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# Minerals Yearbook

## 1975

*Volume II*

AREA REPORTS: DOMESTIC



*Prepared by staff of the*

BUREAU OF MINES

**UNITED STATES DEPARTMENT OF THE INTERIOR • Cecil D. Andrus, Secretary**

**BUREAU OF MINES • Roger A. Markle, Director**

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

**U.S. GOVERNMENT PRINTING OFFICE**

**WASHINGTON : 1978**

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## Foreword

The Federal Government, through the Minerals Yearbook and its predecessor volumes, has reported annually on mineral industry activities for 94 years. This edition discusses the performance of the worldwide mineral industry during 1975. In addition to statistical data, the volumes provide background information to assist in interpreting the year's developments. Content of the individual volumes follows:

Volume I, Metals, Minerals, and Fuels, contains chapters on virtually all metallic, nonmetallic, and mineral fuel commodities important to the domestic economy. In addition, it includes a general review chapter on the mineral industries, a chapter on mining and quarrying trends, and a statistical summary.

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

Volume III, Area Reports: International, contains the latest available mineral data on more than 130 foreign countries and discusses the importance of minerals to the economies of these nations. A separate chapter reviews the international minerals industry in general and its relationship to the world economy.

The Bureau of Mines continually strives to improve the value of its publications to its users. Therefore, the constructive comments and suggestions of readers of the Yearbook will be welcomed.

ROGER A. MARKLE, *Director*



## Acknowledgments

The chapters of this volume were written by the State Liaison Officers of the Associate Directorate, Mineral and Materials Supply/Demand Analysis, located throughout the country.

The Statistical Summary chapter and the tabular material covering total State mineral production, value of mineral production by county, and economic indicators were prepared in the Office of Technical Data Services. The Minerals Yearbook staff of that office reviewed the manuscripts upon which this volume was based, to insure statistical consistency among the tables, figures, and text between this volume and Volume I, and between this volume and those of former years.

Compilations contained in this volume were based largely on statistical data and other facts provided by the mineral industries. The Bureau gratefully acknowledges the willing contribution of these essential data by both companies and individuals.

In the collection of statistical and other mineral-industry information, the Bureau of Mines was also assisted by various State agencies through cooperative agreements. Many of the chapters in Volume II were reviewed by staff members of these agencies; in some instances the staff members collaborated in preparing the chapters and are shown as coauthors. Our sincere appreciation for this assistance is extended to the following cooperating organizations:

Alabama: Geological Survey of Alabama.  
Alaska: Alaska Department of Natural Resources.  
Arizona: Arizona Bureau of Mines.  
Arkansas: Arkansas Geological Commission.  
California: California Department of Conservation, Division of Mines and Geology.  
Colorado: Division of Mines of the State of Colorado.  
Connecticut: Connecticut Geological and Natural History Survey.  
Delaware: Delaware Geological Survey.  
Florida: Bureau of Geology.  
Georgia: Georgia Department of Natural Resources, Geologic and Water Resources Division.  
Hawaii: Hawaii Department of Land and Natural Resources.  
Idaho: Idaho Bureau of Mines and Geology.  
Illinois: Illinois State Geological Survey.  
Indiana: Geological Survey, Indiana Department of Natural Resources.  
Iowa: Iowa Geological Survey.  
Kansas: State Geological Survey of Kansas.  
Kentucky: Geological Survey of Kentucky.  
Louisiana: Louisiana Geological Survey.  
Maine: Bureau of Geology of Maine.  
Maryland: Maryland Geological Survey.  
Massachusetts: State Geologist of the Commonwealth of Massachusetts.  
Michigan: Geological Survey Division of the Michigan Department of Natural Resources.  
Mississippi: Mississippi Geological, Economic, and Topographical Survey.

- Missouri: Division of Geology and Land Survey, Department of Natural Resources.
- Montana: Montana Bureau of Mines and Geology.
- Nebraska: Conservation and Survey Division of the University of Nebraska, Nebraska Geological Survey.
- Nevada: Nevada Bureau of Mines and Geology.
- New Hampshire: New Hampshire Department of Resources and Economic Development.
- New Jersey: New Jersey Division of Natural Resources, Bureau of Geology and Topography.
- New York: New York State Museum and Science Service.
- North Carolina: Division of Resource Planning and Evaluation, North Carolina Department of Natural and Economic Resources.
- North Dakota: North Dakota Geological Survey.
- Oklahoma: Oklahoma Geological Survey.
- Oregon: Department of Geology and Mineral Industries.
- Pennsylvania: Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources.
- Puerto Rico: Department of Natural Resources; Economic Development Administration (Fomento).
- South Carolina: South Carolina Division of Geology, State Development Board.
- South Dakota: South Dakota State Geological Survey.
- Tennessee: Tennessee Division of Geology.
- Texas: Bureau of Economic Geology, The University of Texas at Austin.
- Utah: Utah Geological and Mineral Survey.
- Vermont: Geological Survey of Vermont.
- Virginia: Virginia Division of Mineral Resources.
- Washington: Washington Division of Geology and Earth Resources.
- West Virginia: West Virginia Geological and Economic Survey.
- Wisconsin: Wisconsin Geological and Natural History Survey.
- Wyoming: Geological Survey of Wyoming.

ALBERT E. SCHRECK, *Editor-in-Chief.*

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# Statistical Summary

By Staff, Office of Technical Data Services

This chapter summarizes data on crude mineral production for the United States, its island possessions, and the Commonwealth of Puerto Rico. Included also are tables that show the principal mineral commodities exported from and imported into the United States, and that compare world and U.S. mineral production. The detailed data from which these tables were derived are contained in the individual commodity chapters of volume I and in the State chapters of volume II of this edition of the Minerals Yearbook.

