazoria County and the Duval Corp. plant at Fort Stockton in Pecos County. Phelan Sulphur Co. began operations at a Frasch plant late in 1966 at the Nash salt dome in Fort Bend County.

Table 27.—Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1963	2,413	2,550	$50,109
1964	2,489	3,302	65,780
1965	2,534	3,674	83,282
1966	2,916	3,703	96,820
1967	2,956	3,448	111,931

No major discoveries of native sulfur were reported as a result of exploration along the Texas gulf coast and in the Gulf of Mexico. Much attention, however, was focused on the sulfur deposits of the west Texas Permian Basin. In Pecos County, Duval Corp., after a period of trial production at its pilot Frasch plant, was expanding its operation to 500-ton-per-day. Sinclair Oil & Gas Co. announced plans for the construction of a Frasch pilot plant about 4 miles southeast of the Duval plant in Pecos County. In December, The University of Texas at Austin held a sulfur-lease sale on lands in Pecos County. Bonus bids, received for sulfur leases on 15 tracts of land containing slightly more than 10,000 acres, totaled $766,124.43. Successful bidders included Amax Petroleum Corp., Bear Creek Mining Co., Duval Corp., Jefferson Lake Sulphur Co., Pan American Petroleum Corp., and Texas Gulf Sulphur Co.

Sulfur activities also extended into additional portions of the Permian Basin, including Culberson, Reeves, and Tom Green Counties. Plans to develop a new source of elemental sulfur were revealed in August when Elcor Chemical Corp. of Midland announced plans to construct a plant in Culberson County, about 35 miles northeast of Van Horn. The facility, which would have a capacity of 1,000 long tons of sulfur per day, would be used to extract sulfur from surface deposits of gypsum.

In addition to Frasch sulfur production, sulfur was recovered from sour gas at 37 plants in 20 counties during 1967. Shipments of recovered sulfur amounted to 674,483 long tons valued at $21,714,822. During 1967, production was reported for the first time from three recovery plants located in Brazoria, Ector, and Pecos Counties.

Talc and Soapstone.—Four companies mined crude talc at five operations in the Allamoore area of Hudspeth County. One of the companies also mined crude soapstone at an open pit in Gillespie County. Total talc and soapstone output was 11 percent less than that of 1966. A talc grinding mill was operated by Pioneer Talc in Allamoore and by United Sierra Division of Cyprus Mines Corp. in Llano. Ground material was used in ceramic products, paint, insecticides, roofing, textiles, and for other purposes.

Vermiculite.—Crude vermiculite was mined in Llano County by Perlite Producers, Inc., and exfoliated at the company plant in Llano. Three other exfoliating plants, located in Dallas, Houston, and San Antonio processed vermiculite mined outside of Texas. The processed material was used in plaster, as aggregate in concrete, as soil conditioner, for roof deck, and for miscellaneous purposes.

METALS

Metal mining in 1967 was limited to iron, mercury, and uranium, with magnesium metal being recovered by chemical methods from gulf sea water. An important metals extractive industry processed ores, concentrates, and smelter residues from other States and from foreign countries. The primary metals production was supplemented by metals recovered from scrap. A new iron mine began production in Cass County in 1967; another firm planned to construct a plant in Scurry County to recover magnesium metal from brines.

Aluminum and Bauxite.—Bauxite ores from Surinam, Dominican Republic, and Jamaica were processed at the Point Comfort alumina plant of Aluminum Company of America (Alcoa) and at the Sherwin

Table 28.—Smelters, refineries, and reduction plants in 1967

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	San Patricio	Bauxite.
San Patricio	do	Alumina.
Antimony: National Lead Co.: Laredo smelter	Webb	Ore.
Cadmium: American Smelting & Refining Co., 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 plant	Brazoria	Sea water.
Manganese: Tenn-Tex Alloy & Chemical Corp	Harris	Ore.
Tin-Tungsten: Wah Chang Corp. Texas City smelter	Galveston	Ore.
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 smelter	Moore	Concentrates and fumes

Table 29.—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.

works of Reynolds Metals Co. at Gregory, San Patricio County. The alumina was further reduced to metal at the Reynolds reduction plant in San Patricio County and at reduction plants of Alcoa in Calhoun and Milam Counties.

A total of 117 large heat exchangers was installed at the Sherwin works of Reynolds. The company also installed the largest rotary kiln in the alumina industry which would remove moisture from more than 2 million pounds of alumina per day. Alcoa was adding a seventh potline to its Rockdale reduction plant which would increase metal capacity from 175,000 tons to approximately 225,000 tons per year.

This, the third major addition to the Rockdale facility in the past 2 years, also included new atomizing facilities for the production of aluminum powders and a new aluminum redraw rod-casting unit.

Antimony.—Antimony ores from Mexico were treated at the Laredo smelter of National Lead Co. Domestic smelter output was down due to the extended strike at lead smelters. Ending stocks of ore, concentrates, and oxides were less than in 1966, while stocks of the metal and residues were greater.

Cadmium.—Cadmium in flue dust was recovered as a byproduct at the Corpus Christi smelter of American Smelting & Refining Co. (Asarco). The domestic cadmium industry experienced continued low metal production, increased imports, and a substantial withdrawal of industrial stocks. The decline in metal output was due largely to strikes at lead and zinc smelters during the latter part of 1967.

Copper.—Phelps-Dodge Refining Corp. refined blister and anode copper from Arizona operations at the Nichols refinery in El Paso. A plant expansion to a capacity of 400,000 tons per year was announced by the company. The new capacity was required to handle the future output of the company development at Tyrone, N. Mex. The company was adding a new rod mill to its El Paso Refinery to supply the rapidly growing wire cable industry of southwest and west coast markets.

Ores and concentrates from other States and from foreign countries were smelted at the El Paso smelter of Asarco. Output of both the smelter and Phelps-Dodge refinery was curtailed the latter part of 1967 due to a strike of mine, mill, and smelter workers. Asarco will construct the World's largest smokestack at the El Paso plant—an 825-foot tower with a 60-foot diameter base and a 30-foot-diameter top.

A chemical manufacturing plant to produce cupric hydroxide and related copper chemicals was built on a 30-acre site in Houston by Kennecott Copper Corp. This highly automated plant will be equipped with the latest air and water pollution-control equipment. Completion was scheduled for September 1968.

Iron Ore and Steel.—Iron ore was reported in 1967 from six open-pit operations in four counties—Cass, Cherokee, Morris, and Nacogdoches. Concentrate production was down 20 percent from 1966 and shipments down 17 percent. Most of the ore was used in making pig iron at the Daingerfield plant of Lone Star Steel Co.

A new mining venture, Bonanza Mining Co., began iron ore production in October from open pits near Linden in Cass County. A crushing and screening plant produced 500 tons of crushed ore per day. Ore reserves of high-grade, self-fluxing ore were reported to exceed 2 million tons. Pig iron and steel were produced at the Houston integrated mill of Armco Steel Corp. and at the Daingerfield works of Lone Star Steel Co. A multimillion-dollar industrial gas plant was built at Lone Star by Air Products & Chemicals, Inc., to supply oxygen to the Lone Star works and other consumers in the southwest.

Grading and foundation construction started at the integrated steel mill of U.S. Steel Corp. in the Bayport area off the Galveston coast. Cameron Iron Works, Inc., began construction of a rolling mill, a metal production mill, and accessory facilities at its Houston steel complex. The rolling mill will have both hot and cold rolling lines, complete with heat treating, cleaning, trimming, and inspection facilities. The metal production unit will include a 50-ton electric arc furnace, a degassing chamber, a 60-ton vacuum induction furnace, and associated scrap handling and ingot stripping facilities.

Bethlehem Steel Corp. began production at its new steel reinforcing bar fabricating plant on a 167-acre site near Houston. The plant containes the latest automatic bending, shearing, and material handling equipment and has a fabricating capacity of 25,000 tons per year. The bar works is housed in two adjoining bays equipped with three automatic shears, five automatic bending machines, and three radio-controlled cranes. Houston has become one of the major metal fabricating centers in the Nation, with over 310 fabricating plants that employed nearly 18,000 workers. In addition, 68 firms, that employed nearly 8,000 workers, produced primary metal products. Other expansions include a program of the Houston works of Armco Steel Co. which will add a new electric furnace shop and improvements to the billet and blooming mill and a vacuum degassing unit. Plans for a flange structural mill was

announced by the company. National Steel Corp. announced plans for a steel building manufacturing complex on a 155-acre site near Houston. Coastal Forge and Steel Co. completed construction of two furnaces for the production of plate die forgings and roll forgings.

Lead.—Ores and concentrates from other States and from foreign countries were treated at the El Paso lead works of Asarco. Output from scrap metal smelters increased slightly during the year. Lead was produced from one primary smelter and six secondary smelters located within the State during 1967.

Magnesium and Magnesium Compounds.—The Dow Chemical Co. recovered magnesium metal, magnesium chloride and other magnesium compounds from gulf sea water by an electrochemical process. Output of metal at the Freeport and Velasco plants was near capacity as market demand for the metal increased 20 percent. The metal was used in alloys of aluminum for die casting, and as a reductant in metal production, particularly for titanium and ductile iron.

Uses of the compounds included preparation of paper, pulp, refractory magnesia, oxychloride and oxysulfate cements, magnesium insulation, and sugar. Also at Freeport, E. J. Lavino & Co. processed magnesium hydroxide, supplied by Dow, to produce refractory magnesia (periclase).

A second magnesium producer—American Magnesium Company of Tulsa, Okla.—planned a 30,000-ton-per-year magnesium metal recovery plant to be located near Snyder in Scurry County. Initial production is scheduled for early 1969. The plant will produce magnesium metal and chlorine from subsurface brines near Gail in Borden County. The brine contains about 11 percent magnesium chloride, compared with 0.25 percent magnesium in sea water. Magnesium chloride will be separated from the other brine constituents by a dehydration process and magnesium metal recovered from the chloride crystals by electrolysis. Chlorine gas will be recovered as a byproduct, about 3 pounds of chlorine gas per pound of magnesium produced.

Manganese.—Ferroalloys, including ferromanganese, were produced from foreign manganese ores at the Houston plant of Tenn-Tex Alloy & Chemical Corp.

Mercury.—Mercury was recovered as the result of exploration and development work at five properties in 1967. Output and value were considerably larger than in 1966. Mercury demand continued to exceed supply with a resultant rise in metal price to about $500 per flask. Principal markets for the versatile metal remained the electrolytic preparation of chlorine and caustic soda, electrical apparatus, and industrial control equipment.

Tin-Tungsten.—Tin and tungsten were recovered from foreign ores and concentrates at the Texas City smelter of Wah Chang Corp. during 1967. The company deferred an earlier decision to discontinue tin smelting at the smelter. The facility, which has processed low-grade Bolivian tin ores, will not be able to compete with the proposed new tin smelter the Bolivian Government planned to build.

Uranuim.—Uranium ores from Karnes County were processed at the Fall City mill of Susquehanna Corp. The company increased its mill capacity to 1.2 million pounds of yellow cake per year.

Uranium prospecting increased substantially in 1967 as lease and exploration projects were active in a 300-mile strip from Fayette County in south-central Texas to Starr County on the Rio Grande River. The activity included nearly every major oil company and several major mining companies. Many oil companies were enlarging geological staffs to include mineral exploration as others formed wholly-owned subsidiaries. An example of the latter was Amarillo Oil Co. which formed Amarillo Minerals, Inc., for the purpose of leasing, exploring, and developing mineral leases.

Zinc.—Zinc retort facilities at Amarillo and Dumas and the electrolytic zinc plant at Corpus Christi produced zinc metal during 1967. Metal output was substantially reduced because of the mine and smelter strike.

Table 30.—Principal producers of metals and minerals

Commodity and company	Type of activity	County	Address	Remarks
Asphalt (native):				
Uvalde Rock Asphalt Co	Mine	Uvalde	San Antonio, Tex.	
White's Uvalde Mines	do	do	do	
Barite:				
Dresser Minerals	Grinding plant	Cameron	Houston, Tex.	
The Milwhite Co., Inc	do	Harris	do	
National Lead Co	do	do	do	
Do	do	Nueces	do	
Basalt: Trinity Concrete Products	Quarry	Uvalde	Dallas, Tex	Also stone—Johnson and Wise Counties.
Bromine: Ethyl-Dow Chemical Co	Plant	Brazoria	Midland, Mich	
Cement:				
Alpha Portland Cement Co	Quarry and plant	Orange	Easton, Pa	Also clay.
Capitol Aggregates, Inc., Capitol Cement Division.	Plant	Bexar	San Antonio, Tex	
Centex Cement Corporation	Quarry and plant	Nueces	Corpus Christi, Tex	Also clay—San Patricio County.
General Portland Cement Co., Trinity Division.	do	Dallas	Dallas, Tex	Also clay and stone.
Do	do	Harris	do	Also clay.
Do	do	Tarrant	do	Also stone.
Gifford-Hill Portland Cement Co	do	Ellis	Midlothian, Tex	Also clay and stone.
Gulf Coast Portland Cement Co., Division of McDonough.	do	Harris	Houston, Tex	Also clay—Galveston County.
Ideal Cement Co., Texas Portland Cement Division.	Quarry and plant	Harris	Denver, Colo	Also clay—Galveston County.
Kaiser Cement & Gypsum Corp	Plant	Bexar	Permanente, Calif	
Lone Star Cement Corp	Quarry and plant	Dallas	Dallas, Tex	Also clay and stone.
Do	do	Harris	do	Also clay; also clay in Fisher County.
Do	do	Nolan	do	Also stone.
San Antonio Portland Cement Co	do	Bexar	San Antonio, Tex	Also clay and stone.
Southwestern Portland Cement Co., Southwest Division.	do	Ector	El Paso, Tex	Also stone.
Do	do	El Paso	do	Do.
Do	do	Potter	do	Do.
Texas Industries, Inc	do	Ellis	Midlothian, Tex	Also clay and stone.
Universal Atlas Cement Co., Division of United States Steel Corp.	do	McLennan	Pittsburgh, Pa	Do.
Clays:				
Acme Brick Co	Mine and plant	Denton	Fort Worth, Tex	
Do	do	Ellis	do	
Do	do	Guadalupe	do	
Do	do	Harris	do	
Do	do	Henderson	do	
Do	do	Nacogdoches	do	
Do	do	Parker	do	
Do	do	Wise	do	
Dallas Lightweight Aggregate Co., Division of Texas Industries, Inc.	do	Dallas	Arlington, Tex	For lightweight aggregate.
Dresser Minerals Division of Dresser Industries, Inc.	do	Limestone	Kosse, Tex	
Elgin Butler Brick Co	do	Bastrop	Austin, Tex.	

Table 30.—Principal producers of metals and minerals—Continued

Commodity and company	Type of activity	County	Address	Remarks
Clay.—Continued				
Featherlite Co. of San Antonio	Mine and plant	Bexar	Converse, Tex	For lightweight aggregate.
Featherlite Corp	----do	Eastland	Ranger, Tex	Do.
General Portland Cement Co	----do	Dallas	Dallas, Tex	Also cement and limestone.
Do	----do	Harris	----do	Also cement.
Do	----do	Limestone	----do	
Henderson Clay Products Co	----do	Rusk	Henderson, Tex	
The Milwhite Co., Inc	----do	Fayette	Houston, Tex	
Do	----do	Walker	----do	
Texas Clay Products, Inc	----do	Henderson	Malakoff, Tex	
Texas Lightweight Aggregate Co., Division of Texas Industries, Inc.	----do	Fort Bend	Stafford, Tex	For lightweight aggregate.
Do	----do	Eastland	Eastland, Tex	Do.
Coal:				
Atlas Chemical Indust., Inc	Strip mine	Harrison	Marshall, Tex	
Industrial Generating Co	----do	Milam	Rockdale, Tex	
Graphite: Southwestern Graphite Co	Mine	Burnet	Burnet, Tex	
Gypsum:				
The Celotex Corporation	Mine and calcining plant	Fisher	Tampa, Fla	
Fredericksburg Gypsum Co	Mine	Gillespie	Houston, Tex	
Georgia-Pacific Corp	Mine and calcining plant	Hardeman	Portland, Oreg	
The Flintkote Co	----do	Nolan	East Rutherford, N.J	
National Gypsum Co	----do	Fisher	Buffalo, N.Y	
Southwestern Portland Cement Co	Mine	Hudspeth	El Paso, Tex	
United States Gypsum Co	Mine and calcining plant	Nolan	Sweetwater, Tex	
Do	Calcining plant	Harris	Chicago, Ill	
Iron ore:				
Lone Star Steel Co	Open pit	Cass	Dallas, Tex	
Do	----do	Morris	----do	
Jennings and Halbert	----do	Cherokee	Dialville, Tex	
L. B. Haberle Mining Corp	----do	----do	Jacksonville, Tex	
Tex-Iron, Inc	----do	Nacogdoches	Cushing, Tex	
Mathis & Mathis	----do	Cass	Linden, Tex	
Lime:				
Aluminum Company of America	Plant	Calhoun	Pittsburgh, Pa	
Armco Steel Corp	----do	Harris	Houston, Tex	
Austin White Lime Co	Quarry and plant	Travis	McNeil, Tex	Also limestone.
Champion Papers, Inc	Plant	Harris	Pasadena, Tex	
The Dow Chemical Co	----do	Brazoria	Midland, Mich	Also salt (brine) and magnesium.
Eastex, Inc	----do	Jasper	Silbee, Tex	
PPG Industries, Inc	----do	Nueces	Corpus Christi, Tex	
Round Rock Lime Co	----do	Fill	Round Rock, Tex	
Do	Quarry and plant	Williamson	----do	Also stone.
Texas Lime Co	----do	Johnson	Cleburne, Tex	Do.
United States Gypsum Co	Plant	Comal	Chicago, Ill	
Do	----do	Harris	----do	
White Stone & Lime Co	Quarry and plant	Williamson	Leander, Tex	Do.
Magnesium compounds:				
The Dow Chemical Co	Plant	Brazoria	Midland, Mich	Also lime and salt (brine).
E. J. Lavino & Co	----do	----do	Philadelphia, Pa	

Mercury:				
Butte Mining Corp	Mine	Presidio	Terlingua, Tex	
Diamond Shamrock Corp	do	Brewster	do	
Mica: Western Mica Company, Division of United States Gypsum Co.	Plant	Tarrant	Chicago, Ill	
Perlite:				
Filter Media, Inc	do	Harris	Houston, Tex	
Perlite of Houstin, Inc	do	do	do	
Perlite Industries, Inc	do	Midland	Midland, Tex	
Perlite Producers, Inc	Mine	Presidio	do	
Perlite Products Co	Plant	Dallas	Dallas, Tex	
Sil-Flo Corp	do	Tarrant	Fort Worth, Tex	
Texas Lightweight Products Co	do	Dallas	Irving, Tex	
U.S. Gypsum Co	do	Nolan	Chicago, Ill	
Salt:				
Diamond Shamrock Corp	Brine wells	Chambers	Cleveland, Ohio	
The Dow Chemical Co	do	Brazoria	Midland, Mich	**Also lime and magnesium.**
Montex Chemical Co	do	Ward	Monahans, Tex	
Morton Salt Co	Underground mine and brine wells	Van Zandt	Chicago, Ill	
Phillips Petroleum Co	Brine wells	Hutchinson	Bartlesville, Okla	
Pittsburgh Plate Glass Co	do	Duval	Corpus Christi, Tex	
Texas Brine Corp	Brine wells	Jefferson	Houston, Tex	
Do	do	Harris	do	
United Salt Corp	do	Fort Bend	do	
Do	Underground mine	Harris	do	
Vulcan Materials Co	Brine wells	Yoakum	Denver City, Tex	
Sand and gravel:				
Barrett Industries	Stationary	Bexar	San Antonio, Tex	**Also clay.**
Capitol Aggregates, Inc	do	do	do	**Also stone.**
Do	do	Guadalupe	do	
Do	do	Travis	do	
Dresser Minerals	do	Limestone	Kosse, Tex	**Also clay.**
The Fordyce Co	do	Hidalgo	San Antonio, Tex	
Do	do	San Patricio	do	
Do	do	Victoria	do	
Fort Worth Sand & Gravel Co	do	Dallas	Arlington, Tex	
Do	do	Tarrant	do	
Gifford-Hill & Co., Inc	do	Brazos	Dallas, Tex	
Do	do	Robertson	do	
Do	do	Wharton	do	
Do	do	Wichita	do	
Horton & Horton	Dredge	Colorado	Houston, Tex	
Do	do	San Jacinto	do	
R. E. Janes Gravel Co	Stationary	Borden	Austin, Tex	
Do	do	Howard	do	
Do	do	Stonewall	do	
Do	do	Travis	do	
James-Prentice, Inc	do	Crosby	do	
Panhandle Gravel West, Inc	do	Potter	Amarillo, Tex	
Parker Bros. & Co	do	Colorado	Houston, Tex	
Do	Dredge	Harris	do	
Pennsylvania Glass Sand Corp	Stationary	McCulloch	Hancock, West Va	**Silica sand.**
Southwest Constr. Matls. Co	do	Dallas	Dallas, Tex	
Do	do	Henderson	do	
Do	do	McLennan	do	
Do	do	Tarrant	do	

Table 30.—Principal producers of metals and minerals—Continued

Commodity and company	Type of activity	County	Address	Remarks
Sand and gravel—Continued				
Texas Construction Materials Co	Stationary, portable and dredges	Colorado	Houston, Tex	
Do	do	Liberty	do	
Thorstenberg Materials Co	Stationary	Colorado	do	
Do	do	Fayette	do	
Do	do	San Jacinto	do	
Wesco-Wamix, Inc	do	Dallas	Dallas, Tex	
Do	do	Navarro	do	
Do	do	Tarrant	do	
Shell:				
Bauer Dredging Company	Dredges	Calhoun	Port Lavaca, Tex	
Corpus Christi Shell Co., Inc	do	Nueces	Corpus Christi, Tex	
General Dredging Corp	do	do	do	
W. D. Haden Company	do	Chambers	Houston, Tex	
Heldenfels Brothers	do	Aransas	Corpus Christi, Tex	
Do	do	Nueces	do	
Horton & Horton	do	Galveston	Houston, Tex	
Matagorda Shell Co., Inc	do	Matagorda	Matagorda, Tex	
Parker Brothers & Co., Inc	do	Chambers	Houston, Tex	
Sodium sulfate:				
American Cyanamid Co	Plant	Tarrant	Wayne, N. J	
Ozark-Mahoning Mining Co	do	Gaines	Tulsa, Okla	
Do	do	Terry	do	
Do	do	Ward	do	
Stone:				
Border Road Constr. Co	Quarry	Various	Monahans, Tex	
Bridgeport Stone Co	do	Wise	Arlington, Tex	
Crushers, Inc	do	Grayson	Sherman, Tex	
Do	do	Wise	do	
Gifford-Hill & Co., Inc	do	do	Dallas, Tex	
McDonough Bros., Inc	do	Bexar	San Antonio, Tex	
Olmos Rock Products Corp	do	do	do	
Servtex Materials Co	do	Comal	New Braunfels, Tex	
Texas Construction Materials Co	do	Burnet	Houston, Tex	
Texas Crushed Stone Co	do	Williamson	Austin, Tex	
Texas Granite Corp	do	Burnet	Marble Falls, Tex	
Trinity Concrete Products Co	do	Johnson	Dallas, Tex	
Do	do	Wise	do	
Wesco-Wamix, Inc	do	do	do	
Sulfur (native):				
Duval Corp	Frasch process	Pecos	Houston, Tex	
Do	do	Fort Bend	do	
Hooker Chemical Corp	do	Brazoria	Freeport, Tex	
Jefferson Lake Sulphur Co	do	Fort Bend	New Orleans, La	
Phelan Sulphur Co	do	do	Houston, Tex	
Texas Gulf Sulphur Co	do	Jefferson	New York, N.Y	
Do	do	Liberty	do	
Do	do	Matagorda	do	
Do	do	Wharton	do	

Sulfur (byproduct):			
Getty Oil Company	Secondary Recovery	Franklin	Scroggins, Tex.
Gulf Oil Corp.	do.	Jefferson	Port Arthur, Tex.
Pan American Petroleum Corp.	do.	Andrews	Tulsa, Okla.
Do.	do.	Ector	do.
Do.	do.	Hockley	do.
Do.	do.	Van Zandt	do.
Do.	do.	Wood	do.
Phillips Petroleum Co.	do.	Brazoria	Bartlesville, Okla.
Phillips Petroleum Co.	Secondary recovery	Crane	Bartlesville, Okla.
Do.	do.	Ector	do.
Shell Oil Co.	do.	Cass	Houston, Tex.
Do.	do.	Karnes	do.
Warren Petroleum Corp.	do.	Crane	Tulsa, Okla.
Do.	do.	Hopkins	do.
Do.	do.	Karnes	do.
Talc:			
Dallas Ceramics	Mine	Hudspeth	Allamoore, Tex.
Pioneer Talc Co.	Plant	do.	Chatsworth, Ga.
Southern Clay Products, Inc.	Mine	do.	Gonzales, Tex.
The United Sierra Division, Cyprus Mines Corp.	do.	do.	Trenton, N.J.
Do.	do.	Gillespie	do.
Do.	Plant	Llano	do.
Westex Talc Co.	Mine and plant	Hudspeth	Houston, Tex.
Uranium: Susquehanna Western, Inc.	Mine	Karnes	Falls City, Tex.
Vermiculite:			
Perlite Producers, Inc.	Mine and exfoliating plant	Llano	Midland, Tex.
Texas Vermiculite Co.	Exfoliating plant	Bexar	Dallas, Tex.
Do.	do.	Dallas	do.
Vermiculite Products, Inc.	do.	Harris	Houston, Tex.
Volcanic (pumicite) ash: Pozzolana, Inc.	Mine and plant	Starr	Mission, Tex.

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 Utah Geological and Mineralogical Survey.

By Douglas H. Hileman [1] and William C. Henkes [2]

For the first time since 1963 the State recorded a decrease in the annual value of mineral output—$94.4 million less than the record-high 1966 value of $448.9 million. The major loss was in metals resulting from the copper strike, although losses were also recorded in mineral fuels and nonmetals. The value of mineral production in 1967 was $354.5 million, less than in any year since 1957 when production amounted to $359.3 million.

A total of 81.9 million tons of material was handled of which 37.2 million tons was valuable material—including material from tailings and dumps—and 44.7 million

[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	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Carbon dioxide (natural)—thousand cubic feet	94,006	$7	65,664	$5
Clays [2]—thousand short tons	89	r 240	114	288
Coal (bituminous)—do	4,635	26,762	4,175	24,281
Copper (recoverable content of ores, etc.)—short tons	265,383	191,978	168,609	128,905
Gem stones	NA	75	NA	80
Gold (recoverable content or ores, etc.)—troy ounces	438,736	15,356	288,350	10,092
Iron ore (usable)—thousand long tons, gross weight	1,956	13,478	1,708	11,916
Lead (recoverable content of ores, etc.)—short tons	64,124	19,385	53,813	15,068
Lime—thousand short tons	200	3,640	169	3,182
Natural gas (marketed)—million cubic feet	69,366	8,809	48,965	6,463
Petroleum (crude)—thousand 42-gallon barrels	24,112	63,760	24,048	63,221
Salt—thousand short tons	427	3,770	403	3,525
Sand and gravel—do	12,368	12,937	9,412	8,631
Silver (recoverable content of ores, etc.) thousand troy ounces	7,755	10,028	4,875	7,556
Stone—thousand short tons	2,246	4,269	1,831	4,108
Uranium [3] (recoverable content U_3O_8)—thousand pounds	1,225	9,797	1,287	10,300
Vanadium—short tons	353	1,519	471	2,024
Zinc (recoverable content of ores, etc.)—do	37,323	10,824	34,251	9,483
Value of items that cannot be disclosed: Asphalt and related bitumens, cement, clays (fire clay and halloysite), fluorspar, gypsum, magnesium chloride, molybdenum, natural gas liquids, perlite, phosphate rock, potassium salts, pumice, pyrites, and tungsten concentrate (1967)	XX	[4] 52,243	XX	[5] 45,349
Total	XX	r 448,877	XX	354,477
Total 1957–59 constant dollars	XX	r 395,652	XX	308,157

r Revised. NA Not available. XX Not applicable.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Excludes fire clay and halloysite; included with "Value of items that cannot be disclosed."
[3] Method of reporting changed from short tons of ore and f.o.b. mine value (AEC Circular 5, Revised price schedule) to recoverable pounds of uranium oxide and f.o.b. mill value.
[4] Value of metals and mineral fuels, $29,251,000; value of nonmetals, $22,992,000.
[5] Value of metals and mineral fuels, $22,458,000; value of nonmetals, $22,891,000.

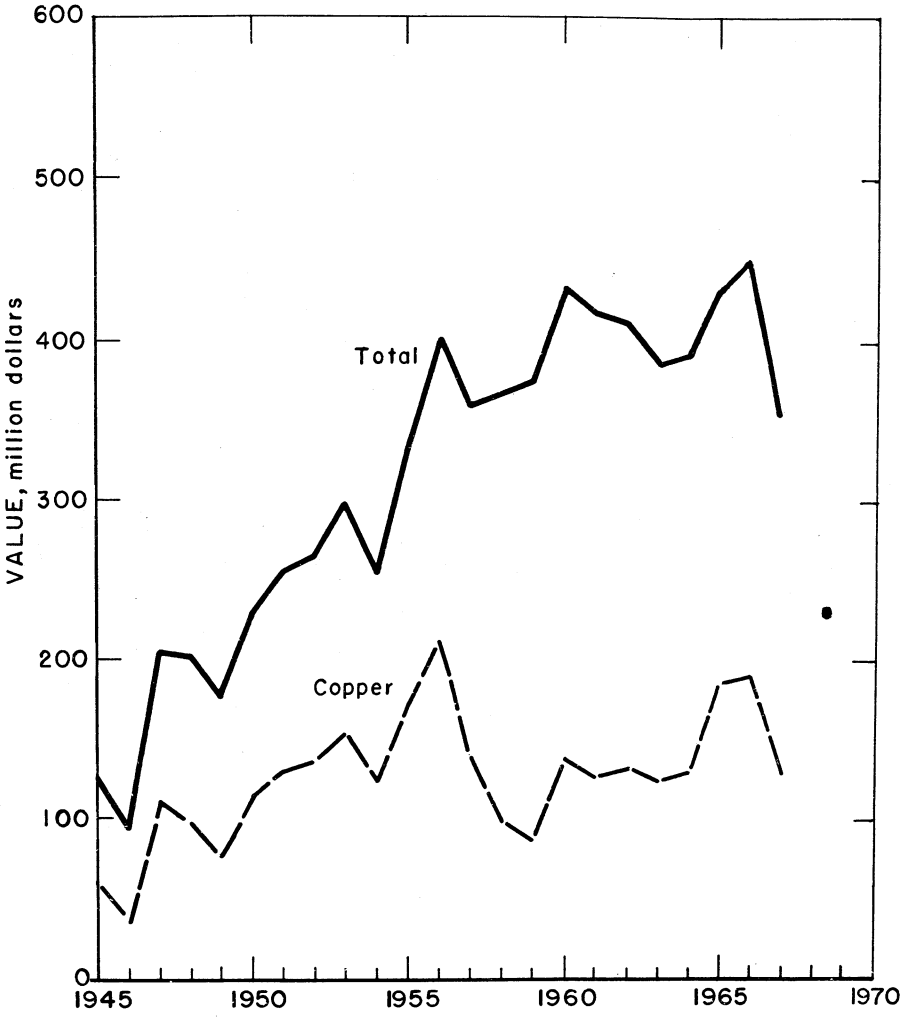

Figure 1.—Value of copper, and total value of mineral production in Utah.

tons was waste or leach material. Of the 37.2 million tons of valuable material produced, metals accounted for 23.9 million tons and nonmetals for 13.3 million.

Kennecott Copper Corp. employees were on strike from mid-July to beyond yearend. This contributed to a 29-percent decrease in the output value of the metals group. Copper, gold, lead, silver, and zinc had a combined value of $171.1 million, $76.5 million less than in 1966. Copper amounted to only 36 percent of the total value of mineral production, compared with 43 percent in 1966. All metals except uranium and vanadium had losses.

Despite a strong gain in potassium salts, the nonmetal group decreased 11 percent in value. Declines were recorded in nine out of the 16 nonmetals produced.

Coal production value was down 10 percent. Losses in output value were also recorded in asphalt (gilsonite), carbon dioxide, natural gas, and petroleum for

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

County	1966	1967	Minerals produced in 1967 in order of value
Beaver	$2,578,591	$2,188,944	Copper, silver, sand and gravel, gold, lead, zinc, pumice, perlite.
Box Elder	1,243,578	1,175,133	Sand and gravel, lime, salt, stone, petroleum.
Cache	W	516,203	Sand and gravel, stone, lime.
Carbon	21,257,554	18,630,198	Coal, natural gas, sand and gravel, carbon dioxide.
Daggett	349,650	331,000	Natural gas, sand and gravel, natural gasoline, petroleum.
Davis	1,212,182	363,060	Sand and gravel, stone.
Duchesne	756,371	1,005,351	Petroleum, gilsonite, sand and gravel, stone, natural gas.
Emery	r 6,099,224	6,112,976	Coal, uranium, natural gas, sand and gravel, petroleum, tungsten concentrate, stone.
Garfield	r 769,783	1,300,489	Petroleum, uranium, sand and gravel, vanadium.
Grand	r 8,311,494	9,004,385	Potassium salts, natural gas, uranium, petroleum, vanadium, sand and gravel.
Iron	14,004,961	12,218,864	Iron ore, sand and gravel, coal, stone, pumice.
Juab	1,509,223	1,208,994	Clays, fluorspar, stone, silver, gold, copper, sand and gravel.
Kane	68,837	55,823	Sand and gravel, coal.
Millard	20,150	W	Sand and gravel, fluorspar, stone.
Morgan	W	W	Cement, stone, sand and gravel.
Piute	r 586,639	358,162	Zinc, lead, silver, uranium, clays, gold, copper.
Rich	W	W	Phosphate rock, sand and gravel, stone.
Salt Lake	251,156,406	171,873,213	Copper, molybdenum, gold, lead, silver, zinc, sand and gravel, cement, salt, lime, stone, clays.
San Juan	r 58,320,958	56,513,155	Petroleum, uranium, LP gases, vanadium, natural gas, natural gasoline, copper, sand and gravel, stone, silver.
Sanpete	r 215,216	121,531	Salt, sand and gravel, clays, natural gas.
Sevier	r 1,265,072	1,366,125	Gypsum, coal, clays, sand and gravel, salt, gold, silver.
Summit	6,163,526	5,685,055	Petroleum, zinc, lead, silver, stone, copper, coal, clays, sand and gravel, pyrites, gold.
Tooele	8,408,685	8,147,164	Lime, salt, potassium salts, lead, stone, zinc, sand and gravel, silver, magnesium chloride, copper, clays, pyrites, gold.
Uintah	29,604,838	27,612,152	Petroleum, gilsonite, natural gas, phosphate rock, sand and gravel, LP gases, natural gasoline.
Utah	14,948,895	10,854,987	Lead, zinc, stone, silver, sand and gravel, lime, clays, copper, gold.
Wasatch	6,965,546	6,802,641	Gold, lead, zinc, silver, copper, sand and gravel, stone.
Washington	183,196	405,450	Sand and gravel, silver, stone, copper.
Wayne	----------	W	Sand and gravel, stone, vanadium, uranium.
Weber	W	W	Sand and gravel, clays, stone.
Undistributed [1]	r 12,876,579	10,617,054	
Total	r 448,877,000	354,477,000	

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

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

an overall 5-percent loss in the value of mineral fuels. However, production of natural gas liquids increased in value.

In June Lithium Corporation of America, Inc., (LCA) was merged into Gulf Resources & Chemical Corp. and was to operate as a subsidiary of the latter company. The Great Salt Lake Minerals & Chemical Corp. (GSL) was formed by LCA and Salzdetfurth, A.G., to produce minerals from Great Salt Lake. A system of evaporation ponds was completed near Ogden at a total cost of $9 million. According to the company annual report, anticipated annual production from the brines will approximate 225,000 tons of potassium sulfate, 100,000 tons or more of sodium sulfate, up to 350,000 tons of magnesium chloride, and very large quantities of salt. Total cost of the evaporating ponds and the chemical processing complex was estimated at $26 million.

LCA retained title to the concentrated brines left after processing by GSL. Annual recovery is expected to be 5,000 tons of lithium products and 2,000 tons of elemental bromine. These facilities, scheduled for construction in the early 1970's, will cost about $4 million.

Construction of a $52 million magnesium reduction plant to recover minerals

Table 3.—Indicators of Utah business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$2,502	$2,680	+7.1
Per capita		$2,697	$2,859	+6.0
Bank debits	millions	$16,323.8	$15,295.2	−6.3
Total State revenue	do	$326.8	$326.1	−.2
Total State expenditures	do	$340.8	$342.4	+.5
Electric power used	million kilowatt hours	5,726.5	5,772.8	+.8
New construction:				
Total construction valuation	millions	$210.6	$263.3	+25.0
Residential	number	3,982	5,116	+28.5
Residential value	millions	$62.1	$78.3	+26.1
Non-residential	number	2,980	2,803	−5.9
Non-residential value	millions	$83.7	$98.6	+17.8
Highway construction contracts awarded	do	$41.4	$52.9	+27.8
Truck gross ton-mile tax [1] (fiscal year July 1-June 30)	do	$3.6	$3.7	+2.8
Cash receipts from farm marketing	do	$187.5	$188.7	+.6
Mineral production	do	$448.9	$354.5	−21.0
Work force (monthly average):				
Total labor force	thousands	392.0	407.3	+3.9
Total employment	do	373.9	384.8	+2.9
Total unemployment	do	18.8	19.6	+4.3
Unemployment rate	percent	4.8	4.8	----
Employment (monthly average):				
Total agricultural	thousands	14.2	14.0	−1.4
Total non-agricultural	do	318.3	329.3	+3.5
Mining	do	11.7	10.1	−13.7
Contract construction	do	15.5	14.3	−7.7
Manufacturing	do	50.4	49.8	−1.2
Finance, insurance, real estate	do	12.9	13.0	+.8
Transportation and utilities	do	21.8	22.6	+3.7
Trade	do	70.2	72.3	+3.0
Services and miscellaneous	do	45.0	47.9	+6.4

[1] This is a combination of special fuel taxes and temporary permit and mileage fees.

Source: Bureau of Economic and Business Research, University of Utah, Salt Lake City, Utah.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Non-fatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1966:								
Coal	1,375	212	291	2,302	5	94	43.01	14,738
Metal	4,941	310	1,530	12,238	10	222	18.96	6,006
Native asphalt	189	271	51	410	----	17	41.42	387
Nonmetal	932	280	261	2,094	6	116	58.25	18,284
Sand and gravel	645	205	132	1,061	----	22	20.73	493
Stone	469	276	130	1,035	----	14	13.52	3,628
Total [1]	8,551	280	2,395	19,141	21	485	26.44	7,845
1967: [p]								
Coal	1,240	206	255	2,015	----	80	39.70	1,667
Metal	NA	NA	1,140	9,123	4	196	21.92	3,517
Native asphalt	222	248	55	440	----	23	52,25	5,306
Nonmetal	1,010	266	268	2,147	----	113	52.62	1,750
Sand and gravel	600	205	122	1,008	1	24	24.80	6,796
Stone	400	261	105	836	1	11	14.35	7,326
Total [1]	NA	NA	1,945	15,570	6	447	29.09	3,502

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

from Great Salt Lake was proposed by Magnesium Project, a joint venture of National Lead Co. and Hogle-Kearns Corp. The plant would be constructed in Utah or Idaho, depending on the cost of electric power because large amounts of power would be used in the electrolytic separation of magnesium and chlorine. A

company spokesman estimated that initial production would be about 45,000 tons yearly of magnesium, 81,000 tons of liquid chlorine, 48,000 tons of gypsum, and an unspecified amount of lithium and other forms of salt. Reportedly $4 million had already been spent on the project.

Exploration work for eight commodities was reported. A total of 7,500 feet was drilled by churn drilling, 267,212 feet by diamond drilling, 344,041 by rotary drilling, and 733,222 by percussion drilling. Exploration work in the uranium industry accounted for 37 percent of the drilling.

Employment and Injuries.—Final employment and injury data for 1966 and preliminary data for 1967, excluding all mineral fuels except the coal and asphalt (gilsonite) industries, compiled by the Bureau of Mines are shown in table 4.

Legislation and Government Programs.—The Office of Minerals Exploration awarded no contracts in 1967. Under a contract awarded in 1966 Thomas P. Miller continued an exploration program for silver.

The Public Service Commission of Utah has under consideration a proposal by Raft River Rural Electrical Cooperative, Inc., to bring power from the facilities of the Bonneville Power Administration to the proposed magnesium reduction plant of Magnesium Project. The supporters of this action emphasize that the plant might be constructed outside of Utah if low-cost power were unavailable. The officials of Utah Power & Light Co., however, question the need for power in Utah from the Bonneville Power Administration.

Engineers at the Bureau of Mines Salt Lake City Metallurgy Research Center are investigating potential uses for materials in waste dumps from mining and milling operations. Research in dump stabilization was also in progress. Extensive work has been done with tailings from the Kennecott Copper Corp. operation and other mine dumps in Utah.

Contractors completed 37.5 miles of road that met interstate highway standards. Utah has completed 290.6 miles of the 933.8 miles designated as interstate highway in the State.[3] The policy of the State has been to complete first the most heavily traveled and expensive part of the interstate system; as a result, most of the highway has been completed along the heavily populated Wasatch front.

Contracts totaling $52.9 million were awarded by Utah for highway construction in 1967 ($41.9 for interstate contracts). Contract plans in 1968 total $74.7 million, a 41-percent increase.[4]

REVIEW BY MINERAL COMMODITIES

METALS

Beryllium.—The Brush Beryllium Co. and Topaz-Beryllium Co. both made small shipments of ore to their respective plants for metallurgical testing. The Brush Beryllium Co. announced commercial mining and milling operations would begin on beryllium ores near Delta during the latter part of 1969. Mined first by open-pit methods, initial production was to be approximately 500 tons of ore per day, with the grade ranging from 0.8 to 1.0 percent beryllia (BeO). The mill was to be located 10 miles northeast of Delta. The mine is on Spor Mountain, 45 miles northwest of the mill. The cost of the mine and mill plant was estimated at approximately $8 million. For further processing, the BeO product was to be shipped to the Ohio plant of the company.

Copper.—A strike called on July 15 stopped production for the remainder of the year at the Kennecott Copper Corp. properties. Among the operations closed were the mine at Bingham Canyon, the mills-smelter-refinery complex, and the new Burgin mine near Eureka. Although production of copper for the year was 36 percent less than the 1966 figure, Utah still was ranked second to Arizona in output in the Nation.

The largest production came from the open-pit mine of the Utah Copper Division of Kennecott Copper Corp. Other

[3] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1967. Press Release FHWA-118, Feb. 14, 1968.

[4] Engineering News-Record. State Highway Departments' Construction Contracting Plans for 1968 . . . and Budgets for Maintenance: Highway Spending Goes for a New Record Despite Federal Aid Cuts. V. 180, No. 14, Apr. 4, 1968, pp. 86–87.

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)
1963	31	----	27,035	285,907	$10,007	4,791	$6,128
1964	28	----	25,279	287,674	10,069	4,552	5,886
1965	34	----	32,387	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
1864–1967	NA	NA	[3] 1,166,535	18,492,374	547,460	846,067	651,756

Year	Copper		Lead		Zinc		Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	203,095	$125,107	45,028	$9,726	36,179	$8,321	$159,289
1964	199,588	130,131	40,249	10,545	31,428	8,548	165,179
1965	259,138	183,470	37,700	11,762	27,747	8,102	225,542
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
1864–1967	9,705,890	4,204,626	5,390,536	761,619	1,751,938	336,119	6,501,580

NA Not available.
[1] Includes recoverable metal content of gravel washed (placer operations), ore milled, old tailings, or slimes retreated; and ore, old tailings, or copper precipitates shipped to smelters during the calendar year indicated.
[2] Does not include gravel washed, tonnage of precipitates shipped, or uranium ore milled.
[3] Figures estimated for certain years before 1901.

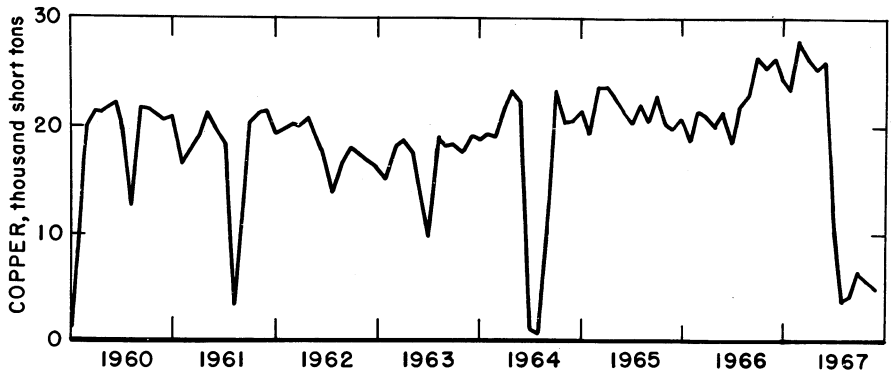

Figure 2.—Mine production of copper in Utah, by months, in terms of recoverable metals.

major copper producing companies were American Mining Co. at the Bawana mine, which was closed in December 1967, United States Smelting Refining and Mining Co. (USSR&M Co.) at the U.S. and Lark, and Hecla Mining Co. at the Mayflower. Copper was produced from 22 mines in 10 counties.

With the $100 million expansion program at the Utah Copper Division of Kennecott Copper Corp. nearly completed, the company reached its daily ore-production goal of 108,000 tons on March 3. Trucks, loaded by new and larger shovels, were used at the mine to remove overburden formerly handled by rail haulage.