Although crude mineral production may be measured at any of several stages of extraction and processing, the stage of measurement used in this chapter is what is normally termed "mine output." It usually refers to minerals or ores in the form in which they are first extracted from the ground, but customarily includes the prod-

uct of auxiliary processing at or near the mines.

Because of inadequacies in the statistics available, some series deviate from the foregoing definition. In the cases of gold, silver, copper, lead, zinc, and tin, the quantities are recorded on a mine basis (as the recoverable content of ore sold or treated). However, the values assigned to these quantities are based on the average selling price of refined metal, not on the mine value. Mercury is measured as recovered metal and valued at the average New York price for the metal.

The weight or volume units shown are those customarily used in the particular industries producing the commodities. Values shown are in current dollars, with no adjustment made to compensate for changes in the purchasing power of the dollar.

Table 1.—Value of crude mineral production<sup>1</sup> in the United States, by mineral group  
(Million dollars)

Year	Mineral fuels	Nonmetals (except fuels)	Metals	Total
1971	21,247	6,058	3,406	30,711
1972	22,061	6,482	3,642	32,185
1973	25,012	7,413	4,362	36,787
1974	40,937	<sup>r</sup> 8,642	5,552	<sup>r</sup> 55,131
1975	47,561	9,518	5,196	62,275

<sup>r</sup> Revised.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Mineral production in the United States

Mineral	1972			1973			1974			1975		
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MINERAL FUELS												
Asphalt and related bitumens, native: Bituminous lime-												
stone, sandstone, gilsonite	1,995,374	\$10,303	2,088,657	\$8,464	2,021,165	\$16,666	1,901,715	\$19,838	1,901,715	\$16,666	1,901,715	\$19,838
Carbon dioxide, natural	1,228,741	165	1,134,986	259	966,118	237	1,070,024	279	1,070,024	237	1,070,024	279
Coal:												
Bituminous and lignite <sup>2</sup>	595,386	4,561,983	591,738	5,049,612	603,406	9,502,347	648,438	12,472,486	648,438	9,502,347	648,438	12,472,486
Pennsylvania anthracite	7,106	85,251	6,830	90,260	6,617	144,695	6,203	198,481	6,203	144,695	6,203	198,481
Helium:												
Crude	3,467	41,604	2,558	30,696	184	2,208	334	4,008	334	2,208	334	4,008
High-purity	629	15,673	647	16,121	699	18,105	745	19,915	745	18,105	745	19,915
Natural gas	22,531,698	4,180,462	22,647,549	4,894,072	21,600,522	6,573,402	20,108,661	8,945,062	20,108,661	6,573,402	20,108,661	8,945,062
Natural gas liquids:												
Natural gasoline and cycle products	193,480	604,423	187,390	668,784	168,152	1,107,158	151,872	878,698	151,872	1,107,158	151,872	878,698
thousands 42-gallon barrels	444,736	847,810	447,053	1,188,289	447,946	1,980,769	444,086	1,893,390	444,086	1,980,769	444,086	1,893,390
do.	7,112	7,112	621	7,547	706	10,989	746	12,294	746	10,989	746	12,294
thousand short tons	3,455,368	11,706,510	3,360,903	13,057,905	3,202,585	21,580,549	3,056,779	23,116,059	3,056,779	21,580,549	3,056,779	23,116,059
Petroleum (crude)	XX	22,061,000	XX	25,012,000	XX	40,937,000	XX	47,551,000	XX	40,937,000	XX	47,551,000
Total mineral fuels												
NONMETALS (EXCEPT FUELS)												
Abrasive stones <sup>3</sup>	3,241	670	3,466	697	3,134	717	2,953	1,060	3,134	717	2,953	1,060
Asbestos	131,663	13,408	150,036	16,288	109,091	13,393	98,654	14,220	109,091	13,393	98,654	14,220
Barite	906	14,883	1,104	16,888	1,106	16,322	1,287	20,673	1,106	16,322	1,287	20,673
Boron minerals	1,121	95,882	1,225	113,648	1,185	128,306	1,172	158,772	1,172	128,306	1,172	158,772
Bromine	386,854	63,689	418,250	67,131	432,094	117,715	407,163	113,126	407,163	117,715	407,163	113,126
Calcium-magnesium chloride	W	W	609,300	17,581	r 739,100	r 24,552	594,400	29,047	r 739,100	r 24,552	594,400	29,047
Cement:												
Portland	77,973	1,588,290	82,718	1,810,292	75,983	1,992,695	65,215	2,015,625	75,983	1,992,695	65,215	2,015,625
Masonry	3,777	100,269	4,057	119,547	3,871	111,106	3,868	111,801	3,871	111,106	3,868	111,801
Clays	59,456	303,022	64,351	354,058	60,796	422,542	49,047	424,556	60,796	422,542	49,047	424,556
Diatomite	576,089	37,554	608,906	36,083	664,303	50,693	573,000	45,812	664,303	50,693	573,000	45,812
Emerald	2,884	W	2,884	W	W	W	3,487	W	2,884	W	3,487	W
Feldspar	746,212	10,623	791,900	12,830	853,702	14,432	684,898	11,993	853,702	14,432	684,898	11,993
Fluorspar	250,347	17,315	248,601	17,381	201,116	14,997	139,913	10,888	201,116	14,997	139,913	10,888
Garnet (abrasive)	18,916	1,957	22,772	2,381	24,684	2,550	17,204	1,690	24,684	2,550	17,204	1,690
Gem stones <sup>4</sup>	NA	2,728	NA	2,739	NA	4,553	NA	NA	2,739	4,553	NA	NA
Gypsum	12,328	48,504	13,558	56,660	11,999	52,894	9,761	44,564	11,999	52,894	9,761	44,564
Lime	20,230	339,304	21,090	365,849	21,606	473,656	19,133	523,305	21,606	473,656	19,133	523,305
Magnesium compounds from seawater and brine												
(except for metal)	729,472	63,915	853,907	77,733	907,492	96,742	W	W	907,492	96,742	W	W
Mica:												
Scrap	160	4,353	177	6,082	137	5,475	135	5,219	137	6,082	135	5,219
Sheet	14,280	7	r 30,000	r 15	r 20,000	r 10	5,000	3	r 30,000	r 15	5,000	3
Perlite	544,594	6,231	543,683	5,591	555,000	7,024	512,000	7,282	555,000	7,024	512,000	7,282
Phosphate rock	40,831	207,910	42,137	238,667	45,686	501,429	48,816	1,122,184	45,686	501,429	48,816	1,122,184