Table 6.—Mine production of gold, silver, copper, lead, and zinc in 1967, by counties, in terms of recoverable metals

County	Mines producing [1] (lode)	Mines producing [1] (placer)	Lode material sold or treated [2] (short tons)	Gold Troy ounces	Gold Value	Silver Troy ounces	Silver Value
Beaver	3	--	[3] 142,323	[3] 1,054	[3] $36,890	[3] 1,055,410	[3] $1,635,886
Juab	1	--	15,485	480	16,800	29,771	46,145
Piute	1	--	(3)	(3)	(3)	(3)	(3)
Salt Lake	3	--	21,088,731	220,439	7,715,365	2,686,027	4,163,342
San Juan	3	--	30,630	--	--	604	936
Sevier	--	1	--	1	35	1	2
Summit	5	--	88,917	1,234	43,190	310,449	481,196
Tooele	3	--	38,395	154	5,390	235,999	365,798
Utah	1	--	(3)	(3)	(3)	(3)	(3)
Wasatch	1	--	131,347	64,988	2,274,580	552,699	856,683
Washington	1	--	1,500	--	--	3,680	5,704
Total:							
1967	22	1	21,537,328	288,350	10,092,250	4,874,640	7,555,692
1966	33	--	34,458,734	438,736	15,355,760	7,755,411	10,027,746

County	Copper Short tons	Copper Value	Lead Short tons	Lead Value	Zinc Short tons	Zinc Value	Total value
Beaver	[3] 2,364	[3] $1,807,058	[3] 15,190	[3] $4,252,920	[3] 8,577	[3] $2,374,905	[3] $10,107,659
Juab	14	10,436	--	--	--	--	73,381
Piute	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Salt Lake	164,593	125,835,252	25,349	7,097,916	13,744	3,805,039	148,616,914
San Juan	515	393,995	--	--	--	--	394,931
Sevier	--	--	--	--	--	--	37
Summit	87	66,475	4,159	1,164,730	4,938	1,367,038	3,122,629
Tooele	178	136,123	3,441	963,424	2,178	602,904	2,073,639
Utah	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Wasatch	857	655,002	5,674	1,588,650	4,814	1,332,846	6,707,761
Washington	1	612	--	--	--	--	6,316
Total:							
1967	168,609	128,904,953	53,813	15,067,640	34,251	9,482,732	171,103,267
1966	265,383	191,977,918	64,124	19,384,685	37,323	10,823,655	247,569,764

[1] Operations at slag dumps and old mill or miscellaneous cleanups not counted as producing mines; various uranium mines from which copper was recovered as a byproduct not included as they are in the mine count of uranium.
[2] Does not include gravel washed, tonnage of precipitates shipped, or uranium ore milled.
[3] Production of Beaver, Piute, and Utah Counties combined to avoid disclosing individual company confidential data.

With the new Bonneville crushing and grinding plant in operation and the expansion program completed at the smelter, facilities were available to handle more ore. The cost of handling smelter slag was greatly reduced at the Garfield smelter by granulation before placing on slag dumps. The copper ore mined in Bingham Canyon contained about 15 pounds of copper per ton of ore, compared with 19 pounds in 1952. Even though a 20-percent increase occurred in daily ore production, copper output (not including the leaching operation) was about the same as in the mid-1950's. The installation of 26 precipitation cones increased daily copper production at the leaching operation from 150,000 to 400,000 pounds.

West Toledo Mining Co. purchased a controlling interest in American Mining Co. The Bawana mine was closed and production was started at the O K mine. A newly constructed $300,000 leaching plant was operated for the first time on December 29.

Gold.—Gold output, recovered principally as a byproduct of copper and complex ores containing copper, lead, and zinc from 18 mines in six counties, was down because of the strike; however, an increase in production was recorded at the Mayflower mine of Hecla Mining Co. Utah was the third largest gold-producing State in the Nation.

Iron Ore.—Iron ore was produced at five mines, all in Iron County: the Blowout and Comstock mines operated by Utah Construction & Mining Co. for CF&I Steel Corp. (CF&I), the Desert Mound

Table 7.—Mine production of gold, silver, copper, lead, and zinc in 1967, by classes of ore or other source materials, in terms of recoverable metals

Source	Number of mines [1]	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode ore:							
Dry gold-silver	2	23,575	573	18,623	238,300	----------	----------
Dry silver	2	14,306	87	10,191	8,900	----------	----------
Total	4	37,881	660	28,814	247,200	----------	----------
Copper	6	20,895,061	213,122	1,762,264	274,675,800	----------	----------
Copper-lead-zinc	1	127,182	64,937	535,131	1,704,300	10,848,900	9,028,600
Lead	3	253	5	2,863	600	48,400	8,900
Lead-zinc	8	443,733	9,140	2,507,977	2,926,200	96,399,000	57,841,400
Total	17	21,466,229	287,204	4,808,235	279,306,900	107,296,300	66,878,900
Other lode material:							
Gold-silver tailings	1	15,485	480	29,771	27,300	----------	----------
Silver tailings	1	1,500	-------	3,680	1,600	----------	----------
Copper clean-up, copper-lead cleanup, uranium [2]	([3])	[4] 13	2	758	199,400	200	600
Copper precipitates	2	34,571	-------	----------	57,427,500	----------	----------
Lead-zinc mill cleanup and zinc slag [2]	([5])	16,220	3	3,381	8,100	329,500	1,622,500
Total	4	67,789	485	37,590	57,663,900	329,700	1,623,100
Total lode material	22	21,571,899	288,349	4,874,639	337,218,000	107,626,000	68,502,000

[1] Detail will not necessarily add to totals because some mines produce more than one class of material.
[2] Combined to avoid disclosing individual company confidential data.
[3] From properties not classed as mines and excluding the mine count of uranium mines from which copper was recovered as a byproduct.
[4] Excludes uranium ore tonnage.
[5] From properties not classed as mines.

Table 8.—Mine production of gold, silver, copper, lead, and zinc in 1967, by types of material processed and methods of recovery, in terms of recoverable metals

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Lode:					
Concentration, and smelting of concentrates:					
Ore [1]	287,110	4,165,072	278,767,400	88,170,800	60,069,100
Tailings	-------	3,680	1,600	----------	----------
Total	287,110	4,168,752	278,769,000	88,170,800	60,069,100
Direct-smelting:					
Ore	755	672,769	288,400	19,133,300	6,814,600
Cleanup and old slag	4	3,347	10,100	321,900	1,618,300
Copper precipitates	-------	----------	57,427,500	----------	----------
Tailings	480	29,771	27,300	----------	----------
Total	1,239	705,887	57,753,300	19,455,200	8,432,900
Other:					
Leaching of copper ore	-------	----------	695,700	----------	----------
Placer	1	1	----------	----------	----------
Grand total	288,350	4,874,640	337,218,000	107,626,000	68,502,000

[1] Includes uranium ore concentrate.

mine of United States Steel Corp. (USS), and the Iron Springs and McCahill-Thompson Alluvial mines of Utah Construction & Mining Co. The Desert Mound mine led in production. No production was reported from the Duncan mine by CF&I.

A multimillion dollar addition was begun at the Geneva works of USS to produce wire-flange beams. Geneva will be the only plant west of Denver producing this item.

Table 9.—Usable iron ore shipments

(Thousand long tons and thousand dollars)

Year	Quantity	Value
1963	1,881	$12,900
1964	2,082	14,306
1965	2,139	14,229
1966	1,956	13,478
1967	1,708	11,916
1906–67	76,427	367,339

Lead.—Lead production from 11 mines in seven counties decreased 16 percent. The five largest producing mines in order of rank were the U.S. and Lark mine of USSR&M Co.; the Burgin mine, Tintic Division, Kennecott Copper Corp.; the Mayflower mine, Hecla Mining Co.; the United Park City mines, United Park City Mines Co.; and the Ophir mine, USSR&M Co.; (McFarland & Hullinger, lessees). An increase in production was reported only from the Ophir mine.

The daily ore production at the Burgin mine exceeded the design rate of 500 tons per day for the first part of the year; caving ground conditions, however, limited production, and thus the yearly average was 466 tons per operating day. Plans were announced to increase the daily mining rate to 800 tons in early 1969 and to complete a 500-ton-per-day concentrator in 1968 near the Burgin mine.

Molybdenum.—Molybdenum sulfide was recovered from the copper ore processed by Utah Copper and a large portion converted to molybdic oxide in a recently completed plant. Because of the strike, production was 36 percent below the 1966 level.

Rhenium.—Production of rhenium was down because of the reduction in copper mining. Utah Copper was the only producer of rhenium.

Selenium.—Selenium, recovered as a byproduct of the electrolytic refining of copper, was shipped from the Garfield plant of Kennecott Copper; shipments increased 22 percent.

Silver.—Mostly because of the strike, production decreased 37 percent. In order of rank, the four leading companies in silver production were Kennecott Copper Corp., USSR&M Co., Hecla Mining Co., and United Park City Mines Co. Total silver production came from 20 mines in 10 counties. In the United States, only Idaho produced more silver than Utah.

Uranium.—Although the number of uranium operations decreased from 208 to 117, uranium production increased 5 percent. Emery, Garfield, and Grand Counties reported decreases; Piute and San Juan Counties reported increases. The average ore grade remained at 0.26 percent (5.3 pounds per ton).

Prospecting for uranium almost reached a record high. Several mining companies established exploration offices in Monticello; in San Juan County, a total of 2,070 mining claims was filed during the first 11 days of October. Grand County also reported increased uranium activity.

Vanadium.—Vanadium output, recovered from Utah uranium ores at four locations, increased 33 percent over the 1966 figure. The mill at Grand Junction, Colo., had a substantial increase in vanadium output from Utah ores. A new vanadium oxide recovery circuit at the Moab uranium processing mill went into operation March 7 and contributed to the increased production.

Table 10.—Mine production of uranium (U_3O_8) in 1967, by counties in terms of recoverable content

County	Number of operations	Pounds	Value [1]
Emery	17	[2] 52,187	[2] $417,489
Garfield	12	11,589	92,714
Grand	21	105,540	844,322
Piute	2	(2)	(2)
San Juan	64	1,118,138	8,945,104
Wayne	1	(2)	(2)
Total	117	1,287,454	10,299,629

[1] F.o.b. mill value; based on $8 per pound of U_3O_8 contained in concentrate.

[2] Emery, Piute, and Wayne Counties combined to avoid disclosing individual company confidential data.

Zinc.—Decreases in zinc production were reported at seven mines, increases at only three. The overall zinc production from 15 operations in seven counties was down 8 percent.

MINERAL FUELS

Asphalt and Related Bitumens.—Successful bidders leased 10,000 acres of asphaltic sands near Vernal. Phillips Petroleum Co. paid $162 per acre for a 157.4-acre tract. A total of $50,000 was paid in bonus rentals.

The Castle Peak gilsonite mine near Duchesne was closed after 30 years of operation. Production of gilsonite, from five mines in two counties, was down 10 percent.

Carbon Dioxide.—Farnham Dome Carbon County, the only source of commercial carbon dioxide, yielded 30 percent less gas than during the previous year; the one producing well was the Equity Oil Co. Mounds No. 3.

Coal (Bituminous).—Coal, down 10 percent to 4.2 million tons, had the lowest annual output in the last 26 years—equal to only 56 percent of the peak production year in 1947. Coal was produced at 24 underground mines in six counties. Trucks were used to transport 10 percent of the shipments; 90 percent was shipped by rail.

Equipment used at the mines included 42 loading machines, 29 continuous mining machines, and one longwall mining unit. Continuous mining machines were used to produce 69 percent of the coal. Only 65 percent was cleaned mechanically.

The Columbia mine of USS was closed during 1967, after producing 17 million tons of coking coal since opening in 1923. Coking coal for the Geneva steel plant will now be supplied by the Geneva mine and the Somerset, Colo., mine, both owned by USS.

Coking coal used at the Fontana, Calif., plant of Kaiser Steel Corp. came from the Sunnyside mines and from the new York Canyon mine opened in 1966 near Raton, N. Mex.

New coal mines were started at three locations. In Carbon County coal seams near the old Wattis mine were opened by Plateau Mining Co., and extensive construction work was carried out on surface facilities. In Gordon Creek, Swisher Coal Co. made preparations to mine the Castlegate "A" seam. Castle Valley Mining Co. opened a new mine in Emery County. Two entries were driven about 2,500 feet to determine the quality of a large reserve of coal above Orangeville.

Table 11.—Coal (bituminous) sold or used [1], by counties

(Short tons)

County	1966		1967	
	Number of mines operating (all underground)	Quantity	Number of mines operating (all underground)	Quantity
Carbon	14	3,379,907	14	2,971,422
Emery	7	1,170,402	6	1,113,017
Iron	1	3,500	1	3,000
Kane	1	1,719	1	2,117
Sevier	1	64,739	1	72,255
Summit	1	15,063	1	13,446
Total	25	4,635,330	24	4,175,257

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

The Office of Coal Research, U.S. Department of the Interior, signed a contract with the University of Utah for research work in 1967 and 1968. The university received $181,000 to develop optimum operating conditions for conversion of Western U.S. coals into liquid and gaseous products. The scientists will experiment primarily with hydrogenation of coals; however, work will be conducted in several other phases.

Directors of the two companies involved agreed to the sale of the Independent Coal & Coke Co. properties at Castle Gate, Kenilworth, and Clear Creek to The North American Coal Corp. for about $3.6 million. The new company plans to operate the mines with little change in the present management. Since about 1900 these properties have been among the largest sources of coal in Utah for the commercial market.

Natural Gas.—The 20.4-billion-cubic-foot decline in marketed natural gas amounted to 29 percent of the quantity marketed in 1966. Production from San Juan County, which ranked second in the State, decreased from 28.0 billion to 13.4 billion cubic feet. Uintah County led with 22.0 billion cubic feet, followed by San Juan and Grand Counties (8.3 billion cubic feet). Although Lisbon field, San

Juan County, had the highest gas production (21.7 billion cubic feet) the product was all returned to the reservoir for pressure maintenance. The Greater Red Wash Area, Uintah County, yielded 20.9 billion and the Greater Aneth Area, San Juan County, yielded 9.2 billion cubic feet of gas. San Arroyo field, Grand County, had the highest dry gas output—4.3 billion cubic feet.

Royalties on gas paid to State and Federal Government agencies amounted to $816,432; of this, $273,099 was from production on Indian lands, $487,084 from public domain, and $56,249 from State lands.[5] Under the Mineral Leasing Act of 1920, the State was to receive 37.5 percent of the royalties paid on production from public domain.

The American Petroleum Institute (API) and the American Gas Association, Inc., (AGA) estimated gas reserves in Utah at 1.2 trillion cubic feet, 145.7 billion cubic feet less than the 1966 estimate. Extensions and revisions caused a net decline of 90.8 billion; new fields and pools added only 1.7 billion cubic feet.[6]

A gas-gathering system in the Horseshoe Bend Area was completed by Uinta Pipe Line Corp.; deliveries of gas were to Mountain Fuel Supply Co.

Natural Gas Liquids.—Mainly because of the start of operations at the new plant of Union Oil Company of California, output of total natural gas liquids increased 21 percent. Production of LP gases increased 25 percent; that for natural gasoline was 12 percent greater. On July 1 Union's new Lisbon gasoline plant in San Juan County commenced operations; the plant extracted about 120,000 gallons of liquids per day from the wet gas produced from the Lisbon field. The residue gas, approximately 60 million cubic feet per day, was returned to the reservoir for pressure maintenance.

Petroleum.—Production of crude petroleum declined very slightly—64,000 barrels. As in the past San Juan County was ranked first with 64 percent of the production; output, however, declined more than 600,000 barrels. Yield from the Bridger Lake field, Summit County, more than tripled because of development drilling in this new field; at yearend, a pipeline outlet for the field was partly completed. Production from the Upper Valley field, Garfield County, almost doubled.

Greater Aneth Area (including Aneth, Cahone Mesa, McElmo Creek, Ratherford, and White Mesa fields), San Juan County, led the State in production of oil, with 9.7 million barrels. Greater Red Wash Area, Uintah County, second with an output of 6.4 million barrels, included the Red Wash, Walker Hollow, White River, and Wonsits-Wonsits Valley fields. Lisbon field, San Juan County, and Bridger Lake field, Summit County, were ranked third and fourth, respectively, with 3.6 million and 861,000 barrels.

The API and AGA estimates of crude oil reserves for January 1, 1968, listed 201 million barrels for Utah. Additions because of revisions and extensions amounted to 10.4 million barrels and new fields and new pools added 1.7 million barrels; however, production caused a net decline of 12.3 million barrels.

State and Federal Government agencies received royalty payments on petroleum

Table 12.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1966	1967	Principal fields in 1967 in order of production
Box Elder	(1)	2	Rozel Point.
Carbon	2	------	
Daggett	5	3	Clay Basin.
Duchesne	145	215	Monument Butte, Indian Ridge, Duchesne.
Emery	16	11	Grassy Trail, Ferron.
Garfield	224	432	Upper Valley.
Grand	162	139	Long Canyon, Salt Wash, Agate.
San Juan	15,948	15,304	Lisbon, McElmo Creek, Aneth, Ratherford.
Summit	241	861	Bridger Lake.
Uintah	7,368	7,081	Red Wash, Wonsits-Wonsits Valley, Ashley Valley.
Washington	1	------	
Total	24,112	24,048	

[1] Less than ½ unit.

Source: Utah Oil & Gas Conservation Commission.

[5] Utah Department of Natural Resources, Division of Oil & Gas Conservation. Monthly Royalty Report. December 1967, 32 pp.

[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 as of Dec. 31, 1967. V. 22, May 1968, p. 125.

Table 13.—Oil and gas well drilling in 1967, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Carbon	--	----	3	3	23,979
Duchesne	2	----	5	7	52,171
Emery	--	----	7	7	29,155
Garfield	--	----	2	2	6,751
Grand	--	----	7	7	18,123
Kane	--	----	3	3	12,513
San Juan	3	----	11	14	79,961
Sanpete	--	----	1	1	8,100
Sevier	--	----	1	1	6,485
Summit	--	----	2	2	28,881
Uintah	2	----	5	7	45,346
Utah	--	----	1	1	8,207
Total	7	----	48	55	319,672
Development completions:					
Box Elder	1	----	----	1	260
Duchesne	2	----	2	4	28,428
Garfield	2	----	1	3	20,800
Grand	1	1	5	7	4,894
San Juan	18	----	15	33	124,600
Summit	3	----	----	3	47,583
Uintah	24	7	3	34	171,399
Total	51	8	26	85	397,964
Total all drilling	58	8	74	140	717,636

Sources: Utah Department of Natural Resources, Division of Oil and Gas Conservation, Yearly Well Completion Report, 1967, 25 pp.; Petroleum Information Corp., 1967 Resume, Oil and Gas Operations in the Rocky Mountain Region.

production amounting to $8,663,962; of this, $4,712,675 was from production on Indian lands, $3,488,668 from public domain and $462,619 from State lands. As with natural gas, 37.5 percent of the royalties received from production on public domain was to be returned to the State.

Seven oil- and gas-lease sales held during the year brought bonuses totaling $511,660. Four of these were State-land sales involving 59,191 acres, for which the State received bonuses of $166,001; two were sales by the Uintah-Ouray Indian agency, which covered 91,528 acres and brought bonus payments of $344,586; the other was a sale of leases on 1,118 acres of public domain, for which a bonus of $1,073 was paid.

Drilling declined slightly below the 1966 total of 142 wells; although exploratory drilling was down 14 wells, development drilling was up 12. Wildcat activity accounted for 39 percent of the drilling—most of it in the Paradox and Uinta basins. The seven discovery wells, all oil, gave a success ratio of 7.9 percent, much lower than that for 1966. Uintah County was ranked first in development drilling because of activity in the Wonsits-Wonsits Valley and Coyote Basin fields.

Of the seven discovery wells, the most significant, on the basis of initial production, was Chevron Oil Co., Western Division, Boren-Fee (11–11) No. 1, sec. 11, T1S, R2W, Uintah Meridian, Duchesne County. The well was completed flowing 1,080 barrels of 30° API oil from the Green River Formation (Tertiary) at a depth of 9,650 to 11,128 feet.

In San Juan County the Sinclair Oil & Gas Co. Rabbit Ears-Navajo No. 1, sec. 19, T43S, R22E (SLM), was completed as a new field discovery, flowing 322 barrels of oil and 4.3 million cubic feet of gas per day from the Ismay zone of the Paradox Formation (Pennsylvanian). The H. P. McLish and L. R. Miracle Gose-Government No. 1, sec. 19, T6S, R21E (SLM), Uintah County, was completed, pumping 400 barrels of oil per day from the Green River-Wasatch formations (Tertiary).

Crude-oil runs to stills in the State's five refineries totaled 36.1 million barrels; 26.4 million came from out of State and 9.7 million was from local production. Colorado again supplied most of the out-of-State oil, 18.6 million barrels; Wyoming furnished 7.6 million barrels. Shipments out of State were chiefly to California

Table 14.—Oil and gas discoveries in 1967

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Duchesne County:												
Bluebell	No. 1 Brown	Uqueahgut, Inc.	3	1 S	2 W	Green River	9,042–9,499	9,728	122	-----	June 16	Pumped. Old well workover.
Bluebell area	No. 1 Boren-Fee	Chevron Oil Co.	11	1 S	2 W	Lower Green River.	9,650–11,128	11,283	1,080	550	Nov. 24	Flowed. New field.
San Juan County:												
Wildcat	No. 1 Aztec-Navajo.	Gulf Oil Corp.	33	41 S	26 E	Lower Ismay	5,731–5,735	5,974	184	-----	Sept. 21	Do.
River Bank	No. 1 Navajo-C	Monsanto Co	20	42 S	26 E	Upper Ismay	5,566–5,582	5,821	22	-----	June 20	Do.
Wildcat	No. 1 Rabbit Ears-Navajo.	Sinclair Oil & Gas Co.	19	43 S	22 E	Ismay	4,849½–4,855½	5,500	322	4,260	Nov. 14	Do.
Uintah County:												
Wildcat	No. 1 Twelve Mile Federal.	Tenneco Oil Co.	27	5 S	20 E	Green River	6,956–6,960	9,100	97	-----	Dec. 7	Pumped. New field.
Halfway Hollow	No. 1 Gose-Government.	H. P. McLish-L. R. Miracle.	19	6 S	21 E	Green River-Wasatch.	6,906–7,084	7,728	400	-----	Apr. 1	Do.

Source: Petroleum Information Corp., 1967 Resume, Oil and Gas Operations in the Rocky Mountain Region.

(11.4 million barrels) and Texas (2.1 million barrels). At yearend, Caribou Four Corners Oil Co. was completing an expansion to its Woods Cross refinery; crude-oil capacity was increased to 12,000 barrels per day; a 1,500-barrel-per-day vacuum unit and a 2,000-barrel-per-day Unicracker-JHC were added.

NONMETALS

Barite.—No production of barite was reported in Utah during 1967. Crude barite prepared for use in well drilling by Yuba Minerals & Milling Co., Salt Lake City, came from four operations in Nevada.

Cement.—The output of portland cement decreased 13 percent. Ideal Cement Co. at Devil's Slide in Morgan County was the main producer of cement. A $3 million modernization program for handling materials throughout its operation was completed by Portland Cement Company of Utah near Salt Lake City.

On December 31, Potash Company of America and Ideal Cement Co. merged to form Ideal Basic Industries, Inc. Each company will continue to operate its own business as a division of Ideal Basic Industries, Inc.

Clays.—The output of clay increased 6 percent in quantity and decreased 11 percent in value. Production of fire clay and halloysite declined; however, output of bentonite, fuller's earth, and miscelleneous clays increased. Although clays were used by many industries, 90 percent of the total output was used in manufacturing building brick, as a catalyst in oil refining, and as a raw material for lightweight aggregate. Clays were produced at 19 operations in nine counties.

Fluorspar.—Shipments of fluorspar, used entirely at steel mills, increased 42 percent. A new mine was opened in Millard County but the major production came from a mine near Spor Mountain in Juab County.

Gypsum.—The output of gypsum from two operations near Sigurd increased 8 percent. A metallurgical process to remove sulfur from gypsum had been developed by the Bureau of Mines Metallurgical Research Center in Salt Lake City which permits recovery of 1 ton of sulfur from 7 tons of gypsum. Companies with large reserves of low-cost gypsum in Utah were considering the use of the process to produce sulfur.

Lime.—Lime production decreased 16 percent (31,000 tons) because less lime was used in the construction trade, in agriculture, in the refractory industry, and in the chemical industry. A slight increase in the use of lime was reported at beet sugar plants. Companies producing lime were The Amalgamated Sugar Co.; U.S. Lime Division, The Flintkote Co.; Utah Copper Division, Kennecott Copper Corp.; Lakeside Lime, Inc.; Utah Marblehead Lime Co.; and Utah-Idaho Sugar Co. Three of these companies produced lime only for use in their own operations.

Magnesium Chloride.—A substantial increase in the production of magnesium chloride from Great Salt Lake, the only production reported in Utah, was at the Bonneville, Ltd., plant of Kaiser Aluminum & Chemical Corp.

Perlite.—Production of crude perlite was greatly reduced at the North Pearl Queen mine of Henry Schoo Co., the only source of crude perlite in the State.

Phosphate Rock.—San Francisco Chemical Co., with mines in Rich and Uintah Counties, was the only producer of phosphate rock. Output decreased 13 percent, partly because sulfuric acid used to process the ore at the Garfield plant of Stauffer Chemical Co., Fertilizer Division was no longer available from Kennecott Copper Corp.

Potash.—The output of potassium salts increased 27 percent. Production gains were reported by Texas Gulf Sulphur Co. and Kaiser Aluminum & Chemical Corp.

A second shaft was sunk at the Cane Creek potash mine of Texas Gulf Sulphur Co. The concrete-lined shaft had a cased inside diameter of 4 feet and a depth of 2,710 feet; the first 300 feet was 8 feet in diameter. A 450-ton-per-day crystallizer, under construction to recover previously lost fine materials, was scheduled for completion early in 1968.

Pumice.—Production of pumice decreased 83 percent. All of the product from the three producing mines was used as an aggregate in concrete.

Pyrites.—Pyrite production (from two operations) more than doubled the previous years output. The pyrite, shipped to The Anaconda Company, Yerington, Nev., was used for manufacturing sulfuric acid.

Salt.—Since no shipments were reported for manufacturing chlorine, production of salt decreased 6 percent (24,000 tons). Evaporated salt was produced by five companies—Hardy Salt Co. in Tooele County, Lake Crystal Salt Co. in Box Elder County, Morton Salt Co. in Salt Lake County, Solar Salt Co. in Tooele County, and Utah Salt Co. in Tooele County. Rock salt was produced by two companies—Albert Poulson Salt Co. in Sanpete County and Redmond Clay & Salt Co. in both Sanpete and Sevier Counties. Only 30 percent of the salt was used in Utah. The output of both evaporated and rock salt decreased.

Sand and Gravel.—With the lowest annual production since 1960, sand and gravel decreased 3 million tons (24 percent) from that of 1966. The use of sand and gravel for road construction decreased 2.6 million tons (30 percent) and for building, 900,000 tons (28 percent). Production was from 166 operations in 28 counties. More than half of the commercial production came from 13 pits, each with more than 100,000 tons annual production; only 7 percent of the commercial production came from 35 pits each with less than 25,000 tons annual production.

Stone.—The output of stone decreased 18 percent in quantity but only 4 percent in value. Production of crushed miscellaneous stone and crushed sandstone both decreased substantially.

Crushed limestone (97 percent of the total stone production) was used as a fertilizer filler, flux, mineral food, poultry grit, railroad ballast, raw material in making cement and lime, and stone sand; in cast stone panels, refractories, and road construction; and for controlling coal dust in coal mines, landscaping, and roofing gravel.

Table 15.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Beaver	181	$188
Box Elder	642	612
Cache	225	279
Carbon	48	65
Daggett	51	51
Davis	459	363
Duchesne	W	W
Emery	51	48
Garfield	W	W
Grand	23	24
Iron	262	287
Juab	4	4
Kane	88	50
Millard	15	15
Morgan	112	113
Rich	23	27
Salt Lake	3,423	3,114
San Juan	21	20
Sanpete	46	46
Sevier	108	106
Summit	51	53
Tooele	1,025	524
Uintah	301	311
Utah	1,164	1,169
Wasatch	99	90
Washington	276	396
Wayne	32	32
Weber	435	457
Undistributed	247	187
Total	9,412	8,631

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

Table 16.—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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	1,053	$1,209	951	$1,105
Paving	167	200	203	219
Railroad ballast	1	1	24	20
Fill	76	38	128	64
Other	1	3	[1] 45	[1] 76
Industrial:				
Molding	------	--------	(1)	(1)
Blast	[2] 22	[2] 25	(1)	(1)
Fire or furnace	(2)	(2)	(1)	(1)
Engine	8	20	(1)	(1)
Foundry (ground)	5	14	--------	--------
Total	1,333	1,510	1,351	1,484
Gravel:				
Construction:				
Building	1,830	2,194	1,241	1,216
Paving	1,167	1,328	1,138	1,089
Railroad ballast	34	24	18	15
Fill	198	109	260	136
Other	1	1	--------	--------
Miscellaneous	24	28	84	88
Total	3,254	3,684	2,741	2,544
Total sand and gravel	4,587	5,194	4,092	4,028
Government-and-contractor operations:				
Sand:				
Paving	1,170	1,184	485	427
Fill	37	19	129	111
Total	1,207	1,203	614	538
Gravel:				
Building	287	335	86	43
Paving	6,065	6,095	4,147	3,707
Fill	222	110	473	315
Total	6,574	6,540	4,706	4,065
Total sand and gravel	7,781	7,743	5,320	[3] 4,605
All operations:				
Sand	2,540	2,713	1,965	2,022
Gravel	9,828	10,224	7,447	6,609
Total	12,368	12,937	9,412	8,631

[1] Molding, Blast, Fire or furnace, and Engine sand combined with "Other (Construction)" sand to avoid disclosing individual company confidential data.
[2] Fire or furnace sand combined with blast sand to avoid disclosing individual company confidential data.
[3] Data do not add to total shown because of independent rounding.

Table 17.—Stone production in 1967, by counties

County	Short tons	Value	County	Short tons	Value
Box Elder	3,357	$115,655	Salt Lake	W	W
Cache	W	W	San Juan	802	$4,443
Davis	30	60	Summit	35,651	74,367
Duchesne	46,053	120,906	Tooele	W	W
Emery	216	213	Utah	W	W
Iron	W	W	Wasatch	244	4,880
Juab	W	W	Washington	387	3,134
Millard	36	90	Wayne	217	214
Morgan	W	W	Weber	1,023	2,345
Rich	2,664	5,625	Undistributed	1,739,980	3,775,955
			Total	1,830,660	4,107,887

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

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

Use	1966		1967	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction short tons	W	W	W	W
Rubble do	15	$60	----------	----------
Rough architectural cubic feet	W	W	W	W
Sawed stone do	12,847	68,731	14,838	$94,410
Flagging do	32,978	22,699	8,794	21,515
Total (approximate, in short tons)	3,900	126,480	3,600	141,855
Crushed and broken stone:				
Riprap short tons	243,193	416,239	90,556	201,121
Metallurgical do	893,656	1,435,204	858,469	1,945,199
Concrete and roadstone do	109,361	197,257	W	W
Lime do	248,893	597,796	181,537	432,243
Other do	[1] 746,920	[1] 1,496,221	[2] 637,425	[2] 1,249,951
Total do	2,242,023	4,142,717	1,827,095	3,966,032
Total stone (approximate, in short tons)	2,246,000	4,269,197	1,830,700	4,107,887

W Withheld to avoid disclosing individual company confidential data; included in "Totals."
[1] Includes stone used in asphalt filler, cast stone aggregates, cement, coal dust, decorative use, foundry, poultry grit, precasting, railroad ballast, roofing granules, slope protection, stone sand, stucco, and terrazzo.
[2] Includes stone used in cast stone, cement, coal dust, decorative use, fertilizer filler, foundry, landscaping, mineral food, poultry grit, railroad ballast, roofing gravel, stone sand, and unspecified uses.

Table 19.—Stone sold or used by producers, by kinds

Year	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
	Basalt and related rocks (traprock)		Granite		Limestone [1]		Marble	
1963	-------	---------	15,704	$253,225	1,716,450	$3,219,167	W	W
1964	-------	---------	800	160,000	2,003,925	3,860,409	626	$17,255
1965	200	$800	W	W	1,852,365	3,733,580	461	11,145
1966	24	236	------	-------	1,943,014	3,573,365	W	W
1967	36	90	------	-------	1,766,852	3,843,469	---------	----------
	Sandstone		Slate		Other stone [2]		Total	
1963	611,628	524,713	------	-------	2,106	43,200	2,345,888	4,040,305
1964	967,781	2,549,006	------	-------	131,899	343,333	3,105,031	6,930,003
1965	202,141	499,364	1,660	82,360	100,821	224,982	2,157,648	4,552,231
1966	201,507	447,260	795	42,820	100,630	205,516	2,245,970	4,269,197
1967	53,962	162,235	W	W	9,810	102,093	1,830,660	4,107,887

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

Table 20.—Principal producers and processing plants in 1967

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Asphalt and related bitumens:					
American Gilsonite Company	Suite 1150, Kennecott Bldg Salt Lake City Utah 84110	Mine and refinery	Uintah		Mine near Bonanza; refinery near Fruita, Colo.
Carbon dioxide (natural):					
Equity Oil Co	806 American Oil Building Salt Lake City, Utah 84101	Well and plant	Carbon (Farnham Dome Field).		Extraction plant.
Cement:					
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Denver National Building Denver, Colo. 80202	Plant	Morgan	Limestone, sandstone.	Wet process; two-rotary-kiln cement plant.
Clays:					
Filtrol Corp	3250 East Washington Blvd. Los Angeles, Calif. 90023	Open-pit-underground mine.	Juab		
International Pipe and Ceramics Corp.	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	Four open-pit mines	Salt Lake, Sevier, Summit, Utah.		
Interstate Brick Co	Box 6239 Salt Lake City, Utah 84106	do	Sevier, Summit, Tooele, Utah.		
Utelite Corp	R. F. D. Coalville, Utah 84017	Open pit mine and plant.	Summit		Expanding plant.
Coal (bituminous):					
Independent Coal & Coke Co	Box 1740 Salt Lake City, Utah 84111	Three underground mines and two plants.	Carbon		Crushing and screening plant at Clear Creek; cleaning, thermal-drying, and oil-treatment plant at Castle Gate.
Kaiser Steel Corp	Sunnyside Coal Mine Sunnyside, Utah 84539	Three underground mines and plant.	do		Cleaning, drying, and crushing plant at Sunnyside.
United States Fuel Co	Box 1769 Salt Lake City, Utah 84111	Underground mine and plant.	Carbon, Emery		Cleaning, drying, crushing, and oil treatment plant at Hiawatha.
United States Steel Corp., Western District.	Box 807 Dragerton, Utah 84520	Two underground mines and plant.	do		Cleaning, drying, and crushing plant at Wellington.
Copper:					
American Mining Co	320 Newhouse Building Salt Lake City, Utah 84111	Open pit mine and mill.	Beaver	Gold, silver	Flotation mill.
Hecla Mining Co	Box 320 Wallace, Idaho 83873	*See* Silver	Wasatch	Gold, silver, lead, zinc.	
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	Open pit mine, crusher, two mills, precipitation plant, smelter, and refinery.	Salt Lake	Gold, silver, molybdenum, rhenium, selenium.	Bonneville crusher, Arthur and Magna flotation mills, Garfield copper smelter, Garfield electrolytic refinery, cone precipitation plant near Copperton.
United States Smelting, Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	*See* lead	Salt Lake, Tooele.	Gold, silver, lead, zinc.	

Fluorspar:					
Willden Fluorspar Co	Box 536 Delta, Utah 84624	Underground mine	Juab		
Gold:					
Hecla Mining Co	Box 320 Wallace, Idaho 83873	*See* silver	Wasatch	Silver, copper, lead, zinc.	
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	*See* copper	Salt Lake	Silver, copper, molybdenum, rhenium, selenium.	
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	*See* lead	Salt Lake, Tooele	Silver, copper, lead, zinc.	
Gypsum:					
Georgia Pacific Corp., Gypsum Division.	Commonwealth Building Portland, Oreg. 97207	Open pit mine and plants.	Sevier		Crushing, grinding, and screening plant; calcining equipment; wallboard plant.
United States Gypsum Co	101 South Wacker Drive Chicago, Ill. 60606	----do	----do		Do.
Iron ore:					
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002	Two 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	Two open-pit mines and two plants.	----do		Mobile crushing and screening plant, Iron Springs beneficiation plant.
Lead:					
Hecla Mining Co	Box 320 Wallace, Idaho 83873	*See* silver	Wasatch	Gold, silver, copper, zinc.	
International Smelting & Refining Co.	R.F.D. No. 1 Tooele Utah 84074	Smelter	Tooele		
Kennecott Copper Corp., Tintic Division.	Box 250 Eureka, Utah 84626	Underground mine	Utah	Gold, silver, copper, zinc.	
United Park City Mines Co	Star Route 1 Heber, Utah 84032	*See* zinc	Summit, Wasatch	Gold, silver, copper, zinc, pyrites.	
United States Smelting, Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	Two underground mines.	Salt Lake, Tooele	Gold, silver, copper, zinc.	
Do	----do	Midvale custom mill.	Salt Lake		Flotation mill; lead, zinc, and pyrite concentrates.
Lime:					
Utah Marblehead Lime Co	300 West Washington St. Chicago, Ill. 60606	Plant	Tooele	Stone	Rotary-kiln lime plant.
Magnesium chloride:					
Kaiser Aluminum & Chemical Corp., Bonneville, Ltd., Division.	300 Lakeside Dr. Oakland, Calif. 94612	*See* potash	----do	Potash	
Molybdenum:					
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	*See* copper	Salt Lake	Gold, silver, copper, rhenium, selenium.	Molybdenum recovery circuits at Arthur and Magna mills, molybdic oxide plant.

Table 20.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Natural gas and petroleum:			Principal fields		
American Oil Co	Box 898 Salt Lake City, Utah 84110	Plant	----------	----------	Salt Lake City refinery.
Aztec Oil & Gas Co	2000 First National Bank Bldg Dallas, Tex. 75202	Crude oil wells	Ratherford, Aneth, Gothic Mesa.	----------	
Belco Petroleum Corp	630 Third Ave New York, N.Y. 10017	Crude oil and natural gas wells.	Lisbon, Wonsits Wonsits Valley, White River.	----------	
Chevron Oil Co., Western Division.	Box 599, 1700 Broadway Denver, Colo. 80201	Crude oil and natural gas wells and plants.	Red Wash, Horseshoe Bend, Lisbon, Ratherford, White River.	Gasoline/LP gas	Red Wash gas-processing plant, Uintah County; Salt Lake City Refinery.
Continental Oil Co	1300 Main St. Houston, Tex. 77001	Crude oil wells	White Mesa, Ratherford, Bluff.	----------	
El Paso Natural Gas Co	Box 1526 Salt Lake City, Utah 84110	Plant	----------	----------	Aneth gas-processing plant, Aneth field, San Juan County.
Gulf Oil Corp	Gulf Building. Pittsburgh, Pa. 15219	Crude oil wells	Wonsits-Wonsits Valley, Aneth, Indian Ridge.	----------	
Humble Oil Refining Co	2000 Classen Center North Building, Oklahoma City, Okla.	Crude oil and natural gas wells.	McElmo Mesa, Walker Hollow, Lisbon.	----------	
Monsanto Co., Hydrocarbons & Polymers Division.	800 North Lindbergh Blvd. St. Louis, Mo. 63116	----do----------	McElmo Mesa, River Bank.	----------	
Phillips Petroleum Co., Western Region.	Security Life Building, Denver, Colo. 80202	Crude oil wells and plant.	Bridger Lake, Ratherford, Roosevelt.	----------	Woods Cross refinery.
Shell Oil Co	50 West 50th St New York, N.Y. 10020	Crude oil wells	Ratherford, Aneth	----------	
Sinclair Oil & Gas Co	Box 521 Tulsa, Okla. 74102	Crude oil and natural gas wells.	Boundary Butte, San Arroyo.	----------	
Superior Oil Co	First City National Bank Building, Houston, Tex. 77002	----do----------	McElmo Creek, Ratherford, Aneth.	----------	
Texaco Inc	1570 Grant St. Denver, Colo. 80203	----do----------	Aneth, McElmo Creek, Ismay Flodine.	----------	
Union Oil Company of California	Box 7600 Los Angeles, Calif. 90055	Crude oil wells and plant.	Lisbon, Aneth, Ismay Flodine.	----------	Lisbon gas processing plant, Lisbon field, San Juan County.
Phosphate rock:			County		
San Francisco Chemical Co	Drawer F Montpelier, Idaho 83254	One underground and one open pit mine.	Rich, Uintah	----------	

Potassium salts:					
Kaiser Aluminum & Chemical Corp., Bonneville, Ltd., Division.	300 Lakeside Drive Oakland, Calif. 94612	Lake bed and plant.	Tooele	Magnesium compounds.	Solar evaporation ponds, flotation refinery.
Texas Gulf Sulphur Co	200 Park Ave. New York, N.Y. 10021	Underground mine and plant.	Grand		Flotation refinery.
Pyrites:					
United Park City Mines Co	Star Route 1 Heber, Utah 84032	*See* lead	Summit	Gold, silver, copper, lead, zinc.	
Salt:					
Morton Salt Co	110 North Wacker Dr. Chicago, Ill. 60606	Processing lake brines.	Salt Lake		Vacuum pans and solar evaporation.
Solar Salt Co	340 W. 1455 S. Salt Lake City, Utah 84115	----do	Tooele		Solar evaporation and pressing plant.
Sand and gravel (commercial):					
Breitling Bros. Construction, Inc.	3645 South 500 West Salt Lake City, Utah 84104	Pit and plant	Salt Lake		Portable crushing and screening plant.
Dan R. Fogle Sand & Gravel Products.	337 Hartwell Ave. Salt Lake City, Utah 84115	Two pits and two plants.	----do		Portable crushing and screening plant, stationary crushing and screening plant near Salt Lake City.
Geneva Rock Products Co	Box 528 Orem, Utah 84057	----do	Salt Lake, Utah.		Two portable crushing and screening plants.
Gibbons & Reed Co., Concrete Products Co. Division.	41 West Central Ave. Murray, Utah 84107	Four pits and four plants.	Salt Lake		Three portable crushing and screening plants, one stationary crushing and screening plant near Salt Lake City.
Holley Co	5100 South Washington Blvd. Ogden, Utah 84403	Pit and plant	Weber		Stationry crushing and screening plant.
Pioneer Sand & Gravel Co	3200 West 5400 S. Granger Dr. Salt Lake City, Utah 84118	----do	Salt Lake		Do.
Utah Sand & Gravel Products	Box 537 Salt Lake City, Utah 84110	Two pits and two plants.	----do		Portable crushing and screening plant; stationary crushing and screening plant near Salt Lake City.
Walker Sand & Gravel Co	21 S. 10th West Salt Lake City, Utah 84121	Pit and plant	----do		Stationary crushing and screening plant.
Selenium:					
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	*See* copper	----do	Gold, silver, copper, molybdenum, rhenium.	Recovered as a byproduct at electrolytic refinery.
Silver:					
Deer Trail Mines & Arundel Mining Co.	Marysvale, Utah 84750	*See* zinc	Piute	Gold, copper, lead, zinc.	
Hecla Mining Co	Box 320 Wallace, Idaho 83873	Underground mine and mill.	Wasatch	----do	Flotation mill.
Kennecott Copper Corp., Tintic Division.	Box 250 Eureka, Utah 84626	*See* lead	Utah	----do	
Kennecott Copper Corp., Utah Copper Division.	Box 11299 Salt Lake City, Utah 84111	*See* copper	Salt Lake	Gold, copper, molybdenum, rhenium, selenium.	
United Park City Mines Co	Star Route 1 Heber, Utah 84032	*See* zinc	Summit, Wasatch	Gold, copper, lead, zinc, pyrites.	

Table 20.—Principal producers and processing plants in 1967—Continued

Commodity and company	Address	Type of activity	County	Other commodities	Remarks
Silver—Continued					
United States Smelting, Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	*See* lead	Salt Lake, Tooele	Gold, copper, lead, zinc.	
Stone:					
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	620 Denver National Building Denver, Colo. 80202	Quarry and plant	Morgan	Cement	Stationary crushing and screening plant.
Le Grand Johnson Corp	Box 248 Logan Utah 84321	do	Cache		Do.
Portland Cement Company of Utah.	Box 1469 Salt Lake City, Utah 84110	do	Salt Lake	Cement	Do.
United States Steel Corp., Western Ore Operations.	Lander, Wyo. 84520	do	Utah		Do.
Uranium:					
Atlas Corp., Atlas Minerals Division.	910 Security Life Building Denver, Colo. 80202	Sixteen underground mines.	Emery, San Juan	Copper, vanadium	
Do	do	Moab mill	Grand		Acid and alkaline leach with copper and vanadium recovery circuits.
Homestake Mining Co	Box 563 Moab, Utah 84532	Underground mine	San Juan		
Climax Uranium Co., Unit Amax Nuclear Division, American Metal Climax, Inc.	Box 1629 Grand Junction, Colo. 81501	Eight underground mines.	Garfield, Grand, San Juan.		
Vanadium:					
Climax Uranium Co., Unit Amax Nuclear Division, American Metal Climax, Inc.	do	*See* uranium	do	Uranium	
The Rice Development Co	Fruita, Colo. 81521	Underground mine	San Juan	do	
Shumway Bros	Blanding, Utah 84511	Two underground mines.	do	do	
Shumway & Dade Mining Co	Box 967 Grand Junction, Colo. 81501	do	do	do	
Zinc:					
Deer Trail Mines & Arundel Mining Co.	Marysvale, Utah 84750	Underground mine	Piute	Gold, silver, copper, lead.	
Hecla Mining Co	Box 320 Wallace, Idaho 83873	*See* silver	Wasatch	do	
International Smelting and Refining Co.	R.F.D. No. 1 Tooele, Utah 84074	Fuming plant	Tooele		
Kennecott Copper Corp., Tintic Division.	Box 250 Eureka, Utah 84626	*See* lead	Utah	Gold, silver, copper, lead.	
United Park City Mines Co	Star Route 1 Heber, Utah 84032	Underground mine	Summit, Wasatch	do	
United States Smelting Refining and Mining Co.	Box 1980 Salt Lake City, Utah 84110	*See* lead	Salt Lake, Tooele	do	

The Mineral Industry of Vermont

By Harold F. York [1]

The value of mineral production in Vermont in 1967 was $27.3 million, 5 percent greater than in 1966 and only slightly less than the record year of 1965. Stone, the principal commodity produced, increased in both quantity and value as did sand and gravel, talc, and lime, in order of decreasing importance. Clay and peat declined in both output and value.