STATISTICAL SUMMARY

Potassium salts	2,659	106,680	2,603	112,613	2,552	r 159,148	2,501	223,098
Urnice	3,313	6,539	3,937	8,881	3,937	9,121	3,892	11,203
Furites	741	6,652	659	4,961	424	4,238	625	4,776
Salt	45,022	296,772	43,910	306,103	46,536	360,763	41,030	368,063
Sand and gravel	914,324	1,200,701	983,629	1,359,370	r 904,846	r 1,421,237	789,436	1,416,346
Sodium carbonate (natural)	3,218	71,689	3,722	94,385	4,059	137,486	4,328	182,620
Sodium sulfate (natural)	do	do	do	do	do	do	do	do
Sodium carbonate (natural)	701	11,896	672	11,597	684	16,411	667	27,667
Stone	920,423	1,672,293	1,060,124	1,990,463	1,043,542	2,186,155	902,900	2,123,049
Sulfur, Frasch process	7,613	132,385	7,488	138,578	7,898	241,066	6,077	304,843
Talc, soapstone, pyrophyllite	1,107,404	7,828	1,246,554	9,144	r 1,289,462	r 9,569	927,548	8,309
Tripoli	87,864	797	101,519	980	r 85,121	r 623	80,562	565
Vermiculite	337	8,092	365	9,464	341	10,120	330	13,761
Value of items that cannot be disclosed: Aplite, natural and slag cement, graphite, iodine, kyanite, lithium minerals, magnesite, greensand marl, olivine, stauroilite, wollastonite, and values of nonmetal items indicated by symbol W								
Total nonmetals	XX	39,730	XX	28,926	XX	r 34,125	XX	157,180
	XX	6,482,000	XX	7,413,000	XX	r 8,642,000	XX	9,518,000

METALS

Antimony ore and concentrate								
short tons, antimony content	489	386	545	688	661	2,040	886	2,131
Bauxite	1,812	23,288	1,879	26,686	1,949	25,663	1,772	25,083
Copper (recoverable content of ores, etc.)	1,664,840	1,704,796	1,717,940	2,044,346	1,597,002	2,468,964	1,413,366	1,814,763
Gold (recoverable content of ores, etc.)	1,449,943	84,967	1,175,760	115,000	1,126,886	180,009	1,052,252	169,928
Iron ore, usable (excluding byproduct iron sinter)								
thousand long tons, gross weight	77,884	950,365	90,654	1,163,710	84,985	1,388,447	75,695	1,620,599
thousand long tons, gross weight	618,915	186,046	603,024	196,465	663,870	298,742	621,464	267,230
Manganese ore (35% or more Mn)								
short tons, gross weight	578	W	289	W	--	--	--	--
Manganiferous ore (5% to 35% Mn)	147,161	W	203,055	W	272,908	2,323	158,725	1,412
Mercury	7,333	1,601	2,171	621	2,189	617	7,366	1,165
Molybdenum (content of concentrate)	102,197	170,580	135,097	217,701	118,163	234,658	106,170	259,328
Nickel (content of ore and concentrate)	16,864	W	18,272	W	16,618	W	16,987	W
Rare-earth metal concentrates	19,520	8,479	31,273	13,780	35,218	15,966	W	W
Silver (recoverable content of ores, etc.)								
thousand troy ounces	37,233	62,737	r 37,484	r 95,883	33,762	159,018	34,938	154,424
long tons	W	W	W	W	139	1,056	W	W
Titanium concentrate:								
limonite	739,801	16,739	804,355	r 20,128	r 755,838	22,715	702,252	26,946
rutile	W	W	9,045	1,212	6,446	996	W	W
Tungsten ore and concentrate								
thousand pounds contained W	7,045	18,104	7,059	19,154	7,836	37,413	5,490	29,090
thousand pounds contained U <sub>3</sub> O <sub>8</sub>	25,768	162,272	25,803	167,718	23,227	243,884	22,877	281,388
Vanadium (recoverable in ore and concentrate)	4,887	30,867	4,377	26,611	4,870	38,266	4,743	49,329
short tons								

See footnotes at end of table.

Table 2.—Mineral production<sup>1</sup> in the United States—Continued

Mineral	1972		1973		1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS—Continued								
Zinc (recoverable content of ores, etc.) ----- short tons	478,318	\$169,803	478,850	\$197,861	499,872	\$358,908	469,335	\$366,097
Value of items that cannot be disclosed: Beryllium, magnesium chloride for magnesium metal, manganese residue, platinum-group metals (crude), zircon concentrate, and values of metal items indicated by symbol W -----	XX	50,650	XX	54,004	XX	72,772	XX	127,459
Total metals -----	XX	3,642,000	XX	4,362,000	XX	5,552,000	XX	5,196,000
Grand total -----	XX	32,185,000	XX	36,787,000	XX	55,131,000	XX	62,275,000

<sup>0</sup> Estimate. <sup>r</sup> Revised. N/A Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Includes a small quantity of anthracite mined in States other than Pennsylvania.

<sup>3</sup> Grindstones, pulpstones, grinding pebbles, sharpening stones, and tube mill liners.

<sup>4</sup> Excludes abrasive stone, bituminous limestone, and soapstone, all included elsewhere in table.

Table 3.—Minerals produced in the United States and principal producing States in 1975

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

Table 3.—Minerals produced in the United States and principal producing States in 1975—Continued

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

Table 4.—Value of mineral production in the United States and principal minerals produced in 1975

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
Alabama	\$968,973	18	1.56	Coal, petroleum, cement, stone.
Alaska	480,745	24	.77	Petroleum, natural gas, stone, sand and gravel.
Arizona	1,288,423	14	2.07	Copper, molybdenum, cement, sand and gravel.
Arkansas	436,441	25	.70	Petroleum, bromine, natural gas, stone.
California	3,152,937	4	5.06	Petroleum, cement, natural gas, sand and gravel.
Colorado	960,800	20	1.54	Petroleum, molybdenum, coal, cement.
Connecticut	33,010	46	.05	Stone, sand and gravel, feldspar, lime.
Delaware	<sup>1</sup> 1,906	50	( <sup>2</sup> )	Sand and gravel, magnesium compounds, clays, gem stones.
Florida	1,775,500	9	2.85	Phosphate rock, petroleum, stone, cement.
Georgia	333,387	29	.54	Clays, stone, cement, sand and gravel.
Hawaii	49,710	44	.08	Stone, cement, sand and gravel, pumice.
Idaho	233,788	31	.38	Phosphate rock, silver, zinc, lead.
Illinois	1,490,598	11	2.39	Coal, petroleum, stone, sand and gravel.
Indiana	541,600	23	.87	Coal, cement, stone, petroleum.
Iowa	195,740	33	.31	Cement, stone, sand and gravel, coal.
Kansas	970,611	17	1.56	Petroleum, natural gas, natural gas liquids, cement.
Kentucky	2,738,859	6	4.40	Coal, petroleum, stone, natural gas.
Louisiana	8,513,275	2	13.67	Petroleum, natural gas, natural gas liquids, sulfur.
Maine	36,741	45	.06	Cement, sand and gravel, zinc, stone.
Maryland	164,919	34	.26	Coal, stone, cement, sand and gravel.
Massachusetts	58,846	43	.09	Stone, sand and gravel, lime, clays.
Michigan	1,291,653	13	2.07	Iron ore, petroleum, cement, copper.
Minnesota	1,097,088	16	1.76	Iron ore, sand and gravel, stone, cement.
Mississippi	410,009	27	.66	Petroleum, natural gas, sand and gravel, cement.
Missouri	722,728	21	1.16	Lead, cement, stone, iron ore.
Montana	573,150	22	.92	Petroleum, copper, coal, cement.
Nebraska	111,905	40	.18	Petroleum, cement, sand and gravel, stone.
Nevada	258,390	30	.41	Copper, gold, sand and gravel, cement.
New Hampshire	17,107	48	.03	Sand and gravel, stone, clays, gem stones.
New Jersey	123,702	38	.20	Stone, sand and gravel, zinc, titanium concentrate.
New Mexico	2,091,541	8	3.36	Petroleum, natural gas, copper, potassium salts.
New York	397,728	28	.64	Cement, stone, zinc, salt.
North Carolina	152,880	36	.25	Stone, phosphate rock, lithium minerals, sand and gravel.
North Dakota	201,504	32	.32	Petroleum, coal, sand and gravel, natural gas liquids.
Ohio	1,356,454	12	2.18	Coal, petroleum, stone, lime.
Oklahoma	2,267,095	7	3.64	Petroleum, natural gas, natural gas liquids, coal.
Oregon	106,004	41	.17	Stone, sand and gravel, cement, nickel.
Pennsylvania	2,907,838	5	4.67	Coal, cement, stone, lime.
Rhode Island	6,198	49	.01	Sand and gravel, stone, gem stones.
South Carolina	115,467	39	.19	Cement, stone, sand and gravel, clays.
South Dakota	101,821	42	.16	Gold, cement, stone, sand and gravel.
Tennessee	424,768	26	.68	Coal, stone, zinc, cement.
Texas	15,529,931	1	24.94	Petroleum, natural gas, natural gas liquids, cement.
Utah	966,407	19	1.55	Petroleum, copper, coal, gold.
Vermont	28,779	47	.05	Stone, asbestos, sand and gravel, talc.
Virginia	1,261,974	15	2.03	Coal, stone, cement, sand and gravel.
Washington	158,505	35	.25	Cement, coal, sand and gravel, stone.
West Virginia	3,390,212	3	5.44	Coal, natural gas, petroleum, natural gas liquids.
Wisconsin	132,260	37	.21	Sand and gravel, stone, iron ore, cement.
Wyoming	1,644,438	10	2.64	Petroleum, sodium compounds, coal, natural gas.
Total	62,275,000	--	100.00	

<sup>1</sup> Incomplete total.  
<sup>2</sup> Less than ½ unit.