[1] Geologist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in Vermont [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Peat—short tons	333	$5	280	$4
Sand and gravel—do	2,323,000	1,744	3,718,000	2,178
Stone—do	2,649,716	19,926	2,760,821	20,520
Value of items that cannot be disclosed: Asbestos, clays, gem stones, lime, and talc	XX	4,235	XX	4,566
Total	XX	25,910	XX	27,268
Total 1957–59 constant dollars	XX	25,092	XX	p26,572

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 Vermont, by counties

County	1966	1967	Minerals produced in 1967 in order of value
Addison	$123,700	$126,830	Sand and gravel, clays, stone.
Bennington	388,065	351,398	Sand and gravel, stone.
Caledonia	W	W	Sand and gravel.
Chittenden	W	W	Stone, sand and gravel, lime, clays.
Essex	35,020	W	Sand and gravel.
Franklin	W	W	Stone, sand and gravel.
Grand Isle	1,000	W	Stone.
Lamoille	W	W	Talc, sand and gravel.
Orange	W	W	Stone, sand and gravel.
Orleans	W	W	Asbestos, stone, sand and gravel.
Rutland	W	W	Stone, sand and gravel.
Washington	W	W	Do.
Windham	161,984	W	Sand and gravel, talc, stone.
Windsor	W	W	Stone, sand and gravel, talc, peat.
Undistributed	25,199,886	26,789,723	
Total	25,910,000	27,268,000	

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

Table 3.—Indicators of Vermont business activity

	1966	p1967	Change, percent
Personal income:			
Total ---millions--	$1,066	$1,158	+8.6
Per capita	$2,595	$2,775	+6.9
Construction activity:			
Construction projects ---thousands--	$123,325	$129,562	+5.1
Cement shipments to and within Vermont thousand 376-pound barrels--	597	641	+7.4
Mineral production ---thousands--	$25,910	$27,268	+5.2
Employment:			
All manufacturing	43,400	44,100	+1.6
Durable goods, total	29,350	30,150	+2.7
Lumber/wood products	3,750	3,650	−2.7
Furniture and fixtures	2,100	2,000	−4.8
Stone, clay, and glass	3,250	3,300	+1.5
Primary metals	1,350	1,400	+3.7
Fabricated metal production	700	650	−7.1
Machinery (excluding electrical)	7,350	7,550	+2.7
Electrical equipment	7,700	8,550	+11.0
Transportation equipment	1,500	1,700	+13.3
Instruments	1,650	1,350	−18.2
Nondurable goods, total	14,050	13,950	−.7
Mining and quarrying	1,150	1,050	−8.7
All nonmanufacturing	121,650	126,250	+3.8

p Preliminary.

Sources: U.S. Bureau of Mines; U.S. Department of Labor, Bureau of Employment Security; U.S. Department of Commerce, Industrial Development Division; Vermont Development Department and F. W. Dodge Division, McGraw-Hill Information Systems Co.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Frequency	Severity
1966:								
Nonmetal and peat	286	289	83	663	—	15	22.61	1,061
Sand and gravel	235	188	44	367	—	10	27.23	645
Stone	1,812	256	464	3,775	—	125	33.12	1,353
Total	2,333	253	591	4,805	—	150	31.21	1,259
1967: p								
Nonmetal and peat	295	289	85	682	—	15	22.01	726
Sand and gravel	345	191	66	557	—	10	17.96	343
Stone	1,770	251	445	3,606	—	125	34.67	738
Total	2,410	247	595	4,844	—	150	30.97	691

p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Asbestos.—The Ruberoid Division, General Aniline & Film Corp. (formerly the Vermont Asbestos Mines Division of the Ruberoid Co.), produced chrysotile asbestos. The mill and quarry are located on Belvidere Mountain, about 6 miles southwest of Lowell, Orleans County. The primary uses for chrysotile asbestos are for textiles, asbestos cement products, paper stock, and miscellaneous purposes. Some tailings were sold to the Vermont Highway Department for roadstone.

For its outstanding safety record in 1967, The Ruberoid Company received from the Bureau of Mines the Certificate of Achievement in safety. While operating an open pit mine, the company compiled a total of 131,079 man-hours worked without a disabling work injury.

Clays.—The gross production of clays declined in value compared with that of

1966. The output of clay at Essex Junction, Chittenden County, for the manufacture of building brick increased slightly, but not enough to offset the decline in the production of kaolin in Addison County. Kaolin was produced for use as filler in paper, rubber, plastics, refractories, and other products. Estimated prices per ton, ranged from $1 for common brick clay to about $10 for kaolin.

Gem Stones.—At various locations, specimens of actinolite, talc, magnetite, garnet, and other minerals were collected, mostly by amateurs.

Lime.—In Chittenden County, Vermont Associated Lime Industries quarried limestone at its Winooski operation. This production was crushed for use as agricultural limestone, or converted to quicklime for use in the manufacture of paper. The company reported no production at its New Haven plant in Addison County. The production of lime was 20 percent greater in quantity and 19 percent greater in value than that of 1966. The value of the 1967 lime production is the highest since 1960.

Mica, Reconstituted.—Samica Corp., a subsidiary of Minnesota Mining & Manufacturing Co., at its Rutland plant, fabricates reconstituted mica from specially delaminated mica scrap. The product has various uses in the manufacture of electrical devices.

Peat.—Output of peat decreased 16 percent in quantity and 20 percent in value from the 1966 level. The average price per short ton declined from $15 to $14. Kirk's Green Mountain Peat at Woodstock, Windsor County, produced reed-sedge peat for sale in both package and bulk for use in general soil improvement. Bulk peat sold for $12.86 per short ton while packaged material sold for $15.71. Kleen Moss Co., Inc., at Williston, Chittenden County, and King's Pine Peat, Hartland, Windsor County, reported no production during the year.

Sand and Gravel.—Production of sand and gravel totaled 3.7 million tons, valued at $2.2 million, a new record high. Almost two-thirds of the output was Government-and-contractor and came from operations of the Vermont Highway Department or its contractors, as part of the continuing highway construction program. All of the counties reported production of sand and gravel except Grand Isle. Windsor was the leading county in production, followed by Rutland, Windham, and Bennington, which combined, produced 70 percent of the State total. Twenty-eight commercial operations reported production during 1967. Most producers annual output was in the 25,000- to 50,000-ton range. The output of seven operations in the 50,000- to 100,000-ton range accounted for almost 35 percent of the total output. Only three operators reported production in excess of 100,000 tons each.

Table 5.—Sand and gravel production by Government-and-contractor operations, by counties

(Thousand short tons)

County	1966	1967
Addison	-----	56
Bennington	66	2
Caledonia	-----	19
Chittenden	9	36
Essex	64	-----
Franklin	89	45
Grand Isle	1	-----
Lamoille	81	2
Orange	-----	5
Orleans	50	30
Rutland	38	438
Washington	2	99
Windham	53	207
Windsor	644	1,395
Total	1,097	2,334

Of the commercial sand production, 54 percent was used for building purposes, 36 percent for paving, a small amount for engine sand, and the remainder for fill and miscellaneous other purposes. Paving consumed 44 percent of the commercial gravel production while 39 percent was used for building. Fill purposes consumed most of the remainder. Almost two-thirds of the commercial sand and gravel production was processed by washing and screening. Average price for processed material was about $1.25 per ton. Bank run sand and gravel was valued at about $0.45 per ton.

All the sand and gravel used in Government-and-contractor operations was unprocessed. Average value per ton was $0.35.

Stone.—During 1967, stone production totaled 2.8 million tons, valued at $20.5

million. Compared with that of 1966, the total value was 3 percent greater, but this was still 5 percent less than that of the record year 1965. The output of dimension stone was valued at $13.6 million. Dimension granite and marble were the principal stone types, followed by dimension slate. Crushed stone production was valued at $6.9 million. Crushed and broken limestone accounted for over $4 million of the total. Crushed miscellaneous stone was likewise significant; lesser values were attached to crushed marble, slate, and granite. In terms of value, Rutland was the principal producing county, followed by Washington and Windsor Counties. In terms of tonnage, Windsor County led the State.

As the leading stone type, dimension granite, both rough and dressed, was quarried and processed for use as monuments and mausoleums. Additional dimension granite was used for rough construction work and for both rough and dressed architectural purposes, and for curbing and flagging. Crushed granite was used for concrete aggregate and roadstone. Washington County led the State in production of granite, followed by Orange and Windsor Counties.

Rutland County was the leading producer of dressed marble for architectural and monumental purposes. At West Rutland, dimension stone was cut and dressed for interior and exterior architectural work and for memorial stone. At Proctor, Grand Isle County, rough and dressed stone was produced for building purposes and for monuments. Crushed and broken marble was produced for use as chips, flagging, and miscellaneous purposes at Rochester, Windsor County. Almost 150,000 tons of crushed and broken marble was produced by the Vermont Highway Department for use as concrete aggregate and roadstone.

The output of dimension slate was in excess of 32,000 tons, valued at $2.4 million. All of the slate production was in Rutland County. Seventeen operators were active during 1967. Most of the dimension slate was used for flagstones, and for electrical, structural, and sanitary products. Over 4,000 tons of roofing slate was produced, as well as slate for miscellaneous purposes including blackboards and billiard table tops. Some crushed and broken slate was expanded for use as lightweight aggregate.

No dimension limestone was produced during 1967. However, 1.2 million tons of crushed limestone, valued at $4 million, was produced. Rutland County led in value of output, but Chittenden and Franklin Counties led in production. At Florence, limestone was produced and crushed for use as aggregate, roadstone, and for agricultural purposes. At South Wallingford, limestone was quarried and crushed for use as filler in paints, rubber, flooring, plastics, and pottery and for miscellaneous purposes.

At Colchester, Chittenden County, limestone was produced for concrete aggregate and roadstone, and at Winooski, a quarry and lime plant were in operation for the production of agricultural lime and quicklime for use in the paper industry. At Swanton, Franklin County, crushed limestone was produced for aggregate, roadstone, quicklime, and a small amount for riprap.

The production of miscellaneous stone was in excess of 1 million tons for use in highway construction. Most of the output was quarried in Windsor County through contracts with the Vermont Highway Department, and a relatively small amount was produced in Orleans County. In Bennington and Windsor Counties, 19,000 tons of sandstone was produced, also in Government-and-contractor operations.

Talc.—Talc production increased 18 percent in tonnage and 21 percent in value from that of 1966, the highest levels since 1952. Of the three mines in operation the largest was in Windsor County, followed by the ones in Lamoille and Windham Counties. Most of the talc was ground for use in ceramics, foundry facings, insecticides, paint, paper, roofing, toilet preparations, and other uses.

Table 6.—Principal producers

Commodity and company	Type of activity	County	Address	Remarks
Asbestos:				
General Aniline & Film Corp., The Ruberoid Div.	Quarry and Mill	Orleans	140 West 51st St. New York, N. Y.	Also miscellaneous stone.
Clays:				
Miscellaneous:				
Densmore Brick Co	Pit	Chittenden	Hanover Street, Lebanon, N. H.	
Kaolin:				
White Pigment Corp	do	Addison	Proctor, Vt	Also crushed limestone.
Lime:				
Vermont Assoc. Lime Industries	Plant	Chittenden	25 Airport Drive, Winooski, Vt.	Also crushed limestone.
Peat:				
Kirks Green Mountain Peat	Bog	Windsor	P.O. Box 456 Woodstock, Vt.	
Sand and gravel:				
A. G. Anderson Co., Inc	Pit	Franklin	Railroad Street Waterbury, Vt.	
Brattleboro Sand & Gravel, Inc.	do	Windham	P.O. Box 358 Brattleboro, Vt.	
Caledonia Sand & Gravel Co., Inc.	do	Caledonia	Box 428 St. Johnsbury, Vt.	
Do	do	Washington	do	
Calkins Construction, Inc	do	Orleans	Danville, Vt.	
J. P. Carrara & Sons, Inc	do	Rutland	North Clarendon, Vt.	
Do	do	Addison	do	
William E. Dailey, Jr	do	Bennington	N. Bennington, Vt.	
G. & H. Sand & Gravel Co., Inc.	do	do	Manchester Depot, Vt.	
S. T. Griswold, Inc	Pit	Chittenden	P.O. Box 8 Williston, Vt.	
Albert S. Nadeau	do	Lamoille	Johnson, Vt.	
Lawrence Sangravco, Inc	do	Essex	138 Portland St. Johnsbury, Vt.	
Stone:				
Granite (Dimension):				
Garand-Teed Quarries, Inc.	Quarry	Washington	Box 14, Adamant, Vt.	
Nationwide Granite Industries, Inc.	do	Orleans	P.O. Box 220 Barre, Vt.	
Rock of Ages	do	Orange	Barre, Vt.	
Do	do	Washington	do	
Do	do	Windsor	do	
Wells-Lamson Quarry Co., Inc.	Quarry	Washington	102 N. Main St. Barre, Vt.	
WoodburyQuarries,Inc	Processing plant	do	State Street Concord, N. H.	
Granite (Crushed):				
Kelley Construction, Inc	Crushing plant	do	102 N. Main Street Barre, Vt.	
Limestone (Crushed):				
L. A. Demers Crushed Rock Co.	Quarry	Chittenden	Upper Main Street Winooski, Vt.	
Swanton Lime Works, Inc.	do	Franklin	Swanton, Vt.	
Vermarco Lime Co	do	Rutland	W. Rutland, Vt.	
Marble (Dimension):				
Green Mountain Marble, Div. of Georgia Marble Co.	Quarry	do	do	
Vermont Marble Co	do	Grand Isle	Proctor, Vt	Also crushed.
Do	do	Rutland	do	Do.
Do	do	Windsor	do	Do.
Talc:				
Eastern Magnesia Talc Co., Inc.	Underground	Lamoille	Baldwin Ave. South Burlington, Vt.	
Do	Underground, open pit	Windsor	do	
Vermont Talc Co	Mine and mill	Windham	Chester, Vt.	

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] and James L. Calver [2]

A record-breaking output of coal more than offset value declines in most other mineral commodities, so that the total value of 1967 mineral production in Virginia rose to a new high of $283.7 million. The value was 3 percent greater than the $274.3 million reported in 1966, the previous record high value. Reflecting slackened building activity were decreases in the production of commodities supplying the construction industries—stone, cement, sand and gravel, clays, and gypsum; the declines were moderate to substantial. Mineral fuels produced in the State in addition to coal included limited quantities of oil and natural gas; production of mineral fuels is confined to southwestern counties. Other mineral commodities produced included aplite, cement, clays, feldspar, gem stones, gypsum, kyanite, lime, iron ore (pigment material), lead and zinc ore, titanium concentrates (ilmenite and rutile), salt, sand and gravel, and stone (including soapstone and marine shell). Of the 1967 mineral production value, 61 percent was contributed by fuels (56 percent in 1966), 36 percent by nonmetals (41 percent in 1966), and 3 percent by metals (3 percent in 1966).

[1] Chemist, Bureau of Mines, Pittsburgh, Pa.
[2] State Geologist, Virginia Division of Mineral Resources, Charlottesville, Va.

Table 1.—Mineral production in Virginia [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Clays—thousand short tons	1,486	$1,813	1,382	$1,623
Coal (bituminous)—do	35,565	153,341	36,721	171,183
Gem stones	NA	7	NA	7
Lead (recoverable content of ores, etc)—short tons	3,078	930	3,430	960
Lime—thousand short tons	840	10,486	829	10,345
Natural gas—million cubic feet	4,249	1,275	3,818	1,149
Petroleum (crude)—thousand 42-gallon barrels	1	W	3	W
Sand and gravel—thousand short tons	17,191	16,635	9,863	12,494
Soapstone—short tons	3,989	10	W	W
Stone—thousand short tons	34,151	55,550	31,324	52,470
Zinc [2] (recoverable content of ores, etc.)—short tons	17,666	5,123	18,846	5,088
Value of items that cannot be disclosed: Aplite, cement (portland and masonry), feldspar, gypsum, iron ore (pigment material), kyanite, salt, titanium concentrate (ilmenite and rutile), and data indicated by symbol W	XX	29,127	XX	28,366
Total	XX	274,297	XX	283,685
Total 1957–59 constant dollars	XX	282,663	XX	p 285,291

p Preliminary. NA Not available. XX Not applicable.
W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
[2] Recoverable zinc valued at the yearly average price of prime western slab zinc, East St. Louis market. Value established after transportation, smelting, and manufacturing charges have been added to the value of ore at the mine.

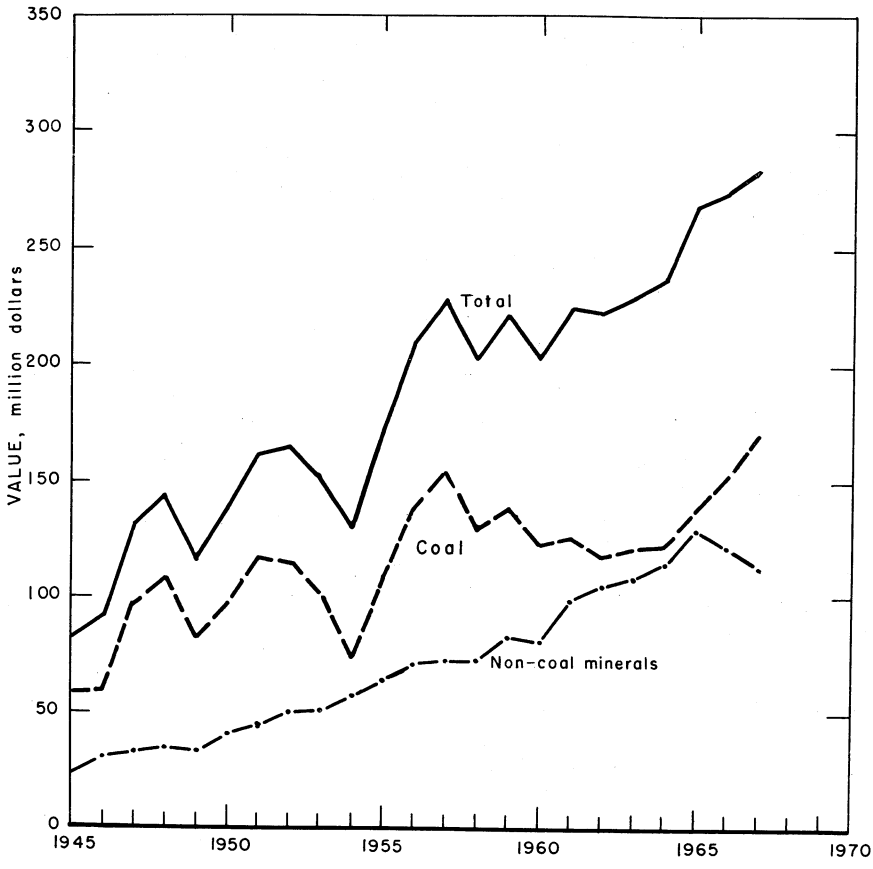

Figure 1.—Value of all minerals except coal, value of coal, and total value of all mineral production in Virginia.

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

County	1966	1967	Minerals produced in 1967 in order of value
Accomack	$42,000	W	Sand and gravel.
Albermarle	W	W	Stone, sand and gravel.
Alleghany	W	W	Do.
Amherst	W	W	Titanium concentrate, sand and gravel.
Appomattox	79,177	$78,762	Stone.
Augusta	6,433,660	5,463,718	Cement, stone, sand and gravel, clays.
Bath	----------	W	Sand and gravel.
Bedford	W	W	Feldspar.
Bland	15,632	10,844	Stone.
Botetourt	W	W	Cement, stone, clays.
Brunswick	W	W	Stone, clays.
Buchanan [2]	67,343,568	70,540,794	Coal, sand and gravel.
Buckingham	4,508,602	4,586,117	Stone, kyanite.
Campbell	W	1,810,221	Stone.
Caroline	W	W	Sand and gravel.
Carroll	W	W	Stone.
Charles City	W	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Virginia by counties [1]—Continued

County	1966	1967	Minerals produced in 1967 in order of value
Chesapeake (City)	W	W	Cement, stone, lime.
Chesterfield	W	W	Stone, sand and gravel, clays.
Clarke	W	W	Stone.
Craig	W	W	Do.
Culpeper	W	W	Do.
Dickenson [3]	$40,010,090	$46,481,918	Coal, clays.
Dinwiddie	W	W	Stone, clays.
Essex	W	W	Sand and gravel.
Fairfax	6,030,361	5,209,050	Sand and gravel, stone.
Fauquier	W	W	Stone.
Floyd	26,818	W	Do.
Fluvanna	W	W	Do.
Franklin	9,972	W	Stone, soapstone.
Frederick	3,769,230	4,195,240	Stone, lime, sand and gravel, clays.
Giles	W	W	Lime, stone.
Gloucester	W	W	Sand and gravel.
Goochland	W	W	Stone.
Grayson	W	W	Stone, sand and gravel.
Greensville	W	W	Stone.
Halifax	W	W	Stone, sand and gravel.
Hampton (City)	W	W	Sand and gravel
Hanover	W	W	Aplite, stone, titanium concentrate.
Henrico	W	3,272,000	Sand and gravel.
Henry	W	W	Stone.
Highland	33,457	42,489	Do.
Isle of Wight	W	W	Sand and gravel, lime, stone.
King William	W	W	Sand and gravel.
Lee [4]	2,015,692	3,485,336	Coal, stone, petroleum.
Loudoun	2,682,435	3,134,340	Stone.
Louisa	W	W	Do.
Mecklenburg	W	W	Do.
Middlesex	----------	W	Sand and gravel.
Montgomery	W	W	Stone, clays, coal.
Nansemond	W	W	Stone, clays.
Nelson	W	W	Stone, aplite.
New Kent	W	W	Sand and gravel.
Northampton	W	W	Do.
Northumberland	11,000	7,000	Do.
Nottaway	W	W	Stone.
Orange	W	W	Clays.
Page	120,000	W	Sand and gravel.
Patrick	W	W	Stone.
Pittsylvania	363,160	W	Stone, sand and gravel.
Powhatan	W	W	Stone.
Prince Edward	W	W	Kyanite, stone.
Prince George	W	W	Sand and gravel.
Prince William	W	W	Stone, clays.
Pulaski	W	W	Stone, iron ore (pigment material).
Rappahannock	W	W	Stone.
Roanoke	W	W	Stone, clays.
Rockbridge	1,259,386	1,299,439	Stone, sand and gravel, clays.
Rockingham	2,615,566	1,417,455	Stone, sand and gravel.
Russell	11,140,876	13,422,489	Coal, stone, clays.
Scott	1,111,676	1,058,144	Stone, coal.
Shenandoah	4,903,719	2,723,989	Lime, stone.
Smyth	W	W	Lime, salt, stone, gypsum, sand and gravel, clays.
Spotsylvania	W	W	Sand and gravel, stone.
Stafford	W	W	Sand and gravel.
Sussex	71,000	----------	
Tazewell [5]	973,804	1,139,522	Stone, coal, lime, clays.
Virginia Beach (City)	3,886,000	710,000	Sand and gravel.
Warren	W	W	Cement, stone, sand and gravel.
Washington	1,625,324	1,682,500	Stone, gypsum.
Westmoreland	----------	W	Sand and gravel.
Wise [5]	32,665,861	36,834,975	Coal, stone.
Wythe	W	W	Zinc, stone, lead, sand and gravel.
York	W	W	Sand and gravel.
Undistributed [6]	80,551,160	75,079,667	
Total [7]	274,297,000	283,685,000	

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

[1] The following counties are not listed because no production was reported: Alexandria (City), Amelia, Arlington, Charlotte, Cumberland, Greene, James City, King and Queen, King George, Lancaster, Lunenberg, Madison, Mathews, Richmond, Southampton, and Surry.

[2] Excludes sand and gravel; included with "Undistributed."

[3] Excludes clays; included with "Undistributed."

[4] Excludes stone and petroleum; included with "Undistributed."

[5] Excludes stone; included with "Undistributed."

[6] Includes sand and gravel that cannot be assigned to specific counties (1967), gem stones, natural gas, and values indicated by symbol W.

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

Table 3.—Indicators of Virginia business activity

		1966	1967 p	Change, (percent)
Personal income:				
Total	millions	$11,641.0	$12,592.0	+8.2
Per capita		$2,605.0	$2,776.0	+6.6
Construction activity:				
Building permits	millions	$300.5	$322.0	+7.2
Construction contracts:[1]				
Nonresidential buildings	do	$422.4	$446.4	+5.7
Residential buildings	do	$525.9	$498.5	−5.2
Nonbuilding construction	do	$339.9	$238.7	−29.8
Total	do	$1,288.2	$1.183.6	−8.1
Portland cement shipments to and within Virginia	thousand 376-pound barrels	8,558.0	8,314.0	−2.9
Total value attributable to forest resources	millions	$626.0	$667.0	+6.5
Cash receipts from farm marketings:				
Livestock and products	millions	$282.0	$279.0	−1.1
Crops	do	$225.0	$241.0	+7.1
Government payments	do	$18.0	$18.0	
Total	do	$525.0	$538.0	+2.5
Mineral production	millions	$274.0	$284.0	+3.6
Population	thousands	4,465.0	4,536.0	+1.6
Civilian work force	do	1,646.4	1,686.4	+2.4
Workers on strike	do	0.3	1.2	+400.0
Unemployment	do	45.1	47.8	+6.0
Total employment	do	1,601.0	1,637.4	+2.3
Agriculture	do	93.8	90.2	−3.8
Nonagriculture	do	1,507.2	1,547.2	+2.7
Manufacturing:				
Durable goods	do	138.3	139.9	+1.2
Nondurable goods	do	201.7	204.8	+1.5
Total	do	340.0	344.7	+1.4
Nonmanufacturing	do	945.3	984.0	+4.1
Other [2]	do	221.9	218.6	−1.5

p Preliminary.
[1] F. W. Dodge Division, McGraw-Hill Information Systems Company.
[2] Includes self-employed, unpaid family workers and domestics, and Federal Government workers in the Virginia portion of Washington, D.C., metropolitan area.

Source: U.S. Department of Commerce; Bureau of Mines; U.S. Department of Agriculture; Federal Reserve Bank of Richmond; U.S. Department of Labor, Virginia Department of Agriculture; Virginia Employment Commission, and Virginia Division of Forestry.

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

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	12,579	191	2,400	19,138	30	923	49.80	11,752
Metal	333	268	89	714	----	30	42.01	1,978
Nonmetal	651	262	171	1,362	----	45	33.04	924
Sand and gravel	711	257	183	1,637	----	29	17.71	351
Stone	4,000	273	1,091	9,030	----	175	19.38	721
Total	18,274	215	3,934	31,881	30	1,202	38.64	7,361
1967: p								
Coal	14,090	191	2,691	21,901	28	986	46.30	9,877
Metal	335	267	90	718	----	32	44.58	599
Nonmetal	700	263	184	1,474	----	39	26.46	491
Sand and gravel	605	239	145	1,358	----	34	25.03	373
Stone	3,715	266	989	8,222	4	168	20.92	4,044
Total [1]	19,445	211	4,098	33,673	32	1,259	38.34	7,461

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

Studies of the geology and mineral resources of Virginia included reports on Page County;[3] the Staunton, Churchville, Greenville, and Stuarts Draft Quadrangles, Virginia;[4] an evaluation by the Virginia Division of Mineral Resources, in cooperation with the U.S. Department of the Interior, Bureau of Mines, of the potential ceramic and nonceramic uses of clay materials in 27 eastern Virginia counties;[5] and a directory of the mineral industry in Virginia.[6] The last publication lists 253 companies and individuals, exclusive of coal producers, on record as of March 15, 1967. 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 raw material or commodity under the appropriate county or city. 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. The Directory is issued annually.

Trends and Developments.—During 1967, announcements were made to locate 116 new manufacturing plants in Virginia and to expand 96 existing plants according to the State's Division of Industrial Development. About 16,500 new manufacturing jobs are expected to occur from the announced new plants and expansions. While the total number of new plants and expansions was less than record announcements of 1966, employment is expected to be greater for the 1967 announcements.

The year was also one of strong growth for new and expanded research and development facilities in Virginia. During 1967, 30 new firms announced plans to locate in the State and 5 existing firms announced plans to expand. Total employment for the new and expanded facilities is expected to reach about 1,800.

According to a recently published report, "New Manufacturing Plants in Virginia since 1960," by the State's Division of Industrial Development, apparel and electrical machinery were the two leading industries in terms of new employment during 1960–66. The former industry led in new employment (21 percent) and the latter was second with 15 percent. Several other industries had substantial gains in new plant employment. These included textiles, chemicals, fabricated metals, nonelectrical machinery, and furniture. During the 1960–66 period, a total of 339 new plants with 35,255 employees were established in Virginia. Seventy-one of Virginia's 96 counties and 30 of its 35 independent cities gained new plants.

The long established trend of declining mine employment in Virginia was reversed in 1967. Employment in the State's coal mines gained about 3 percent in 1967, according to the Virginia Division of Industrial Development. Coal mining is by far the most important section of Virginia's mining industry, accounting for more than three-quarters of all mine employment.

A new billion-dollar company—the Seaboard Coast Line Railroad Company—was created July 1, 1967, when the Seaboard Air Line Railroad Company and the Atlantic Coast Line Railroad Company merged to form the new rail system. The new system now operates 9,629 route miles in Virginia, North Carolina, South Carolina, Georgia, Florida, and Alabama, and ranks eighth in mileage and ninth in both assets and revenues among the Nation's railroads. The new road employs a total of approximately 23,000 persons. Pooling of freight cars will give the new company one of the largest fleets in the country. The Seaboard Coast Line Railroad Company is chartered in Virginia and has its corporate headquarters in Richmond.

Virginia's fuel capability was increased by the opening of a new coal mine (the Virginia-Pocahontas No. 1), which became initially productive early in 1967 and is expected to produce 2 million tons of metallurgical coal annually at full capacity. The mine is the second one developed by Island Creek Coal Co. in the company's Pocahontas No. 3 seam metallurgical reserves (located in Buchanan County), which are estimated to exceed half a bil-

[3] Allen, Rhesa M., Jr. Geology and Mineral Resources of Page County, Virginia Div. of Miner. Res. (Charlottesville, Va.), Bull. 81, 1967, 78 pp.

[4] Rader, Engene K. Geology of the Staunton, Churchville, Greenville, and Stuarts Draft Quadrangles, Virginia. Virginia Div. of Miner. Res. (Charlottesville, Va.), Rept. of Inv. 12, 1967, 43 pp.

[5] Johnson, Stanley S., and Miles E. Tyrrell. Analysis of Clay and Related Materials—Eastern Counties. Virginia Div. Miner. Res. (Charlottesville, Va.) Miner. Res. Rept. 8, 1967, 232 pp.

[6] Le Van, D. C. Directory of the Mineral Industry in Virginia. Virginia Div. of Miner. Res. (Charlottesville, Va.), Inf. Circ. 13, 1967, 45 pp.

lion tons of low-volatile coal. The first mine, the Beatrice Pocahontas mine, a joint venture with Republic Steel Corp., became productive late in 1963. A third mine, Virginia-Pocahontas No. 2, is under development by Island Creek Coal Co. in the Pocahontas No. 3 seam. Initial production is scheduled for late in 1968, and the projected full production and capacity rate of 2 million tons per year is expected by 1971.

Construction progressed substantially on a sixth coal-fired generating unit at Virginia Electric & Power Co.'s Chesterfield Power Station near Richmond. The new unit's capacity will nearly double the electrical energy output of the whole station and thus will substantially increase the tonnage of fuel consumed.

Construction of a new lightweight aggregate plant near Richmond was begun in 1967 by the Wheelwright Corp. The facility will be adjacent to the Chesterfield power station of Virginia Electric & Power Co. and will utilize as raw material fly ash conveyed from the steam-generating plant. The product will be marketed to the concrete block and ready-mix concrete industries. Completion of the new plant is planned for early in 1968.

Sand and gravel are basic construction materials whose output nationally constitutes the largest volume of any raw mineral commodity produced in the United States. Restoration of depleted sand and gravel sites is of increasing importance and interest nationally and locally; for eastern Virginia such restoration is described in a recent publication.[7]

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Coal (Bituminous).—Abetted by the ever increasing demand for electrical energy, coal production increased in all but one (Buchanan) of the eight coal-producing counties and rose to 36.7 million short tons, 3 percent higher than the 35.6 million tons reported in 1966, the previous record output year. The year was also one of record value; mine output value increased 12 percent over that of 1966 and 11 percent over that of 1957, the former peak value year. The greater than proportional total value increase of coal was due to an 8-percent increase in the average value per ton ($4.66) in 1967 compared with the $4.31 reported in 1966. Production data includes coal produced from deposits within Virginia, whether the mine opening is or is not inside the State boundary and excludes operations producing less than 1,000 tons per year. Consequently, production data published by the Federal Bureau of Mines may differ somewhat from data published by the State.

Both high- and low-volatile bituminous coals were produced for electric power generation, industrial 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 eight southwestern counties in which coal was mined—Buchanan, Dickenson, Wise, and Russell—accounted for 97 percent of the total output compared with 98 percent in 1966. Buchanan County, where 62 percent of Virginia's coal mines were located, produced 42 percent of the State's output in 1967.

The State's recordbreaking coal production was achieved with 215 fewer mines of all types than in 1966. Underground production comprised 83 percent of the total output, 1 percent less than in 1966, but almost 755,000 additional tons of coal were mined with 218 fewer underground mines than the 1,002 active in 1966.

Of the total coal produced in 1967, 83 percent was from underground mines (84 percent in 1966), 11 percent was from strip mines (10 percent in 1966), and 6 percent was from auger mines (6 percent in 1966).

Coal was produced by underground mines in all 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,

[7] Pharr, R. F. Reclamation of Depleted Sand and Gravel Sites in Eastern Virginia. Virginia Minerals, v. 13, No. 3, August 1967, pp. 21–27.

and Dickenson Counties in auger mine production. The average value per ton for underground-mined coal was $4.92; for strip-mined coal, $3.46; for auger-mined coal, $3.20; and for the combined output by all three mining methods, $4.66. Principal seams mined included 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.

Of the total underground output, 80 percent was mechanically loaded, 13 percent higher than in 1966, and 40 percent higher than in 1962. These increases reflected the trend toward modernization and mechanization in the State's underground mines.

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

(Thousand short tons and thousand dollars)

County	1966					1967				
	Number of mines			Total production		Number of mines			Total production	
	Underground	Strip	Auger	Quantity	Value [2]	Underground	Strip	Auger	Quantity	Value [2]
Buchanan	659	18	34	16,288	$67,344	520	23	28	15,529	$70,541
Dickenson	92	16	8	9,339	40,010	75	13	10	9,579	46,482
Lee	49	3	1	433	2,016	43	5	5	835	3,485
Montgomery [3]	1	----	----	2	10	1	----	----	W	W
Russell	35	3	2	1,917	10,374	26	4	2	2,278	12,695
Scott	1	----	----	11	48	1	----	----	W	W
Tazewell	10	2	3	244	874	5	2	1	311	1,044
Wise	155	24	17	7,331	32,665	113	23	18	8,171	36,835
Undistributed	-----	----	----	--------	--------	-----	----	----	19	100
Total	1,002	66	65	35,565	153,341	784	70	64	[4] 36,721	[4] 171,183

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 selling cost. Includes value for coal not sold but used by producer, such as mine fuel and coal coked as estimated by producer at average prices that might have been received if such coal had been sold commercially.
[3] Semianthracite coal; quantity and value included in bituminous coal total.
[4] Data may not add to totals shown because of rounding.

A total of 316 mobile loading machines (51 more than in 1966) accounted for 60 percent of the mechanically loaded tonnage; 94 continuous mining machines (14 more than in 1966) accounted for 37 percent; long-wall machines and hand-loaded face conveyors accounted for the remainder. Of the total coal mines, 50 percent of the product was mechanically cleaned in 37 plants (1 plant more than in 1966). Wet washing other than with jigs was the principal method of cleaning, accounting for 81 percent of the cleaned coal. Of the cleaned coal 49 percent was thermally dried. Of the total coal mined 40 percent was crushed. Sixteen percent of the total coal output was treated with dust-allaying and antifreezing preparations, of which oil predominated (86 percent).

Coke.—Coal was converted to coke in beehive, Mitchell, and sole flue ovens; no byproduct recovery was made. The coke was produced in six plants (five companies); one in Buchanan County and five in Wise County. Three plants in Wise County, however, closed down in 1967—two plants early in spring and one near yearend. Production of coke was about 34 percent less than in 1966, primarily because of the plant shutdowns during 1967. The average value per ton was $15.63, an increase of 0.4 percent over the $15.56 reported in 1966.

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 3,818 million cubic feet, 10 percent less than that of 1966; the total value was $1,149,000 and the average wellhead value was $0.30 per thousand cubic

feet. The output was delivered to the pipelines of Consolidated Gas Supply Corp., the Atlantic Seaboard Line, and the Kentucky-West Virginia Gas Co. Natural gas was produced in three southwestern counties—Tazewell, Buchanan, and Dickenson. Tazewell County led in production with about 60 percent of the State's output. Buchanan County and Dickenson County contributed 25 percent and 15 percent, respectively. Compared with 1966, only Dickenson County had an increase in natural gas output, but this increase was more than offset by declines in the other producing counties. At the close of the year, 112 gas wells were operating, compared with 104 in 1966 and 99 in 1965.

Reserves of natural gas were 37,798 million cubic feet, as reported by the American Gas Association. This is 212 million cubic feet more than reported in 1966.

There were no facilities for the underground storage of natural gas; however, the Washington Gas Light Co. operated a mined granite facility in Fairfax County for the storage of liquefied petroleum gases. The Oil and Gas Journal (Oct. 16, 1967) reported the capacity to be 300,000 barrels of propane.

During 1967, production of crude petroleum in Virginia totaled 3,491 barrels, a substantial increase over the 1,073 barrels produced in 1966. All production was from Lee County, with the Rose Hill field accounting for 1,870 barrels and the Ben Hur field for 1,621 barrels. At yearend, four oil wells were operating compared with six at the close of 1966, according to Virginia Department of Labor and Industry, Division of Mines and Quarries.

The No. 1 J.V. Graham well reportedly (Oil and Gas Journal, May 22, 1967) was completed for about 400 barrels per day of 48° API gravity oil from the Ordovician Trenton Limestone. Depth of the pay zone was 2,215 to 2,540 feet. The incident reportedly resulted in an extensive lease play in Southwestern Virginia. However, the Virginia Division of Mineral Resources reported in the Virginia Minerals journal for May 1968 that the well only produced 519 barrels during April and May of 1967. Apparently the subsequent results did not substantiate the earlier rumors.

The American Oil Co. operated a coking and catalytic cracking and reforming refinery at Yorktown, York County. Operating capacity was 43,600 barrels per calendar day. The gasoline output capacity was 22,200 barrels per calendar day. The Oil and Gas Journal (April 1, 1968) reports, additionally, that the plant had a coke capacity of 900 tons per stream day.

NONMETALS

Aplite.—Interrupting an increasing trend, output and value were slightly less than those in 1966. Production of this feldspar commodity, chiefly for use in glass manufacture, was from two operations—one in Nelson County and one in Hanover County. A limited quantity of the material from a second operation in Nelson County was produced for use chiefly as an aggregate.

Cement.—Sales of portland cement declined for the third consecutive year. Shipments were 7 percent lower than in 1966, but value of shipments was only 1 percent lower, due to an average increase of $0.20 per barrel (376 pounds) over last year's average value per barrel of $2.97. Masonry cement shipments declined 8 percent and value of shipments 7 percent; the average value per barrel (280 pounds) was slightly higher in 1967. Of the total cement shipped, including portland and masonry, portland cement accounted for 88 percent of shipments and 82 percent of the total value.

Portland cement plant capacity was virtually unchanged during the year. Four plants manufactured cement; three made both portland and masonry cement and one plant produced only masonry cement. The wet process of manufacturing portland cement was used by one plant while two plants used the dry process. Cement was produced in Augusta, Botetourt, and Warren Counties and 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, oystershell, mill scale, gypsum, various air-entraining compounds and a variety of grinding aids. Over four-fifths 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 nonair-trained types were produced; the latter type 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 rail and truck.

For the various consumer uses, portland cement was distributed as follows: 58 percent to ready-mixed concrete companies (60 percent in 1966); 18 percent to concrete products manufacturers (18 percent in 1966); 13 percent to contractors, including highway contractors (11 percent in 1966) and 11 percent to other users, including building material dealers, Federal, State, and local government agencies, and miscellaneous customers (11 percent in 1966).

Slightly more than two-thirds of portland cement shipments terminated within the State; the remainder, in order of decreasing shipments, went to North Carolina, West Virginia, Alabama, South Carolina, Maryland, Georgia, and Florida. Masonry cement shipments went to 28 States; chiefly Virginia, North Carolina, Maryland, West Virginia, South Carolina, and District of Columbia; 61 percent of shipments terminated in Virginia.

Clays.—Sharing in the decline of commodities supplying the construction industries, clay output and value were 7 and 10 percent lower respectively, than in 1966. About 68 percent of the clay and shale output was consumed in brick manufacture, compared with 69 percent in 1966. The principal uses for the balance were light-weight aggregate and in manufacturing portland cement. Some was also consumed in the making of vitrified sewer pipe, flue linings, pottery, clay dummies (shot-hole tampers), and other clay products.

Clay production was reported from 24 operations in 15 counties. The chief producing counties in order of output were Botetourt, Russell, Orange, Chesterfield, and Nansemond; in order of output value they were Orange, Botetourt, Prince William, Nansemond, and Chesterfield. Five counties produced almost two-thirds of the State output and five accounted for almost three-quarters of the value.

Feldspar.—Production was by one company from two mines in Bedford County.

Table 6.—Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Short tons	Value
1963	1,410	1,558
1964	1,440	1,614
1965	1,415	1,657
1966	1,486	1,813
1967	1,382	1,623

The output was substantially less than in 1966. The average market value was the same as in 1966, thus the drop in total value was also substantial. Mixed feldspar (soda and potash) was mined near the company's processing and grinding mill in Bedford. In order of decreasing tonnage the mill output was marketed chiefly in Maryland, Ohio, Massachusetts, Pennsylvania, and New York, principally for pottery and ceramic enamel manufacture, although smaller quantities were used in the manufacture of welding rod coatings, soap and abrasives, and for brick glaze.

Gem Stones.—Mineral collectors and hobbyists collected a variety of semiprecious gems and mineral specimens from various Virginia counties. The rock and mineral varieties include agate, amazonite, blue corundum, lepidolite, olivine, staurolite, and unakite.

Gypsum.—Production of crude gypsum declined substantially compared with output reported in 1966. Gypsum, mined near Chatham Hill, Smyth County, and 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 near Norfolk for use in their products. Imported gypsum was processed by several firms in the Norfolk area for use as a land dressing. The United States Gypsum Co.'s Plasterco No. 6 Mine, Saltville, was awarded a Certificate of Achievement in Safety (National Safety Competition) for operating during 1967 without a lost-time work injury. The National Safety Competition is jointly sponsored by the Federal Bureau of Mines and the American Mining Congress.

Kyanite.—Production of crude kyanite ore and sales of the refined material to manufacturers of refractories and other

ceramic products decreased slightly. Two mines and three processing plants were operated by one company in the adjacent counties of 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. Virginia is North America's leading producer of kyanite. Quartz sand recovered during kyanite ore beneficiation was marketed by a subsidiary organization for industrial and construction applications.

Lime.—While output and value of lime decline slightly for the second consecutive year, 1967 was only 2 percent lower in both production and value than the record year of 1965. Compared with 1966, the output values were smaller for all uses of lime; the decreases were 17 percent for building lime, 6 percent for agricultural lime, and 1 percent for chemical and other industrial lime. All but 4 percent of lime sold or used, including both quicklime and hydrated lime, was consumed in chemical, metallurgical or other industrial use. Ten companies in six counties and one independent city reported primary lime production.

Giles, Smyth, and Shenandoah Counties, in order of output, were the chief producing areas and accounted for 86 percent of the State's 1967 lime output.

Processing equipment used in lime making included pot, shaft, and rotary kilns and batch and continuous hydrators. Raw materials included high-calcium limestone (predominately), dolomitic limestone, and oystershell. Fuels used included bituminous coal, coke, and natural gas.

Virtually the entire output was high-calcium lime of which 92 percent was used or marketed as quicklime and the remainder as the hydrated product. Uses for lime included the manufacture of alkalies, calcium carbide, and paper; flux in steelmaking and electrometallurgical operations; sewage and trade-wastes treatment; purification and treatment of water; agricultural purposes, leather tanning; construction; and miscellaneous applications. Of the State's output, 38 percent was sold or used within Virginia and the remainder was shipped principally to Florida, Georgia, Kentucky, Maryland, North and South Carolina, Ohio, Pennsylvania, Tennessee, Texas, and West Virginia.

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

(Thousand short tons and thousand dollars)

Year	Agricultural		Building		Chemical and other industrial		Total [1]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1963	W	W	W	W	603	$7,583	639	$8,058
1964	W	W	W	W	742	9,251	780	9,781
1965	W	W	W	W	809	10,080	847	10,584
1966	26	343	10	142	805	10,001	840	10,486
1967	28	324	8	118	793	9,903	829	10,345

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

Mica.—No production of crude mica was reported. Domestic and foreign mica were processed for use in paint, plastics, rubber, wallpaper, and other products by Asheville Mica Co. and Mica Co. of Canada (N.Y.), Inc., both in Newport News.

Nitrogen Compounds.—Allied Chemical Corp., Nitrogen Division, Hopewell, produced nitrogen compounds such as ammonia, urea, and ammonium sulfate for use chiefly as fertilizer or fertilizer ingredients.