Table 5.—Value of mineral production per capita and per square mile in 1975, by State

State	Area (square miles)	1975 popula- tion (thou- sands)	Total (thou- sands)	Value of mineral production			
				Per square mile		Per capita	
				Dollars	Rank	Dollars	Rank
Alabama	51,609	3,615	\$968,973	18,775	13	268	18
Alaska	586,412	365	480,745	820	50	1,317	5
Arizona	113,909	2,212	1,288,423	11,311	22	582	11
Arkansas	53,104	2,110	486,441	8,219	27	207	22
California	158,693	21,198	3,152,937	19,868	12	149	26
Colorado	104,247	2,541	960,800	9,217	25	378	14
Connecticut	5,009	3,100	33,010	6,590	31	11	47
Delaware	2,057	579	1,906	927	49	3	50
Florida	58,560	8,277	1,775,500	30,319	9	215	21
Georgia	58,876	4,931	333,387	5,663	32	68	34
Hawaii	6,450	868	49,710	7,707	29	57	36
Idaho	83,557	813	233,788	2,798	40	288	16
Illinois	56,400	11,197	1,490,598	26,429	10	133	28
Indiana	36,291	5,313	541,600	14,924	18	102	30
Iowa	56,290	2,861	195,740	6,777	36	68	33
Kansas	82,264	2,280	970,611	11,799	20	426	13
Kentucky	40,395	3,387	2,738,859	67,802	3	809	8
Louisiana	48,523	3,806	8,513,275	175,448	1	2,237	2
Maine	33,215	1,058	36,741	1,106	47	35	41
Maryland	10,577	4,122	164,919	15,592	17	40	40
Massachusetts	8,257	5,814	58,846	7,127	30	10	48
Michigan	58,216	9,111	1,291,653	22,187	11	142	27
Minnesota	84,068	3,921	1,097,088	13,050	19	280	17
Mississippi	47,716	2,341	410,009	8,593	26	175	23
Missouri	69,686	4,767	722,728	10,371	23	152	24
Montana	147,138	746	573,150	3,895	34	768	10
Nebraska	177,227	1,544	1,11,905	1,449	45	72	32
Nevada	110,540	590	258,390	2,338	42	438	12
New Hampshire	9,304	812	17,107	1,839	44	21	45
New Jersey	7,838	7,333	123,702	15,786	16	17	46
New Mexico	121,666	1,144	2,091,541	17,191	14	1,828	4
New York	49,576	18,076	397,728	8,023	28	22	44
North Carolina	52,586	5,441	152,880	2,907	38	28	43
North Dakota	70,665	637	201,504	2,852	39	316	15
Ohio	41,222	10,735	1,356,454	32,906	6	126	29
Oklahoma	69,919	2,715	2,267,095	32,425	7	835	7
Oregon	96,981	2,284	106,004	1,093	48	46	37
Pennsylvania	45,333	11,860	2,907,838	64,144	4	245	20
Rhode Island	1,214	931	6,198	5,105	33	7	49
South Carolina	31,055	2,816	115,467	3,718	35	41	39
South Dakota	77,047	681	101,821	1,322	46	150	25
Tennessee	42,244	4,173	424,768	10,053	24	102	31
Texas	267,338	12,238	15,529,931	58,092	5	1,269	6
Utah	84,916	1,203	966,407	11,381	21	803	9
Vermont	9,609	472	28,779	2,995	37	61	35
Virginia	40,817	4,981	1,261,974	30,918	8	253	19
Washington	68,192	3,559	158,505	2,324	43	45	38
West Virginia	24,181	1,799	3,390,212	140,201	2	1,884	3
Wisconsin	56,154	4,589	132,260	2,355	41	29	42
Wyoming	97,914	376	1,644,438	16,795	15	4,374	1
Total	3,615,055	212,322	62,275,000	17,227	--	293	--

<sup>1</sup> Incomplete total.

Table 6.—Mineral production<sup>1</sup> in the United States, by State

Mineral	1972		1973		1974		1975	
	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)
ALABAMA								
Cement:								
Masonry	2,407	\$11,221	2,425	\$13,074	314	\$11,322	262	\$10,253
Portland	2,860	48,577	2,896	56,890	2,190	61,990	1,868	62,699
Clays <sup>2</sup>	2,850	7,812	2,894	8,788	2,985	13,298	2,231	9,077
Coal (bituminous)	20,514	200,430	19,230	211,698	19,524	432,036	22,644	600,767
Iron ore (usable)	327	1,912	271	1,408	W	W	W	W
Lime	739	11,761	881	14,060	1,054	22,846	985	29,404
Natural gas	3,644	1,282	11,271	4,307	27,865	20,704	37,814	32,898
Petroleum (crude)	9,934	30,466	11,677	41,772	13,323	113,808	13,477	186,641
Sand and gravel	6,362	8,630	9,805	13,870	19,454	19,120	9,232	17,876
Stone	4,18,485	4,42,027	4,20,043	4,40,117	4,28,773	4,60,231	22,252	61,615
Value of items that cannot be disclosed: Asphalt (native), bauxite, cement (slag, 1972-73), clay (bentonite), mica (scrap), natural gas liquids, salt, stone (dimension, 1972-74), talc, and values indicated by symbol W								
Total	XX	7,633	XX	8,155	XX	9,891	XX	8,543
	XX	371,241	XX	413,056	XX	764,746	XX	968,973
ALASKA								
Barite	W	W	W	W	20	401	2	30
Coal (bituminous)	668	W	694	W	700	W	766	W
Gem stones	N/A	57	N/A	57	N/A	57	N/A	57
Gold (recoverable content of ores, etc.)	8,639	596	7,107	695	9,146	1,461	14,980	2,419
Lead (recoverable content of ores, etc.)			6					
Natural gas	125,595	18,463	131,007	19,483	128,935	21,910	160,970	48,402
Petroleum (crude)	72,893	295,444	72,323	261,877	70,603	347,408	69,684	364,630
Sand and gravel	14,187	15,214	14,989	19,913	45,644	22,954	48,145	26,750
Silver (recoverable content of ores, etc.)	( <sup>3</sup> )	( <sup>3</sup> )	1	2	1	3	W	W
Stone	652	3,012	5,967	12,741	5,484	12,947	8,877	26,649
Tin	W	W	5	12	W	W	11	60
Value of items that cannot be disclosed: Copper (1974), mercury (1972-74), natural gas liquids, platinum-group metals, uranium (1972-73), and values indicated by symbol W								
Total	XX	13,442	XX	14,156	XX	11,453	XX	12,718
	XX	286,138	XX	328,938	XX	418,603	XX	480,745
ARIZONA								
Clays	3,134	3,355	3,117	3,459	199	622	129	483
Coal (bituminous)	W	W	3,247	W	6,448	W	6,986	W
Copper	908,612	990,419	927,271	1,103,453	858,783	1,327,678	813,211	1,044,162
Gem stones	N/A	168	N/A	170	N/A	1,590	N/A	5,000
Gold (recoverable content of ores, etc.)	102,996	6,036	102,848	10,060	90,686	14,470	85,790	13,854
Gypsum	W	W	158	669	141	473	117	419
Helium (high-purity)	W	W	W	W	W	W	W	W
See footnotes at end of table.								