Perlite.—Virginia Perlite Corp., Hopewell, processed perlite from Western United States and imported vermiculite, chiefly for use as a lightweight concrete aggregate and building plaster. The company terminated the Hopewell processing operation late in 1967.

Salt.—Chlorine, caustic soda, soda ash, and other chemicals were produced by Olin-Mathieson Chemical Corp., Saltville, Smyth County, using brine recovered from nearby captive salt wells. Production of salt was moderately lower than in 1966. The company began modernization of its Saltville complex last year; the improvements include not only its chemical facilities but also the company's captive limestone and lime-making operations near the Saltville plant. When the modernization program is completed, soda ash production is expected to increase substantially with a parallel increase in salt and lime consumption.

Sand and Gravel.—A lower tempo of housing starts and roadbuilding activity in Virginia in 1967 sharply reduced the demand for construction materials; production and value of sand and gravel declined 43 percent and 25 percent, respectively, compared with 1966, the record output year. The less severe total value decline was due to an increase of $0.30 in the average value per ton over the $0.97 of last year. All but about 5 percent of the total output was consumed in construction applications, for which about 9 million tons were required, compared with almost 17 million tons in 1966.

Commercial output comprised 98 percent of total production and value; the remainder was State and local Government output, mainly for highway maintenance. Of the commercial production, 86 percent was used in building (39 percent) and paving (47 percent). Other sand and gravel uses included other construction uses (fill material and miscellaneous and unspecified applications). Sand comprised 59 percent of the total commercial sand and gravel output and 50 percent of the

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	2,305	$2,561	2,332	$2,757
Paving	6,627	4,033	2,233	1,862
Fill	1,913	1,105	634	305
Other [1]	386	927	492	1,257
Total	11,231	8,626	5,691	6,181
Gravel:				
Building	2,218	3,732	1,433	2,739
Paving	2,649	3,675	2,307	3,157
Other [2]	986	564	203	179
Total	5,853	7,971	3,943	6,075
Total sand and gravel	17,084	16,597	9,634	12,256
Government-and-contractor operations:				
Sand:				
Paving	38	13	27	10
Fill	53	18	34	13
Total	91	31	61	23
Gravel:				
Paving	16	7	162	204
Fill	--	--	6	11
Total	16	7	168	215
Total sand and gravel	107	38	229	238
All operations:				
Sand	11,322	8,657	5,752	6,204
Gravel	5,869	7,978	4,111	6,290
Grand total	17,191	16,635	9,863	12,494

[1] Includes glass, engine, ground sand, and sand for other construction and industrial uses.
[2] Includes fill and gravel for miscellaneous and other uses.

total commercial value. While less than one-tenth of the sand output was marketed as special industrial silica sands used for glass manufacture, engine sand, filler, and other nonconstruction uses, about two-tenths of the value of sand output was attributed to these market uses.

Eighty-nine percent of the total commercial sand and gravel output was screened, washed, or otherwise processed compared with 83 percent in 1966. Of the 78 commercial sand and gravel operations reporting, 55 processed their output at 41 stationary, 11 portable, and 3 dredging installations. The remaining 23 operations recovered unprocessed material. Of the commercial tonnage, 60 percent was shipped by truck, and most of the remainder by rail or water; a small quantity was used at the processing plant or transported by unspecified methods.

Production of sand and gravel was reported from 36 counties and 2 independent cities, compared with 30 counties and 3 independent cities in 1966. In order of output the principal sand-and-gravel producing areas were Henrico, Fairfax, and Chesterfield Counties, the independent city of Virginia Beach, and Prince George County. Almost three-quarters of both the total output and value were contributed by these five producing areas.

Of the 78 commercial sand and gravel operations reporting in 1967 (60 in 1966), 3 had an output range of from 500,000 to 1 million tons and accounted for 26 percent of the total commercial output; 21 had an output range of from 100,000 to 500,000 tons and accounted for 54 percent; 19 had an output range of from 50,000 to 100,000 tons and accounted for 13 percent; and 35 had an output range of up to 50,000 tons and accounted for 7 percent. The number of operations producing less than 50,000 tons of sand and gravel annually was over double that of 1966. 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 quantity was obtained in the beneficiation of kyanite ore.

Soapstone.—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 were moderately less than in 1966. 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 18.5 percent of the State's total value of mineral production in 1967 (20.3 percent in 1966). Compared with 1966, production and value declined 8 percent and 6 percent, respectively. A lessened demand for construction aggregates (concrete aggregate and roadstone) was mainly responsible for the decline in production and value. A lower output of limestone derived products, in addition to aggregates, was also contributory.

Varied types of stone were mined or quarried in the State; in order of output value they were limestone (including dolomite), granite, basalt (including 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) was also produced, chiefly by dredging reef shell deposits in Chesapeake Bay; a limited quantity was obtained as a coproduct of oyster processing.

Crushed stone comprised virtually all of the total output (99.8 percent) and the major share of the total value (91.2 percent). Crushed stone was produced from all the stone varieties, although that prepared from limestone, granite, and basalt, the three leading stone varieties in order of output and value, accounted for 94 percent of total stone output and 86 percent of total value. Of the total crushed stone output, 22.9 million tons, or 73 percent, was used for building purposes (concrete aggregate and roadstone) compared with 24.6 million tons in 1966. In addition 11 percent was limestone used in cement and lime manufacture; 3 percent was used as fluxstone (limestone); and the remainder was used as agricultural dressing, railroad ballast, riprap, stone sand, and in miscellaneous and unspecified applications.

Of the three leading crushed stone varieties only basalt (including diabase) gained in output (28 percent) and value (27 percent). Granite declined 13 percent

in output, but only 10 percent in value because of a higher unit value in 1967. Limestone declined 8 percent in output and 9 percent in value. Reduced demand for both granite and limestone in construction aggregates and for limestone in other products was largely responsible for the output declines. Compared with 1966, the output of limestone for agstone, cement and lime manufacture, fluxstone, railroad ballast, and miscellaneous uses, was about 1 million tons lower. Of the five remaining crushed stone varieties, three gained and two declined in output. Sandstone declined 45 percent in output but only 28 percent in value because of a higher unit value in 1967. Miscellaneous stone declined substantially in output and value. Slate, calcareous marl, and marble all gained slightly in output and value. Crushed slate was used in producing lightweight aggregate and roofing granules and as roadstone; the calcareous marl was used mainly in cement manufacture, and the marble was produced for use as terrazzo. Oystershell, the bulk of which was reef shell dredged from the Chesapeake Bay area, decreased substantially in output and value. The decline was due chiefly to cessation of a dredging operation in midsummer of 1967. The shell was used mainly in the manufacture of agricultural lime, cement, oyster bed replanting, poultry grit, and roadstone.

Four varieties of dimension stone were also produced in the State. In order of output value they were miscellaneous stone (amphibolite, schist, soapstone, and "Virginia Greenstone"), slate, diabase, and sandstone. Three gained in output value and one declined. Miscellaneous stone declined slightly in output, and slate gained slightly; both gained moderately in value, principally because of higher prices received for the dimensioned products in 1967. Laboratory and architectural stone and flagging were the principal products derived from the soapstone. The output of "Virginia Greenstone" included rough and dressed building stone and dressed

Table 9.—Stone sold or used by producers, by kinds and uses

(Thousand short tons and thousand dollars)

Kind and use	1966		1967	
	Short tons	Value	Short tons	Value
Dimension stone:				
Sandstone: All uses	W	W	1	$21
Undistributed [1]	71	$4,387	69	4,616
Total [2]	71	4,387	71	4,637
Crushed and broken stone:				
Basalt:				
Concrete and roadstone [3]	2,755	4,568	3,534	5,817
Granite:				
Concrete and roadstone	10,032	15,420	8,680	13,847
Riprap [4]	265	420	266	471
Limestone:				
Fluxing stone	967	1,507	805	1,320
Concrete and roadstone	10,577	13,942	10,094	13,447
Railroad ballast	396	539	268	309
Agricultural	1,140	2,023	1,132	2,045
Riprap	W	W	11	12
Miscellaneous	[5] 5,290	[5] 9,190	4,586	7,660
Sandstone:				
Concrete and roadstone	1,140	1,256	593	867
Miscellaneous [6]	93	254	80	214
Undistributed [7]	1,424	2,044	1,206	1,825
Total [2]	34,080	51,163	31,254	47,833
Grand total [2]	34,151	55,550	31,324	52,470

W Withheld to avoid disclosing individual company confidential data.
[1] Includes sandstone (1966), limestone (1966), basalt, slate, and miscellaneous stone.
[2] Data may not add to totals because of independent rounding.
[3] Includes stone sand and riprap.
[4] Includes railroad ballast.
[5] Includes riprap.
[6] Includes refractory (1966), riprap (1966), railroad ballast, and other uses.
[7] Includes miscellaneous stone, calcareous marl, marble, shell, and slate.

refractory stone (bakery oven-hearth stones). Production of these two miscellaneous stone varieties was confined to one county and one independent city. A limited quantity of dimension stone was produced from the other two miscellaneous varieties—amphibolite and schist in two counties. Slate for roofing, structural and sanitary use, flagging, wall facing, and flooring tile was produced in one county. Diabase, a basaltic rock, was produced as dimension stone in one county; output and value were substantially lower in 1967. A limited output of dimension sandstone was produced in two counties; output and value increased in 1967.

Commercial stone production including marine shell was reported from 55 counties and 1 independent city. The principal stone producing counties, in terms of output, were Botetourt (crushed limestone), Loudoun (crushed diabase), Augusta (crushed limestone and sandstone), Frederick (crushed limestone), and Tazewell (crushed limestone). In terms of product value, the most important counties were Botetourt, Loudoun, Buckingham (dimension and crushed slate), Giles (crushed limestone, largely for lime making), and Frederick. Twenty-eight percent of the total stone output was contributed by five counties, and five counties accounted for almost 29 percent of the output value.

In 1967, commercial production of limestone was reported from 23 counties, granite from 19, basalt and diabase from 7, sandstone (including quartzite and quartz) from 12, slate from 1, calcareous marl from 2, miscellaneous stone from 3, and marble from 1. Oystershell was produced in 1 independent city and 1 county. The number of counties listed in the two preceding sentences exceeds the number of counties in which all types of commercial stone was produced because of duplication of counties when considering each variety produced. Twelve counties (11 in 1966) produced more than 1 million tons of stone and there were 21 counties with output valued in excess of $1 million each (23 in 1966). Crushed stone was produced in all but one of the producing counties, and in one independent city; dimension stone was produced in six counties. Government-and-contractor stone was produced in seven counties and accounted for less than 1 percent of the total stone output and value.

As a result of the National Safety Competition, Certificates of Achievement in Safety were awarded to a number of companies whose quarry groups operated during 1967 without a lost-time work injury. Among companies receiving awards were Augusta Stone Corp. (Staunton limestone quarry); Burkeville Stone Corporation (Burkeville granite quarry); Charlottesville Stone Corp. (Charlottesville basalt quarry); Chemstone Corp., subsidiary of Minerals & Chemicals Philipp Corp., (Strasburg limestone quarry); Fairfax Quarries, Inc. (Fairfax diabase quarry); Lehigh Portland Cement Co. (Fordwick limestone quarry); Southern Materials Co., Inc. (Chester granite quarry); Interstate Stone Corp. (Verona limestone quarry); and Vulcan Materials Co., Mideast Division (Manassas diabase quarry, Royal Stone granite quarry, and South Boston granite quarry).

Sulfur.—Hydrogen sulfide was recovered from fuel gas and converted to sulfur by the American Oil Co. at its Yorktown refinery. Shipments increased substantially; the greater-than-proportional increase in total value of shipments was due to a higher average unit value in 1967.

METALS

Ferroalloys.—E. J. Lavino & Co., Division of International Minerals & Chemicals Corp., suspended production for an indefinite period at their ferroalloys plant in Lynchburg during August 1967 but maintained sales from stockpile. The plant utilized fluxstone and coke from Virginia in the blast-furnace reduction of imported manganese ore to produce ferromanganese for use by the steel industry.

Iron Ore (Pigment Material).—Natural iron-oxide pigments were produced by one firm at Hiwassee, Pulaski County, from local deposits of earthy forms of hydrous and anhydrous iron oxides—ocher, sienna, and umber. More than a hundred different colors are produced at the Hiwassee plant by combination of raw, burnt, and blended ochers, siennas, and umbers. Manufactured iron oxides, for use in pigment manufacture and in magnetic tape manufacture, were produced at the company's Pulaski facilities. Natural iron-oxide pigments were also produced from out-of-State hematite by a firm at Henry, Henry County. The finished iron-oxide pigments are used

in paints, printing inks, fertilizers, foundry facings, cement, and other products. Total marketed output of both natural and manufactured iron-oxide pigments was substantially less than in 1966, but a higher unit value in 1967 partially offset the production decline, resulting in only a moderate decrease in total value.

Lead and Zinc.—Production of lead and zinc ore was limited to two mines in Wythe County, operated by New Jersey Zinc Co. Output of the crude lead-zinc ore was greater than in 1966 and the production of recoverable lead and zinc was 11 and 7 percent higher, respectively, in 1967. Lead rose only 3 percent in total value due to a decrease of 7 percent in unit value. A decline of 7 percent in the unit value of zinc more than offset the production gain, resulting in a slight decline in total value.

Table 10.—Mine production of recoverable lead and zinc

Year	Lead		Zinc	
	Short tons	Value	Short tons	Value [1]
1963	3,500	$756,000	23,988	$5,724,628
1964	3,857	1,010,534	21,004	5,699,645
1965	3,651	1,139,112	20,491	5,942,390
1966	3,078	930,479	17,666	5,123,140
1967	3,430	960,400	18,846	5,088,420

[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.

Manganese.—Howmet Corp., Minerals/Refractories Division, ground imported manganese ore at a plant in Lynchburg. Imported ore was processed for use in the company products by Union Carbide Corp., Mining & Metals Division, at a plant near Newport News.

Titanium Concentrates.—Marketed production of titanium concentrates rose 19 percent and value of shipments increased 14 percent compared with 1966 figures. The gain in total shipments and value was due entirely to ilmenite, which comprised the bulk of marketed production; rutile declined moderately in both shipments and value. Both the ilmenite ($FeTiO_3$) and rutile (TiO_2) are used in the manufacture of titanium dioxide pigments, which, in turn, are used in producing paints, lacquers, plastics, paper, rubber, textiles, linoleum, and many other materials. Ilmenite was produced by American Cyanamid Co., Pigments Division, in Amherst County, and both ilmenite and rutile were produced by M & T Chemicals, Inc., in Hanover County.

Table 11.—Principal producers

Commodity and company	Type of activity	County	Address	Remarks
Aplite (crude):				
International Minerals & Chemical Corp., Industrial Minerals Division.	Quarry	Nelson	Piney River, Va.	
M & T Chemicals, Inc.	do.	Hanover	P.O. Box 471 Rahway, N.J.	Coproducts-rutile and ilmenite.
Cement:				
Lehigh Portland Cement Co.	Plant	Augusta	718 Hamilton Street Allentown, Pa.	Portland and masonry.
Lone Star Cement Corp.	do.	Botetourt	3315 W. Broad Street Richmond, Va. and P.O. Box 6237 West End Branch Richmond, Va.	Do.
Do.	do.	Chesapeake (city)	3315 W. Broad Street Richmond, Va.	Do.
Riverton Lime & Stone Co., Inc.	do.	Warren	Riverton, Va.	Masonry only.
Clays (miscellaneous and shale):				
Brick and Tile Corp.	Pit	Brunswick	P.O. Box 45 Lawrenceville, Va.	
General Shale Prod. Corp.	do.	Chesterfield	Box 60 Johnson City, Tenn.	
Lightweight Aggregate Division, Clinchfield Coal Company.	Plant	Russell	Dante, Va.	Shale obtained in coal preparation process.
Locher Brick Co., Inc.	Pit	Botetourt	Glasgow, Va.	
Lone Star Cement Corp.	do.	Nansemond	3315 W. Broad Street Richmond, Va. and P.O. Box 6237 West End Branch Richmond, Va.	Used in cement manufacturing.
Redford Brick Co., Inc.	Pit	Chesterfield	Box 4106 Richmond, Va.	
Webster Brick Co., Inc.	do.	Botetourt	Box 780 Roanoke, Va.	
Do.	do.	Nansemond	do.	
Do.	do.	Orange	do.	
Woodbridge Clay Products Co.	do.	Prince William	Rt. 3, Box 240 Manassas, Va.	
Coal (bituminous):				
Beatrice Pocahontas Co.	Underground	Buchanan	Box 141 Holden, W. Va.	
Betty B. Corp.	do.	Dickenson	Clintwood, Va.	
Clinchfield Coal Co.	do.	Buchanan	Dante, Va.	
Do.	do.	Dickenson	do.	
Do.	do.	Russell	do.	Coproduct: Shale obtained from coal preparation plant.
Coal Processing Corp.	do.	Wise	Box 497 Norton, Va.	
Harman Mining Corp.	do.	Buchanan	Harman, Va.	
Island Creek Coal Co.	do.	do.	Keen Mountain, Va.	

Jewell Ridge Coal Corp	----do	----do	Jewell Valley, Va		
Westmoreland Coal Co	----do	Wise	P.O. Box 229 Big Stone Gap, Va.		
Big Six Corp	Strip	Dickenson	Clintwood, Va		
Contracting Enterprises	----do	----do	----do		
Stallard Womack Mining Corp	----do	----do	P.O. Drawer 389 Appalachia, Va.		
Chloe Drilling Co	Auger	----do	Pikeville, Ky		
Sun Trucking Co	----do	Wise	Hazard, Ky		
Coke:					
Christie Coal and Coke Co., Inc	Plant	----do	P.O. Box 409 Norton, Va.		
Jewell Smokeless Coal Corp	----do	Buchanan	Dismal Route, Box 2 Vansant, Va.		
Norton Coal Co., Inc	----do	Wise	432 Park Avenue Norton, Va.	Two plants—both closed in 1967.	
Westmoreland Coal Co., Stonega Division	----do	----do	Big Stone Gap, Va		
Wise Coal and Coke Co	----do	----do	Dorchester, Va	Closed in 1967.	
Fledspar (crude):					
Clinchfield Sand & Feldspar Co., Division of Harry T. Campbell Sons' Corp.	Mines	Bedford	Campbell Bldg. Towson, Baltimore, Md.		
Gypsum:					
United States Gypsum Co	Plant	Norfolk (city)	101 S. Wacker Drive Chicago, Ill.	Process imported gypsum.	
Do	Mine	Smyth	----do	Processed at plant in Washington County.	
Do	Mine and plant	Washington	----do	Also mined in Smyth County.	
Iron-oxide pigments (crude):					
Imperial Color & Chemical Dept., Hercules, Inc.	Mine	Pulaski	Hiwassee, Va		
Iron-oxide pigments (finished):					
Blue Ridge Talc Co., Inc	Plant	Henry	P.O. Box 8 Henry, Va.		
Imperial Color & Chemical Dept., Hercules Inc.	----do	Pulaski	Hiwassee, Va		
Do	----do	----do	Drawer 431 Pulaski, Va.		
Kyanite:					
Kyanite Mining Corp	Quarry	Buckingham	Dillwyn, Va	Coproduct: Quartz sand.	
Do	----do	Prince Edward	----do	Do.	
Lime:					
Battery Park Fish & Oyster Co	Plant	Isle of Wight	Battery Park, Va	Calcined oystershell.	
Blue Grass Lime Co	----do	Tazewell	Route 2 Tazewell, Va.	Calcined limestone.	
Chemstone Corp	----do	Shenandoah	Menlo Park Edison, N.J.	Do.	
Foote Mineral Co	----do	Giles	Route 100 Exton, Pa.	Do.	
W. S. Frey Co., Inc	----do	Frederick	257 E. Market Street York, Pa.	Do.	
M. J. Grove Lime Co., Division of The Flintkote Co.	----do	----do	Lime Kiln, Md	Do.	
National Gypsum Co	----do	Giles	325 Delaware Avenue Buffalo, N.Y.	Do.	
Olin Mathieson Chemical Corp	----do	Smyth	445 W. 59th Street New York, N.Y.	Do. Lime used in company's chemical manufacture.	

Table 11.—Principal producers—Continued

Commodity and company	Type of activity	County	Address	Remarks
Lime—Continued				
Peery Lime Co	Plant	Tazewell	Box 5 N. Tazewell, Va.	Calcined limestone.
Reliance Fertilizer & Lime Corp	----do	Chesapeake (city)	P.O. Box 4596 Norfolk, Va.	Calcined oystershell and dolomite.
Natural gas:				
Ashland Oil and Refining Co	Gas wells	Buchanan	Box 67, Vansant, Va.	
Cabot Corp	----do	----do	P.O. Box 1473 Charleston, W. Va.	
Clinchfield Coal Co., Division of the Pittston Co.	----do	Dickenson	Dante, Va	
Consolidation Coal Co.—Ray Bros	----do	Tazewell	Pocahontas, Va	
P and S Oil and Gas Corp	----do	Buchanan	305 Nelson Bldg. Charleston, W. Va.	
United Fuel Gas Co	----do	----do	P.O. Box 1273 Charleston, W. Va.	
Do	----do	Tazewell	----do	
Perlite (expanded):				
Virginia Perlite Corporation	Plant	Prince George	P.O. Box 158 Goldhill, N.C.	Virginia operation discontinued in late 1967.
Petroleum:				
David Law	Oil well	Lee	413–414 Union Trust Bldg. Parkersburg, W. Va.	
Neal Brothers	----do	----do	Ewing, Va.	
Wilshire Oil Co. of Texas	----do	----do	300 Filmore Street Denver, Colo.	
Petroleum refineries:				
American Oil Company	Plant	York	910 S. Michigan Avenue Chicago, Ill.	Coproducts: Sulfur and coke.
Salt:				
Olin Mathieson Chemical Corp	Brine wells	Smyth	445 W. 59th Street New York, N.Y.	Various chemicals manufactured from salt and lime at plant.
Sand and gravel:				
Commonwealth Sand & Gravel Corp	Pit	Henrico	P.O. Box 7589 Richmond, Va.	
George F. Dodd Gravel Corp	----do	Fairfax	P.O. Box 4143 Alexandria, Va.	
Fredericksburg Sand & Gravel Co., Inc	----do	Stafford	Rt. 4, Box 57 Fredericksburg, Va.	
Friend Sand & Gravel Co., Inc	----do	Prince George	Box 388, Petersburg, Va.	
Hilltop Sand & Gravel Co., Inc	----do	Fairfax	7950 Telegraph Road Alexandria, Va.	
Locher Silica Corp	Quarry	Rockbridge	Glasgow, Va	Mainly industrial silica (crushed sandstone).
Massaponax Sand & Gravel	Pit	Spotsylvania	P.O. Box 270 Fredericksburg, Va.	
Sadler Sand & Gravel Corp	----do	Henrico	P.O. Box 5417 Virginia Beach, Va.	

Southern Materials Co., Inc	----do	Charles City	P.O. Box 420 Norfolk, Va.	
Do	----do	Chesterfield	----do	
Do	Dredge	Henrico	----do	
Do	Pit	Prince George	----do	
Southwest Materials, Inc	----do	Augusta	P.O. Box 69 Salem, Va.	Crushed gravel.
Virginia Glass Sand Corp	Quarry	Frederick	P.O. Box 445 Winchester, Va.	Mainly industrial silica (crushed sandstone).
Virginia Sand & Gravel Co., Inc	Pit	Fairfax	P.O. Box 666 Springfield, Va.	
West Sand & Gravel Co., Inc	----do	Henrico	P.O. Box 6008 Richmond, Va.	
Soapstone (talc):				
Blue Ridge Talc Co., Inc	Mine and plant	Henry	P.O. Box 8 Henry, Va.	Also process out-of-State hematite for pigment manufacture.
Stone:				
Diabase—dimension:				
Buena Black Granite Corp	Quarry	Culpeper	Box 74 Rapidan, Va.	
Virginia Granite Co	----do	----do	P.O. Box 782 Elberton, Va.	
Diabase and basalt—crushed:				
Arlington Stone Co	----do	Loudoun	Box 310 Leesburg, Va.	Diabase.
B. M. Brosius	----do	Fauquier	Box 853 Warrenton, Va.	Do.
Bull Run Stone Co., Inc	----do	Loudoun	Box 469 Manassas, Va.	Do.
Chantilly Crushed Stone, Inc	----do	----do	Box 112 Chantilly, Va.	Do.
Charlottesville Stone Corp	----do	Albemarle	Box 7155 Richmond, Va.	Basalt.
Fairfax Quarries, Inc	----do	Fairfax	----do	Diabase.
Loudoun Quarries, Inc	----do	Loudoun	Box 110 Chantilly, Va.	Do.
Sanders Quarry, Inc	----do	Fauquier	355 Waterloo Street Warrenton, Va.	Do.
Silver Lake Shale Pit	----do	Prince William	Haymarket, Va	Do.
Virginia Trap Rock, Inc	----do	Loudoun	Box 705 Leesburg, Va.	Do.
Vulcan Materials Co	----do	Prince William	P.O. Box 7506 Winston-Salem, N.C.	Do.
Granite—crushed:				
Boscobel Granite Corp	----do	Goochland	Box 7155 Richmond, Va.	
Burkeville Stone Corp	----do	Nottoway	----do	
The General Crushed Stone Co	Quarry	Hanover	712 Drake Bldg. Easton, Pa.	
Martinsville Stone Corp	----do	Henry	Route 2, Box 31 Martinsville, Va.	
Rockville Stone Co	----do	Goochland	Box 7155 Richmond, Va.	

Table 11.—Principal proudcers—Continued

Commodity and company	Type of activity	County	Address	Remarks
Stone—Continued				
Granite—Crushed—Continued				
Southern Materials Co., Inc	Quarry	Brunswick	P.O. Box 420 Norfolk, Va.	
Do	----do	Chesterfield	----do	
Do	----do	Dinwiddie	----do	
Superior Stone Co., Div. Martin Marietta Corp.	----do	Albermarle	Box 2568 Raleigh, N.C.	
Tidewater Crushed Stone & Asphalt Co., Inc.	----do	Richmond (city)	Deepwater Terminal Road Richmond, Va.	
Trego Stone Corp	----do	Greensville	P.O. Box 2459 Roanoke, Va.	
Vulcan Materials Co	----do	Brunswick	P.O. Box 7506 Winston-Salem, N.C.	
Do	----do	Fairfax	----do	
Do	----do	Goochland	----do	
Do	----do	Halifax	----do	
Limestone—Crushed:				
Blue Ridge Stone Corp	Quarry	Bedford	Box 2459 Roanoke, Va.	Processed in plant in Botetourt County.
Chemstone Corp., Subsidiary of Engelhard Minerals & Chemicals Corp.	----do	Shenandoah	Menlo Park Edison, N.J.	
Foote Mineral Co	Underground	Giles	Route 100 Exton, Pa.	
W. S. Frey Co., Inc	Underground and open quarry.	Frederick	257 E. Market Street York, Pa.	
M. J. Grove Lime Co., Division of The Flintkote Co.	Quarry	----do	Lime Kiln, Md.	
James River Hydrate & Supply Co	----do	Botetourt	Box 355 Buchanan, Va.	
Liberty Limestone Corp	----do	----do	Buchanan, Va.	
Lone Star Cement Corp	----do	----do	3315 W. Broad Street Richmond, Va.	
National Gypsum Co	Underground	Giles	325 Delaware Avenue Buffalo, N.Y.	
Olin Mathieson Chemical Corp	----do	Smyth	445 W. 59th Street New York, N.Y.	Mainly converted to lime for use in chemical plant.
Penn-Dixie Cement Corp	Quarry	Scott	P.O. Box 152 Nazareth, Pa.	
Pounding Mill Quarry Corp	----do	Tazewell	Box 2459 Roanoke, Va.	
Rockydale Stone Service Corp	----do	Campbell	Rt. No. 8, Box 635 Roanoke, Va.	
Rockydale Quarries Corp	----do	Roanoke	----do	
Vulcan Materials Co	Quarry	Washington	Box 7 Knoxville, Tenn.	
Marble—crushed:				
Jamison Black Marble Co	Quarry	Rockingham	P.O. Box 1198 Roanoke, Va.	

Calcareous marl:				
J. C. Digges & Sons	Pit	Clarke	White Post, Va.	
Lone Star Cement Corp	----do	Nansemond	3315 W. Broad Street Richmond, Va. and P.O. Box 6237 Richmond, Va.	Used in cement manufacture.
Miscellaneous stone—dimension:				
Alberene Stone, Division of the Georgia Marble Co.	Quarry	Nelson	Schuyler, Va	Stone variety is soapstone.
Virginia Greenstone Co., Inc	----do	Lynchburg (city)	Box 897 Lynchubrg, Va.	
Wade and Griffey	----do	Patrick	Route No. 1 Floyd, Va.	
Miscellaneous stone—crushed:				
Dominion Stone Plant, Inc	----do	Nelson	Piney River, Va.	
Oystershell:				
Battery Park Fish & Oyster Co	Plant	Isle of Wight	Battery Park, Va.	
Radcliff Materials, Inc	Plant	Norfolk	P.O. Box 816 Norfolk, Va.	Dredging operations discontinued in mid-summer 1967.
Sandstone (including quartzite and quartz)—crushed:				
Castle Sands Co	Quarry	Craig	New Castle, Va.	
H. D. Crowder & Sons	----do	Carroll	Route 1 Austinville, Va.	
Culpeper Stone Co., Inc	----do	Culpeper	Box 650 Culpeper, Va.	
Eastside Quarry	----do	Augusta	Route 1 Waynesboro, Va.	
The Economy Cast Stone Co	----do	Albemarle	P.O. Box 3–P Richmond, Va.	Vein quartz.
Ironto Sand Corp	----do	Montgomery	P.O. Box 768 Radford, Va.	
Lone Jack Limestone Co., Inc	----do	Rockbridge	P.O. Box 1196 Lynchburg, Va.	
Newman Brothers Quarry, Inc	----do	Wythe	Route 3 Hillsville, Va.	
Stone & Mineral Corp	----do	Albemarle	213 Culpeper Street Warrenton, Va.	Do.
Do	----do	Fluvanna	----do	Do.
Vulcan Materials Co	----do	Pittsylvania	P.O. Box 7506 Winston-Salem, N.C.	
Sandstone—dimension:				
B. M. Brosius	Quarry	Fauquier	Box 853 Warrenton, Va.	
J. W. Costello	----do	----do	Box 46, Route 1 Haymarket, Va.	
Lofton Lambert	----do	----do	The Plains, Va.	
Slate—crushed or broken:				
Blue Ridge Slate Corp	Processing	Buckingham	P.O. Box 320 Charlottesville, Va.	Roofing granules.
Solite Corp	----do	----do	Box 9138 Richmond, Va.	Lightweight aggregate.
Slate—dimension:				
Arvonia-Buckingham Slate Co., Inc	Quarry	----do	Arvonia, Va	Also crushed.
Le Sueur-Richmond Slate Corp	----do	----do	----do	

Table 11.—Principal producers—Continued

Commodity and company	Type of activity	County	Address	Remarks
Titanium concentrate:				
American Cyanamid Co	Mine and plant	Amherst	Wayne, N.J.	Ilmenite (pigment material).
M & T Chemicals, Inc	do	Hanover	P.O. Box 23, Rt. 1 Montpelier, Va.	Ilmenite and rutile (pigment materials).
Vermiculite (Exfoliated):				
Virginia Perlite Corp	Plant	Prince George	P.O. Box 158 Goldhill, N.C.	Virginia operation discontinued in late 1967.
Zinc:				
The New Jersey Zinc Co	Underground mine and plant.	Wythe	160 Front Street New York, N.Y.	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 Ronald P. Collins [1] and William N. Hale [2]

Washington's mineral production was valued at $82 million in 1967, a decrease of 8 percent compared with the 1966 total. The decrease was due mainly to lower values of stone, cement, lead, zinc, and gold-silver ore; the latter was largely affected by the closure of a gold mine near Wenatchee early in the year. Fifty-seven percent of total mineral value was attributed to sand and gravel and stone.

Primary aluminum production amounted to 746,321 tons valued at $370.3 million. The value of aluminum was not included in the State mineral production total, which represents only the value of output from mines, pits, quarries, and mills.

Because of the lagging demand for zinc, American Smelting and Refining Company (Asarco) suspended operations indefinitely at its open-pit Van Stone zinc-lead mine located near Leadpoint.

The Spokane Indian Reservation was the site for expanding activity in uranium. Western Nuclear, Inc., began a 5-year exploration program, then announced that

[1] Economist, Bureau of Mines, Albany Oreg.
[2] Mineral specialist, Bureau of Mines, Albany, Oreg.

Table 1.—Mineral production in Washington [1]

Mineral	1966 Quantity	1966 Value (thousands)	1967 Quantity	1967 Value (thousands)
Barite—short tons	------	--------	100	$1
Cement:				
Portland—thousand 376-pound barrels	6,820	$24,340	5,614	20,581
Masonry—thousand 280-pound barrels	60	187	65	200
Clays [2]—thousand short tons	185	249	139	203
Coal (bituminous)—do	59	514	59	517
Copper (recoverable content of ores, etc.)—short tons	34	25	21	16
Gem stones	NA	75	NA	75
Lead (recoverable content of ores, etc)—short tons	5,859	1,771	2,762	773
Peat—do	25,599	136	40,608	181
Sand and gravel—thousand short tons	29,002	26,806	28,164	27,520
Stone—do	13,250	20,273	14,454	19,099
Talc and soapstone—short tons	3,880	22	4,916	26
Zinc (recoverable content of ores, etc)—do	24,772	7,184	21,540	5,964
Value of items that cannot be disclosed: Carbon dioxide, diatomite, fire clay, gold, gypsum, lime, magnesite, olivine, pumice, silver, tungsten (1967), uranium (1966), and vanadium (1966)	XX	r 7,514	XX	6,911
Total	XX	r 89,096	XX	82,067
Total 1957–59 constant dollars	XX	r 84,473	XX	p 78,119

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

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

(Thousands)

County	1966	1967	Minerals produced in 1967 in order of value
Adams	$284	$395	Stone, sand and gravel.
Asotin	W	W	Sand and gravel.
Benton	1,832	534	Sand and gravel, stone.
Chelan	W	496	Stone, sand and gravel, gold, pumice, silver, lead.
Clallam	291	143	Sand and gravel.
Clark	1,320	881	Stone, sand and gravel, clays.
Columbia	1,825	6,262	Sand and gravel, stone.
Cowlitz	408	391	Sand and gravel, stone, clays.
Douglas	321	149	Do.
Ferry	W	W	Gold, silver, stone.
Franklin	783	2,240	Stone, sand and gravel.
Garfield	333	2,029	Do.
Grant	1,983	2,185	Diatomite, sand and gravel, lime, stone.
Grays Harbor	695	925	Sand and gravel, stone.
Island	89	160	Do.
Jefferson	W	W	Stone, sand and gravel.
King	16,745	17,570	Cement, sand and gravel, stone, coal, clays, peat.
Kitsap	276	334	Sand and gravel, peat, stone.
Kittitas	655	1,903	Sand and gravel, stone, pumice.
Klickitat	924	663	Sand and gravel, carbon dioxide, stone.
Lewis	510	466	Stone, sand and gravel, coal, clays.
Lincoln	182	207	Stone, sand and gravel.
Mason	2	86	Sand and gravel, stone.
Okanogan	240	327	Sand and gravel, stone, gypsum, tungsten.
Pacific	349	211	Stone.
Pend Oreille	7,880	4,728	Cement, zinc, lead, stone, sand and gravel, silver, copper.
Pierce	5,601	4,954	Sand and gravel, lime, stone, clays, peat.
San Juan	W	W	Stone, sand and gravel.
Skagit	6,940	5,059	Cement, olivine, stone, sand and gravel, soapstone, barite.
Skamania	W	165	Stone, sand and gravel, gold, silver.
Snohomish	2,963	3,066	Sand and gravel, stone, peat, clays.
Spokane	r 5,707	3,276	Sand and gravel, cement, stone, clays, peat.
Stevens	6,685	W	Zinc, stone, magnesite, lead, sand and gravel, silver, copper, clays, gold.
Thurston	352	305	Sand and gravel, coal, peat, stone.
Wahkiakum	145	(1)	Sand and gravel.
Walla Walla	1,982	676	Stone, sand and gravel.
Whatcom	W	W	Cement, stone, sand and gravel, clays.
Whitman	2,081	983	Stone, sand and gravel.
Yakima	2,434	1,264	Sand and gravel, lime, stone.
Undistributed [2]	16,279	19,034	
Total	r 89,096	82,067	

r Revised. W Withheld to avoid disclosing individual company confidential data.
[1] Less than ½ unit.
[2] Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

a mill will be constructed with a capacity of 3,000 to 4,000 tons per day. Another firm, North Star Uranium, Inc., leased 360 acres across the Spokane River from the area being developed by Western Nuclear, Inc.

A comprehensive survey of mineral exploration in the State was presented by the Division of Mines and Geology, Washington Department of Natural Resources, at the 73d Annual Convention of the Northwest Mining Association held in Spokane. In addition to reviewing mineral activity in each county, the survey discussed the exploration done by the U.S. Geological Survey on the Continental Shelf, off the coast of Washington. The purpose of the offshore exploration was to find clues to deposits of heavy metals, mainly gold, and to provide basic geologic data for use by private industry in its search for mineral resources. Geologic and geophysical studies, including acoustical profiling, magnetic surveys, and dredge and core sampling, were conducted from a University of Washington research vessel, under a contract with the U.S. Geological Survey; the contract also included work in the Bering Sea, off the coast of Alaska.

Atlantic Richfield Co. received the contract to operate the Atomic Energy Commission's chemical processing complex at the Hanford plant near Richland. The complex includes processing plants for separating plutonium and uranium from irradiated reactor fuel, waste management

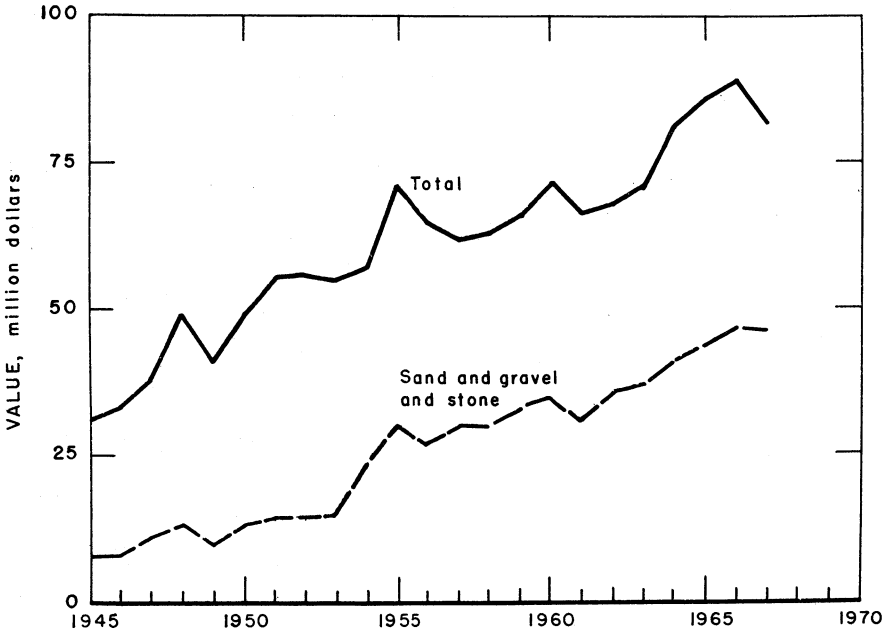

Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Washington.

facilities, and other process and service facilities. Employment was about 1,400 people, and operating costs were about $24 million per year.

A report was published that discussed producing alumina by a seldom-used process, with special modifications to treat the iron-bearing bauxites of Oregon and Washington.[3]

Exploration and development of mineral deposits in the State were conducted by 23 companies. A directory was published by the Washington State Department of Conservation that lists the firms and also shows locations of both metallic and nonmetallic minerals operations and the 1965 mineral production by county.[4]

Sales of electric energy by the Bonneville Power Administration (BPA) to aluminum reduction and rolling plants in Washington increased nearly 24 percent compared with 1966 sales; total revenue generated by these sales amounted to $23.5 million. Electric energy production for the State's domestic needs rose by 13 percent in 1967 from the prior year to reach 60.4 billion kilowatt-hours.

Economic Activity and Employment.—Washington experienced a rate of economic growth greater than that of any postwar year, excepting 1966 and 1951. Continued economic strength was indicated for the State by measuring the significant gains recorded in several important indicators of business activity. Although the 1966–67 gain in total personal income of 9.7 percent did not equal that for the period 1965–66 (13.1 percent), it still exceeded the U.S. average of 6.9 percent and the Western States average of 7.9 percent. Per capita personal income increased 8.0 percent for the State compared with 5.9 percent for the Nation. According to the Federal Reserve member bank report, bank loans rose 8.1 percent in the State, compared with 6.2 percent nationally. Residental construction starts were up 60

[3] Blake, Henry E., Jr., Oliver C. Fursman, Arden D. Fugate, and Lloyd H. Banning. Adaptation of the Pedersen Process to the Ferruginous Bauxites of the Pacific Northwest. BuMines Rept. of Inv. 6939, 1967, 21 pp.

[4] Moen, Wayne S. Directory of Washington Mining Operations, 1965–66. Washington State Department of Conservation, Inf. Circ. 43, 1967, 80 pp.

Table 3.—Indicators of Washington business activity

		1966	1967 p	Change, percent
Personal income:				
Total	millions	$9,797.0	$10,746.0	+9.7
Per capita		$3,222.0	$3,481.0	+8.0
Construction activity:				
Building permits	millions	$565.1	$782.0	+38.4
Heavy engineering awards	do	$247.9	$295.9	+19.4
State highway commission:				
Value of contracts awarded	do	$101.4	$105.5	+4.0
Value of contract work performed	do	$119.6	$105.5	−11.8
Cement shipments to and within Washington	thousand 376-pound barrels	7,926.0	7,368.3	−7.0
Mineral production	millions	$89.1	$82.1	−8.0
Cash receipts from farm marketings	do	$726.5	$767.5	+5.6
Factory payrolls	do	$4,721.1	$5,167.6	+9.5
Annual average labor force and employment:				
Total labor force	thousands	1,257.7	1,313.7	+4.5
Unemployment	do	52.0	55.2	+6.2
Employment:				
Construction	do	54.6	55.5	+1.6
Aerospace	do	85.4	98.7	+15.6
Lumber and wood products	do	28.4	29.5	+3.9
Food processing	do	46.6	44.1	−5.4
All manufacturing	do	265.2	277.9	+4.8
All industries	do	1,204.5	1,257.5	+4.4

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	1966		1967	
	Employment	Wages (thousands)	Employment	Wages (thousands)
Mining:				
Metal mining	537	$3,788	485	$3,490
Bituminous coal, crude petroleum, and natural gas	92	619	88	607
Nonmetallic mining and quarrying	1,162	9,676	1,185	10,304
Total	1,791	14,083	1,758	14,401
Stone, clay, and glass products:				
Cement, hydraulic	554	4,263	535	4,329
Structural clay products	278	1,596	298	1,712
Concrete, gypsum, and plaster products	3,862	29,739	3,727	30,029
Other	949	6,782	977	7,206
Total	5,643	42,380	5,537	43,276
Smelting, refining, and castings:				
Blast furnaces, steel works, rolling and finishing mills	1,901	14,370	1,774	13,387
Iron and steel foundries	1,189	9,196	1,135	9,007
Smelting, refining, and casting of nonferrous metals, except aluminum	1,186	8,273	962	6,896
Smelting, rolling, drawing, and casting of aluminum	8,577	69,374	8,784	72,518
Miscellaneous	527	4,712	517	4,824
Total	13,380	105,925	13,172	106,632
Industrial chemicals [1]	5,334	49,535	5,094	47,934
Petroleum refining and related industries	1,199	10,009	1,211	10,672
Grand total	27,347	221,932	26,772	222,915

[1] The Hanford atomic plant is the largest in this classification.

Source: Washington Employment Security Department bulletins on industries covered by Washington State Employment Security Act. Industry groups may vary from those in the Bureau of Mines canvass.

Table 5.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries: Fatal	Number of injuries: Non-fatal	Injury rates per million man-hours: Frequency	Injury rates per million man-hours: Severity
1966:								
Coal	80	229	18	146	----	4	27.37	609
Peat	28	136	4	31	----	----	----	----
Metal	409	284	116	932	1	56	61.14	13,679
Nonmetal	173	141	24	200	----	4	19.96	514
Sand and gravel	1,497	198	296	2,393	----	53	22.14	653
Stone	1,120	194	217	1,748	----	29	16.59	600
Total [1]	3,307	204	676	5,450	1	146	26.97	2,854
1967: [p]								
Coal	70	229	16	128	----	3	23.44	516
Peat	30	192	6	47	----	1	21.30	2,130
Metal	370	211	78	624	----	34	54.46	1,451
Nonmetal	130	107	14	111	----	4	36.12	740
Sand and gravel	1,565	201	315	2,546	----	63	24.74	1,205
Stone	1,270	197	250	2,007	----	29	14.45	524
Total [1]	3,435	198	679	5,463	----	134	24.53	965

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

percent in Washington compared with an 11-percent gain in the United States. Construction activity increased substantially, 38.4 percent and 19.4 percent, respectively, for the value of building permits and heavy engineering awards. Factory payrolls were up almost 10 percent because of the gains in manufacturing employment—a high-salary group. Employment in aerospace increased 16 percent to a 99,000 annual average; in December, the total was 105,300. The Boeing Co. announced record $2.9 billion sales and a yearend backlog of $5.9 billion. Employment in the mineral industries group failed to maintain the pace it had set the year before and by yearend 1967 the total of this group was about even with the level of the prior period. Nonferrous metals, which had been bolstered by new and expanded aluminum plants in 1966, experienced personnel reductions and a labor-management dispute which caused yearend totals to fall below 1966 levels. Despite the number of jobs added during the year, unemployment was above 1966 levels through nearly all of 1967. According to the Washington Employment Security Department, this was not an indication of any weakness, but rather an indication of the rapid growth of the labor force.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasives.—Carborundum Co., Vancouver, continued manufacturing silicon carbide for abrasive, chemical, and refractory purposes. Much of the abrasive-grade material was shipped to grain-sizing and treatment plants in the Eastern States for further processing into products suitable for use in bonded and other types of abrasives; some was shipped to Western States for use in sandblasting. Chemical-grade silicon carbide was used by the steel and petroleum industries. Refractory-grade crude silicon carbide was shipped to the company's Perth Amboy, N.J., refractory plant.

Barite.—Barite production from the Madsen quarry, by W.A. Madsen, was sold to Northwest Talc & Magnesium Co., Clear Lake, for grinding.

Cement.—Portland cement shipments, by four firms operating seven plants, totaled 5.6 million barrels valued at $20.6 million. Cement was distributed from the plants and seven distribution terminals to consumers in the State (84 percent), and to other Pacific Northwest States and Alaska. Of the total cement shipped, 75

percent was transported by truck, 17 percent by rail, and 8 percent by boat. The ratio of bulk to paper bag shipments was about 10:1.

About 85 percent of the portland cement produced was distributed to firms manufacturing commercial concrete products, such as ready-mixed concrete companies (70 percent), concrete product manufacturers (11 percent), and building material dealers (4 percent). The remaining 15 percent was sold to highway (9 percent) and other contractors (5 percent), and local government agencies (1 percent).

The Ideal Cement Co. 2.5-million-barrel-annual-capacity cement plant at Seattle started operating in March. The operation, providing centralized manufacturing facilities with minimum labor requirements, replaced company cement-producing plants, with combined capacity of about 2 million barrels annually at Spokane and Grotto, Wash., and at Gold Hill, Oreg. Storage and packing facilities at the latter plants were converted to distribution terminals later in the year. Aspects of the plant's operations were described in several articles.[5]

Waterborne shipment and storage facilities were installed at the Kaiser Cement & Gypsum Corp. proposed cement-plant site at Seattle. Equipment was ordered, and cement plant construction was to begin in 1968, with completion expected late in 1969. Speed in constructing the company distribution terminal at Seattle was discussed.[6]

Lone Star Cement Corp. announced plans to expand its Seattle plant rather than construct another plant at Anacortes.

Clays.—The tonnage of clays sold or used by Washington producers declined 23 percent from the 1966 total, largely because of less output of miscellaneous clay for heavy clay products (building brick and draintile), and less fire clay output for use in refractory products.

Fire clay was mined from five pits in three counties. International Pipe & Ceramics Corp. produced firebrick from material dug at the Blum and Harris pits in King County. Clay dug by the firm from the Mica and Sommer pits in Spokane County was used for manufacturing fire clay refractories at the Mica plant. L–D Mines, Inc., exported fire clay dug in Douglas County.

Miscellaneous clay for making heavy clay products (building brick and vitrified pipe), and for manufacturing cement came from 14 pits in nine 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 the Lande pit (Stevens County). Mutual Materials Co. dug clay for use in making building brick from the Elk and Newcastle pits (King County) and Clay City pit (Pierce County). Raw material for manufacturing building brick also came from operations of Hidden Brick Co. (Clark County), R.L.Fleshman (Cowlitz County), Chehalis Brick & Tile Co. (Lewis County), Lowell Brick Co. (Snohomish County), and Lynden Clay Products, Inc. (Whatcom County). Clay used in manufacturing cement came from pits dug by Ideal Cement Co. (King and Spokane Counties) and Jim Hoy (Whatcom County).

Diatomite.—Production of diatomite increased 11 percent over the 1966 total. Kenite Corp. continued to mine and process diatomite in Grant County. Crude diatomite was trucked 18 miles from a pit southeast of Quincy to a company plant at Quincy, where it was calcined, ground, sized, and packaged for shipment. Prepared diatomite was marketed as a filtering aid, as a filler, and for insulation purposes.

Gypsum.—Agro Minerals, Inc., mined gypsite (a mixture of gypsum, quartz, and clay) from the Poison Lake deposit and 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 also was marketed by the company as a portland-cement retarder. Greenacres Gypsum Co., Spokane, sold gypsum imported from Canada for agricultural purposes.

[5] Ideal Cement Mixer, Seattle Plant. V. 22, No. 2, May 1967, pp. 1–11..
The Northwest. Ideal Cement Co. Builds its Biggest Kiln in Seattle. Sept.-Oct. 1967, V. 42, No. 4, pp. 3–5.
Bergstrom, John H. Maximum Efficiency with Minimum Horsepower. Rock Products, V. 70, No. 10, October 1967, pp. 74–81.

[6] Bryan, Lee M. A Silo Complex, and How It Grew. Rock Products, V. 70, No. 10, October 1967, p. 87.

Lime.—Production of lime declined 10 percent from the 1966 total. Pacific Lime, Inc., Tacoma, continued manufacturing primary open-market lime, and sold it to Pacific Northwest and Canadian customers for a wide variety of chemical uses, and for construction and agricultural purposes. The Tacoma lime operation received limestone by barge from company quarries at Texada Island, British Columbia, Canada. Limestone was calcined to lime for use in sugar refining at Utah-Idaho Sugar Co. plants in Grant and Yakima Counties. Calcium carbonate sludge was converted to lime at seven pulp operations for their own use in manufacturing pulp and paper products.

Magnesian Minerals.—Lessened demand for refractory-grade magnesia by the steel industry resulted in a 48-percent decrease in magnesite tonnage mined by Northwest Magnesite Co. Magnesite from the Finch, Keystone, and Red Marble quarries was converted to refractory magnesia at the firm's Chewelah plant. Shipments of the refractory-grade product by the company declined 26 percent.

Olivine production, remaining substantially constant with the 1966 total, was from the Twin Sisters Mountain (Skagit County) quarries of Northwest Olivine Corp. and Scheel Stone Co. Olivine mined at the Twin Sisters quarry was trucked 20 miles to the Northwest Olivine Co. grinding plant at Hamilton. Processed tonnages were marketed mainly for use as foundry sand to Pacific Coast States and Canadian consumers. Olivine also was mined at the Sisters Mountain quarry by Scheel Stone Co. and processed at the Hamilton grinding plant.

Pumice.—Output of pumice and pumiceous materials increased 33 percent over the 1966 total. Ewer Lumber Co. continued to produce pumice for use as concrete aggregate from a pit near the southeastern part of Chelan Lake, Chelan County. The screened material was sold to Pacific Northwest and Canadian consumers for use in manufacturing building blocks. Volcanic cinder, from a talus slope in Kittitas County, was marketed for landscaping purposes.

Sand and Gravel.—Sand and gravel output declined 3 percent from the 1966 total. Increased requirements for sand and gravel by the State highway department partially offset a decline in demand for these materials by the U.S. Army Corps of

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Building	6,801	$7,859	6,242	$7,406
Road material	6,341	6,541	6,586	6,368
Fill	3,046	1,734	2,628	1,546
Railroad ballast	1,892	1,151	151	104
Other [1]	766	894	1,534	2,049
Total	18,846	18,179	17,141	17,473
Government-and-contractor operations:				
Building	1,280	1,684	329	455
Road material	7,195	5,740	8,223	6,822
Fill	1,516	1,088	553	289
Other [1]	165	120	1,918	2,481
Total	10,156	8,627	11,023	10,047
All operations:				
Building	8,081	9,543	6,571	7,861
Road material	13,536	12,281	14,809	13,190
Fill	4,562	2,817	3,181	1,835
Railroad ballast	1,892	1,151	151	104
Other [1]	931	1,014	3,452	4,530
Grand total	29,002	26,806	28,164	27,520

[1] Includes special sands for construction and industrial uses and sand and gravel for miscellaneous unspecified purposes.

Engineers at dam construction projects. Considerable sand and gravel from Columbia County was used for constructing Little Goose Dam.

Sand and gravel was produced in 37 of the 39 counties. Commercial firms operated 110 plants—73 stationary and 37 portable. Output from Government-and-contractor operations, largely production by Federal, State, and local government agencies for roadbuilding and dam construction projects, was from 53 plants—21 stationary and 32 portable.

Sand and gravel output was valued at over $5 million in King County, $3 million each in Pierce and Columbia Counties, $2 million in Snohomish County, and more than $1 million each in Kittitas and Spokane Counties.

Distribution of output by use was as follows: Roadbuilding and maintenance, 53 percent; construction, 23 percent; fill, 11 percent; railroad ballast, 1 percent; and miscellaneous, 12 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 production (53 percent) was centralized at 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 Steilacoom operations of Pioneer Sand & Gravel Co. and Glacier Sand & Gravel Co., both in Pierce County, and the Renton operation of Stoneway Concrete, Inc., King County.

High productivity was reflected in value of sand and gravel produced at these large operations in the Puget Sound drainage system where the prices for sand and gravel ranged between $0.50 and $0.75 per ton, f.o.b. plant, whereas the State composite value for commercial sand and gravel averaged $1.02 per ton, f.o.b. plant.

Of 56 sand and gravel and stone operations subject to Washington Pollution Control Commission permit regulations in the Puget Sound drainage system, an area comprising parts of 12 counties or about 14,000 square miles in western Washington, 52 had permanent permits and were in compliance with the effluent requirements established by the State; four were operating on a temporary basis pending their compliance with the regulations.

Stone.—Stone was quarried in 36 counties. Columbia, Franklin, Garfield, and King Counties each had production valued at over $1 million. Intensive use of stone at dam construction projects included operations in Columbia (Little Goose Dam), Franklin (Lower Monumental Dam), and Garfield (Lower Granite Dam) Counties. Stone output in King County was used largely in road construction.

Basalt, accounting for 13 million tons, 90 percent of the total stone output, came from operations in 32 counties. Basalt was used for building purposes, and for concrete aggregate, roadstone, riprap, and ballast.

Limestone production of 900,000 tons valued at $1.5 million came from operations in Chelan, Pend Oreille, San Juan, Skagit, Snohomish, Stevens, and Whatcom Counties. Most of the limestone was used by the cement industry; some, from

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

(Thousand short tons and thousand dollars)

Use	1966		1967	
	Quantity	Value	Quantity	Value
Dimension stone (building)	23	$291	41	$319
Concrete and roadstone	9,406	13,084	8,870	11,775
Riprap	1,132	1,854	915	1,514
Other [1]	2,688	5,045	4,629	5,491
Total [2]	13,250	20,273	14,454	19,099

[1] Used at cement, paper, metallurgical, and chemical plants, for railroad ballast, and miscellaneous unspecified purposes.
[2] Data may not add to totals shown because of independent rounding.

Chelan, San Juan, Snohomish, and Stevens Counties, was used by the metallurgical industries and for roadstone and agricultural purposes. Large tonnages of limestone continued to be imported for manufacturing cement, lime, and paper.

Output of 121,779 tons of industrial silica valued at $700,000 came from sandstone, quartz, and quartzite operations in Chelan, Ferry, Pend Oreille, Spokane, and Stevens Counties. The crushed and sized material was marketed for use in manufacturing abrasives, cement, ferrosilicon, glass, roofing granules, and sodium silicate, and for use as filtration and foundry sand. Large tonnages of silica-bearing material from sources outside the State continued to supplement material mined in the State. Dimension sandstone was produced in Chelan, Ferry, Kittitas, Lincoln, Pierce, and Skagit Counties.

Small but important tonnages of granite and marble were produced. Granite from King County was used for poultry grit, riprap, and for landscaping purposes. Dimension granite came from King and Yakima Counties. Crushed and sized marble from operations in Ferry, King, and Stevens Counties was marketed for use as furnace flux, paint filler, roofing granules, stucco, and for agricultural and landscaping purposes. Dimension marble was quarried in Ferry and Stevens Counties.

A general description of the different types of stone that have been quarried for building purposes was published. The distribution of major rock units from which various stones have been quarried, and the map location of the quarries were included.[7]

Talc and Soapstone.—Soapstone was mined at three operations near Marblemount, Skagit County, by Herman Smith, Skagit Talc Products, and Scheel Stone Co. Scheel Stone Co. sold crude material for sculpturing purposes. The other two operators shipped crude material to grinding plants of Northwest Talc & Magnesium Co. (Clear Lake), Miller Products Co., and Stauffer Chemical Co. (both in Portland, Oreg.). The processed material was used as a carrier in insecticides and fertilizers and as a filler for paint.

Vermiculite.—Crude vermiculite from a Montana mining operation was exfoliated at the Vermiculite Northwest, Inc., Spokane plant. Output of the expanded product, slightly less than in 1966 was marketed for use in insulation, lightweight plaster, and concrete aggregates, and for agricultural purposes.

METALS

Aluminum.—Production of primary aluminum was a record-breaking 746,321 short tons valued at $370.3 million, compared with the 1966 totals of 598,260 short tons valued at $294.0 million. The total production figure for the State's five primary aluminum plants was less than the technically rated capacity because several of the potlines under construction were completed during the year and did not have a full year for production. A new potline, placed in operation at Aluminum Company of America's Wenatchee reduction plant, raised annual capacity to 175,000 tons, up 50,000 tons from the previous capacity of 125,000 tons.

Previously announced capacity increases in several aluminum reduction plants continued underway—Reynolds Metals Co., Longview, was to total 190,000 tons by 1970; Intalco Aluminum Corp., Ferndale, was to total 228,000 tons by late 1968; and Kaiser Aluminum & Chemical Corp., Tacoma, was to total 81,000 tons by 1968.

[7] Moen, Wayne S. Building Stone of Washington. Washington Department of Conservation, Division of Mines and Geology, Bull. No. 55, 1967, 85 pp.

Table 8.—Primary aluminum plant capacity and production data

Year	Rated primary capacity, short tons	Primary production			Average U.S. ingot price per pound (cents)
		Short tons	Percent of national total	Value (thousands)	
1963	483,000	439,144	19	$202,327	22.6
1964	483,000	489,919	19	232,893	23.7
1965	524,000	534,680	19	262,702	24.5
1966	676,000	598,260	20	294,115	24.5
1967	770,000	746,321	23	370,287	25.0

Kaiser Aluminum & Chemical Corp. announced that a plant to produce ⅜-inch-diameter rod used for making electrical conduit wire was to be added to its Tacoma complex. Intalco Aluminum Corp. also was to add rod mill facilities at its Ferndale reduction plant, where electrical conduit wire would be made from molten aluminum by a continuous casting process. Reynolds Metals Co. began construction of a cable plant at the Longview complex scheduled for completion in 1968. Included in the operation were to be two holding furnaces and a Properzi unit, which continuously casts molten metal, by quick chilling, into a millable shape for subsequent reduction to rod and wire.

A bulk alumina storage facility, a metal hemispheric dome with 55,000 tons of capacity, owned by the Port of Tacoma but leased to Kaiser Aluminum & Chemical Corp., was placed in operation in June with the arrival of 25,000 long tons of alumina from Queensland, Australia, destined for Kaiser Aluminum & Chemical Corp.'s reduction works at Tacoma and Mead. Initially, 300,000 long tons of Queensland alumina was to be handled through the Port of Tacoma annually for use at the Tacoma and Mead reduction plants. Plans include waterborne deliveries by ore carriers with 55,000-long-ton capacity.

The Port of Everett announced that agreements had been made with Anaconda Aluminum Co. to undertake the revenue bond financing of a planned $3.5 million cargo handling and alumina unloading facility on the Everett waterfront. Construction of the facility, which was to be used to transfer alumina from ocean freighters to rail cars for movement to Anaconda's Columbia Falls, Mont., reduction plant, was scheduled for completion in July 1969. Anaconda Aluminum Co. planned to ship 350,000 long tons of Jamaican alumina per year through the Port of Everett. The total construction project included a specially designed, multipurpose crane, storage dome, and rail car loader.

A study of the potential growth of the Pacific Northwest aluminum industry was published by BPA. A fivefold increase in the productive capacity of the regional aluminum industry was anticipated by 1985, from 800,000 short tons in 1965 to 3.8 million in 1985.[8]

Copper.—Kennecott Copper Corp. continued to study the possibility of developing a copper deposit in the Glacier Peak Wilderness Area of the North Cascade Mountains. The proposed mine was to be an open-pit operation expected to yield 12,000 to 15,000 tons of copper per year. Kennecott owns 350 acres and has mining rights to 3,000 acres on Miners Ridge, 70 miles northeast of Everett in the Mount Baker National Forest.

Chiwawa Mines, Inc., of Spokane, was organized to explore a copper prospect staked in the late 1800's near Chiwawa Mountain in the Leavenworth mining district, Cascade Range. Geological and mining engineering work was performed during the year at the 17-claim property 5 miles east of the Glacier Peak copper property of Kennecott Copper Corp.

At Tacoma, American Smelting and Refining Co. announced a plan that was to cost several million dollars for expansion of refined copper capacity. When completed, the expansion was to increase employment by 150 people.

Gold–Silver.—A continuing decrease in gold and silver production resulted in declines in value from the 1966 figures of 14 and 9 percent, respectively. Production of gold and byproduct silver continued to be from established mines in Ferry County (Knob Hill and Gold Dollar mines). The known gold-silver ore at the Gold King mine in Chelan County, operated by L-D Mines, Inc. was exhausted in February, and mining and milling were terminated. The Gold King mine, Washington's second largest gold producer, had been operated continuously for 17 years. According to the annual report of Day Mines, Inc.,[9] production during the first 2 months of 1967 at the Gold King mine before the gold-silver mining and milling operation was shut down, amounted to 6,951 tons of ore averaging 0.21 ounce of gold and 0.26 ounce of silver per ton. The property was placed on a standby basis, with the expectation that a higher price for gold could make the low-grade material profitable in the future. In the past because of a high silica content, some Gold King ore

[8] Bloch, Ivan, and Samuel Moment. The Aluminum Industry of the Pacific Northwest. Bonneville Power Administration Pacific Northwest Economic Base Study for Power Markets, v. 2, pt. 7B, 1967, 287 pp.

[9] Day Mine, Inc. Annual Report. 1967, 15 pp.

was shipped to the Tacoma smelter for use in smelting copper concentrates.

The Day Mines, Inc., annual report also stated that production from the Gold Dollar ore body continued throughout the year, under lease to the neighboring mining company, Knob Hill Mines, Inc. The J.O. (Joint Operation) No. 3 vein was developed from the 13th level, where drifting and crosscutting exposed 200 feet of commercial-grade ore, plus 665 feet of subcommercial veins.

Gold-mining operations in Chelan and Ferry Counties accounted for 93 percent of silver output as a byproduct. Silver was recovered at an average rate of 3.4 ounces per ounce of recoverable gold. Lead-zinc operations were responsible for most of the remainder, with an average content of 2.3 ounces of recovered silver per ton of concentrate.

The prospects for finding new gold-silver ore deposits in the Republic district of Ferry County were discussed in a published report.[10]

Western Gold Mining, Inc., resumed exploration work at its Hart's Pass property in the Cascade Mountains northwest of Wenatchee.

Lead-Zinc.—The value and quantity of lead produced, primarily from Pend Oreille (Pend Oreille mine) and Stevens (Van Stone mine) Counties, were down 53 percent and 56 percent, respectively, from the 1966 totals. Zinc output, mostly from the Pend Oreille mine and the Calhoun mine (Stevens County), amounted to 21,540 tons valued at nearly $6 million, compared with 24,772 tons valued at $7 million in 1966.

According to the company annual report, the Pend Oreille mine yielded 292,628 tons of ore compared with 594,654 tons in 1966, and through 1967 the property had processed a total of 12,380,712 tons of ore. Total costs per ton of ore were $5.462 compared with $4.258 in 1966. The 1967 cost figure included 0.973 cent per ton for strike costs. Because of the decreased tonnage mined due to the strike, as well as reduced lead and zinc prices, concentrate sales of Pend Oreille Mines & Metals Co. declined to $1.2 million from $2.9 million of the previous year.

American Smelting and Refining Company suspended operations indefinitely at its Van Stone mine at Colville on May 1. Last year, the mine yielded 13 percent of Asarco's total national zinc output.

American Zinc Co.'s Calhoun concentrator near Leadpoint was operated throughout the year at its rated capacity of 1,200 tons of lead-zinc ore per day.

Uranium.—Western Nuclear, Inc., began engineering studies on a mining and milling system to develop uranium ore deposits on the Spokane Indian Reservation, Stevens County. Metallurgical studies of the ore were done at the company's existing mill facility at Jeffrey City, Wyo. The 10 million pounds of uranium oxide reserve outlined by Western Nuclear's exploratory drilling was in a conglomerate 100 feet thick, capped by sandstone and shale. The flat-lying deposit was to be mined by open-pit methods. A mill of 3,000- to 4,000-ton-per-day capacity was being planned by the firm. Production of an estimated 1.25 million pounds of uranium oxide annually was planned to commence in January 1971.

Dawn Mining Co. (Midnite mine), 51 percent owned by Newmont Mining Corp., and 49 percent by Midnite Mines, Inc., contracted for sale of uranium oxide to Jersey Central Power and Light Co., and Metropolitan Edison Co., subsidiaries of General Public Utilities Corp. of New York. The uranium oxide was to be produced from Dawn Mining Co.'s idle Spokane Indian Reservation open-pit mine. The company suspended mining operations in 1965 after having produced sufficient uranium oxide to complete a sales contract with the U.S. Atomic Energy Commission. Dawn Mining agreed to sell 2.5 million pounds of uranium oxide in concentrates to the New York area power companies over a 3½-year period starting in January 1970.

Zirconium.—Construction of a $3 million zirconium tubing plant for Sandvik Special Metals Corp., announced in 1966, was underway at Kennewick. The plant was to be completed in January 1968.

[10] Muessig, Siegfried. Geology of the Republic Quadrangle and Part of the Aneas Quadrangle, Ferry County, Washington. U.S. Geol. Survey, Bull. 1216, 1967, pp. 38.

Initially, the output was to be zirconium tubing for nuclear power plants; however, the plant also was to be equipped to fabricate titanium.

MINERAL FUELS

Carbon Dioxide.—Gas-Ice Corp. recovered carbon dioxide from mineral waters in Klickitat County and converted the gas to dry ice. The firm also maintained a plant at Finley, Benton County, where carbon dioxide was recovered from an ammonia-plant waste product.

Coal.—Coal output, all from four coal mines in the Puget Sound region west of the Cascade Range, was 58,873 tons—an increase of 236 tons over the 1966 total. Coal from underground mining operations in King and Thurston Counties was fed to mechanical cleaning equipment; 16 percent of the material washed was refuse. A strip-mining firm in Lewis County marketed coal directly from the mine without processing. The unit value of coal sold in the open market was $8.78 per ton.

Pacific Power & Light Co. and Washington Water Power Co. announced a joint venture for constructing a 1,400-megawatt coal-fired steam-generating plant near Centralia. The $176 million project involves installing the first 700-megawatt facility at a coalfield northeast of Centralia by 1971 and the second 700-megawatt unit by 1972. Surface mining operations and the power-generating units were to be set up on the 16,000-acre Tono coalfield between Bucoda in Thurston County and Mendota in Lewis County.

Construction began on a 50-ton-per-day coal deashing plant at Tacoma, by Pittsburgh and Midway Coal Co. Scheduled for completion in 1969, the plant was designed to provide engineering data for design and construction of commercial units, and to produce sufficient deashed coal to permit market testing.

Peat.—Production of peat totaled 40,869 tons of which 16,063 tons was unprepared, 18,056 tons was shredded, and 6,750 tons was shredded and kiln dried before marketing. The average unit value of peat was $4.41 per ton. Humus (21,769 tons), peat moss (3,381 tons), and reed-sedge (15,719 tons) peat were produced, and most was sold in bulk. Snohomish County led in peat production, followed by King, Spokane, Thurston, Kitsap, and Pierce Counties.

Petroleum and Natural Gas.—Six exploratory wells, all dry holes were drilled for oil and gas. Two offshore tests were made. One, drilled to a depth of 10,368 feet by Pan American Petroleum Corp., was 20 miles offshore from the mouth of the Hoh River. Another, drilled by Shell Oil Co. to a depth of 13,179 feet, was 15 miles offshore opposite the mouth of Willapa Harbor. Four wells were drilled onshore in exploring for oil and gas in King and Snohomish Counties.

Table 9.—Oil and gas well drilling

County	Exploratory wells			Total footage
	Oil	Gas	Dry	
King	--	--	3	16,402
Snohomish	--	--	1	175

At Jackson Prairie, Lewis County, Washington Water Power Co., Washington Natural Gas Co., and El Paso Natural Gas Co. continued development on a natural gas storage reservoir with ultimate storage capacity of 25 billion cubic feet.

Litigation involving an antitrust issue began on the El Paso Natural Gas Co. 1,500-mile natural gas pipeline, which begins at Sumas and ends at Ignacio, Colo. Gas is gathered and delivered through many branch lines to the pipeline for distribution in the State, and to Oregon, Idaho, Utah, Wyoming, and Colorado communities.

Atlantic Richfield Co. announced plans to construct a crude-oil refinery near Marysville, Snohomish County, with capacity of 100,000 barrels per day. Preservationist groups opposed construction of the oil refinery and attempted to block the development through the Snohomish County Planning Commission.

Table 10.—Principal producers of metals and minerals

Commodity and company	Type of activity	County	Address
Nonmetals:			
Barite:			
W.A. Madsen	Mine	Stevens	Colville, Wash.
Northwest Talc & Magnesium Co	Plant	Skagit	Clear Lake, Wash.
Cement:			
Columbia Cement Co	----do	Whatcom	Bellingham, Wash.
Ideal Cement Co:			Denver, Colo.
Grotto [1]	----do	King	
Irvin [1]	----do	Spokane	
Seattle	----do	King	
Lehigh Portland Cement Co	----do	Pend Oreille	Allentown, Pa.
Lone Star Cement Corp.:			Seattle, Wash.
Concrete	----do	Skagit	
Seattle	----do	King	
Clay:			
Chehalis Brick & Tile Co	Pit and plant	Lewis	Chehalis, Wash.
R.L.Fleshman	Pit	Cowlitz	Castle Rock, Wash.
Hidden Brick Co	Pit and plant	Clark	Vancouver, Wash.
Jim Hoy	Pit	Whatcom	Bellingham. Wash.
Ideal Cement Co.:			Denver, Colo.
Grotto	----do	King	
Spokane	----do	Spokane	
International Pipe & Ceramics Corp.:			Los Angeles, Calif.
Bliessner	----do	Spokane	
Blum	----do	King	
Harris	----do	do	
Lande	----do	Stevens	
Mica	Pit and plant	Spokane	
Palmer	Pit	King	
Pit No. 55	----do	do	
Renton [2]	Pit and plant	do	
Sommer	----do	Spokane	
L-D Mines, Inc	Pit	Douglas	Wenatchee, Wash.
Lowell Brick Co	Pit and plant.	Snohomish	Everett, Wash.
Lynden Clay Products, Inc	----do	Whatcom	Everson, Wash.
Mutual Materials Co.:			Seattle, Wash.
Elk and Newcastle	----do	King	
Clay City	----do	Pierce	
Diatomite:			
Kenite Corp	Mine and plant.	Grant	Scarsdale, N.Y.
Gypsum:			
Agro Minerals, Inc	Mine	Okanogan	Tonasket, Wash.
Kaiser Gypsum Co., Inc	Plant	King	Seattle, Wash.
Lime:			
Pacific Lime, Inc	----do	Pierce	Tacoma, Wash.
Magnesite:			
Northwest Magnesite Co	Mine and plant	Stevens	Pittsburgh, Pa.
Olivine:			
Northwest Olivine Co	----do	Skagit	Mount Vernon, Wash
Scheel Stone Co	Mine	----do	Seattle, Wash.
Expanded perlite:			
Kaiser Gypsum Corp	Plant	King	Seattle, Wash.
Pumice and pumicite:			
Ewer Lumber Co	Pit and plant	Chelan	Omak, Wash.
W.L. Marenakos Co	----do	Kittitas	Issaquah, Wash.
Roofing granules:			
Northwest Talc & Magnesium Co	Plant	Skagit	Clear Lake, Wash.
Sand and gravel:			
Associated Sand & Gravel Co	Pit and plant	Snohomish	Everett, Wash.
Cadman Gravel Co	----do	King	Redmond, Wash.
Cascade Asphalt & Paving	----do	Pierce	Tacoma, Wash.
Central Pre-Mix Concrete Co	----do	Spokane	Spokane, Wash.
Curtis Construction Co	----do	Columbia	Pomeroy, Wash.
Glacier Sand & Gravel	----do	King	Vashon, Wash.
Do	----do	Pierce	Steilacoom, Wash.
Holroyd Land Co	----do	----do	Tacoma, Wash.
Lakeside Gravel Co	----do	King	Bellevue, Wash.
Marine Asphalt Co., Inc	----do	Various	Anacortes, Wash.
Materne Bros	----do	----do	Spokane, Wash.
Miles Sand & Gravel	----do	King	Auburn, Wash.
North Star Sand & Gravel Co	----do	Snohomish	Lynwood, Wash.
Pioneer Sand & Gravel Co	----do	Pierce	Steilacoom, Wash.
Quigg Bros, McDonald, Inc	----do	Grays Harbor	Aberdeen, Wash.
Renton Sand & Gravel	----do	King	Renton, Wash.

See footnotes at end of table.

Table 10.—Principal producers of metals and minerals—Continued

Commodity and company	Type of activity	County	Address
Sand and gravel—Continued			
Rock & Sand, Inc	Pit and Plant	King	Seattle, Wash.
S & S Sand & Gravel Co	do	Various	Ephrata, Wash.
Stoneway Concrete Co	do	King	Renton, Wash.
Western Sand & Gravel Co	do	do	Maple Valley, Wash.
Woodworth & Co., Inc	do	Pierce	Tacoma, Wash.
Yakima Cement Products Co	do	Yakima	Yakima, Wash.
Silicon carbide:			
The Carborundum Co	Plant	Clark	Niagara Falls, N.Y.
Stone:			
Associated Sand & Gravel Co	Quarry and plant.	Jefferson	Seattle, Wash.
Black River Quarry, Inc	do	King	Seattle, Wash.
Columbia Cement Co	do	Whatcom	Bellingham, Wash.
DeAtley Corp	do	Various	Lewiston, Idaho
General Construction Co	do	Jefferson	Seattle, Wash.
Lockheed Shipbuilding & Construction Co.	do	King	Do.
Lone Star Cement Corp	Quarry	Skagit	Do.
Talc and soapstone:			
Skagit Talc Products	Mine	do	Sedro-Woolley, Wash.
Herman Smith	do	do	Marblemount, Wash.
Northwest Talc & Magnesium Co	Plant	do	Clear Lake, Wash.
Exfoliated vermiculite:			
Vermiculite-Northwest, Inc	do	Spokane	Auburn, Wash.
Metals:			
Alloy metals:			
Imperial Metals and Abrasives, Inc. [3]	do	Lewis	Centralia, Wash.
Ohio Ferro-Alloys Corp. [4]	do	Pierce	Tacoma, Wash.
Keokuk Electro-Metals Co.[4]	do	Douglas	Wenatchee, Wash.
Aluminum:			
Aluminum Company of America	do	Clark	Vancouver, Wash.
Do	do	Chelan	Wenatchee, Wash.
Kaiser Aluminum & Chemical Corp	do	Spokane	Spokane, Wash.
Do	do	Pierce	Tacoma, Wash.
Reynolds Metals Co	do	Cowlitz	Longview, Wash.
Intalco Aluminum Corp	do	Whatcom	Bellingham, Wash.
Gold:			
Day Mines, Inc.[5]	Mine	Ferry	Republic, Wash.
L-D Mines, Inc.[6]	Mine and mill	Chelan	Wenatchee, Wash.
Knob Hill Mines, Inc	do	Ferry	Republic, Wash.
Lead-zinc:			
Pend Oreille Mines & Metals Co	do	Pend Oreille	Spokane, Wash.
Tungsten:			
Chief Jo Tungsten, Inc	Mine	Okanogan	Okanogan, Wash.
Zinc:			
American Zinc Co	Mine and mill	Stevens	Leadpoint, Wash.
American Smelting and Refining Co	do	do	Colville, Wash.
Mineral Fuels:			
Carbon Dioxide:			
Gas-Ice Corp	Plant	Klickitat	Seattle, Wash.
Coal:			
Black Prince Coal Co	Mine	Lewis	Centralia, Wash.
Palmer Coking Coal Co	Mines (two)	King	Black Diamond, Wash.
Stoker Coal Mining Co	Mine	Thurston	Centralia, Wash.
Peat:			
Bassetts Gro-Earth	do	King	Seattle, Wash.
Maple Valley Humus	do	do	Renton, Wash.
Asbury Fuel Co	do	Kitsap	Bremerton, Wash.
Harbor Heights Humus Co	do	Pierce	Gig Harbor, Wash.
Fuller's Soils	do	Snohomish	Alderwood, Wash.
Plant Food Co	do	do	Bothell, Wash.
Rhod-A-Zalea Gardens	do	do	Bothell, Wash.
Cunningham Sand & Gravel Co	do	Spokane	Spokane, Wash.
Kildow Brothers, Inc	do	Thurston	Olympia, Wash.

[1] Closed April 1967.
[2] Pit idle.
[3] Silicon metal.
[4] Ferrosilicon, silicon metal.
[5] Joint operation with Knob Hill Mines, Inc.
[6] Closed February 1967.

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 1967, the coal industry experienced its greatest expansion in West Virginia, since 1957, registering an increase of $46.8 million in value, and accounting for 85 percent of the State's mineral output. Thirty-nine new coal mines employing 20 men or more were opened. The value of total mineral output increased by $46.1 million, a gain of 5.2 percent.

[1] Metallurgist, Bureau of Mines, Pittsburgh, Pa.

Table 1.—Mineral production in West Virginia [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays [2] thousand short tons	300	$334	245	$254
Coal (bituminous) do	149,681	753,851	153,749	800,683
Lime do	240	3,492	217	3,099
Natural gas million cubic feet	211,610	49,940	211,460	50,962
Petroleum (crude) thousand 42-gallon barrels	3,674	14,623	3,561	14,244
Salt thousand short tons	1,147	5,446	1,127	5,137
Sand and gravel do	5,448	11,569	5,827	12,167
Stone [3] do	9,738	16,354	9,445	16,447
Value of items that cannot be disclosed: Calcium-magnesium chloride, cement (portland and masonry), fire clay, gem stones, natural gas liquids, and stone (dimension sandstone)	XX	36,191	XX	34,865
Total	XX	891,800	XX	937,858
Total 1957–59 constant dollars	XX	952,276	XX	p 959,820

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 Virginia, by counties [1]

County	1966	1967	Mineral production in 1967 in order of value
Barbour	W	$15,520,420	Coal.
Berkeley	W	W	Cement, stone, lime, clays.
Boone	W	W	Coal, stone.
Braxton	W	W	Stone, coal.
Brooke	W	3,344,944	Coal, sand and gravel, stone.
Cabell	W	W	Clay.
Clay	W	250,167	Coal.
Doddridge	----------	W	Stone.
Fayette	$25,414,729	25,370,409	Coal.
Gilmer	W	1,534,518	Do.
Grant	W	9,309,775	Coal, stone.
Greenbrier	5,847,755	4,700,272	Do.
Hancock	W	W	Clays, sand and gravel, coal, stone.
Hardy	34,747	46,405	Stone.
Harrison	30,650,278	32,391,230	Coal, stone.
Jackson	----------	10,500	Stone.
Jefferson	5,414,152	W	Stone, lime.
Kanawha	51,229,572	55,449,937	Coal, stone, clays, salt, calcium-magnesium chloride.
Lewis	2,126,622	2,519,547	Coal, stone, clays.
Lincoln	28,805	W	Stone, clays.
Logan	83,672,064	86,453,860	Coal.
McDowell	110,982,513	119,216,359	Coal, stone.
Marion	71,064,113	77,232,729	Do.
Marshall	15,441,107	W	Coal, salt.
Mason	W	W	Coal, sand and gravel.
Mercer	W	W	Coal, stone, clays.
Mineral	W	W	Coal, stone.
Mingo	29,789,116	28,592,621	Coal.
Monongalia	W	W	Coal, stone.
Morgan	W	W	Sand and gravel.
Nicholas	42,975,862	45,108,960	Coal, stone.
Ohio	W	11,731,353	Coal, sand and gravel, stone.
Pendleton	W	W	Stone, lime.
Pleasants	W	W	Sand and gravel, salt.
Pocahontas	431,268	W	Coal, stone.
Preston	W	W	Do.
Raleigh	W	W	Coal, stone, sand and gravel.
Randolph	W	W	Coal, stone.
Ritchie	----------	1,808	Stone.
Roane	7,163	16,508	Do.
Taylor	W	W	Coal, clays.
Tucker	W	1,521,417	Coal, stone.
Tyler	W	W	Salt.
Upshur	2,285,924	2,585,346	Coal.
Wayne	310,258	432,395	Stone, coal.
Webster	3,383,707	2,089,105	Coal.
Wetzel	W	W	Sand and gravel.
Wirt	3,734	----------	
Wood	W	W	Sand and gravel, stone.
Wyoming	86,464,044	W	Coal, stone, sand and gravel.
Undistributed [2]	324,242,376	412,427,168	
Total	891,800,000	937,858,000	

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

[1] Calhoun, Hampshire, Monroe, Putnam, and Summers Counties are not listed because no production was reported.

[2] Includes gem stones, natural gas, natural gas liquids, petroleum and some salt and stone that cannot be assigned to specific counties, and values indicated by Symbol W.

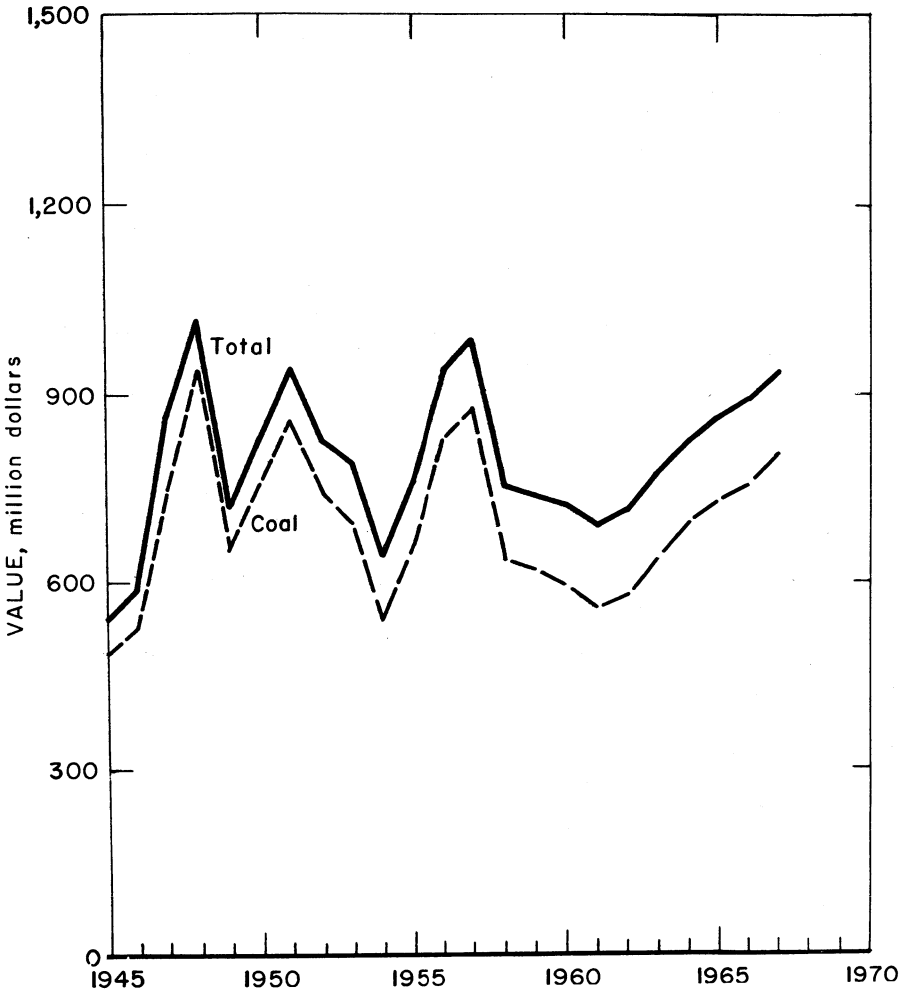

Figure 1.—Value of coal and total value of mineral production in West Virginia.

Table 3.—Indicators of West Virginia business activity

		1966	1967 p	Change, percent
Personal income:				
Total	millions	$3,937	$4,210	+6.9
Per capita		$2,176	$2,341	+7.6
Construction activity:				
Construction contracts [1]	thousands	$275,218	$429,715	+56.1
Nonresidential buildings	do	$87,457	$138,044	+57.8
Residential buildings	do	$83,136	$95,242	+14.6
Nonbuilding construction	do	$104,625	$196,429	+87.7
Cement shipments in and to West Virginia	thousand 376-pound barrels	2,739	2,305	−15.9
Mineral production	thousands	$891,800	$937,858	+5.2
Civilian work force	do	623.6	625.2	+.3
Total civilian employment	do	579.5	584.4	+.8
Unemployment (percent of work force)		6.8	6.4	−5.9
Manufacturing employment	thousands	133.0	132.7	−.2
Durable goods employment	do	81.1	80.6	−.6
Nondurable goods employment	do	51.9	52.1	+.4
Nonmanufacturing employment	do	362.2	370.8	+2.4
Mining	do	47.2	47.9	+1.5
Bituminous coal mining	do	42.0	43.0	+2.4

p Preliminary.
[1] F. W. Dodge Division, McGraw-Hill information Systems Company.

Sources: Bureau of Mines; West Virginia Department of Employment Security; U.S. Department of Commerce; U.S. Department of Labor.

Table 4.—Employment and injury experiences 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
1966:								
Coal	44,369	211	9,378	74,395	80	4,320	59.14	8,734
Nonmetal	1,005	307	309	2,472	----	17	6.88	485
Sand and gravel	264	244	65	557	2	13	26.91	21,898
Stone	1,324	270	357	2,880	----	50	17.36	1,068
Total [1]	46,962	215	10,108	80,305	82	4,400	55.81	8,297
1967: p								
Coal	44,400	215	9,547	75,460	62	4,240	57.01	7,121
Nonmetal	785	248	195	1,559	----	18	11.55	429
Sand and gravel	220	278	61	530	----	13	24.52	792
Stone	1,155	280	323	2,600	1	42	16.54	2,716
Total [1]	46,555	217	10,126	80,149	63	4,313	54.60	6,806

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 153.7 million tons was 4 million tons higher than in 1966, an increase of 3 percent. The value of coal mined increased by 6 percent to $800.7 million from $753.9 million in 1966.

The production of open market coal totaled 133.9 million tons valued at $677 million and that for captive coal totaled 19.9 million tons valued at $123.5 million. Both types of coal reflected increases of 3 percent in quantity and 6 percent in value over comparable data for 1966. The average value per ton of coal rose to $5.21 from $5.04 in 1966. There were 1,396 active mines with production in excess of 1,000 tons, a decrease of 201. Of the total output, 89 percent was at 1,070 under-

ground operations, a decrease of 248; 8 percent at 217 strip mines, an increase of 38; and 3 percent at 109 auger mines, an increase of nine. The value of coal produced by underground mining was $728 million, by strip mining $49 million, and by auger mining $23 million.

Equipment used at underground mines included 1,130 cutting machines, 215 fewer than in 1966; 1,415 hand-held and post-mounted drills, a decrease of 341; 221 mobile drills, a decrease of 10; 903 rotary drills, an increase of 15; and 322 percussion drills, a decrease of three.

Table 5.—Coal (bituminous) production

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1963	132,568	$634,794
1964	141,409	693,572
1965	149,191	726,096
1966	149,681	753,851
1967	153,749	800,683

Table 6.—Coal (bituminous) production by counties

(Thousand short tons and thousand dollars)

County	1966					1967				
	Number of mines			Quantity	Value	Number of mines			Quantity	Value
	Underground	Strip	Auger			Underground	Strip	Auger		
Barbour	30	11	3	3,350	$14,212	36	19	2	3,442	$15,521
Boone	60	6	7	9,068	42,956	49	11	17	9,456	45,163
Braxton	---	---	---	---	---	1	---	---	1	5
Brooke	5	7	2	871	3,095	5	4	1	789	2,827
Clay	W	W	W	W	W	6	1	---	56	250
Fayette	96	10	6	5,586	25,415	77	17	10	5,614	25,370
Gilmer	W	W	W	W	W	8	1	---	338	1,535
Grant	5	3	---	2,035	7,070	W	W	W	W	W
Greenbrier	53	1	1	839	3,659	36	1	---	635	2,996
Hancock	---	2	---	5	13	---	3	---	33	92
Harrison	30	18	5	6,940	30,113	22	21	5	7,106	31,725
Kanawha	81	5	10	11,577	50,299	66	6	11	11,551	54,818
Lewis	3	2	---	546	1,976	W	W	W	W	W
Lincoln	---	3	---	10	24	---	---	---	---	---
Logan	64	3	12	17,293	83,672	62	4	12	17,150	86,454
McDowell	251	9	11	17,057	110,983	201	18	8	17,897	119,198
Marion	11	2	---	13,826	71,064	11	5	---	15,041	77,081
Marshall	W	W	W	W	W	4	---	---	3,244	14,618
Mason	6	1	---	389	1,599	5	1	---	346	1,556
Mercer	31	9	2	1,344	8,721	16	7	2	1,693	10,961
Mineral	3	1	---	141	559	3	3	2	159	661
Mingo	71	---	8	5,411	29,789	51	1	7	5,271	28,593
Monongalia	W	W	W	W	W	31	9	2	10,470	48,489
Nicholas	89	9	2	8,465	42,967	81	6	2	8,329	45,098
Pocahontas	W	W	W	W	W	8	---	1	149	576
Preston	80	25	3	3,692	12,943	57	17	2	2,794	9,734
Raleigh	97	12	9	9,112	52,257	69	16	6	8,611	51,978
Randolph	21	6	1	856	3,382	17	6	1	561	2,206
Taylor	13	6	---	241	876	11	5	---	180	695
Tucker	1	4	---	599	1,772	---	3	---	575	W
Upshur	15	5	2	614	2,286	8	10	3	671	2,585
Wayne	W	W	W	W	W	1	---	---	31	W
Webster	28	3	1	670	3,384	20	5	2	468	2,089
Wyoming	106	5	10	15,274	86,139	100	6	12	15,894	93,444
Other counties [1]	68	11	5	13,870	62,626	8	11	1	5,194	24,365
Total	1318	179	100	149,681	753,851	1070	217	109	153,749	800,683

W Withheld to avoid disclosing individual company confidential data; included with "Other Counties."
[1] Includes data for Ohio County and counties indicated by symbol W.