Table 6.—Mineral production<sup>1</sup> in the United States, by State—Continued

Mineral	1972		1973		1974		1975	
	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)
ARIZONA—Continued								
Iron ore (usable) -----	W	W	W	W	W	W	W	W
Lead (recoverable content of ores, etc.) -----	1,763	\$830	763	\$248	1,069	\$476	420	\$181
Lime -----	356	6,024	365	7,019	422	9,071	512	12,444
Mica (scrap) -----	W	W	W	W	2	82	2	65
Molybdenum (content of concentrate) -----	27,216	46,791	37,657	59,372	28,346	57,067	25,030	61,411
Natural gas -----	442	80	125	23	224	45	208	58
Petroleum (crude) -----	993	3,226	804	3,103	740	3,885	855	3,332
Pumice -----	915	722	853	715	846	865	856	1,294
Sand and gravel -----	24,842	32,420	27,440	38,503	23,417	41,906	17,222	36,490
Silver (recoverable content of ores, etc.) -----	6,653	11,210	7,199	18,416	6,356	29,935	6,285	27,783
Stone -----	4,638	8,018	4,265	9,469	4,932	11,479	3,404	11,030
Zinc (recoverable content of ores, etc.) -----	10,111	3,589	8,427	3,482	9,699	6,964	8,655	6,751
Value of items that cannot be disclosed: Asbestos, cement, clay (fire, 1972-73), diatomite (1972), feldspar, fluorspar (1972-73), perlite, pyrites, salt (1975), tungsten, and values indicated by symbol W -----	XX	41,416	XX	49,827	XX	55,716	XX	63,666
Total -----	XX	1,091,004	XX	1,304,988	XX	1,562,234	XX	1,288,423
ARKANSAS								
Bauxite -----	1,634	21,010	1,686	23,884	1,731	23,597	1,543	22,956
Clays -----	3 885	3 990	3 1,446	3 1,412	984	1,597	995	2,232
Coal (bituminous) -----	428	4,676	434	5,806	455	9,673	488	16,000
Gem stones -----	NA	32	NA	50	NA	60	NA	70
Iron ore -----	W	W	W	W	4	W	( <sup>6</sup> )	14
Lime -----	150	2,456	177	2,742	187	3,189	170	3,848
Natural gas -----	166,522	28,308	157,529	28,985	123,975	32,234	116,237	40,334
Natural gas liquids: -----								
LP gases -----	261	854	204	861	199	1,344	196	1,360
Petroleum (crude) -----	546	1,420	449	1,838	418	2,491	407	2,377
Sand and gravel -----	18,519	58,335	18,016	70,618	16,527	122,517	16,133	143,836
Stone -----	11,574	16,558	12,465	20,625	14,878	29,922	12,415	25,794
Value of items that cannot be disclosed: Abrasive stones, barite, bromine, cement, clay (kaolin, 1972-73), gypsum, phosphate, rock (1975), soapstone, tripoli, vanadium, and values indicated by symbol W -----	XX	81,020	XX	90,825	XX	140,589	XX	139,324
Total -----	XX	241,179	XX	273,705	XX	406,418	XX	436,441
CALIFORNIA								
Asbestos -----	90,967	8,673	105,663	10,886	55,331	5,697	W	W
Barite -----	4	34	11	152	1	W	1	W
Boron minerals -----	1,421	95,882	1,225	113,648	1,185	126,306	1,172	158,772