Strip coal mining equipment included 300 power shovels, 34 draglines, nine carryall scrapers, 341 bulldozers, and 65 horizontal and 101 vertical drills. Transportation of coal from strip pit to tipple, an average distance of 7 miles, was done by 630 trucks. The average capacity of trucks was 20 tons. Equipment at auger mines included 106 augers, 11 power shovels, 113 bulldozers, and four horizontal and two vertical drills. Coal transportation from auger operation to tipple, an average distance of 6 miles, was done by 194 trucks, with an average truck capacity of 22 tons.

Of the total underground production,

mechanically loaded coal increased to 98 percent, 2 percent more than in 1966. Of the total mechanically loaded, 45 percent was by 770 mobile loading machines, 42 less than in 1966. Of the total loading machines, 633 loaded into shuttle cars, and 137 into mine cars or on to conveyors. Continuous mining machines produced 70.8 million tons, equal to 53 percent of the coal mechanically loaded. Of the 561 continuous mining machines in use (24 fewer than in 1966), 367 loaded into shuttle cars, and 127 onto conveyors. An additional 151 mobile loaders were used in conjunction with continuous miners. Of the remainder of the mechanically loaded tonnage, 1.2 percent, was loaded by duckbills and hand-loaded face conveyors.

In 1967, 153 cleaning plants, eight fewer than in 1966, cleaned 79.2 percent of total production, about the same as in 1966. Of this amount, 30 percent was cleaned by jigs, 64 percent by wet washing, and 6 percent by pneumatic methods. Of the total output, 35 percent was crushed, 29 percent was dried in 55 thermal drying plants, and 12 percent was treated for dust control. Of the total treated for dust control, 91 percent was with oil, 3 percent with calcium chloride and oil, and the balance with calcium chloride and with other materials.

Of the total production, 97 percent was transported by rail and water and the remainder by truck and other methods.

Bethlehem Mines Corp. purchased the Youghiogheny & Ohio Coal Co. mines in Boone County in August and all Oglebay-Norton Company mines in Kanawha and Raleigh Counties in July.

The following 39 coal mines employing over 20 men were opened in West Virginia during 1967:

Company	Mine	Address
C & M Coal Co	Arista No. 1	Kegley.
Cannelton Coal Co	Coalburg No. 110-C	Cannelton.
Carbon Fuel Co	No. 34	Carbon.
Central Appalachian C. Co	Stockton No. 1	Montgomery.
Coopers Creek Coal Co	No. 1	Summersville.
Do	No. 8	Do.
Crystal Block Coal & Coke	No. 14	Sarah Ann.
Eastern Associated Coal Corp	No. 3-C	Herndon.
Gauley Coal & Coke Co	Saxsewell No. 11	Richwood.
Do	Saxsewell No. 9	Do.
George Sodder Coal Co	No. 18	Fayetteville.
Hambrick Coal Co	No. 8	Glen Jean.
Iron City Eagle Coal Co., Inc	No. 2	Lockwood.
LaFayette Springs Coal Co	No. 3	Lewisburg.
McCandlish Coal Corp	Simpson Cr. No. 3	Meadowbrook.
Ohio Valley Division, Consolidation Coal Co	McElroy No. 10	Moundsville.
Pocahontas Fuel Co	Jenkinjones No. 6-1	Jenkinjones.
Do	Kegler	Pineville.
Do	Upper Hernshaw No. 3	Lynco.
Do	No. 2	Do.
Princess Coals, Inc	No. 7-A	Mallory.
Ranger Fuel Corp	Clinton No. 2	Wharton.
Do	"A" Mine	Bolt.
Richard Mining Co	No. 9	Winifrede.
Riverton Coal Co	No. 25	Crown Hill.
Robinson Phillips Coal Co	No. 23	Pineville.
Do	No. 21	Do.
Do	No. 22	Do.
Do	No. 19	Do.
Do	No. 20	Do.
Semet Solvay, Allied Chemical Corp	"H" Mine	Montgomery.
Sugar Creek Corp	No. 4	Webster Springs.
Union Carbide Corp	No. 3-K	Mammoth.
Do	No. 31H	Do.
Do	No. 3-J	Do.
Do	Putnam Mine	Leon.
Valley Mining Co	No. 15-C	Whitesville.
Vera Coal Co., Inc	No. 1	Clendenin.
Winding Gulf Coals, Inc	Tams No. 5	Tams.

Under a contract with the Office of Coal Research, U.S. Department of the Interior, Consolidation Coal Co., a subsidiary of Continental Oil Co., in June began operating a pilot plant to demonstrate the feasibility of economic production of gasoline from coal by a company-developed process. By yearend the shakedown operation of the plant was completed and most of the mechanical problems were resolved. By December 1967, the plant was successful in operating using petroleum charred stock prior to operation using coal extract.

At the Bureau of Mines, Morgantown Coal Research Center, a broad research program to improve coal conservation technology was continued during 1967. Work was started on investigation of centrifugal, electrostatic, and magnetic methods for removing pyritic sulfur from coal, and for removing sulfur dioxide from stack gases. In the latter area, processes investigated included absorption by pulverized phosphate rock, a process that results in byproduct fertilizer, and removal of sulfur dioxide by reaction with iron pyrite obtained as a byproduct in coal cleaning operations. Development of an effective system to automatically and continuously analyze ash particles in stack gases was started. Research also continued on the electrostatic precipitation of dust from gases at operating conditions for which commercial equipment is not available. A solid-waste utilization program was initiated during 1967, with an objective of developing techniques for large scale profitable utilization of solid wastes resulting from coal mining and processing. Fly ash removed from powerplant stack gases was evaluated for agricultural purposes, for reclamation of barren strip-mine areas, and in highway construction. Coal mine refuse was analyzed for mineral content and possible economical extraction of these values. Experiments in microwave radiation drying were initiated to determine the feasibilty of removing moisture from coal fines more economically than by present drying methods. Development of such a process would permit utilization of fines presently discarded because of excess water. Research also was conducted on coal handling techniques and development of radioactive methods for continuous analysis of moisture, sulfur, and ash in coal moving on conveyors. Development of a reactor to convert coking coals into pressurized synthesis gas for chemical manufacture and electric power generation continued. In related work, research was underway on removing hydrogen sulfide from the hot gases resulting from the coal gasification. Major attention was given to developing methods of economically converting coal and coal tar into higher valued end products. Studies were conducted to achieve a better understanding of the carbonization and combustion of coals relatively high in sulfur and ash. The objective was to determine factors contributing to optimum yields and quality of tars, char, and gases. Experiments were conducted with fluid-bed furnaces in which coal particles suspended in air were burned at lower-than-normal temperatures to evaluate potential advantages of lower equipment costs, reduced pollutant output, and higher fuel-utilization efficiencies particularly for low-grade coals.

During 1967, the Coal Research Bureau of West Virginia University School of Mines conducted research in many areas of coal preparation and utilization. This research was financed both by appropriations of the State legislature and by contract and grants from Federal agencies and private organizations. Under a contract with the Office of Coal Research, U.S. Department of the Interior, a process was developed for producing structural products from fly ash and other coal-derived waste products. Construction was completed on a pilot-plant at the Morgantown Ordnance Works to produce such products at a rate of 1,000 standard brick equivalents per hour. Under a grant from the Federal Bureau of Mines, a commercial process for producing mineral wool from coal ash was developed. High-quality mineral wool was produced without addition of fluxes, from lignite, subbituminous, bituminous, and anthracite ashes and from limestone modified fly ashes. A 250-pound-capacity, 17-inch, slot-type byproduct recovery coke oven for use in carbonization research was constructed. Potential use of West Virginia coals for treatment of sewage was investigated. Research was conducted to develop a method for analyzing drill core data and projecting the data for use in design of coal preparation plants. Research efforts in the area of desulfurization of pulverized coal by high-intensity magnetic separation continued.

Natural Gas Liquids.—Production of natural gas liquids in 1967 decreased. Reserves of all natural gas liquids at yearend 1967 were 82 million (42-gallon) barrels, about the same as in 1966.[2] There were 35 natural gas processing plants, including 26 small compression plants operated by Pennzoil United, Inc. Other plants were operated by Consolidated Gas Supply Corp. in Wetzel County; Owens, Libbey-Owens Gas Department, Union Oil Co. of California, and United Fuel Gas Co. in Kanawha County; and Union Carbide Corp. in Wetzel and Kanawha Counties.

Petroleum and Natural Gas.—Crude oil production in 1967 was 3.6 million barrels, about the same as in 1966.[3] The wellhead price was maintained at $4 per barrel. The wellhead price of gas was 24.1 cents per 1,000 cubic feet. Natural gas production of 211,460 million cubic feet was about the same as in 1966. The estimated number of producing wells in the State at yearend 1967 was 17,832 gas wells and 12,989 oil wells.

There was a sharp decline in oil and gas drilling activity in the State in 1967. According to the West Virginia Geologic and Ecnomic Survey, during 1967 the State issued 975 permits to drill, deepen, and fracture wells compared with 1,315 permits for 1966. Drilling was reported in 36 of the State's 55 counties. Total footage drilled was 2,148,391 feet, compared with 3,071,074 feet drilled in 1965. There were 1,960,120 feet of development drilling and 188,271 feet of exploratory tests. The average depth of the wells drilled was 2,535 feet. A total of 848 wells was drilled in 1967, 359 less than in 1966. Of these 401 were gas wells, 206 oil wells, 127 dry holes, 91 combination wells, and 23 were miscellaneous wells (storage, injection, etc.). A decline in drilling for shallow gas was the major factor leading to a decrease in 1967 well totals. There were 42 exploratory wells, of which 25 were successful—24 gas wells and one combination oil and gas producer.

Natural gas in storage at yearend 1967 was 346.4 billion cubic feet, 11.5 billion cubic feet more than in 1966. According to the American Gas Association, by the end of 1967 the State had ultimate gas storage capacity of 415 billion cubic feet. The two refineries in the State located near Falling Rock and St. Marys were operated at full capacity. Their combined refining capacity of 8,800 barrels per schedule day of crude oil was not sufficient to refine the entire crude oil production of West Virginia. According to the West Virginia Geological and Economic Survey the slight decrease in oil production probably was the result of refinery limitations which made it necessary for the refineries to sharply reduce the purchase of oil from new wells. The refineries produced gasoline, lubricating oil, and waxes.

According to Oil and Gas Journal, the estimated proved reserves of crude oil at yearend were 56.2 million barrels. Reserves of natural gas at the end of 1967 were 2,580 billion cubic feet, a decrease of 42 billion cubic feet from that of 1966.

Pennzoil United, Inc., the largest oil producing, refining, and transporting company in West Virginia, operated 280,000 acres and held leases on 240,000 unoperated acres of property. The company produced 870,000 barrels of Penn Grade oil and 5 billion cubic feet of natural gas in the State during 1967. During the year, the company reported significant activity in prospecting for new primary reserves and developing secondary recovery techniques. It produced 24 percent of the total crude refined in the company-owned refineries at Falling Rock, W. Va., and Oil City, Pa.

Important discoveries of new gasfields were made in the Newburg Limestone in Jackson and Kanawha Counties, where gas wells producing 20 million cubic feet or more per day were completed. Of a total of 68 deep wells drilled in 1967, 46 were drilled in the Newburg. Thus, it was for the first time in many years that the Oriskany Sandstone was not the principal deep target in the State. Of the remaining 22 wells drilled to deep formations, 16 were drilled to the Onondaga-Oriskany interval, two dry holes to Keefer Sandstone, and four to Tuscarora Sandstone. The Oriskany Sandstone and its contiguous units produced gas in 14 wells. In 1967, shallow sand gas discoveries included a new field in Upshur County, and a new

[2] American Gas Association. Report of the Committee on Natural Gas Reserves. Apr. 8, 1968, table 2.

[3] Source: West Virginia Geological and Economic Survey.

pool and a deeper pool in Nicholas and Harrison counties, respectively.

As in previous years, the Big Injun sand (Middle Mississippian) was the State's main oil- and gas-producing formation. Of the 416 wells drilled to this sand, 140 were gas wells, 166 oil wells, 61 combination, and 49 dry. Most of the oil wells were in the Walton field, Roane County. The largest reported gas well during the year was in Rocky Fork field from fractured Newburg sand. The highest initial production reported during 1967 was 319 barrels per day from fractured Big Injun sand in Doddridge County.

NONMETALS

Cement.—Shipments of portland cement increased 1 percent and masonry cement decreased by 17 percent from the 1966 levels. The average price per barrel was slightly higher. The sole producer, Capitol Cement Co., Division, Martin Marietta Corp., at Martinsburg, Berkeley County, completed its modernization program during 1967, when three old cement kilns were phased out of operation. The company continued to operate three coal-fired rotary kilns. The underground limestone mine was shut down, and output from the company's open pit was increased. Most of the cement was used for ready-mix concrete, concrete products, and building and highway construction. Shipments were to Delaware, District of Columbia, Maryland, North Carolina, Ohio, western Pennsylvania, Virginia, and West Virginia. Two-thirds of the cement was shipped by truck and one-third by railroad.

Clays.—Miscellaneous clay output declined 55,565 tons. Miscellaneous clay was chiefly used in the manufacture of building brick and cement. Fire clay was used mostly for producing firebrick and block (including ladle brick). A total of 13 mines was in operation, two more than in 1966. Nine of the mines were open pit and four were underground operations. The highest production of miscellaneous clay was from Berkeley County. Evaluation of clays and related materials was carried out under a cooperative program between the State and the Federal Bureau of Mines. Sampling was done by personnel of the West Virginia Geological and Economic Survey. The samples were than evaluated for potential ecnomic value by the Bureau of Mines' Tuscaloosa (Ala.) Metallurgy Research Laboratory. During 1967, 33 clay samples were evaluated. Many of these evaluations indicated that the clay in the deposits from which the samples came could be used in the manufacture of face brick, structural clay products, and lightweight aggregate.

Gem Stones.—Mineral specimens were collected by hobbyists at scattered locations. Quartz specimens and various cherts were collected from bedrock expqsures. Chert, quartz, and granite, and the harder varieties of gravel were collected from Ohio River Valley terraces.

Lime.—Total lime production was 217,000 tons compared with 240,000 tons in 1966. Chief uses were for steel production, refractory lime, and pulp and paper manufacture. Three companies operated plants —one each in Berkeley, Jefferson, and Pendleton Counties.

Natural Salines.—Sodium chloride and calcium-magnesium chloride were recovered from natural well brines near South Charleston, Kanawha County. The sodium chloride was used for making caustic soda and chlorine in South Charleston. Production of the brine was terminated at the end of February because it was found more economical to secure sodium chloride from another source in the State.

Salt.—Production of salt from brines was about the same as in 1966. Most of it was used by the producers for manufacture of chlorine and caustic soda. Production, reported from Kanawha, Marshall, Pleasants, and Tyler Counties, was from deep well solution mining, except for Kanawha County output, which was obtained from naturally occurring brines.

Sand and Gravel.—Output of sand and gravel increased 7 percent and total value increased 5 percent over that of 1966. The average price declined by $0.03 to $2.09. Of the total output, 58 percent was sand and 42 percent was gravel. About 64 percent of the output was shipped by barge and the balance was shipped by railroad and truck.

Production was reported from 10 counties. Of the leading producing counties, Morgan was first in value, followed in descending order by Hancock, Pleasants, Wood, Brooke, Ohio, and Wetzel Counties.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	1,704	$2,200	1,674	$2,142
Paving	418	705	478	782
Fill	44	55	W	W
Gravel:				
Building	1,400	1,764	1,500	1,880
Paving	671	1,065	909	1,411
Undistributed [1]	1,211	5,780	1,266	5,952
Total sand and gravel	5,448	11,569	5,827	12,167

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Includes glass, molding, blast, fire or furnace, engine, grinding and polishing (1966), filtration, ground and other industrial sands; railroad, and fill gravel and items indicated by symbol W.

During 1967, the West Virginia Geological and Economic Survey conducted a study of geology of construction sand and gravel resources of West Virginia. Alluvium, residuum, and bedrock samples at 178 sites were collected. Results of this study are scheduled for publication during 1968.

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) decreased by 3 percent from that of 1966. Production of crushed limestone decreased 10 percent to 7.9 million tons. Major uses for the limestone were for concrete aggregate and road metal, as flux in iron and steel production, railroad ballast, agricultural purposes, and lime and cement manufacture. Berkeley, Jefferson, Monongalia, and Greenbrier Counties were the leading areas of limestone production.

Production of crushed sandstone which was mostly used for concrete aggregate and highway construction increased to 1,590,257 tons valued at $2.9 million from 1,015,276 tons valued at $2 million in 1966. Leading sandstone producing counties were Kanawha, Wyoming, Harrison, Doddridge, Wayne, and Lewis.

Table 8.—Stone sold or used by producers, by uses

Use	1966		1967	
	Short tons	Value	Short tons	Value
Crushed and broken stone:				
Concrete and roadstone	3,988,880	$6,642,228	3,952,065	$6,675,266
Railroad ballast	640,885	839,182	563,012	594,345
Agriculture	124,955	295,519	130,862	326,678
Other uses [1]	4,983,593	8,577,140	4,800,024	8,850,294
Total	9,738,313	16,354,069	9,445,963	16,446,583

[1] Includes limestone for glass, paper (1967), asphalt filler, coal dust, filter beds, stone sand, cement, lime, riprap, flux, refractory materials, and miscellaneous uses, and sandstone for stone sand, glass, engine (1966), and refractory use.

METALS

Aluminum.—The completely integrated aluminum works of Kaiser Aluminum & Chemical Corp. at Ravenswood, Jackson County, operated at full capacity during 1967. Alumina for the plant was processed from Jamaican bauxite at Baton Rouge and Gramercy, La., and shipped to Ravenswood by rail. Ingots of electrolytic aluminum produced at the plant were rolled into sheet, plate and commercial foil. Transportation of the rolled products was by rail and trucks. A $55 million expansion of the sheet and plate department was begun during 1967.

Ferroalloys.—Union Carbide Corp.'s large ferroalloy plant at Alloy, Fayette County, operated 18 submerged arc electric furnaces. During 1967 the company completed a new 25,000 kilovolt-ampere-three-phase submerged arc electric furnace. It is equipped with a wet venturi type scrubber to prevent pollution resulting from furnace operation. Construction was started on a 20,000 kva three-phase submerged arc open top furnace. This furnace will be equipped with bag collectors to eliminate pollution. Except for the quartzite consumed, most mineral raw materials for the plant were obtained from other States or imported. The company obtained 20 percent of their total quartzite consumption 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. The mining and transportation of the quartzite was contracted on a fixed charge delivered basis and transported from the quarry to the plant in 25-ton dump trucks. 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. In 1967, 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, increasing number of users of ferroalloys installed bulk-handling systems in their plants. Of the finished products, 20 percent was shipped by barge, 40 percent by rail, and 40 percent by truck.

During 1967, Vanadium Corporation of America merged with Foote Mineral Co., which became the surviving corporation. The company completed a 57,700 kva three-phase submerged arc furnace, which is one of the largest in the world. It was operated for the production of various grades of silicon alloys. The company also operated four 10,000 kva three-phase submerged arc furnaces and a 8,000 kva open arc furnace which was used to melt materials for production of ferrochromium.

Of the raw materials consumed, quartzite of 99 percent silica was obtained from North Carolina, Ohio, and Maryland. Chromium ore was obtained from Southern Rhodesia, Turkey, and Government surplus material from the General Services Administration (GSA). High-grade manganese ore was imported from Southern Rhodesia. All coal consumed by the company was obtained from various mines in West Virginia and coke was obtained from the Pittsburgh district in Pennsylvania. Coal mixed with coke is used for reducing ores. A total of 40,000 tons of mild steel machine shop turnings was obtained through scrap brokers from Ohio, Pennsylvania, and Michigan. The scrap turnings were transported to the plant by rail. The company makes ferrochromium, ferrosilicon, foundry alloys, nodular iron alloy and 98 percent pure silicon metal. All power requirements which totaled 80,000 kva was purchased.

Nickel.—The Huntington Alloy Products Division, The International Nickel Company, Inc., rolled various types of high-nickel alloys at its Huntington operations. The Division obtained nickel from Canada, but other basic materials were secured from West Virginia and adjoining States.

The Huntington Division is the largest plant in the world devoted exclusively to the production of nickel and high-nickel alloys. Principal products include wrought nickel and high-nickel alloys in mill forms such as strip, sheet, plate, pipe, tube, wire, rod, bar, and welding products such as nickel and high-nickel bare welding filler wire, coated electrodes, and welding fluxes. The plant utilizes various electric, vacuum, and induction melting furnaces.

High-nickel Huntington alloys are marketed throughout the free world. The Division has an extensive sales and distributor force in the United States and Canada.

Zinc.—Mathiessen & Hegeler Zinc Co. refined zinc from precalcined zinc sulfide concentrates imported from Canada and from zinc dross. The plant has 20 vertical zinc retorts. Coal for the operation is obtained from mines in the vicinity of the plant. Clay is obtained from Ohio, anthracite from Pennsylvania, and waste sulfite liquor from Michigan. Zinc slabs, dust, and ball anodes were produced.

During 1967, the plant was shut down for 4 months because of a strike. In August 1967, the strike ended with a 3-year contract providing annual wage increases

and other employee benefits. As a result of the strike, many of the retorts had to be entirely rebuilt.

Zirconium.—In 1967, American Metal Climax, Inc., bought out 50 percent interest of Carborundum Metals, which became Amax Specialty Metals, Inc. The company produces zirconium sponge from zircon sand at this plant. Imported zircon from Australia is converted to zirconium carbonitride by fusing it with carbon in a 5,000 kva arc type electric furnace. The zirconium carbonitride is chlorinated in fixed bed water-cooled exothermic chlorinators, and the resulting zirconium chloride processed to remove hafnium by selective solvent extraction. The purified zirconium in aqueous solution is reprecipitated as oxide, calcined, pelletized with sugar, the pellets carbonized, and then chlorinated to zirconium tetrachloride. The zirconium tetrachloride is reduced to sponge zirconium with metallic magnesium and shipped to the company's plant in Akron, N.Y., for conversion into ingots and rolling the ingots into various shapes. The byproduct hafnium oxide is partly sold as such and partly converted into metallic hafnium.

Table 9.—Principal producers

Commodity and company	Type of activity	County	Address
Calcium-magnesium chloride:			
Inorganic Chemicals Division FMC Corp.[1]	Plant	Kanawha	South Charleston, W. Va.
Cement (Portland and masonry):			
Capitol Cement Co., Division Martin Marietta Corp.[2]	do	Berkeley	Box 5618, Baltimore, Md.
Clays:			
Fire clay:			
Charleston Brick & Tile Corp	Underground	Kanawha	P.O. Box 207, Charleston W.Va.
Crescent Brick Co., Inc	do	Hancock	Box 368, New Cumberland W. Va.
Globe Refractories, Inc	do	do	P.O. Box D, Newell W. Va.
West Virginia Brick Co	do	Kanawha	442 Virginia St., East Charleston, W. Va.
Miscellaneous clay and shale:			
Barboursville Clay Manufacturing Co.	Pit	Cabell	P.O. Box 1048 Charleston, W. Va.
Capitol Cement Co. Division Martin Marietta Corp.	do	Berkeley	Box 5618, Baltimore, Md.
Continental Clay Products Co	do	do	931 Investment Building 15th and K. Sts., N.W. Washington, D.C.
Grafton Brick Co	do	Taylor	Grafton, West Va.
Gum Bros	do	Lewis	795 W. 2d St. Weston, W. Va.
Lincoln Clay Product Co	do	Cabell	West Hamlin, W. Va.
Sanders Dummy Co	do	Lincoln	Midkiff, W. Va.
The United Clay Products Co	do	Berkeley	931 Investment Building Washington, D.C.
Virginian Brick & Tile Co	do	Mercer	P.O. Box 983, Princeton, W. Va.
Coal (bituminous):			
Armco Steel Corp.[3]	Underground.	Boone	Montcoal, W. Va.
Bethlehem Mines Corp.[3]	do	Marion	701 East Third St. Bethlehem, Pa.
Bishop Coal Co	do	McDowell	Pocahontas, Va.
Boone County Coal Corp	do	Logan	Sharples, W. Va.
The Carbon Fuel Co	do	Kanawha	1310 Kanawha Valley Building. Charleston, W. Va.
Christopher Coal Co., Division of Consolidation Coal Co.[4]	do	Monongalia	P.O. Box 100, Osage, W. Va.
Eastern Associated Coal Corp.[5]	do	Wyoming	Koppers Bldg., Pittsburgh, Pa.
Do	do	Marion	Do.
Do	do	McDowell	Do.
Hanna Coal Co., Division of Consolidation Coal Co.	do	Marshall	Cadiz, Ohio
Island Creek Coal Co.[5]	do	Logan	Holden, W. Va.
Itmann Coal Co	do	Wyoming	Pocahontas, Va.

See footnotes at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Coal (bituminous)—Continued			
Mountaineer Coal Co., Division of Consolidation Coal Co. [5]	Underground.	Marion	Box 1632 Fairmont, W. Va.
Do	do	Harrison	Do.
National Coal Mining Co	do	Mingo	Holden, W. Va.
Olga Coal Co.[3]	do	McDowell	P.O. Box 900 Youngstown, Ohio
Rochester & Pittsburgh Coal Co	do	Marion	655 Church St. Indiana, Pa.
Slab Fork Coal Co	do	Raleigh	Slab Fork, W. Va.
The Valley Camp Coal Co	do	Ohio	P.O. Box 218 Triadelphia, W. Va.
United States Steel Corp.[3]	do	McDowell	525 William Penn Place Pittsburgh, Pa.
Lime:			
Germany Valley Limestone Co., Division of Greer Limestone Co.[6]	Plant	Pendleton	Riverton, W. Va.
Jones & Laughlin Steel Corp.[6]	do	Berkeley	R.D. No. 3, Martinsburg, W. Va.
Standard Lime & Refractories Co.[6]	do	Jefferson	2000 First National Bank Building, Baltimore, Md.
Magnesium compounds:			
Amax Specialty Metals, Inc	do	Wood	P.O. Box 32 Akron, N.Y.
Petroleum refineries:			
Elk Refining Company	do	Kanawha	Falling Rock, W. Va.
Quaker State Oil Refining Corp	do	Pleasants	St. Marys, W. Va.
Salt:			
Industrial Chemicals Division, Allied Chemical Corp.	wells	Marshall	P.O. Box 70 Morristown, N.J.
Inorganic Chemical Division FMC Corp.[7]	do	Kanawha	Box 8127 South Charleston, W. Va.
Do	do	Tyler	Do.
Do	do	Pleasants	Do.
Pittsburgh Plate Glass Co., Chemical Division.	do	Marshall	1 Gateway Center Pittsburgh, Pa.
Sand and gravel:			
The Brilliant Materials Co	Pit	Brooke	P.O. Box Q, Follansbee W. Va.
Delta Concrete Co	Dredge	Ohio	41st. and Noble Sts. Bellaire Ohio
Dravo Corp.[8] Keystone Division [8]	do	Hancock	Fifth and Liberty Avenues Pittsburgh, Pa.
Duquesne Sand Co	do	Brooke	East Beaver St. Glenfield, Pa.
Iron City Sand & Gravel Corp. Division of McDonough Co.	Pit	Hancock	P.O. Box 538 Parkersburg, W. Va.
Kanawha Sand Co	Dredge	Wood	Box 607 Parkersburg, W. Va.
Ohio River Sand & Gravel Division of McDonough Co.	do	Pleasants	P.O. Box 538 Parkersburg, W. Va.
Ohio Valley Sand Co., Inc	Pit	Wetzel	P.O. Box 99 New Martinsville, W Va..
Pennsylvania Glass Sand Corp	do	Morgan	Hancock, W. Va.
Pfaff & Smith Builders Supply Co	Dredge	Wood	P.O. Box 2508 Charleston, W. Va.
Smelters:			
Kaiser Aluminum & Chemical Corp	Plant	Jackson	300 Lakeside Drive Oakland, Calif.
Mathiessen & Hegler Zinc Co	do	Harrison	Ninth and Sterling Sts. La Salle, Ill.
Stone:			
Limestone (crushed):			
Acme Limestone Co	Mine and quarry.	Greenbrier	Fort Spring, W. Va.
Capitol Cement Co. Division Martin Marietta Corp.	do	Berkeley	Box 5618 Baltimore, Md.
Elkins Limestone Co	Mine	Randolph	Elkins, W. Va.
The H. Frazier Co., Inc	Quarry	Greenbrier	P.O. Box 1377 Richmond, Va.
Germany Valley Limestone Co. Division of Greer Limestone Co.[9]	do	Pendleton	Riverton, W. Va.
Green Bag Cement Co. Division of Marquette Cement Manufacturing Co.	Mine	Monongalia	20 North Wacker Drive Chicago, Ill.
Greer Limestone Co	Mine and quarry.	do	Box 844, Morgantown, W. Va.
Paul Harrold	Mine	Harrison	Route No. 1, Wolf Summit, W. Va.

See footnotes at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Type of activity	County	Address
Stone—Continued			
Limestone (crushed)—Continued			
Jones & Laughlin Steel Corp. Blair Limestone Division.[9]	Quarry	Berkeley	R.D. No. 3, Martinsburg, W. Va.
Do	do	Jefferson	Do.
Standard Lime & Refractories Co. Division of Martin Marietta Corp.[9]	do	do	2000 First National Bank Baltimore, Md.
Terra Alta Limestone Co	do	Preston	Aurora, W. Va.
United States Steel Corp	do	Jefferson	Millville, W. Va.
Sandstone (dimension):			
Tony Pacifico Stone Quarry, Inc.[10]	do	Kanawha	1417 Camden Drive Charleston, W. Va.
Rhine Creek Stone Co	do	Preston	Box 265, Eglon, W. Va.
Sandstone (crushed):			
Fairfax Sand & Crushed Stone Co.	do	Tucker	Thomas, W. Va.
Greer Limestone Co	do	Doddridge	P.O. Box 844 Morgantown, W. Va.
Basil R. Heavner	do	Lewis	French Creek, W. Va.
Mazzella Quarries, Inc	do	Kanawha	2087 Oakridge Dr. Charleston, W. Va.
Meadows Stone & Paving, Inc	do	Braxton	P.O. Box 518 Gassway, W. Va.
Raleigh Stone Co. of Beckley, West Va.	do	Raleigh	P.O. Box 1387 Roanoke, Va.
Salerno Brothers, Inc	do	Harrison	Shinnston, W. Va.
Southwest Materials, Inc	do	Wyoming	P.O. Box 69 Salem, Va.
Table Rock Sand Plant	do	Raleigh	Grandview Road Beckley, W. Va.
Terra Alta Limestone Co	do	Monongalia	Aurora, W. Va.
Weston Stone	do	Lewis	P.O. Box 546 Weston, W. Va.

[1] Also salt
[2] Also limestone and shale.
[3] Captive.
[4] Four mines
[5] Two mines
[6] Also limestone.
[7] Also calcium magnesium chloride.
[8] Two dredges.
[9] Also lime.
[10] Also crushed sandstone.

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]

Value of mineral production in Wisconsin in 1967 established a record high of $79.6 million, an increase of nearly 5 percent over that of 1966. Nonmetals represented about 89 percent of the total mineral value and metals nearly 11 percent. Value of metals produced increased 10 percent, and values of nonmetals increased 4 percent, from that of 1966. Increases in quantity and value were recorded for lime, sand and gravel, stone, and zinc. The output of abrasive stone, portland and masonry cement, clays, lead, and peat decreased in quantity and value from that of 1966. Higher average unit values were recorded for all mineral commodities except masonry cement, lead, stone, and zinc.

Mineral production was reported from 71 of the 72 counties in Wisconsin, again led, in descending order of value, by Waukesha, Manitowoc, Lafayette, Milwaukee, and Marathon. Collectively, these five counties provided 38 percent of the State mineral value. Mineral production exceeded $1 million in 20 counties compared with 17 in 1966.

[1] Industry economist, Bureau of Mines, Minneapolis, Minn.

Table 1.—Mineral production in Wisconsin

Mineral		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clays	thousand short tons	123	$148	89	$112
Lead (recoverable content of ores, etc.)	short tons	1,694	512	1,596	447
Lime	thousand short tons	204	3,186	212	3,414
Peat	short tons	2,379	164	1,823	W
Sand and gravel	thousand short tons	41,523	30,713	42,542	32,955
Stone	do	16,150	23,735	17,122	24,863
Zinc (recoverable content of ores, etc.)	short tons	24,775	7,185	28,953	8,016
Value of items that cannot be disclosed: Abrasive stone (grinding pebbles), cement, gem stones, and value indicated by symbol W		XX	10,367	XX	9,805
Total		XX	76,010	XX	79,612
Total 1957–59 constant dollars		XX	72,363	XX	p 75,950

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

(Thousands)

County	1966	1967	Minerals produced in 1967 in order of value
Adams	W	W	Sand and gravel.
Ashland	$293	$347	Sand and gravel, stone.
Barron	377	450	Sand and gravel.
Bayfield	W	93	Do.
Brown	936	1,235	Lime, stone, sand and gravel.
Buffalo	289	295	Stone, sand and gravel.
Burnett	114	143	Sand and gravel, stone.
Calumet	380	256	Stone, sand and gravel.
Chippewa	160	194	Sand and gravel.
Clark	W	531	Do.
Columbia	W	W	Sand and gravel, stone.
Crawford	321	558	Stone, sand and gravel.
Dane	2,668	3,200	Sand and gravel, stone.
Dodge	1,504	1,701	Sand and gravel, lime, stone.
Door	247	332	Sand and gravel, stone.
Douglas	W	W	Lime, sand and gravel.
Dunn	132	142	Sand and gravel, stone, clays.
Eau Claire	578	1,497	Sand and gravel.
Florence	W	W	Do.
Fond du Lac	1,703	1,684	Stone, sand and gravel, lime, clays.
Forest	96	85	Sand and gravel.
Grant	1,506	3,122	Zinc, stone, lead, sand and gravel.
Green	439	467	Stone, sand and gravel.
Green Lake	600	570	Sand and gravel, stone.
Iowa	940	829	Zinc, stone, lead.
Iron	W	W	Sand and gravel.
Jackson	215	632	Do.
Jefferson	264	191	Sand and gravel, stone.
Juneau	W	W	Stone, sand and gravel.
Kenosha	130	66	Sand and gravel.
Kewaunee	445	516	Do.
La Crosse	433	W	Stone, sand and gravel.
Lafayette	W	W	Zinc, stone, lead, sand and gravel.
Langlade	374	354	Sand and gravel.
Lincoln	267	343	Sand and gravel, peat.
Manitowoc	W	W	Cement, sand and gravel, lime, stone, clays.
Marathon	3,299	3,760	Stone, sand and gravel.
Marinette	W	W	Do.
Marquette	W	238	Do.
Menominee	W	------	
Milwaukee	6,536	W	Cement, stone, sand and gravel.
Monroe	343	338	Stone, sand and gravel.
Oconto	343	477	Sand and gravel, stone.
Oneida	274	313	Sand and gravel.
Outagamie	804	606	Stone, sand and gravel.
Ozaukee	401	934	Sand and gravel.
Pepin	W	84	Stone, sand and gravel.
Pierce	388	355	Stone, sand and gravel, clays.
Polk	831	1,047	Stone, sand and gravel.
Portage	518	527	Sand and gravel, stone.
Price	86	97	Sand and gravel.
Racine	1,494	1,716	Stone, sand and gravel, clays.
Richland	170	W	Stone, sand and gravel.
Rock	2,717	2,463	Sand and gravel, stone.
Rusk	W	226	Sand and gravel.
St. Croix	682	467	Sand and gravel, stone.
Sauk	1,481	1,758	Stone, sand and gravel, abrasives.
Sawyer	W	146	Sand and gravel.
Shawano	338	287	Sand and gravel, stone.
Sheboygan	602	705	Do.
Taylor	436	460	Sand and gravel.
Trempealeau	154	148	Stone, sand and gravel.
Vernon	432	W	Do.
Vilas	135	135	Sand and gravel.
Walworth	616	855	Do.
Washburn	35	73	Do.
Washington	1,415	1,692	Do.
Waukesha	7,449	8,296	Sand and gravel, stone, peat.
Waupaca	330	366	Sand and gravel, stone.
Waushara	W	103	Sand and gravel.
Winnebago	2,289	2,571	Stone, sand and gravel.
Wood	390	482	Sand and gravel, stone.
Undistributed [1]	25,614	28,057	Stone, sand and gravel.
Total [2]	76,010	79,612	

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

[1] Includes some sand and gravel and stone that cannot be assigned to specific counties, and values indicated by symbol W.

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

Table 3.—Indicators of Wisconsin business activity

	1966	1967	Change, percent
Personal income:			
Total millions	$12,390	p $13,208	+6.6
Per capita	$2,973	p $3,153	+6.1
Construction activity:			
Building permits:			
Valuation of authorized residential and nonresidential private construction millions	$434.9	$439.4	+1.0
Number of private and public residential building permits issued	14,510	16,054	+10.6
Contract construction work performed:			
Total millions	$1,065	$1,072	+.7
Nonresidential building do	$488	$450	−7.8
Residential building do	$358	$362	+1.1
Nonbuilding do	$219	$261	+19.2
State highway commission contracts awarded do	$126.5	$105.8	−16.4
Portland cement shipments to and within Wisconsin thousand 376-pound barrels	9,410	10,000	+6.3
Cash receipts from farm marketings millions	$1,420.4	$1,436.3	+1.1
Mineral production do	$76.0	$79.6	+4.7
Manufacturing payrolls do	$3,457.4	$3,587.2	+3.8
Annual average labor force and employment: [1]			
Total labor force thousands	1,782.8	1,815.9	+1.9
Agricultural employment do	181.0	167.2	−7.6
Nonagricultural employment [2] do	1,543.3	1,580.1	+2.4
Manufacturing do	508.6	508.0	−.1
Construction do	64.2	64.3	+.2
Transportation and public utilities do	75.7	75.9	+.3
Mining and quarrying do	2.7	2.7	-----
Stone, clay, and glass products do	7.9	7.2	−8.9
Primary metal industries do	31.3	30.6	−2.2

p Preliminary.
[1] Adjusted to March 1967 benchmark levels.
[2] Includes nonagricultural, self-employed, and unpaid family workers, and domestic workers in private households.

Sources: Survey of Current Business; Construction Review; Statistical Abstract of the United States; Wisconsin Department of Transportation, Division of Highways; Farm Income Situation; Wisconsin Department of Industry, Labor, and Human Relations, Unemployment Compensation Division in cooperation with the U.S. Department of Labor; and the Bureau of Mines.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Peat	15	77	1	9	----	-----	-------	-------
Metal	255	283	72	573	1	35	62.87	19,947
Nonmetal	95	132	13	103	----	4	38.94	1,421
Sand and gravel	2,014	219	441	3,784	1	78	20.88	2,059
Stone	2,002	221	442	3,656	2	112	31.18	5,413
Total [1]	4,381	221	968	8,124	4	229	28.68	4,818
1967: p								
Peat	12	159	2	15	----	1	67.97	476
Metal	215	279	59	475	----	36	75.79	1,501
Nonmetal	105	108	12	97	----	1	10.31	24,742
Sand and gravel	2,010	202	407	3,589	3	69	20.06	5,358
Stone	1,930	215	415	3,476	2	99	29.06	4,569
Total [1]	4,270	209	895	7,652	5	206	27.57	4,997

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

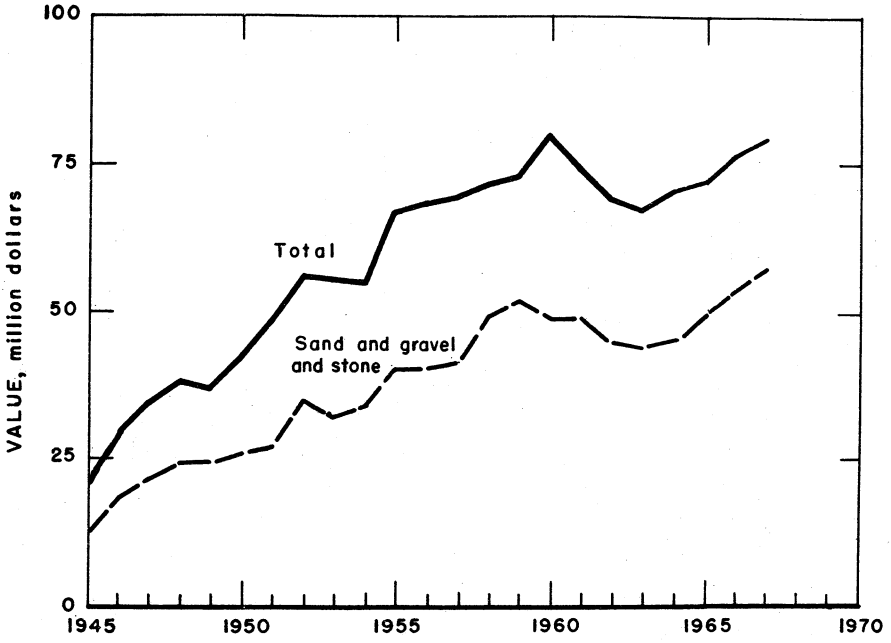

Figure 1.—Value of sand and gravel, stone, and total value of mineral production in Wisconsin.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Abrasive Stone.—Baraboo Quartzite Co., Inc., produced grinding pebbles from a quartzite deposit in Sauk County. Production decreased in quantity and value from that of 1966. The entire output was used for deburring purposes.

Cement.—Portland cement shipments declined 6 percent in quantity and value from those of 1966; shipments of masonry cement decreased 23 percent in quantity and value. Production of portland cement consisted of types I and II (general use and moderate heat) and type III (high-early-strength). About 29 percent of the portland cement production was air-entrained.

Average mill value per 376-pound barrel of portland cement was $3.42, an increase of $0.01 from that of 1966.

About 93 percent of the portland cement was shipped in bulk and the remainder in paper bags. Truck shipments comprised 82 percent of the total and rail shipments 18 percent, compared with 68 percent by truck and 32 percent by rail in 1966. Most of the portland cement was consumed within the State, with lesser amounts shipped to Minnesota and Michigan. In addition to cement produced and consumed within the State, shipments were received from plants in 10 other States. Total shipments of cement into and within Wisconsin were about 10 million barrels of portland cement and 482,000 barrels of masonry cement.

Marquette Cement Manufacturing Co. produced types I, II, and III portland cement and masonry cement at its Milwaukee plant. Manitowoc Portland Cement Co., a subsidiary of Medusa Portland Cement Co., produced types I and II portland cement at Manitowoc until November, when production was discontinued preparatory to converting its plant to white cement production. The company planned to begin the conversion in 1968. Cement markets served by the Manitowoc plant were expected to be supplied by Medusa

Portland Cement Co.'s new plant at Charlevoix, Mich.

Clays.—Miscellaneous clay or shale was produced in Dunn, Fond du Lac, Manitowoc, Pierce, and Racine Counties. The entire output was consumed by the five producing companies. Products manufactured, in decreasing order of quantity of clay or shale used, were portland cement, building brick, vitrified sewer pipe, and other heavy clay products. Production decreased 28 percent in quantity and 24 percent in value from that of 1966 mainly because of decreased output of clay used in the manufacture of portland cement. Manitowoc Portland Cement Co., discontinued mining of clay at Manitowoc.

The Wisconsin Geological Survey began a study of the industrial potential of certain Wisconsin clays. Exploratory drilling was conducted in western Pierce and St. Croix Counties.

Lime.—Combined shipments of quicklime, which comprised about two-thirds of the total lime shipments, and hydrated lime increased 4 percent in quantity and 7 percent in value over those of 1966. About 71 percent of the total production was for chemical and other industrial uses. Principal among these uses, in decreasing order of tonnage, were paper manufacture, water purification, steelmaking, copper ore concentration, sewage disposal, disinfectant, tanning, food processing, abrasives,

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Building	3,925	$3,279	4,301	$3,838
Paving	2,889	2,080	2,661	1,924
Blast	W	W	37	131
Fill	1,355	637	1,860	1,005
Molding	1,076	2,953	995	2,859
Other [1]	193	247	160	202
Total	9,438	9,196	10,014	9,959
Gravel:				
Building	3,880	3,436	4,742	4,180
Paving	13,265	9,859	16,115	12,502
Railroad ballast	W	W	169	101
Fill	1,659	747	1,655	808
Other	224	120	1	1
Total	19,028	14,162	22,682	17,592
Total sand and gravel	28,466	23,358	32,696	27,551
Government-and-contractor operations:				
Sand:				
Building	15	6	-------	-------
Paving	2,519	1,257	2,035	949
Fill	622	203	472	189
Other	162	71	129	54
Total	3,318	1,537	2,636	1,192
Gravel:				
Building	-------	-------	4	2
Paving	9,409	5,710	6,707	4,015
Fill	330	108	499	195
Total	9,739	5,818	7,210	4,212
Total sand and gravel	13,057	7,355	9,846	5,404
All operations:				
Sand	12,756	10,733	12,650	11,151
Gravel	28,767	19,980	29,892	21,804
Grand Total	41,523	30,713	42,542	32,955

W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes oil (hydrafrac) (1967), engine, filtration, glass, railroad ballast, and other construction sand.

petroleum refining, plastics, brickmaking, metallurgy, paint manufacturing, and miscellaneous uses. About 28 percent of the total lime output was used for construction purposes including mason's lime, soil stabilization, and finishing lime. The remainder was used for agricultural purposes. About 41 percent of the lime shipments were to Wisconsin consumers. The remainder was shipped to 12 other States and to Canada; out-of-State shipments were principally to Minnesota and Illinois.

Lime was produced by four companies, operating six plants in Brown, Dodge, Douglas, Fond du Lac, and Manitowoc Counties. In addition to lime produced and consumed within the State, shipments were received from seven other States. Total shipments of lime into and within Wisconsin were about 149,000 tons.

Perlite.—Expanded perlite, which increased in both quantity and value, was produced at Milwaukee and Appleton from crude material mined outside the State. The material was used for lightweight aggregate in concrete and building plaster, loose fill insulation, and soil conditioning.

Sand and Gravel.—Production of sand and gravel established a record high in 1967 of 42.5 million tons, exceeding the previous record set in 1959 by approximately 540,000 tons and the 1966 output by about 1 million tons. Sand and gravel constituted 41 percent of the State total mineral value. The largest quantity increase, 1.2 million tons, was in production of sand and gravel for building purposes, while output of sand and gravel for road construction decreased about 2 percent from that of 1966. Sand and gravel for road construction represented 65 percent of the total, building 21 percent, fill 11 percent, molding 2 percent, and other industrial sand, railroad ballast, and miscellaneous uses the remainder. Wisconsin producers supplied about 5 percent of the Nation's 1967 sand and gravel output, ranking fifth in quantity and eighth in value.

Sand and gravel production was recorded from 70 of the 72 counties in the State. Counties producing more than 1 million tons, in decreasing order of tonnage, were Waukesha, Washington, Rock, Dane, Eau Claire, Ozaukee, Winnebago, Racine, and Walworth. Collectively, these nine counties represented nearly 47 percent of the State total sand and gravel output. Of these counties, all except Eau Claire are in the heavily populated southeastern quarter of the State.

Production of industrial sands for molding, glass manufacture, sand blasting, engine, filtration, and oil (hydrafrac) purposes decreased 6 percent in quantity but remained virtually unchanged in total value. Chief reason for the decrease was lesser demand for molding sand. Industrial sand was produced in Columbia, Dane, Eau Claire, Green Lake, Pierce, and Rock Counties. Manley Sand Division (Martin Marietta Corp.) completed a major expansion project at its Portage, Wis., operation. The Wisconsin Geological Survey studied the possibility of using silica sand from various locations throughout the State for industrial purposes.

Table 6.—Production of sand and gravel and stone in 1967, by counties [1]

(Thousand short tons and thousand dollars)

County	Sand and gravel		Stone		Type of stone produced
	Quantity	Value	Quantity	Value	
Adams	W	W	--------	--------	
Ashland	254	W	W	W	Dimension granite.
Barron	700	$450	--------	--------	
Bayfield	113	93	--------	--------	
Brown	585	359	429	W	Crushed and dimension limestone.
Buffalo	60	21	254	$274	Crushed limestone.
Burnett	261	142	2	1	Marl.
Calumet	75	59	176	197	Crushed limestone.
Chippewa	349	194	--------	--------	
Clark	662	531	--------	--------	
Columbia	838	W	87	101	Do.
Crawford	W	W	369	W	Do.
Dane	2,002	1,873	1,097	1,327	Do.
Dodge	952	632	378	W	Do.

See footnotes at end of table.

Table 6.—Production of sand and gravel and stone in 1967, by counties [1]—Continued

(Thousand short tons and thousand dollars)

County	Sand and gravel		Stone		Type of stone produced
	Quantity	Value	Quantity	Value	
Door	526	$303	7	$29	Crushed and dimension limestone.
Douglas	743	471	--------	--------	
Dunn	169	W	W	W	Crushed limestone.
Eau Claire	1,322	1,497	--------	--------	
Florence	W	W	--------	--------	
Fond du Lac	355	W	488	1,313	Crushed and dimension limestone.
Forest	160	85	--------	--------	
Grant	135	111	865	716	Crushed limestone.
Green	63	W	446	W	Do.
Green Lake	356	546	22	24	Do.
Iowa	--------	--------	463	378	Do.
Iron	W	W	--------	--------	
Jackson	693	632	--------	--------	
Jefferson	282	W	W	W	Do.
Juneau	W	W	W	W	Do.
Kenosha	117	66	--------	--------	
Kewaunee	571	516	--------	--------	
La Crosse	116	W	W	W	Do.
Lafayette	W	W	473	301	Do.
Langlade	592	354	--------	--------	
Lincoln	534	W	--------	--------	
Manitowoc	901	584	170	W	Crushed and dimension limestone.
Marathon	712	780	1,198	2,980	Crushed and dimension granite and sandstone.
Marinette	379	203	W	W	Crushed basalt and dimension granite.
Marquette	74	W	25	W	Dimension granite and crushed limestone.
Milwaukee	162	118	W	W	Crushed limestone.
Monroe	193	134	160	204	Do.
Oconto	764	W	W	W	Do.
Oneida	514	313	--------	--------	
Outagamie	145	168	425	438	Do.
Ozaukee	1,179	934	--------	--------	
Pepin	W	W	78	W	Do.
Pierce	185	W	222	173	Do.
Polk	W	W	W	W	Crushed basalt and limestone.
Portage	585	526	(2)	1	Dimension sandstone.
Price	107	97	--------	--------	
Racine	1,121	W	W	W	Crushed limestone.
Richland	62	44	W	W	Do.
Rock	2,074	2,156	356	307	Do.
Rusk	339	226	--------	--------	
St. Croix	442	W	219	W	Do.
Sauk	544	W	843	1,105	Crushed limestone, crushed quartzite, and dimension sandstone.
Sawyer	206	146	--------	--------	
Shawano	341	W	54	W	Crushed limestone.
Sheboygan	959	658	47	47	Do.
Taylor	907	460	--------	--------	
Trempealeau	W	W	129	W	Do.
Vernon	44	17	480	W	Do.
Vilas	199	135	--------	--------	
Walworth	1,008	855	--------	--------	
Washburn	128	73	--------	--------	
Washington	2,345	1,692	--------	--------	
Waukesha	7,580	5,056	1,668	W	Crushed and dimension limestone.
Waupaca	583	346	27	20	Crushed limestone.
Waushara	173	103	--------	--------	
Winnebago	1,154	795	1,367	1,776	Do.
Wood	557	306	151	176	Crushed granite and dimension sandstone.
Undistributed [3]	2,291	7,095	3,945	12,979	
Total [4]	42,542	32,955	17,122	24,863	

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] No sand and gravel or stone production reported from Menominee County in 1967.
[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.

Commercial production represented about 77 percent of the total tonnage and 84 percent of the total value. The remainder was produced by, or under contract for, the State and county highway departments and other governmental agencies. Approximately 94 percent of the commercial sand and gravel output was transported by truck, and the remainder by rail. Average value for sand and gravel produced in 1967 was $0.77 per ton, an increase of $0.03 per ton from that of 1966. About 89 percent of the total sand and gravel output was processed; the remainder was pit-run material.

Stone.—Stone production (consisting of basalt, granite, limestone, marl, quartzite, and sandstone) was 17.1 million tons, valued at $24.9 million, exceeding the previous tonnage record set in 1960 and the value record established in 1959. Production increased 6 percent in quantity and 5 percent in value over that of 1966. Major reason for the increase was greater demand for crushed and broken stone for concrete aggregate and roadstone. Stone ranked second in value among the mineral commodities produced in the State, accounting for 31 percent of the total value. Crushed and broken stone accounted for 99 percent in quantity and 85 percent in value of the total stone output with production increasing 6 percent in quantity and 8 percent in value. About 94 percent of the total crushed and broken stone was produced by commercial operators. Of this amount, 92 percent was transported by truck and the remainder by rail.

Production of crushed and broken limestone was reported from 39 counties. Production in 1967 was 14.7 million tons valued at $16.7 million, representing 86 percent in quantity and 79 percent in value of the total crushed and broken stone output. About 91 percent of the total output was used for concrete aggregate and roadstone, about the same proportion as in 1966. Output of agricultural limestone decreased approximately 13 percent in quantity from that of 1966, and comprised about 6 percent of the total crushed and broken limestone output. Other uses for crushed and broken limestone, in decreasing order of quantity, included barnlime, lime manufacture, riprap, railroad ballast, asphalt filler, flux, fertilizer, and rockfill. Average value of crushed and broken limestone was $1.14 compared with $1.12 in 1966.

About 850,000 tons of crushed and broken granite, used for roadstone, was produced in Marathon and Wood Counties. Crushed and broken quartzite was produced in Marathon and Sauk Counties.

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

Use		1966		1967	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Dimension:					
Rough construction	thousand short tons	[1] 49	[1] $416	19	$238
Rubble	do	([1])	([1])	24	222
Rough architectural	thousand cubic feet	14	15	17	26
Sawed	do	56	168	50	149
House stone veneer	do	526	1,285	316	618
Cut	do	37	84	33	128
Flagging	do	89	97	69	76
Total	approximate thousand short tons [2]	106	2,065	83	[3] 1,456
Crushed and broken:					
Riprap	thousand short tons	46	55	50	63
Concrete aggregate and roadstone	do	12,356	13,429	13,374	14,424
Agriculture	do	1,062	1,531	927	1,355
Other [4]	do	254	412	336	874
Total [3]	do	13,718	15,426	14,686	16,716
Grand total [3]	do	13,824	17,492	14,769	18,172

[1] Rough construction and rubble combined to avoid disclosing individual company confidential data.
[2] Average weight of 160 pounds per cubic foot used to convert cubic feet to short tons.
[3] Data may not add to totals shown because of independent rounding.
[4] Includes limestone used for filter beds (1966), asphalt, fertilizer, flux, lime, railroad ballast, and other uses.

Uses, in decreasing order of quantity, included railroad ballast, roofing granules, concrete aggregate and roadstone, silica brick, and abrasives. Crushed and broken basalt, used for roofing granules, railroad ballast, and concrete aggregate and roadstone, was produced in Marinette and Polk Counties. Calcareous marl was produced in Burnett County for agricultural purposes.

Output of dimension stone, consisting of limestone, granite, and sandstone, decreased 20 percent in quantity and 10 percent in value. Quantity decreases were recorded for all types of dimension stone whereas only limestone decreased in value.

Limestone constituted 87 percent in quantity and 39 percent in value of the total State dimension stone production, although output decreased 22 percent in quantity and 30 percent in value from that of 1966. Major reason for the decline was a reduction in sales of house stone veneer, which accounted for 42 percent of the total dimension limestone output value, compared with 62 percent in 1966. Other uses, in descending order of value, were rough construction, rubble, sawed stone, cut stone, flagging, and rough architectural stone. Dimension limestone was produced in five counties by 27 companies. The two leading counties were Fond du Lac and Waukesha, accounting for about 91 percent of the State total value of dimension limestone. Wisconsin accounted for about 15 percent in quantity and 9 percent in value of the Nation's 1967 dimension limestone output, ranking second in quantity and third in value among the States.

Granite comprised 10 percent in quantity and 59 percent in value of all dimension stone produced in the State. Output of dimension granite decreased 1 percent in quantity and increased 9 percent in value from that of 1966. Dimension granite was produced by seven companies in Ashland, Marathon, Marinette, and Marquette Counties. Rough and dressed monumental stone accounted for about 91 percent of the total output. The remainder was sold for rubble and architectural purposes. Of all dimension stone, dressed monumental granite continued to have the highest average unit value at $26.64 per cubic foot, an increase of $0.26 from that of 1966.

Seven companies in Marathon, Portage, Sauk, and Wood Counties produced dimension sandstone for rough construction, cut stone, flagging, and rubble. Production in 1967 was valued at $50,000 an increase of 3 percent over that of 1966.

Vermiculite.—Exfoliated vermiculite was produced by Zonolite Division, W. R. Grace & Co., at Milwaukee from crude material mined outside the State. The exfoliated material was used for loose fill insulation, lightweight aggregate in concrete and plaster, and for agricultural purposes.

METALS

Iron Ore.—Jackson County Iron Co., a wholly-owned subsidiary of Inland Steel Co., began initial site preparation late in the year for its new 750,000-ton-per-year taconite operation near Black River Falls, Jackson County. The Dravo Corp., of Pittsburgh, Pa., was awarded the contract for design, engineering, and construction of the concentrator and pellet plant. This facility was scheduled to produce pellets containing 65 percent iron, utilizing the Dravo Lurgi traveling gate pelletizing process, by late 1969. Pellets were expected to be shipped by rail on a year-round basis to Inland Steel Co.'s Indiana Harbor Works in East Chicago, Ind. The Black River Falls operation was expected to supply approximately 10 percent of Inland Steel Co.'s annual iron ore needs Exploration activities were conducted on the western portion of the Gogebic Range by Jackson County Iron Co. in Iron County, and The Hanna Mining Co. near Mellen, in Ashland County. Depletion tax allowances were granted for low-grade iron ore mining in the State, reducing the State tax assessment from $0.37 to $0.25 per ton of concentrates.

Iron ore, produced in Minnesota, was shipped by lake vessel from ore docks operated at Superior by Great Northern Railway Co. and the Northern Pacific Railway Co. Great Northern Railway Co. completed construction of its 2.5-million-ton-capacity taconite storage area near its Allouez (Superior) docks. This facility, designed for winter storage of taconite pellets, began receiving unit train shipments in 1967 from The Hanna Mining Co.'s Butler Taconite Project and from the National Steel Pellet Plant, both located on the Mesabi Range in Minnesota.

Lead and Zinc.—Production of zinc increased about 17 percent in quantity and 12 percent in value. Wisconsin producers supplied about 5 percent of the Nation's mine production of zinc in 1967, ranking seventh in production of this metal. Lead output declined 6 percent in quantity and 13 percent in value.

Average yearly weighted prices of lead and zinc were 14.00 cents per pound for lead and 13.84 cents per pound for zinc, compared with 15.12 cents for lead and 14.50 cents for zinc in 1966.

Lead and zinc were produced in Grant, Iowa, and Lafayette Counties. Companies operating mines and mills throughout the year were American Zinc Co., Eagle-Picher Industries, Inc., and Ivey Construction Co. The New Jersey Zinc Co. began production of lead and zinc concentrates in May at its new mill near Elmo. The flotation mill has a capacity of 800 tons of crude ore per day. Crude ore for this operation was supplied by the company's nearby Elmo mine. Mifflin Mining Co. shipped crude ore for custom milling. Eagle-Picher Industries, Inc., closed its Kennedy mine near Hazel Green in January. The company also discontinued milling material from "boulder piles" from the Old Mulcahy mine near Shullsburg. American Zinc Co. ceased operations at its Burnham mine in early 1967.

Table 8.—Mine production of lead and zinc in 1967, by months, in terms of recoverable metals

(Short tons)

Month	Lead	Zinc
January	90	1,865
February	120	1,970
March	130	2,385
April	155	2,290
May	125	2,295
June	200	2,625
July	125	2,385
August	145	2,540
September	155	2,465
October	135	3,055
November	115	2,600
December	101	2,478
Total	1,596	28,953

Table 9.—Mine production of lead and zinc, in terms of recoverable metals

Year	Mines producing	Ore treated (short tons)	Lead		Zinc		Total value (thousands)
			Short tons	Value (thousands)	Short tons	Value (thousands)	
1963	8	445,742	1,116	$241	15,114	$3,476	$3,717
1964	13	849,943	1,742	456	26,278	7,148	7,604
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

Sales of lead concentrate by Wisconsin producers during the latter part of 1967 were prevented by a strike at the American Smelting & Refining Co.'s El Paso, Tex., smelter. American Zinc Co., Eagle-Picher Industries, Inc., Ivey Construction Co., and The New Jersey Zinc Co. conducted exploration and development activities including drilling, underground development, electromagnetic surveying, induced polarization, and geochemical sampling of spring water. Some exploratory drilling was discontinued because of the drop in price of lead and zinc.

Tailings from several lead-zinc milling operations were used for road construction, railroad ballast, and agricultural purposes. The Federal Bureau of Mines awarded a grant to the University of Wisconsin for a 2½-year research program to investigate the possibility of recovering burnt dolomitic lime, usable as flux in steelmaking, from lead-zinc mining and milling wastes.

MINERAL FUELS

Peat.—Output of peat decreased 23 percent in quantity with a lesser decrease recorded for value. Major reason for the decrease was a decline in sales of peat used for general soil improvement and seed inoculant. Peat was produced by three companies in Lincoln and Waukesha Counties; one company produced only moss peat, one humus peat, and one produced both types. Most of the peat was shipped in packaged form. Major uses, in decreasing order of quantity, were seed inoculant, general soil improvement, packing shrubs and other plants, and as an ingredient for potting soils.

Table 10.—Principal producers and processors of metals, minerals, and mineral fuels

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Abrasive material: Grinding pebbles:			
Baraboo Quartzite Co., Inc.	Baraboo	Sauk	
Cement:			
Manitowoc Portland Cement Co., Medusa Portland Cement Co.	Manitowoc	Manitowoc	Portland, wet process. Ceased production in November.
Marquette Cement Mfg. Co.	Milwaukee	Milwaukee	Portland and masonry, dry process.
Clays and shale: [1]			
Manitowoc Portland Cement Co., Medusa Portland Cement Co.	Manitowoc	Manitowoc	Cement. Ceased production late in 1967.
Menomonie Brick Co.	Menomonie	Dunn	Brick.
Oakfield Shale Brick & Tile Co.	Oakfield	Fond du Lac	Brick.
Red Wing Sewer Pipe Corp.	Elmwood	Pierce	Pit only; clay processed at company vitrified-sewer pipe plant in Red Wing, Minn.
Coke:			
Manganese Chemicals Corp., Milwaukee Solvay Coke Division	Milwaukee	Milwaukee	
Lead and zinc:			
American Zinc Co.			
No. 1 and No. 2	Tennyson	Grant	Mines and mill.
Burnham	Platteville	do	Ore treated at Tennyson mill. Ceased production in 1967.
Blackstone-Coulthard-Hancock-Winskell	Shullsburg	Lafayette	Ore treated at Vinegar Hill mill.
Champion and Temperly-Thompson	New Diggings	do	Do.
Shullsburg Mill	Shullsburg	do	
Eagle-Picher Industries, Inc.			
Birkett-Bastian-Andrews and Kennedy	Hazel Green	do	Ore treated at Galena, Ill. Kennedy mine closed in January.
Mulcahy Boulders	Shullsburg	do	Ore treated at Vinegar Hill mill. Ceased production in 1967.
Shullsburg	do	do	Mine and mill.
Ivey Construction Co., Graysville	Mineral Point	Iowa	Do.
Mifflin Mining Co., Coker No. 1	Rewey	do	
The New Jersey Zinc Co., Elmo	Elmo	Grant	Mine and mill.
Lime:			
Cutler-LaLiberte-McDougall Corp.	Superior	Douglas	Quicklime, two rotary kilns.
Mayville White Lime Works	Mayville	Dodge	Quicklime, one shaft kiln.
Rockwell Lime Co.	Manitowoc	Manitowoc	Quick and hydrated, one rotary kiln.
The Western Lime & Cement Co.	Green Bay	Brown	Quick and hydrated, five shaft kilns.
Do.	Knowles	Dodge	Hydrated, five shaft kilns.
Do.	Eden	Fond du Lac	Quick and hydrated, five shaft kilns.
Peat:			
Demilco, Inc.	Delafield	Waukesha	Humus peat.
Expanded perlite:			
Midwest Perlite Co.	Appleton	Outagamie	
Zonolite Division, W. R. Grace & Co.	Milwaukee	Milwaukee	

See footnotes at end of table.

Table 10.—Principal producers and processors of metals, minerals, and mineral fuels—Continued

Commodity and company	Location of operation(s)		Remarks
	Nearest town	County	
Sand and gravel: [2]			
Courtney & Plummer, Inc.	Neenah	Winnebago	Stationary plant.
Eau Claire Sand & Gravel Co.	Eau Claire	Eau Claire	Stationary plant, industrial sand.
Genesee Sand & Gravel Co., Inc., Jaeger Sand & Gravel Co., Inc.	New Berlin	Waukesha	Stationary plant.
Hillview Sand & Gravel Co.	do	do	Do.
Janesville Sand & Gravel Co.	Janesville	Rock	Stationary plants.
Johnson Sand & Gravel	Pewaukee	Waukesha	
Edward Kraemer & Sons, Inc.	Various locations	Barron, Bayfield, Brown, Dane, Dodge, Douglas, Dunn, Eau Claire, Iron, Jackson, La Crosse, Milwaukee, Oconto, Outagamie, Ozaukee, Pierce, Racine, Rusk, St. Croix, Sawyer, Washburn, Washington, Waukesha, Waushara, Wood.	
C. C. Linck, Inc.	Chilton	Calumet	
Do	Columbus	Columbia	
Do	Beaver Dam, Burnett, Fox Lake, Horicon, Lowell, Neosho, Randolph, Theresa, Watertown	Dodge	
Do	Oakfield, Ripon	Fond du Lac	
Do	Green Lake and Markesan	Green Lake	
Do	Pewaukee	Waukesha	
Manley Sand Division, Martin Marietta Corp.	Portage	Columbia	Stationary plant, industrial sand.
Lyle T. Manley Co., Inc.	Hanover	Rock	Do.
Mann Bros. Sand & Gravel, Inc.	Palmyra	Jefferson	
	Big Bend, Delavan, East Troy, Elkhorn, Genoa City, Lake Geneva, Whitewater, Williams Bay	Walworth	Pit run at Big Bend.

Plautz Bros., Inc	Granton, Greenwood, Neillsville, Withee	Clark	
Do	Fairchild	Eau Claire	
Do	do	Jackson	
Rein, Schultz & Dahl, Inc	Madison, Oregon, Stoughton	Dane	
Do	Black River Falls	Jackson	
Do	Merrill, Tomahawk	Lincoln	
Do	Wautoma	Waushara	
State Sand & Gravel Co	Big Bend, Merton	Waukesha	Stationary plants.
Wissota Sand & Gravel Co	Rice Lake	Barron	Do.
Do	Eau Claire	Eau Claire	Do.
Do	Colgate and Polk	Washington	Do.
Stone:			
Basalt:			
Bryan Dresser Trap Rock, Inc	Dresser	Polk	Stationary and portable plants.
The Ruberoid Co., Division General Aniline & Film Corp	Pembine	Marinette	
Granite:			
Anderson Bros. & Johnson Co	Wausau	Marathon	Quarry and finishing plant; dimension.
Do	Amberg	Marinette	Dimension granite.
Cold Spring Granite Co	Mellen	Ashland	Stone processed at company plant in Minnesota; dimension.
Do	Wausau	Marathon	Do.
Gottschalk Brothers, Inc	Edgar	do	Decomposed granite.
Lake Wausau Granite Co	Wausau	do	Quarry and finishing plant; dimension.
Prehn Granite Quarries, Inc	do	do	Do.
Tony Schilling Granite Pit	Mosinee	do	Decomposed granite.
Wisconsin Quarries, Inc., Subsidiary of Rock of Ages Corp	Wausau	do	Rough stone processed outside the State; dimension.
Limestone: [2] [3]			
Badger Highways Co., Inc	Menasha	Winnebago	Stationary plant.
Becker & Tuckwood	Lancaster	Grant	
Courtney & Plummer, Inc	Neenah	Winnebago	Stationary and portable plants.
Daanen & Janssen	De Pere, Howard, Wrightstown	Brown	
Franklin Stone Products, Inc	Franklin	Milwaukee	Stationary plant.
Halquist Lannon Stone Co	Sussex	Waukesha	Stationary plant. Dimension and crushed and broken stone.
Edward Kraemer & Sons, Inc	Various locations	Buffalo, Columbia, Crawford, Marquette, Monroe, Pepin, Richland, Sauk, Sheboygan, Vernon.	
Madison Stone Co., Inc	Madison	Dane	Stationary plant.
Arthur Overgaard, Inc	Various locations	Various counties	Stationary plant in La Crosse County.
Arthur Overgaard Co	Mauston	Juneau	Stationary plant.
Panetti Stone, Inc	Fond du Lac	Fond du Lac	Stationary plant. Dimension and crushed and broken stone.

See footnotes at end of table.

Table 10.—Principal producers and processors of metals, minerals, and mineral fuels—Continued

Commodity and Company	Location of operation(s)		Remarks
	Nearest town	County	
Stone—Continued			
Limestone—Continued			
P. W. Ryan Sons, Inc	Albany, Argyle, Brodhead, Brooklyn, Monroe, Monticello, New Glarus	Green	
Do	Janesville	Rock	
Vulcan Materials Co., Midwest Division	Franklin	Milwaukee	Stationary plant.
Do	Racine	Racine	Do.
Do	Sussex	Waukesha	Do.
Do	Oshkosh	Winnebago	Do.
G. A. Watson	Bridgeport	Crawford	
Do	Blue Mounds	Dane	
Do	Bloomington, Patch Grove	Grant	
Do	Avoca, Barneveld, Dodgeville, Spring Green	Iowa	
Do	Lamont, South Wayne, Wiota	Lafayette	
Waukesha Lime & Stone Co	Waukesha	Waukesha	Stationary plant.
George Wendtlandt, Inc	Cuba City, Hazel Green, Platteville	Grant	
Do	Barneveld, Dodgeville, Linden, Mineral Point, Ridgeway	Iowa	
Do	Argyle, Belmont, Blanchardville, Cuba City, Darlington, Mineral Point	Lafayette	
Sandstone and quartzite:			
Ellis Quarries, Inc	Guenther	Marathon	Dimension.
Do	Stevens Point	Portage	Do.
Do	Rudolph	Wood	Do.
Foley Bros., Inc	Rock Springs	Sauk	Crushed.
General Refractories Co	Baraboo	Sauk	Do.
Klesmith Stone Co	Rudolph	Wood	Dimension.
Minnesota Mining & Manufacturing Co	Wausau	Marathon	Crushed.
Exfoliated vermiculite:			
Zonolite Division, W. R. Grace & Co	Milwaukee	Milwaukee	

[1] All companies listed under "Clays and Shale" operated pits and processing plants; products manufactured are shown under "Remarks" column.
[2] Portable plants were operated at the listed locations unless otherwise specified.
[3] Crushed limestone was produced at the listed locations unless otherwise specified.

The Mineral Industry of Wyoming

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

By H. C. Meeves [1] and William C. Henkes [2]

Mineral-production value in Wyoming reached an alltime high of $530.7 million during 1967, an increase of $6.3 million over the $524.4 million reported in 1966. Mineral fuels increased 2 percent and accounted for $412.7 million of the total.

Increased values were reported for coal, gem stones, lime, LP gases, natural gasoline, petroleum, pumice, sand and gravel, sodium carbonate, sodium sulfate, uranium, and vermiculite. Decreased values were reported for cement, clays, feldspar, gypsum, iron ore, marketed natural gas, phosphate rosk, stone, and vanadium.

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

Table 1.—Mineral production in Wyoming [1]

Mineral	1966		1967	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays—thousand short tons	1,559	$15,874	1,495	$14,313
Coal (bituminous)—do	3,670	11,840	3,588	11,876
Gem stones	NA	120	NA	125
Iron ore (usable)—thousand long tons, gross weight	1,978	19,700	1,854	19,186
Natural gas (marketed)—million cubic feet	243,381	35,290	240,074	35,051
Natural gas liquids:				
LP gases—thousand gallons	166,080	7,308	173,821	7,648
Natural gasoline and cycle products—do	96,372	6,281	99,180	6,447
Petroleum (crude)—thousand 42-gallon barrels	134,470	344,243	136,312	351,685
Sand and gravel—thousand short tons	7,187	7,496	8,181	8,253
Stone—do	1,393	2,560	1,246	2,375
Uranium [2] (recoverable content U_3O_8)—thousand pounds	4,593	36,741	4,655	37,243
Vanadium—short tons	W	555	W	W
Value of items that cannot be disclosed: Cement, feldspar, gypsum, lime, phosphate rock, pumice (1967), sodium carbonate, sodium sulfate, vermiculite (1967), and values indicated by symbol W	XX	36,379	XX	36,494
Total	XX	r 524,387	XX	530,696
Total 1957–59 constant dollars	XX	r 512,387	XX	511,605

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] Method of reporting changed from short tons of ore and f.o.b. mine value (Atomic Energy Commission (AEC) Circular 5, Revised, price schedule) to recoverable pounds of uranium oxide and f.o.b. mill value.

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

County	1966	1967	Minerals produced in 1967 in order of value
Albany	$6,614,616	$4,959,009	Cement, petroleum, stone, sand and gravel, iron ore, gypsum, feldspar.
Big Horn	r 26,715,939	23,842,798	Petroleum, clays, natural gas, sand and gravel, lime, gypsum, stone.
Campbell	r 23,234,933	30,482,911	Petroleum, LP gases, coal, natural gas, sand and gravel, uranium, vanadium.
Carbon	r 14,470,648	18,816,450	Petroleum, uranium, coal, natural gas, sand and gravel, LP gases, natural gasoline, stone.
Converse	r 19,020,293	17,466,798	Petroleum, coal, sand and gravel, natural gas, LP gases, stone.
Crook	r 24,875,195	19,657,074	Petroleum, clays, natural gas, LP gases, natural gasoline, uranium, sand and gravel, vanadium, stone.
Fremont	r 81,556,699	82,141,616	Petroleum, uranium, iron ore, natural gas, natural gasoline, sand and gravel, LP gases, stone.
Goshen	W	329,465	Lime, sand and gravel, petroleum, stone.
Hot Springs	45,303,166	43,674,156	Petroleum, natural gas, coal, natural gasoline, sand and gravel.
Johnson	25,599,698	22,648,133	Petroleum, clays, natural gas, sand and gravel, LP gases, natural gasoline, stone.
Laramie	4,144,571	2,920,028	Petroleum, stone, sand and gravel, natural gas.
Lincoln	8,307,666	8,279,124	Natural gasoline, coal, phosphate rock, LP gases, sand and gravel.
Natrona	r 47,936,627	54,137,995	Petroleum, uranium, sand and gravel, natural gas, LP gases, natural gasoline, clays, sodium sulfate, stone, feldspar.
Niobrara	2,637,000	2,083,000	Petroleum, natural gas, sand and gravel, LP gases.
Park	86,371,753	90,678,712	Petroleum, natural gas, LP gases, sand and gravel, natural gasoline, gypsum, stone.
Platte	W	W	Iron ore, stone, sand and gravel, vermiculite.
Sheridan	2,528,674	2,749,243	Coal, petroleum, sand and gravel, stone, clays.
Sublette	r 21,402,316	20,666,670	Natural gas, petroleum, sand and gravel, LP gases, stone.
Sweetwater	59,560,460	60,713,030	Sodium carbonate, petroleum, natural gas, coal, LP gases, sand and gravel, stone, pumice.
Teton	343,846	W	Sand and gravel, stone.
Uinta	1,446,610	1,786,792	Natural gas, sand and gravel, petroleum, clays, natural gasoline, stone.
Washakie	7,135,422	7,969,800	Petroleum, natural gas, LP gases, sand and gravel, lime.
Weston	10,880,659	10,472,175	Petroleum, clays, natural gas, LP gases, sand and gravel.
Yellowstone National Park	174,500	14,000	Sand and gravel.
Undistributed [1]	r 4,126,064	4,207,210	
Total	r 524,387,000	530,696,000	

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

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

Table 3.—Indicators of Wyoming business activity

		1966	1967	Change, percent
Personal income:				
Total	millions	$874	$944	+8.0
Per capita		$2,739	$2,997	+9.4
Bank debits	millions	$1,782.8	$1,909.4	+7.1
Total State receipts	do	$157.1	NA	
Total State expenditures	do	$152.2	NA	
Natural gas used	billion cubic feet	50.9	51.3	+.8
Electric power used	million kilowatt hours	1,795.7	1,920.7	+7.0
Construction activity:				
Building permits	millions	$16.7	$23.4	+40.7
Highway construction contracts awarded	do	$45.5	$43.4	−4.6
Truck gross ton-mile tax	do	$6.8	$7.2	+6.8
Cash receipts from farm marketing	do	$204.1	$203.0	−.5
Mineral production	do	$524.4	$530.7	+1.2
Employment:				
Total agricultural	thousands	16.8	16.3	−3.0
Total non-agricultural	do	98.3	99.2	+.9
Mining	do	9.1	9.1	
Contract construction	do	6.8	6.5	−4.4
Manufacturing	do	6.8	7.0	+2.9
Finance, insurance, real estate	do	3.5	3.5	
Transportation and utilities	do	10.4	10.2	−1.9
Trade	do	21.2	21.3	+.5
Services and miscellaneous	do	13.5	13.8	+2.2
Government	do	27.0	27.8	+3.0

NA Not available.
Source: Wyoming Natural Resource Board.

Major mineral-industry developments included plans for a 20-megawatt, coal-fueled, air-cooled, electric-generating plant by Black Hills Power & Light Co.; plans for a fourth generating unit at the Dave Johnston generating plant of Pacific Power & Light Co. (PP&L); discovery of the Recluse oilfield; completion of the Indus- Minerals & Chemical Corp. (IMC), bentotrial Minerals Division, International nite plant; a $25 million bond issue by the town of Green River for constructing the Allied Chemical Corp. Industrial Chemicals Division complex; sinking the Texas Gulf Sulphur Co. (TGS) shaft; a gold discovery in the Jackson Hole area; and staking over 60,000 uranium claims.

Employment and Injuries.—Final employment and injury data for 1966 and preliminary data for 1967, excluding all mineral fuels industries except the coal, compiled by the Bureau of Mines are shown in table 4.

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

Year and industry	Average men working daily	Days Active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Frequency	Severity
1966:								
Coal	324	231	75	576	----	23	39.92	11,257
Metal	1,556	238	371	3,049	1	78	25.91	3,542
Nonmetal	1,225	260	318	2,589	----	38	14.68	569
Sand and gravel	898	167	150	1,201	----	25	20.82	462
Stone	253	254	64	515	----	10	19.42	672
Total	4,256	230	978	7,930	1	174	22.07	2,479
1967: [p]								
Coal	290	228	66	504	----	20	39.68	1,786
Metal	1,685	246	415	3,413	1	89	26.37	4,389
Nonmetal	1,315	244	321	2,606	1	51	19.95	2,904
Sand and gravel	980	186	183	1,444	----	25	17.31	385
Stone	270	213	58	462	----	13	28.12	6,927
Total [1]	4,540	229	1,042	8,429	2	198	23.73	3,228

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

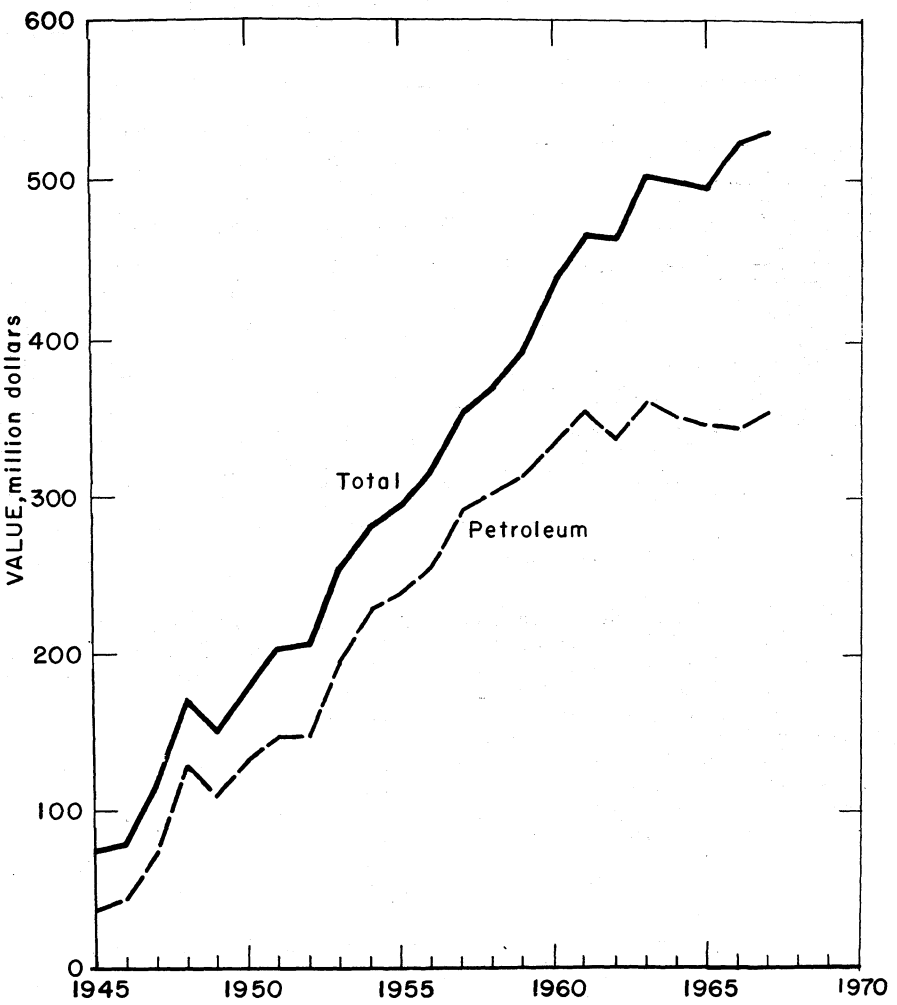

Figure 1.—Value of petroleum, and total value of mineral production in Wyoming.

Government Programs.—At the Federal Bureau of Mines, Laramie Petroleum Research Center Analysis by X-ray diffraction of oil-shale samples from the lower Wilkins Peak-Tipton section in the Rock Springs 1–3 Corehole showed that analcite was common to a depth of about 120 feet, then virtually absent. Below 120 feet montmorillonite occurred continuously as a common constituent of the lower half of the Tipton member. Mordenite and clinoptilolite appeared in the sections where analcite was absent. Evaluation of this hole showed discontinuous oil-shale deposits consisting of very rich and very lean shale in alternating layers. The maximum continuous thickness of 25-gallon-per-ton shale was only 14.8 feet, which included several 1-foot samples assaying over 50 gallons per ton. The Laramie station also continued research of electrofracturing and in-situ retorting of oil shale.

The Federal Bureau of Mines, Federal Geological Survey, and others published reports on the mineral industry of Wyoming.[3]

REVIEW BY MINERAL COMMODITIES

MINERAL FUELS

Accounting for 78 percent of the value of total mineral production in the State, output of mineral fuels in 1967 increased 2 percent, from $405.0 million to $412.7 million. Petroleum, the single most valuable commodity, accounted for 66 percent, or $351.7 million, of the total. Marketed natural gas, the third most valuable commodity, constituted 7 percent, or $35 million, of the total value.

Coal (Bituminous).—Output of coal from 14 mines in 7 counties decreased 2 percent in quantity, while value increased $36,000. Increased production by Wyodak Resources Development Corp. in Campbell County, Kemmerer Coal Co. (Elkol strip) in Lincoln County, Big Horn Coal Co. and Welch Coal Co. in Sheridan County, and Dusky Diamond Coal Co. and T–K Coal Co. in Hot Springs County was offset by decreased production of Monolith Portland Midwest Co. and Rosebud Coal Sales Co. in Carbon County, Best Coal Co. and PP&L (Dave Johnston strip) in Converse County, Kemmerer Coal Co. (Sorensen strip) in Lincoln County, Roncco Coal Co. in Hot Springs County, and Edwin L. Swanson Brothers and Gunn-Quealy Coal Co. in Sweetwater County.

Black Hills Power & Light Co. announced plans for a $5 million, 20-megawatt, coal-fueled, air-cooled condenser, electric-generating plant at Wyodak; a smaller, custom-built experimental unit has been in use for 6 years. Air-cooled condensers, developed in Europe, allow units to be constructed in areas where water supply is limited. Scheduled for operation by fall of 1969, the plant will be the first of its kind in the United States; construction was to begin in early 1968. Success of the plant could result in construction of a 150-megawatt generating plant.

Humble Oil & Refining Co. bid $165.86

[3] Antweiler, J. C., and J. D. Love. Gold-bearing Sedimentary Rocks in Northwest Wyoming—A Preliminary Report. Geol. Survey Circ. 541, 1967, 12 pp.
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Cupps, C. Q., and J. Fry. Reservoir Oil Analysis, Gebo Field, Hot Springs County, Wyo. BuMines Open-File Report, May 1967.
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Tisot, P. R. Alterations in Structure and Physical Properties of Green River Oil Shales by Thermal Treatment. J. Chem. and Eng. Data, v. 12, No. 3, July 1967, pp. 405–411.

Table 5.—Coal (bituminous) sold or used in 1967, by counties

(Excludes mines producing less than 1,000 short tons)

County	Number of mines operating			Sold or used (short tons)		
	Underground	Strip	Total	Underground	Strip	Total
Campbell	---	1	1	---	504,817	504,817
Carbon	---	2	2	---	445,671	445,671
Converse	---	2	2	---	1,414,995	1,414,995
Hot Springs	3	---	3	9,844	---	9,844
Lincoln	---	2	2	---	756,980	756,980
Sheridan	---	2	2	---	348,180	348,180
Sweetwater	2	---	2	107,305	---	107,305
Total	5	9	14	117,149	3,470,643	3,587,792

per acre for 5,457 acres and $90.67 per acre for 4,782 acres of Federal coal land in Wyoming; previous bids averaged about $40 per acre. The acreage was to be included under Humble's liquid fuel research program. The company contracted for 50,000 acre-feet of water annually from the Yellowtail Reservoir for its proposed plant to convert coal to liquid fuels and other products.

PP&L revised the planned construction of the new fourth generating unit at the Dave Johnston generating plant. New plans are for a $44 million, 330-megawatt addition to be in service by mid-1972. West of Green River the company began constructing a $4 million facility which will supply both process steam and electric power to Allied Chemical Corp. The first of its kind to be built and operated by PP&L, the installation will use steam for power generation before delivery of the steam to Allied.

Natural Gas.—Marketed natural gas declined 3.3 billion cubic feet in quantity and $239,000 in value. At yearend, the State Oil and Gas Conservation Commission reported 749 active, producing gas wells, 8 more than at the end of 1966. The leading gas-producing counties were Sublette, Sweetwater and Fremont.

Beaver Creek, Fremont County; Greater LaBarge (including LeBarge and East and North LaBarge), Sublette County; and Worland, Washakie County, were again the principal producing gasfields with outputs of 16.8, 16.2, and 15.0 billion cubic feet, respectively.

Estimates of yearend reserves by the American Petroleum Institute (API) and the American Gas Association, Inc., (AGA) [4] placed the State gas reserves at 3.7 trillion cubic feet, a 2.5-percent increase over that of the previous year. Additions from new fields and new pools were 9.7 billion cubic feet; extension and revisions added 349.4 billion cubic feet.

On the basis of initial production the most important of the eight gas discoveries was the Shamrock Oil & Gas Corp. No. 1 UPRR Quealy well, Sweetwater County. The completed well, in sec 25, T 20 N, R 95 W, flowed 11.5 million cubic feet of gas and 130 barrels of distillate per day from the Almond formation (Cretaceous) at 9,450 to 9,468 feet. The new field, south of the Wamsutter gasfield, is near the pipeline of Colorado Interstate Gas Co.

One of the most significant exploratory wells in the State was the Mountain Fuel Supply Co. and Union Pacific Railroad Co. No. 19 Unit, Church Buttes field sec 8, T 16 N, R 112 W, Uinta County. Completed at yearend, the well was the second deepest drilled in Wyoming and the deepest producing well in the State. It was drilled to a total depth of 19,526 feet; casing was set at 18,754 feet; and the well plugged back to 18,666. Completion was from perforations at 18,050 to 18,200 feet in the Morgan formation (Pennsylvanian) for an initial daily potential of 6.4 million cubic feet of gas and 310 barrels of 48° API condensate. Earlier, the well was tested at a rate of 10.5 million cubic feet of nonflammable gas from the interval 18,313 to 18,431 feet. Established production at the field was from the Dakota formation (Cretaceous).

Carbon County had four gas discoveries —a new field, two new pays, and a new pool. Near the Colorado border Wolf Exploration Co. discovered the Smith Ranch field with its No. 1 Balta well which flowed 2.6 million cubic feet of gas per day from the Wasatch formation (Tertiary). The new pays were in the Diamond Ranch and Simpson Ridge fields; the new pool was in the Cow Creek field. Several indicated gas discoveries were incomplete at yearend.

Natural Gas Liquids.—Total natural gas liquids increased 4 percent in quantity and value. Yield of natural gasoline was 2.8 million gallons above that of 1966; output of LP gases was 7.7 million gallons higher. The increases resulted from plant construction and expansion completed the previous year. The 27 plants had a combined daily capacity of 2 billion cubic feet of gas. AGA and API estimates of natural gas liquids reserves [5] at yearend were 87.2 million barrels, an increase of 876,000 barrels.

True Oil Co., Casper, began operating its 8.5 million-cubic-foot-per-day plant at Coyote Creek, Crook County. The Glenrock plant of Cabot Corp. was dismantled and moved to Texas. The plant of Amax Petroleum Corp. at Boone Dome was

[4] 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, 1967. v. 22, May 1968, p. 125.

[5] Page 128 of work cited in footnote 4.

acquired by CRA, Inc. (formerly Cooperative Refinery Association), when the latter purchased the domestic holdings of Amax. Husky Oil Co. assumed the operation of the gasoline plant previously operated by Ralston Processing Associates, Inc.

Oil Shale.—In January the U.S. Department of the Interior proposed a five-point policy for developing oil shale in Wyoming, Colorado, and Utah. The policy proposed (1) action to clear title to public oil-shale lands burdened with mining claims; (2) possible exchanges of scattered private oil-shale lands for concentrated blocks of public land; (3) establishment of provisional leasing to permit private firms to do research and development; (4) cooperation between private industry, the Atomic Energy Commission (AEC), and the Department on testing underground nuclear explosions as a means for extracting shale oil; and (5) expanded research programs involving the Federal Geological Survey, Bureau of Mines, and Bureau of Land Management. Public response to the proposal, including hearings before a Senate committee, was varied—some people demanded Federal Government development of the oil shale; others urged private development; some wanted quick development; others urged a go-slow policy.