Cement	9,086	182,808	9,895	201,892	8,264	210,520	7,827	232,564
Clays	2,706	7,887	2,723	6,853	2,497	3,238	3,238	3,737
Copper (recoverable content of ores, etc.)	598	612	369	440	194	300	341	341
Diatomite	W	W	W	W	W	W	W	31,186
Gem stones	NA	215	NA	220	NA	220	NA	354
Gold (recoverable content of ores, etc.)	3,974	233	3,647	357	5,049	807	5,046	1,651
Gypsum	1,525	4,965	1,778	5,884	1,716	6,642	1,446	6,332
Lead (recoverable content of ores, etc.)	1,153	347	44	r 14	35	16	66	28
Lime	608	13,059	632	13,602	600	14,877	595	18,626
Magnesium compounds from seawater and bitterns (partly estimated)	176,654	18,421	184,105	19,233	163,847	18,356	W	W
Mercury	5,835	1,274	1,219	349	1,311	370	W	W
Natural gas	487,278	179,318	449,369	167,615	365,354	160,756	318,308	222,816
Natural gas liquids:								
LP gases	8,468	27,654	6,865	23,475	5,709	26,104	4,847	29,543
Natural gasoline and cycle products	5,847	15,922	5,329	19,824	5,095	29,296	4,481	20,668
LP gases	29	620	21	373	14	322	W	W
Petroleum (crude)	347,022	940,430	336,075	1,045,193	323,003	1,710,350	322,199	1,943,048
Pumice	731	1,507	768	3,237	3,219	3,219	348	2,762
Rare-earth metal concentrates	W	W	W	W	W	W	W	W
Salt	1,621	14,860	1,507	15,533	1,533	17,213	88,445	168,248
Sand and gravel	117,288	162,619	117,470	176,286	105,191	176,213	88,445	168,248
Silver (recoverable content of ores, etc.)	175	296	56	143	42	197	80	353
Stone	27,213	65,811	43,638	77,175	45,709	91,891	33,152	72,740
Talc, soapstone, pyrophyllite	185,155	1,186	179,191	1,501	r 163,841	r 1,676	152,978	1,698
Zinc (recoverable content of ores, etc.)	1,202	427	20	8	8	6	206	161
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, carbon dioxide, cement (masonry 1972-73), clays (ball and kaolin, 1975), coal (lignite, 1972), feldspar, iron ore, lithium minerals, molybdenum, perlite, potassium salts, sodium carbonate and sulfate, tungsten concentrate, and values indicated by symbol W	XX	107,266	XX	137,843	XX	r 187,684	XX	233,987
Total	XX	1,851,376	XX	2,041,686	XX	r 2,797,249	XX	3,152,937

COLORADO

Carbon dioxide	W	W	W	W	123,106	W	229,382	W
Clays	747	1,533	794	1,710	663	1,588	860	1,101
Coal (bituminous)	5,522	35,687	6,233	46,190	6,896	64,877	8,219	135,872
Copper (recoverable content of ores, etc.)	3,944	4,039	3,123	3,716	3,012	4,057	3,560	4,571
Gem stones	NA	131	NA	135	NA	NA	NA	145
Gold (recoverable content of ores, etc.)	61,700	3,580	63,422	6,203	52,083	8,320	55,483	8,960
Gypsum	W	W	151	568	191	800	185	782
Lead (recoverable content of ores, etc.)	31,346	9,423	28,112	9,159	24,609	11,074	27,088	11,648
Lime	187	4,070	178	3,371	198	3,815	198	4,577
Mica, sheet	14,280	7						
Natural gas	116,949	19,297	137,725	24,304	144,629	28,926	171,629	44,624
Natural gas liquids:								
LP gases	1,245	3,349	1,424	4,295	1,574	9,319	1,742	9,378
Natural gasoline and cycle products	1,749	3,673	1,978	6,488	2,580	14,190	4,821	22,803
LP gases	39	210	28	163	30	201	37	280

See footnotes at end of table.

Table 6.—Mineral production<sup>1</sup> in the United States, by State—Continued

Mineral	1972		1973		1974		1975	
	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)
COLORADO—Continued								
Perlite	W		W	W	W	W	5	\$73
Petroleum (crude)	32,015	\$109,171	36,590	\$155,507	37,508	\$283,904	38,809	365,654
Pumice	59		W	W	W	W	W	W
Sand and gravel	23,318	34,631	33,767	45,493	23,793	39,674	20,019	34,850
Silver (recoverable content of ores, etc.)	3,664	6,174	3,698	9,204	2,784	13,113	3,866	14,878
Stone (recoverable content of ores, etc.)	4,507	9,599	6,357	14,003	6,572	15,109	5,315	10,940
Uranium (recoverable content U <sub>3</sub> O <sub>8</sub> )	1,877	11,925	1,888	12,274	W	W	W	W
Zinc (recoverable content of ores, etc.)	63,801	22,649	58,339	24,106	49,489	35,533	48,460	37,799
Value of items that cannot be disclosed: Beryllium concentrate (1972), cement, feldspar, fluorspar (1972-74), iron ore, molybdenum, pyrites, salt, tin, tungsten, vanadium, and values indicated by symbol W	XX	146,848	XX	164,806	XX	215,264	XX	251,865
Total	XX	425,841	XX	531,691	XX	750,299	XX	960,800
CONNECTICUT								
Clays	157	292	162	320	156	363	116	307
Feldspar	W	W	77,206	W	W	W	W	W
Gem stones	NA	16	NA	16	NA	15	NA	W
Lime	W	W	W	W	33	1,148	23	1,013
Mica (scrap)	2	W	3	W	2	W	W	W
Sand and gravel	6,763	11,270	7,806	12,783	6,345	11,272	4,900	10,040
Stone	8,719	19,695	9,682	21,305	8,457	18,332	7,832	20,117
Value of items that cannot be disclosed: Mica (sheet, 1974) and values indicated by symbol W	XX	1,850	XX	2,375	XX	1,433	XX	1,533
Total	XX	33,123	XX	36,804	XX	36,365	XX	33,010
DELAWARE								
Clays	15	9	15	9	14	8	9	6
Gem stones	NA	W	NA	W	NA	2	NA	W
Sand and gravel	2,257	2,660	3,408	3,678	2,396	3,783	976	1,900
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	202	XX	202	XX	W	XX	W
Total	XX	2,871	XX	3,859	XX	3,793	XX	1,906
FLORIDA								
Cement:								
Masonry	213	6,901	256	8,706	235	4,737	W	W
Portland	2,425	59,773	2,725	72,666	2,562	75,133	1,721	62,525
Clays	3	10,336	1,139	13,718	3	3,908	1,712	17,083
Lime	180	3,827	187	4,026	186	5,315	199	7,708
Natural gas	15,621	4,967	33,857	11,613	38,137	20,441	44,383	43,185