On May 7 Secretary Udall announced regulations governing oil-shale leasing. Provisions limited the initial leases to 5,120 acres and to 10-year terms, royalty rates ranging from 3 to 50 percent, and requirements that all research discoveries and

Table 6.—Oil and gas well drilling in 1967, by counties

County	Oil	Gas	Dry	Total	Footage
Exploratory completions:					
Albany	---	---	8	8	21,204
Big Horn	---	---	8	8	38,498
Campbell	34	---	90	124	1,013,471
Carbon	1	4	28	33	116,232
Converse	2	---	18	20	80,174
Crook	4	---	34	38	175,923
Fremont	5	---	18	23	104,035
Hot Springs	1	---	4	5	23,838
Johnson	4	---	10	14	159,804
Laramie	1	---	2	3	21,858
Lincoln	---	---	5	5	29,972
Natrona	2	---	33	35	133,617
Niobrara	---	---	9	9	46,568
Park	2	---	8	10	41,683
Sheridan	---	---	2	2	17,579
Sublette	2	1	12	15	67,072
Sweetwater	1	2	24	27	200,611
Uinta	---	---	2	2	9,588
Washakie	4	---	5	9	82,821
Weston	---	1	37	38	200,356
Total	63	8	357	428	2,584,904
Development completions:					
Albany	2	---	---	2	12,030
Big Horn	11	---	4	15	66,909
Campbell	26	---	23	49	366,229
Carbon	2	11	1	14	62,098
Converse	3	1	8	12	39,980
Crook	16	---	21	37	89,325
Fremont	52	2	5	59	239,026
Hot Springs	7	---	2	9	33,142
Johnson	4	---	3	7	87,051
Laramie	8	1	3	12	93,760
Lincoln	---	3	---	3	24,090
Natrona	77	3	8	88	187,512
Niobrara	2	1	7	10	32,279
Park	60	1	6	67	280,252
Sublette	6	7	9	22	108,790
Sweetwater	22	5	7	34	178,014
Washakie	5	---	4	9	45,892
Weston	28	1	19	48	151,329
Total	331	36	130	497	2,097,708
Total all drilling	394	44	487	925	4,682,612

Source: Committee on Statistics of Drilling, American Association of Petroleum Geologists.

patents be the property of the U.S. Government. Industry, in general, rejected the principles of sliding-scale royalty and disclosure of research developments; the governors of Wyoming, Colorado, and Utah joined in urging revisions of the regulations to make them more attractive to private development. At yearend the Department was analyzing comments and opinions from interested groups and individuals.

C. L. Jones Drilling Co., Rock Springs, was awarded a $20,772 contract for studies of high-pressure, 900° F, steam-injection techniques in previously fractured oil shale. The experiments, by the Federal Bureau of Mines near Rock Springs, were in shale that had been fractured by nitroglycerine; the hot steam was to retort the oil shale in place.

Petroleum.—Reversing the downward trend of the previous 3 years, production of petroleum at 136.3 million barrels was slightly higher than in 1966. Cumulative production to the end of 1967 was 2.9 billion barrels of oil. Petroleum output, 66 percent of total mineral-production value, was again the most valuable single mineral commodity.

Park County, with 25 percent of the production, again ranked first in the yield of crude oil. The greatest gain in output was in Campbell County where the increase was 24 percent as a result of the new discoveries in the northwestern part of the county.

The State Oil and Gas Conservation Commission reported 8,547 oil wells were producing at yearend, 113 more than in 1966. The Big Horn basin accounted for 44 percent of the production, 59.7 million barrels; the Powder River basin yielded 30 percent, 40.6 million barrels. The five leading oilfields remained unchanged in rank: Elk Basin, Park County, with output of 17.0 million barrels; Salt Creek, Natrona County, 13.7 million barrels; Oregon Basin, Park County, 10.9 million barrels; Hamilton Dome, Hot Springs County, 6.6 million barrels; and Grass Creek, Hot Springs County, 4.9 million barrels. A $2.5 million waterflood project was begun in the Patrick Draw field, Sweetwater County. The project, in the Monell Unit in the southern part of the field, was to include drilling of 25 productions wells, 6 injection wells, and 3 water wells, and conversion of 32 producing wells to injection wells. The northern part of the field already had a waterflood project underway.

Table 7.—Crude petroleum production, by counties

(Thousand 42-gallon barrels)

County	1966	1967	Principal fields in 1967 in order of production
Albany	559	446	Quealy.
Big Horn	7,931	7,455	Garland, Byron, Torchlight, Sage Creek, Bonanza.
Campbell	8,590	10,670	Timber Creek, Stewart, Little Mitchell Creek, M–D.
Carbon	2,999	2,785	Wertz, Rock River.
Converse	4,758	4,441	Glenrock South, Big Muddy.
Crook	5,755	4,690	Coyote Creek, Moorcroft West, Donkey Creek, Semlek.
Fremont	10,526	11,718	Beaver Creek, Winkleman, Steamboat Butte, Big Sand Draw, Sheldon Dome.
Goshen	8	7	Torrington.
Hot Springs	17,507	16,803	Hamilton Dome, Grass Creek, Little Buffalo Basin, Murphy Dome.
Johnson	9,208	7,860	Sussex, Reno, North Fork, Meadow Creek.
Laramie	592	605	Horse Creek, Golden Prairie.
Natrona	16,798	18,033	Salt Creek, Grieve Unit, Cole Creek.
Niobrara	901	760	Lance Creek, Little Buck Creek.
Park	31,912	33,536	Elk Basin, Oregon Basin, Frannie, Pitchfork.
Sheridan	448	409	Ash Creek South, Ash Creek.
Sublette	4,140	3,922	Hogsback, McDonald Draw, Birch Creek, Green River Bend.
Sweetwater	7,242	7,472	Lost Soldier, Patrick Draw, Arch Unit.
Uinta	[1] 57	[1] 45	Church Buttes.
Washakie	1,543	1,892	Cottonwood Creek, Hidden Dome.
Weston	2,996	2,763	Fiddler Creek, Osage, Skull Creek, Mush Creek.
Total	134,470	136,312	

[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.—Oil and gas discoveries in 1967

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks [1]
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Campbell County:												
Breen	No. 14–12 Breen.	Shell Oil Co	12	47 N	72 W	Minnelusa	10,719–10,741	10,915	251	------	Dec. 30, 1966	Pumped. New field.
Schoonover	No. 1–27 California Oil–Federal.	John H. Trigg Co.	27	48 N	76 W	Ferguson	7,247–7,254	7,507	65	------	Mar. 24	Pumped. New field. OWWO.
Wildcat	No. 1 Ewing	Davis Oil Co	28	50 N	70 W	Minnelusa	8,756–8,760	8,934	448	------	Feb. 17	Pumped. Combined with Rozet field.
Do	No. 1 Hamm	Davis Oil Co.-Petroleum, Inc.	20	51 N	69 W	----do------	7,952–7,978	8,155	291	------	Feb. 19	Pumped. Combined with Kuehn field.
Windmill	No. 26–1 USA	W. B. Osborn, Jr.	32	51 N	69 W	----do------	8,153–8,173	8,270	308	------	Aug. 1	Pumped. New field.
Whisler	No. 1 CW	Davis Oil Co.-Prenalta Corp.	35	51 N	70 W	----do------	8,304–8,316½	8,480	379	------	June 15	Do.
C–H	No. 1 Carson-Hamm.	Davis Oil Co	2	52 N	70 W	----do------	7,566–7,581	7,686	625	------	Jan. 30	Do.
Bullmarch	No. 21–29 Federal.	Bullion Monarch Co.	29	53 N	69 W	----do------	7,414–7,439	7,615	30	------	Oct. 10	Do.
M–D	No. 1 State	J.A. McRae-Thomas G. Dorough.	36	53 N	69 W	----do------	7,164–7,185	7,370	800	------	Jan. 25	Do.
Duck Creek	No. 1 Snyder	Shamrock Oil & Gas Corp.	6	55 N	69 W	Muddy	5,132–5,146	6,990	23	------	Aug. 12	Do.
Recluse	No. 1 U.S.-Fagerness.	Apache Corp	15	56 N	74 W	----do------	7,599–7,636	9,275	1,128	------	Aug. 31	Flowed. New field.
Ute	No. 15–4 Federal.	Husky Oil Co.-Depco, Inc.	4	57 N	72 W	----do------	6,404–6,414	6,913	27	------	Dec. 22	Pumped. New field.
Carbon County:												
Smith Ranch	No. 1 Balta	Wolf Exploration Co.	17	12 N	93 W	Wasatch	1,138–1,142	1,509	------	2,630	June 16	Flowed. New field.
Cow Creek	No. 6–2–13 Federal.	U.S. Natural Gas Corp.	13	16 N	93 W	Mesaverde	3,237–3,247	4,297	------	1,984	June 21	Flowed. New pool. OWWO.
Diamond Ranch.	No. 1–26 State	Post Petroleum-HLM Drilling Co.	26	20 N	78 W	Muddy	5,532–5,552	5,840	------	225	Mar. 17	Pumped. New pay.
Simpson Ridge	No. 1 UPRR-Chace.	Kimbark Exploration Ltd. and others.	17	21 N	80 W	Dakota	11,166–11,215	13,038	33	3,500	July 8	Flowed. New pay.

See footnotes at end of table.

Table 8.—Oil and gas discoveries in 1967—Continued

County and field	Well	Operator	Location			Producing formation	Gross producing interval (feet)	Total depth (feet)	Initial production		Date of completion	Remarks [1]
			Section	Township	Range				Barrels of oil per day	Thousand cubic feet of gas per day		
Converse County:												
Morton	No. 1 Morton Ranch.	E. G. Rodman	20	32 N	70 W	Mesaverde	2,574–2,590	2,987	16	------	June 25	Pumped. New field.
Crook County:												
R. T.	No. 1 R. T. Federal.	Davis Oil Co	19	50 N	68 W	Minnelusa	7,805–7,827	7,920	104	5	June 12	Do.
Wood	No. 1 Wood	United States Smelting, Refining and Mining Co.	14	51 N	68 W	Dakota	5,312–5,318	6,963	75	------	Nov. 5	Pumped. New pay.
Fremont County:												
Pavillion, Northwest	No. 1 Northwest Pavillion-8	Sinclair Oil & Gas Co.	8	4 N	2 E	Fort Union	5,024–5,230	7,500	------	158	May 17	Flowed. New field.
Maverick Springs, Southeast.	No. A–1–X Tribal.	Bagdad Oil Co.-Burks & Burns.	36	6 N	2 W	Phosphoria	1,334–1,344	1,623	85	------	Jan. 25	Pumped. New field.
Travis	No. 1 Federal	Travis Oil Co	13	33 N	90 W	----do------	762–812	812	37	------	Dec. 17	Do.
Park County:												
Garland	No. 17 Harriman.	Farmers Union Central Exchange, Inc.	11	56 N	98 W	Cloverly	3,173–3,179	3,718	105	500	Aug. 1	Flowed. New pay.
Do	No. 15 Harriman.	Farmers Union Central Exchange, Inc.-Mule Creek Oil Co., Inc.	14	56 N	98 W	Morrison	3,499–3,501 3,510–3,512 3,514–3,516	3,850	85	------	Feb. 8	Pumped. New pay.
Sublette County:												
Russ	No. 1 Federal	Fundamental Oil Corp.	12	27 N	111 W	Almy	5,438–5,448	5,851	20	------	Apr. 18	Pumped. New field.
Willow Lake	No. 2 Unit	Robert E. Skinner.	20	36 N	109 W	Knight	315–350	1,040	1	92	Nov. 11	Flowed, New field. OWDD.
Sweetwater County:												
Round Table	No. 24–1 Federal-Robinson.	J.M. Huber Corp.–Stuarco Oil Co., Inc.	24	12 N	96 W	Fort Union	4,326–5,321	5,643	81	------	July 21	Pumped. New field.
Wamsutter	No. 1 UPRR Quealy.	Shamrock Oil & Gas Corp.	25	20 N	95 W	Almond	9,450–9,468	10,143	------	11,500	Nov. 30	Flowed. New field.
Washakie County:												
Marshall	No. 1 UTP Texaco USA.	Union Texas Petroleum Corp.	19	48 N	91 W	Phosphoria	9,740–9,754	10,101	216	86	July 27	Pumped. New field.

[1] OWWO Old well workover; OWDD Old well drilled deeper.

Source: Petroleum Information Corp., 1967 Résumé, Oil and Gas Operations in the Rocky Mountain Region.

The eight refineries in the State processed 39.5 million barrels of crude oil: 37.7 million were from Wyoming sources; 1.7 million were from out of State, mostly Colorado. Of the 100.7 million barrels shipped out of State, 29.5 million went to Indiana, 18.3 million to Montana, 11.1 million to Colorado, and 10.2 million to Illinois. Crude oil prices were raised 5 cents per barrel on much of the oil in the State; prices on sour crude reached $3.00 per barrel for 40° to 44.9° API oil.

The API and AGA [6] estimated that as of January 1, 1968, the crude oil reserves would be 1.0 billion barrels, a decrease of 29.0 million barrels (2.7 percent). Additions due to revisions and extensions were 98.1 million barrels; those from new fields and new pools were 11.6 million.

Overall drilling was slightly greater than in 1966. The increase resulted from more development drilling (5.7 percent higher); exploratory drilling, however, was down 3.8 percent.

Of the 497 development wells, 367 were successful; about 42 percent were in the Powder River basin, and 20 percent were in the Big Horn basin. Exploratory drilling, 17 wells below the record high of 1966, remained at a high rate of activity. The success ratio, 16.6 percent, was much better than the 13.7 percent of the previous year. Campbell County, with 27.4 percent of its exploratory wells successful, led in wildcat drilling and number of successes. The discovery of Recluse field, along with that of Bell Creek field in Montana, spurred exploratory activity in northeastern Wyoming to the highest level in recent years; most of the activity was in Campbell County.

Nine oil- and gas-lease sales on public domain and two on Indian lands were held. The nine sales on public lands totaled 21,017 acres for which bonuses of $163,218 were received, an average of $7.77 per acre. The two Indian land sales, by the Wind River Agency, resulted in the leasing of 6,575 acres for a total bonus of $57,140, an average of $8.69 per acre. Highest bid was $101.75 per acre for public lands offered in the sale of May 16; highest bid for Indian lands was $27.44 per acre offered on October 10.

The most significant oil discovery was the Recluse field, in northwestern Campbell County. The discovery well, Apache Corp. No. 1 U.S.-Fagerness, sec 15, T 56 N, R 74 W, was completed flowing 1,128 barrels of oil per day from the Muddy sandstone (Cretaceous) from the interval 7,599 to 7,636 feet. By yearend, the field had production totaling 236,743 barrels.

The discovery of Recluse field occurred at about the time the full significance of the very important Bell Creek field in Montana was realized. Shortly thereafter, a long (7,500 feet) extension well was drilled at the Kitty field, T 50 N, R 73 W; the first well blew out and burned for 9 days before being extinguished; however, the twin well, drilled to relieve the pressure and control the first well, was successfully completed for a daily gage of 1,640 barrels of oil from the Muddy sandstone. These three events initiated a surge of exploration activity in the Wyoming and Montana parts of the northern Powder River basin, making the area the most active in the entire Rocky Mountain region.

Bell Creek Pipeline Co. and The Permian Corp. completed in 1967 a 6-inch crude-oil pipeline from Bell Creek field to Lightning Flats. Construction was begun by Western Oil Transportation Co., Inc., a subsidiary of The Permian Corp., of a 115-mile, 10 ¾-inch crude-oil pipeline from Bell Creek to the Reno field in Wyoming; the line, to be completed in February 1968 at a cost of $3.25 million, would include a branch line to the Kitty field. Initial designed daily capacity of the line was 20,000 barrels.

Early in the year the M–D field, Campbell County, was discovered when the J. A. McRae and Thomas G. Dorough No. 1 State, sec 36, T 53 N, R 69 W, was completed, pumping 800 barrels of oil per day from the interval 7,164 to 7,185 feet in the Minnelusa formation (Pennsylvanian). Davis Oil Co. completed its No. 1 Carson-Hamm to discover the C–H field; the well, in sec 2, T 52 N, R 70 W, gaged 625 barrels per day from the Minnelusa formation from the interval 7,566 to 7,581 feet.

In August, Husky Oil Canada, Ltd., announced plans for the purchase of Frontier Refining Co. The sale was to include the Frontier refinery at Cheyenne; plans called for Husky to build a 40,000- to 50,000-barrels-per-day refinery east of the existing Frontier refinery.

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[6] Pages 30–31 of work cited in footnote 4.

On June 1 Marathon Pipe Line Co. assumed operation of the 1,222-mile Platte Pipe Line Co. system. The jointly owned 20-inch crude-oil pipeline links fields in Wyoming (starting at Byron, in the Big Horn basin) to the refining complex at Wood River, Ill.

NONMETALS

A slight decrease was recorded in total value of nonmetallic commodities—cement, clays, feldspar, gem stones, gypsum, lime, phosphate rock, pumice, sand and gravel, sodium carbonate, sodium sulfate, stone, and vermiculite.

Cement.—Monolith Portland Midwest Co., the only producer in the State, mined limestone and sandstone for cement production. Output of portland cement declined 18 percent in quantity and 13 percent in value. Output of masonry cement increased 20 percent in quantity and 5 percent in value.

Clays.—A decrease of 4 percent in output and 10 percent in value was recorded for bentonite, fire clay, and miscellaneous clay. Bentonite production decreased from 1.5 million tons valued at $15.8 million to 1.4 million tons valued at $14.2 million. Bentonite for pelletizing iron concentrates continued to lead the list of uses with 35 percent, followed by the foundry industry with 28 percent; rotary drilling, 23 percent; exports, 7 percent; animal feed, 2 percent; reservoir sealant, 1 percent; and other various uses, 4 percent. Output of fire clay and miscellaneous clay decreased 61 percent and 3 percent, respectively. All fire clay was used for building brick. Miscellaneous clay uses were brick, constituting 82 percent of the total, followed by vitrified sewer pipe, 17 percent, and other heavy refractories, 1 percent.

Bentonite producing companies, in order of output, were American Colloid Co.; Ashland Chemical Co., formerly Archer Daniels Midland Co.; Dresser Minerals Division, Dresser Industries, Inc.; Wyo-Ben Products, Inc.; Baroid Division, National Lead Co.; Black Hills Bentonite Co.; International Minerals & Chemical Corp.; and Benton Clay Co., Inc.

A new $1.5 million bentonite plant was put on stream in September by IMC. The highly automated process of drying, milling, and storage is requlated by a central control system. The most significant innovation of the operation is a fluid-bed-type dryer which dries the clay by circulating temperature-controlled air around the clay particles rather than by the conventional agitation of a rotary dryer. The process improves the uniformity of clay properties and prevents scorching. From the dryer the clay moves automatically to either a hammer mill for granular production or to roller mills for fine-grade production. The separate production circuit provides a better control of the respective clay properties.

Wyo-Ben Products, Inc., began mining a 10-foot-thick vertical bed of bentonite. The bed, opened for 1½ miles in the Frontier formation, was to be mined in 10- to 12-foot benches by crawler tractor equipped with blade and ripper and a 30-yard scraper. A dragline placed on the bentonite bed will load directly into haul trucks below the roadway cut. The benchcuts will be carried to a depth of 55 feet where the bed pinches out, maintaining a 1:5 slope on the high wall.

International Pipe and Ceramics Corp. mined fire clay in Uinta County. Miscellaneous clay was mined by The Lovell Clay Products Co. in Big Horn County; Sheridan Block, Brick, & Tile Co. in Sheridan County; and Interstate Brick Co. in Uinta County.

Feldspar.—Overall output of feldspar increased almost twofold. A fourfold increase in feldspar output by Rocky Mountain Aggregates, Inc., from Albany County, for use in precast stone, offset a large decrease in output by IMC from the Morning Dew mine in Natrona County; output from the Morning Dew was used for porcelain and dental bases.

Gypsum.—Although gypsum output increased 10 percent over that of 1966, value decreased 2 percent. Gypsum near Woods Landing was mined by Wyoming Construction Co. for Monolith Portland Midwest Co. in Laramie. Gypsum Division, Georgia-Pacific Corp. (G-P) of Portland, Oreg., acquired the assets of Gypsum Products of America; the ore deposits and nearly completed processing plant were included in the acquisition. G-P completed construction of the plant, installed a gas pipeline, and began producing at approximately one-third capacity on November 13; total capacity was estimated at 80 million square feet of plasterboard

per year. In Park County, Bighorn Gypsum Co. increased output of gypsum for use in manufacturing plasterboard; shipments of gypsum milled by Cody Sulphur Products Co. from the 1955 Wyoming Gulf Sulphur Corp. stockpile declined slightly.

Lime.—Value of quicklime manufactured was $66,000 greater than that of 1966. The Great Western Sugar Co., at Lovell, and Holly Sugar Corp., at Torrington and Worland, produced quicklime for use in refining beet sugar.

Phosphate Rock.—Output of phosphate rock by San Francisco Chemical Co., the only producer in the State, declined 5 percent. Ore produced in Utah also was processed at the company-owned plant in Lincoln County. Susquehanna-Western, Inc., a subsidiary of The Susquehanna Corp., was the successful bidder for an additional 7,000 acres of Federal land in the South Pass area, bringing the total acreage under lease to almost 15,000 acres.

Sand and Gravel.—Production and value of sand and gravel increased 14 percent and 10 percent, respectively; the average value decreased to $1.01 per ton from $1.04 in 1966. Producers reported that 62 commercial operations yielded 14 percent of the total output in 20 counties; the remainder was produced by 137 Government-crew-and contractor operations in every county. Ninety-eight percent of the sand and gravel was prepared for use by washing, crushing, or screening. Uses of sand and gravel were 94 percent for road construction, 4 percent for building, and 2 percent for fill and miscellaneous uses. Major commercial producers reporting output were, in order of quantity, Boatright-Smith; McGarvin-Moberly Construction Co.; Casper Concrete Co.; Kylander Construction; Yeoman Construction Co., Inc.; and Reeves, Inc.

Road construction contracts[7] awarded by the State for 1967 totaled $37.7 million—$23.8 million for the Interstate Highway System, $10.1 million for Federal-Aid Primary and Secondary (ABC) roads, and $3.8 million for roads financed by the State. Under the 1967 Interstate program[8] 30.3 miles of road were opened to traffic, bringing the total opened since July 1, 1956, to 566.8 miles. Total designated mileage for the State was adjusted to 909.2 miles.

Table 9.—Sand and gravel production in 1967, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Albany	323	$325
Big Horn	241	244
Campbell	250	186
Carbon	863	866
Converse	694	694
Crook	186	186
Fremont	438	441
Goshen	133	133
Hot Springs	22	25
Johnson	396	385
Laramie	173	153
Lincoln	344	347
Natrona	1,440	1,495
Niobrara	23	23
Park	351	381
Platte	142	143
Sheridan	449	455
Sublette	154	145
Sweetwater	430	477
Teton	214	226
Uinta	623	615
Washakie	191	205
Weston	87	89
Yellowstone	14	14
Total	8,181	8,253

Sodium Carbonate and Sulfate.—Essentially no change was recorded in the production of sodium carbonate (trona). H.R. 208 "Right of Eminent Domain," passed by the Wyoming legislature, provided that operators of mining properties have a right-of-way, up to 250 feet wide, under or through another owner's property for underground passages or tunnels if the properties have common section corners. Opponent to the bill was Union Pacific Railroad Co.; proponents were Allied Chemical Corp., Olin Mathieson Chemical Corp., Texas Gulf Sulphur Co., Phillips Petroleum Co., Wyandotte Chemical Corp., Diamond Alkali Co., Church & Dwight Co., Inc., and Phiadelphia Quartz Co.

Under the Public Sale Act of 1964, the town of Green River purchased title to 70 acres of public domain land that had been withdrawn for oil shale and sodium compounds and issued $25 million of tax-exempt industrial bonds for construction of all facilities, mine, and processing plant of Allied Chemical Corp., which, in return, signed a long-term lease with Green River.

[7] Engineering News-Record, State Highway Department's Construction Plans for 1968 . . . and Budgets for Maintenance: Highway Spending Goes for a New Record Despite Federal Aid Cuts. v. 180, No. 14, Apr. 4, 1968, pp. 68–87.

[8] Federal Highway Administration. Quarterly Report on The Federal-Aid Highway Program, Dec. 31, 1967. Press Release FHWA–118, Feb. 14, 1968.

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	1966		1967	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	201	$258	131	$186
Paving	105	130	95	115
Fill	27	34	48	52
Total	333	422	274	353
Gravel:				
Construction:				
Building	416	511	156	221
Paving	580	715	627	633
Fill	115	123	41	25
Miscellaneous	78	84	52	44
Total	1,189	1,433	876	923
Total sand and gravel	1,522	1,855	1,150	1,276
Government-and-contractor operations:				
Sand:				
Building	3	3	-----	-----
Paving	2,716	2,716	2,921	2,921
Fill	-----	-----	9	2
Total	2,719	2,719	2,930	2,923
Gravel:				
Building	-----	-----	3	3
Paving	2,936	2,912	4,086	4,042
Fill	10	10	12	9
Total	2,946	2,922	4,101	4,054
Total sand and gravel	5,665	5,641	7,031	6,977
All operations:				
Sand	3,052	3,141	3,204	3,276
Gravel	4,135	4,355	4,977	4,977
Total	7,187	7,496	8,181	8,253

All mineral rights were retained for the Government by the Federal Bureau of Land Management.

FMC Corp. planned sinking a fourth shaft at its Westvaco complex. Largest in the complex, the new shaft would improve mine ventilation and handle expanding ore requirements. The company increased loading and shipping facilities during the year. The chief improvement was the addition of 32 all-aluminum railroad cars with a load capacity of 130 tons each, an increase of 30 tons over that of older cars. Each car is 62 feet 7 inches long, 10 feet 4 inches wide, and 15 feet 5 inches high. Loading is accomplished through 12 circular hatches in the roof, and discharge is through 4 gates in the bottom of the car.

Completed in 1966, the new third refinery unit of Stauffer Chemical Company of Wyoming had an additional, unused production capacity of 150,000 tons built in.

TGS awarded a contract to Winston Brothers Co. for sinking a 16-foot-diameter shaft 1,400 feet on its lease near Green River. TGS also retained Stearns-Roger Corp. of Denver, Colo., for design and specifications of its future processing facilities.

Shipments of natural sodium sulfate by William E. Pratt from saline-lake deposits in Natrona County nearly doubled.

Stone.—Production and value of stone from 58 operations in 17 counties decreased 11 and 7 percent, respectively. All stone produced was crushed and broken, except for 1 percent, which was dimension limestone, sandstone, and miscellaneous stone used for constructing buildings and decorative uses. Crushed and broken limestone accounted for 57 percent of the stone production; crushed and broken granite

for 36 percent; and crushed and broken miscellaneous stone, sandstone, and basalt and crushed marble for 6 percent. Leading counties in order of stone output were Laramie, Platte, Albany, Teton, Sweetwater, and Sheridan. Crushed limestone was produced in Albany, Crook, Laramie, Platte, Sweetwater, and Teton Counties, and broken limestone in Laramie and Platte Counties. Uses were for cement, lime, railroad ballast, concrete, road construction, riprap, mineral foods, and decorative purposes. Dimension limestone was produced in Platte County for building construction. Granite from Laramie County was used for railroad ballast, riprap, concrete, and road construction; a small quantity quarried in Carbon County was used for riprap. Miscellaneous stone was produced in Goshen, Laramie, Park, Sheridan, and Sweetwater Counties; uses were for riprap, concrete, road construction, railroad ballast, building construction, and rubble. Sandstone was produced in Albany, Carbon, Natrona, Sheridan, and Sublette Counties; uses included riprap, making cement, precasting, and building construction. Basalt from Fremont County was used for riprap, and marble from Platte County for precasting.

Table 11.—Stone production in 1967, by counties

County	Short tons	Value
Albany	218,962	$371,360
Big Horn	2,618	5,236
Carbon	5,275	10,820
Converse	490	980
Crook	6,560	10,900
Fremont	8,245	16,740
Goshen	W	W
Johnson	38	76
Laramie	622,679	1,205,028
Natrona	1,182	2,364
Park	W	W
Platte	296,278	566,301
Sheridan	14,861	17,306
Sublette	W	W
Sweetwater	25,500	51,125
Teton	W	W
Uinta	5,886	11,772
Undistributed	37,617	104,688
Total	1,246,191	2,374,696

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

Sulfur.—Production of elemental sulfur, recovered from hydrogen sulfide-bearing natural gas, decreased 14 percent in quantity; shipments decreased from 105,000 tons valued at $1.6 million to 92,300 tons valued at $2.0 million. The increase in value was due to higher sulfur prices, approximately $6.00 per ton, in effect during the last half of the year. Sulfur was recovered by the modified Claus process by Sinclair Refining Co. in Carbon County, Atlantic Richfield Co. and Pan American Petroleum Corp. in Fremont County, Pan American Petroleum Corp. in Park County, and TGS in Washakie County; by the Claus process by Pervin & Gertz, Inc., in Park County; and the Webb process by Husky Oil Co., formerly Ralston Processors Associates, Inc., in Park County.

In October TGS closed its sulfur-recovery plant at Worland because of the gradual depletion of sour-gas reserves. Western Nuclear, Inc., began constructing a 5-ton-per-day sulfur-recovery plant adjacent to Northern Utilities Co. in Sand Draw to utilize the sour gas previously flared off by Northern. Production will be hauled to Western Nuclear plants in Riverton for conversion to sulfuric acid. Two of the three Western Nuclear plants were purchased from Susquehanna-Western Inc., in February.

METALS

A slight decrease was recorded for the total value of the metal commodities; an increase in uranium was more than offset by decreases in iron ore and vanadium.

Gold.—The Federal Geological Survey announced a mass, estimated at 50 cubic miles, of gold-bearing sandstone and conglomerate in the Jackson Hole area. Of 6,000 samples collected in the area, the first 1,200 samples, determined by the cyanide-atomic-absorption method, returned $0.06 to $0.35 in gold per cubic yard; some samples assayed $9.60 per ton. Subsequent reconnaissance drilling and bulk sampling of the area by the Bureau of Mines were not encouraging economically.

Iron Ore.—Output decreased 6 percent in quantity and 3 percent in value; all producers reported decreased production. Taconite deposits in the Bradley Peak area of the Seminoe Mountains were in the 100-million-ton range and amenable to beneficiation by modern technology; deposits in the Owl Creek Mountains may prove as large. Development of the deposits appear

to depend on an economical direct-reducing process for a highly concentrated, pelletized, furnace feed combined with development of lower cost transportation. In Albany County, the Bureau of Mines also estimated an excess of 100 million tons of titaniferous magnetite that would, however, require additional beneficiation research before becoming an economical source of iron.

Uranuim.—A 1-percent increase, both in output and value, was recorded for uranium. Recoverable uranium oxide, from 1.3 million tons of crude ore mined at 45 operations in five counties, was 4.7 million pounds valued at $37.2 million; mined ore was processed at five mills in Wyoming and one mill in South Dakota.

With over 60,000 claims staked in 1967, claim staking for uranium was the highest since the early 1950's. North of Douglas, more than 10,000 claims were staked by large and small companies active in uranium mining. Among the larger companies involved were Kerr-McGee Corp., Humble Oil & Refining Co., Homestake Mining Co., and Union Pacific Railroad Co. At least 40 drilling rigs were used in the area for validation and exploration work, drilling to over 700-foot depths.

More than 6,000 claims were filed in Fremont County during October; yearly total for the county was nearly 20,000 claims. Three persons filed more than 2,400 claims in 1 day. Of the 6,000 claims, 1,450 were lode claims and 986 were placer-type claims covering a quarter section of land each. Most of the claims were in the Gas Hills area.

Over 8,000 claims were filed in Natrona County; 553 were filed in 1 day in June; over 1,700 were filed during October. In December, 210 claims were filed for an area 10 miles northwest of Hiland. In Sweetwater County, Western Nuclear filed 745 lode claims, Kerr-McGee 366, and Bill Harris 310 claims; yearly total was 12,120 claims. Climax Uranium Co. Unit, Amax Nuclear Division, American Metal Climax, Inc., filed 450 claims in the Copper Lake area of Albany County. In Weston County, 287 claims were recorded in a 4-month period. Both Niobrara and Crook Counties were behind on recording uranium filings at yearend; in 1 day, over 800 claims were received in Niobrara County. Exploration diamond, rotary, and percussion drilling for validation and exploration totaled over 4.8 million feet for the year.

The Shoshone and Arapahoe Indian Councils opened bids for 10 tracts of land on the Wind River Indian Reservation. Bidders were Continental Oil Co. (Conoco) on tract 1 at $0.33 per acre for 21,000 acres; the Tidewater Oil Co.-Getty Oil Co.-Skelly Oil Co. combination at $2.00 per acre and Conoco at $0.33 per acre on tract 2, 22,600 acres; Newmont Exploration, Ltd., on tract 3 at $0.45 per acre for 20,100 acres; Climax Uranium Co. on tract 4 at $1.63 per acre for 20,300 acres; and Tidewater-Getty-Skelly at $0.93 per acre and Conoco at $0.33 per acre on tract 6, 22,600 acres. No bids were received for tract 5, 22,800 acres; tract 7, 22,500 acres; tract 8, 23,000 acres; tract 9, 23,000 acres; or tract 10, 22,800 acres. Prospecting permits were to be awarded to the highest bidder; successful holders were to have 2 years to exercise option to lease 2,560 contiguous-acre groups at $1 per acre. The tribes would receive royalties from any mineral production on leased Reservation lands.

Federal American Partners phased out the Sagebrush 3-Tablestake 1 pits in the Gas Hills and were to phase out the Loco C and D pits by late January 1968. The company was to start stripping the new Clyde A–2C pit in November on a double-shift basis. Federal Resources Corp. announced that Federal American contracted to supply Babcock & Wilcox Co. of Lynchburg, Va., with more than $4.5 million of uranium concentrate to be delivered in increments from mid-1967 to mid-1970; the contract, in conjunction with shipments to AEC, was to continue until 1970. Under a private contract until May 1968, or until 50,000 tons of ore was delivered, Federal American was to purchase uranium ore, not under AEC contracting, from Green Mountain Uranium Corp. which is gradually phasing out its mining property in the Crooks Gap area by retreating, pulling pillars, and recovering a number of small pockets of ore left during previous mining. Part of the concentrate recovered under the contract was to be used to fulfill the Babcock & Wilcox Co. sale.

From the merger with Four Corners Oil & Minerals Co., Consolidated Oil & Gas, Inc., acquired 5,600 acres of uranium

claims in the Shirley basin. The company also had a 5-percent royalty on 2,500 acres of claims owned by Kerr-McGee. Consolidated announced the discovery of a low-grade uranium deposit at 12- to 185-foot depths in the Poison Spider area. However, exploration drilling on 17 of 6,500 acres owned by the company had not delineated the ore body.

Petrotomics Co. awarded a $1.5 million contract to Stearns-Roger Corp. of Denver, Colo., to double the size of its uranium processing mill in the Shirley basin area by late 1967. The company received two 100-ton, 900-horsepower, diesel-electric, wheel-drive trucks, the first of six under a $1 million order to Unit-Rig Co. of Tulsa, Okla. Also ordered, for delivery in December, was a 17-cubic-yard shovel to be used for loading the new truck fleet. Tidewater Oil Co. core drilled more than 1.5 million feet to locate and evaluate uranium reserves in the Shirley basin. Kerr-McGee has obtained over 6,000 acres of uranium reserves in the Gas Hills area over the last 2 years.

The Japanese Government authorized Mitsubishi Metal Mining Co. to expend $200,000 to prospect a joint 14,000-acre plot with Rio Algom Corp. in the Shirley basin. If an ore body of 0.2 percent U_3O_8 were found in sufficient quantity, Mitsubishi and Rio Algom were to construct a 1,000-ton-per-day mill to process the ore.

Mining and Metals Division, Union Carbide Corp., contracted with S. S. Mullens of Seattle, Wash., to strip, on a double-shift basis, 6 million cubic yards of waste from a large pit immediately adjacent to and west of Federal American Partners Loco C and D pits; the stripping was to be completed by December 1967. Some small ore bodies, encountered during stripping, were mined by Union Carbide; Union Carbide was to mine the main ore body.

Utah Construction & Mining Co. concluded two more contracts for uranium concentrates totaling more than 1.95 million pounds. One contract, with Sacramento Municipal Utility District, called for shipments ranging from 950,000 pounds minimum to 1.1 million pounds maximum during 1971. The second contract, with General Electric Co. (GE), was for delivery of 1 million pounds during 1972. This was the third contract with GE and brought the total purchased by GE to 8 million pounds for delivery between October 1968 and December 1975; the contract, signed in March, called for 1 million pounds per year from 1971 to 1975. With the new contracts, Utah Construction's backlog for sales of uranium concentrate totaled nearly 13 million pounds, of which 23 percent was committed to AEC agreements until 1970; the remainder was to industrial users. The first shipment of uranium concentrate to Nordostschweizersche Kraftwerke AG, Baden, Sweden, was made in the latter part of March. U.S. Patent 3,309,140 "Leaching of Uranium Ore In-Situ" was granted to John

Table 12.—Contracts for private uranium sales in Wyoming

Company/seller	Sold to—	Pounds	Value	Delivery date
Federal American Partners.	Babcock & Wilcox Co	---	$4,800,000	1970
	Combustion Engineering, Inc	---	9,000,000	1970–71
Union Carbide Corp., Mining and Metals Division	Northern States Power Co. (Minneapolis).	700,000	---	[1]
	Westinghouse Electric Corp	4,000,000	---	1970–73
Utah Construction & Mining Co., Lucky Mc Division.	General Electric Co	1,700,000	---	1969–70
		5,000,000	---	1971–75
		1,000,000	---	1972
	Nordostschweizersche Kraftwerke AG.	750,000	---	[2]
		---	3,250,000	1969
	Oskarshamnsverkets Kraftgruppe Aktiegelag.	765,000	3,250,000	[3] 1969
		765,000	---	[3]
	Sacramento Municipal Utility District.	1,100,000	---	1971
Western Nuclear, Inc	Combustion Engineering, Inc	3,500,000	---	1971–73
	Philadelphia Electric Co	300,000	---	1968
	Public Service Electric & Gas Co. (Philadelphia).	500,000	---	1968
	Westinghouse Electric Corp	1,000,000	---	1970

[1] To begin 1970. [2] Completed 1967. [3] 85 percent completed end of 1967.
Source: The Riverton Ranger, v. 62, No. 79, June 20, 1968, p. 1A.

Gardner and M. I. Ritchie, who assigned the patent to Utah Construction for use in the Shirley basin. The U.S. District Court of Cheyenne upheld the $14 million merger of Utah Construction and Lucky Mc Uranium Corp., a suit which was instituted by W. G. Knauff of Denver, Colo., in 1962.

Western Nuclear signed the fourth and largest contract for delivery of uranium concentrates, which will bring the total backlog of sales to $64 million through 1973. The new contracts with Combustion Engineering, Inc., called for $26 million of uranium concentrate to be delivered in 1971–73.

Contracts for uranium concentrate sales to the end of 1967 are shown in table 12. Production from Western Nuclear's Golden Goose Shaft was begun from five levels; most of the ore coming from sub-level development. The third level of the shaft, connected to the Reserve shaft of Continental, provided an extra escapeway for both shafts. Western Nuclear closed the D–3 underground workings because of hazards but planned on returning to the area later. Salvage operations at the Spook mine were under lease to Malcolm Reeves prior to closing by Western Nuclear. The company began heap leaching of the 300,000-cubic-yard, low-grade stockpile at the Day-Loma and Frazier-Lamac pits. The portable solvent-extraction unit consisted of interconnected wooden laundry feeds, fiber-glass tanks, and lines. The piles were crushed systematically to avoid channeling during leaching. Western Nuclear entered into a joint exploration program with Sohio Petroleum Co. on 10,000 acres in the Powder River basin.

Vanadium.—The quantity and value of vanadium recovered as a byproduct of Wyoming uranium ores processed in the mill of Mines Development, Inc., at Edgemont, S. Dak., decreased considerably. The large decrease was due mainly to the closing of the Hauber mine by Homestake Mining Co.; also, no production was reported from Converse County for 1967.

Table 13.—Principal producers and processing plants in 1967 [1]

Commodity and company	Address	Type of activity	County	Remarks
Cement:				
Monolith Portland Midwest Co.[2]	Box 65677, Glassell Station Los Angeles, Calif. 90065.	Plant	Albany	Wet process; one rotary-kiln cement plant.
Clays:				
American Colloid Co	5100 Suffield Court Skokie, Ill. 60077.	Three open pit mines and 2 plants.	Big Horn, Crook, Weston.	Drying, grinding, screening, and air-separation plants at Lovell and Upton.
Ashland Oil & Refining Co., Ashland Chemical Division.	Box 2458 Columbus, Ohio 43216.	Two-open pit mines and plants.	Crook and Weston	Drying, grinding, screening, and air-separation plant at Colony and Upton.
Black Hills Bentonite Co	Mills, Wyo. 82644	Open pit mine and plant.	Johnson	Drying, grinding screening, and air-separation plant at Casper.
Dresser Industries Inc. Dresser Minerals Division	Box 6504 Houston, Tex. 77005.	----do	Big Horn	Drying, grinding, screening, and air-separation plant.
International Minerals & Chemical Corp., Industrial Chemicals Division.[3]	Administration Center Old Orchard Road Skokie, Ill. 60079.	----do	Crook	Fluid-bed-type dryer, grinding, and screening plant.
National Lead Co., Baroid Division	Box 1675 Houston, Tex. 77001.	Two open pit mines and plant.	Crook and Weston	Drying, grinding, screening, and air-separation plant at Colony.
Wyo-Ben Products, Inc	Box 1979 Billings, Mont. 59103	Open pit mine and plant.	Big Horn	Drying, grinding, screening, and air-separation plant.
Coal:				
The Kemmerer Coal Co	Frontier, Wyo. 83121	Two strip mines and plant.	Lincoln	Crushing and oil treatment plant.
Pacific Power & Light Co	920 SW. 6th Avenue Portland, Oreg. 97204.	Strip mine and plant.	Converse	Crushing plant.
Feldspar:				
Rocky Mountain Aggregates, Inc.[4]	Box 771 Golden, Colo. 80402.	Open pit mine	Albany	
Gypsum:				
Big Horn Gypsum Co	Box 590 Cody, Wyo. 82414.	Open pit mine and plants.	Park	Crushing, grinding, and screening plant; calcining equipment; wallboard plant.
Iron ore:				
United States Steel Corp., Western Ore Operations.	Lander, Wyo. 82520	Open pit mine and plant.	Fremont	Agglomerator.
CF&I Steel Corp	Box 316 Pueblo, Colo. 81002.	Underground mine and mill.	Platte	Beneficiation mill.
Lime:				
The Great Western Sugar Co.[4]	Box 5308 Denver, Colo. 80217.	Kiln	Big Horn	Shaft kiln at beet-sugar plant at Lovell.
Holly Sugar Corp	Holly Sugar Bldg., Colorado Springs, Colo. 80902.	Two kilns	Goshen and Washakie.	Shaft kilns at beet-sugar plants at Torrington and Worland.
Phosphate rock:				
San Francisco Chemical Co	Drawer F. Montpelier, Idaho 83254.	Open pit mine and plant.	Lincoln	Washing and beneficiation plant.
Sand and gravel (commercial):				
Boatright-Smith	Box 1129 Casper, Wyo. 82202.	Five pits and four plants.	Campbell, Johnson, Natrona.	One portable crushing and screening plant.
Casper Concrete Co	1525 East F Street Casper, Wyo. 82601.	Pit and plant	Natrona	Stationary crushing and screening plant.

Table 13.—Principal producers and processing plants in 1967 [1]—Continued

Commodity and Company	Address	Type of Activity	County	Remarks
Sand and gravel (commercial):—Continued				
Kylander Construction	Powell, Wyo 82435	----do----------	Park----------	Portable crushing and screening plant.
McGarvin-Moberly Construction Co	1509 Coburn Avenue Worland, Wyo. 82401.	Five pits and plant.	Carbon, Fremont, Hot Springs, Niobrara, Park.	Do.
Reeves, Inc	Box 389 Buffalo, Wyo. 82834.	Pit and plant------	Johnson----------	Do.
Yeoman Construction Co., Inc.[5]	Box 880 Laramie, Wyo. 82070.	Two pits and plants.	Albany----------	Two stationary crushing and screening plants.
Sodium carbonate:				
FMC Corp	Box 872 Green River, Wyo. 82935.	Open pit mine and refinery.	Sweetwater-------	Soda ash refinery: crushing, dissolving, filtrating, crystallizing, calcining, screening, and further processing.
Stauffer Chemical Company of Wyoming.	Box 513 Green River, Wyo. 82935.	----do----------	----do----------	Soda ash refinery: crushing, dissolving, filtrating, crystallizing, calcining, screening.
Stone:				
The Great Western Sugar Co.[6]	Box 5308 Denver, Colo. 80217.	Quarry and plant---	Laramie----------	Stationary crushing and screening plant.
Guernsey Stone Co	Guernsey, Wyo. 82214--	----do----------	Platte----------	Do.
Monolith Portland Midwest Co.[7]	65677 Glassell Station Los Angeles, Calif. 90065.	Two quarries and plants.	Albany----------	Two stationary crushing and screening plants.
Union Pacific Railroad Co	1416 Dodge Street Omaha, Nebr. 68102.	Quarry and plant---	Laramie----------	Stationary crushing and screening plant.
Uranium:				
Federal American Partners	520 E. Main Street Riverton, Wyo. 82501.	One underground mine, and nine open pit mines, and mill.	Fremont----------	Acid leach process at mill.
Petrotomics Co	Drawer 2450 Casper, Wyo. 82601	One open pit mine, one underground mine, and mill.	Carbon----------	Do.
Utah Construction & Mining Co	Box 911 Riverton, Wyo. 82501	Open pit-underground mine, leaching operation, and mill.	Carbon, and Fremont.	In-place leaching, Carbon County; acid leach process at mill in Fremont County.
Western Nuclear, Inc	Jeffrey City, Wyo. 82310.	Two open pit mines, four underground mines, two leaching operations, and mill.	Fremont----------	Acid leach process at mill.
Vanadium:				
Homestake Mining Co.[8]	Lead, S. Dak. 57754----	Underground mine--	Crook----------	
Susquehanna-Western, Inc.[8]	Edgemont, S. Dak. 57735.	----do----------	----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.
[2] Also gypsum and stone. [3] Also feldspar. [4] Also stone. [5] Also limestone. [6] Also lime. [7] Also cement and gypsum. [8] Also uranium.

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