Peat	45	362	44	384	67	616	82	1,087
Petroleum (crude)	16,897	W	32,695	150,070	36,351	351,331	41,877	490,258
Sand and gravel	22,363	17,009	20,167	21,415	24,372	33,400	13,237	20,199
Stone <sup>4</sup>	53,093	81,621	61,735	103,595	54,660	100,378	39,071	73,372
Titanium concentrate (rutile)	W	W	9,045	1,212	6,446	996	W	W
Value of items that cannot be disclosed: Clay (kaolin, 1972, 1974), kyanite (1972-73), magnesium compounds, natural gas liquids, phosphate rock, rare-earth metal concentrate, staurolite, stone (selected), titanium concentrate (ilmenite), zircon concentrate, and values indicated by symbol W								
Total	XX	242,186	XX	213,695	XX	437,287	XX	1,060,153
	XX	426,652	XX	601,100	XX	1,043,895	XX	1,775,500

GEORGIA

Cement:								
Masonry	68	1,569	67	2,126	40	1,304	W	W
Portland	1,260	27,286	1,201	28,124	1,150	31,535	828	25,822
Clays	3,627	3,132,322	3,772	3,160,419	3,782	3,203,936	6,156	195,300
Feldspar	W	W	51,523	W	W	W	W	W
Peat	W	W	( <sup>c</sup> )	4	1	6	( <sup>c</sup> )	5
Sand and gravel	3,816	4,729	4,976	6,781	4,989	9,639	5,105	8,818
Stone	37,074	82,484	40,841	97,506	40,321	105,582	30,084	91,157
Talc	45,842	338	38,000	114	33,850	102	27,400	82
Value of items that cannot be disclosed: Barite, bauxite, clay (fire 1972-74), coal (1973), iron ore, kyanite, mica (scrap), rare earth metal concentrate (1972-74), titanium concentrate, zircon concentrate, and values indicated by symbol W								
Total	XX	9,589	XX	10,405	XX	10,996	XX	12,203
	XX	258,317	XX	305,479	XX	363,100	XX	333,387

HAWAII

Cement:								
Masonry	13	384	16	587	14	706	13	762
Portland	402	10,732	453	13,213	487	16,405	456	19,942
Gem stones	NA	57	NA	W	NA	W	NA	W
Lime	7	266	6	238	6	221	6	250
Pumice, pumicite, volcanic ash	379	762	354	611	385	792	318	912
Sand and gravel	609	1,893	753	2,012	990	2,379	671	2,460
Stone	45,005	13,494	7,180	18,466	4,768	42,370	7,569	25,319
Value of items that cannot be disclosed: Clays, salt (1972-73), stone (dimension, 1972, 1974), and values indicated by symbol W								
Total	XX	486	XX	70	XX	169	XX	65
	XX	28,074	XX	35,147	XX	42,042	XX	49,710

IDAHO

Antimony ore and concentrate	345	308	322	406	445	W	W	W
Clays	57	415	42	227	39	310	80	284
Copper (recoverable content of ores, etc.)	2,942	3,013	3,625	4,314	2,841	4,333	3,192	4,099
Gem stones	NA	105	NA	110	NA	120	NA	W
Gold (recoverable content of ores, etc.)	2,884	169	2,696	264	2,898	463	2,529	408
Gypsum	--	--	W	W	W	W	W	W
See footnotes at end of table.								

Table 6.—Mineral production<sup>1</sup> in the United States, by State—Continued

Mineral	1972		1973		1974		1975	
	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)
IDAHO—Continued								
Lead (recoverable content of ores, etc.)	61,407	\$18,459	61,744	\$20,116	51,717	\$23,273	50,395	\$21,670
Mercury	161	35						
Pumice	W	W	80	110	108	182	111	187
Sand and gravel	7,696	10,294	8,393	10,246	7,665	10,484	6,881	12,768
Silver (recoverable content of ores, etc.)	14,251	24,012	13,620	34,840	12,436	58,572	13,868	61,207
Stone	3,094	7,042	2,972	8,096	3,628	9,868	3,316	8,962
Zinc (recoverable content of ores, etc.)	38,647	13,720	46,107	19,032	39,469	28,939	40,926	31,922
Value of items that cannot be disclosed: Barite (1974-75), cement, clay (fire, 1974), abrasive garnet, iron ore, lime, perlite, phosphate rock, tungsten concentrate, vanadium, and values indicated by symbol W	XX	28,639	XX	38,300	XX	72,854	XX	92,081
Total	XX	106,206	XX	136,081	XX	208,558	XX	233,788
ILLINOIS								
Cement:								
Masonry	80	2,483	88	2,901	69	3,228	W	42,756
Portland	1,571	33,124	1,572	36,064	1,460	41,023	W	3,249
Clays	<sup>3</sup> 1,716	<sup>3</sup> 3,314	<sup>3</sup> 1,758	<sup>3</sup> 3,613	<sup>3</sup> 1,587	<sup>3</sup> 3,744	1,366	871,377
Coal (bituminous)	65,523	402,481	61,572	413,309	58,215	582,010	59,537	99,898
Fluorspar	132,405	9,961	160,305	11,871	<sup>1</sup> 151,993	12,247	2	2
Gem stones	NA	2	NA	2	NA	2	NA	2
Lead (recoverable content of ores, etc.)	1,335	401	541	176	493	222	W	1,008
Natural gas	1,194	334	1,638	573	1,436	574	1,440	36
Peat	74	935	72	1,037	86	1,412	96	1,511
Petroleum (crude)	34,874	121,013	30,669	132,490	27,553	244,395	26,067	273,182
Sand and gravel	39,929	61,596	43,649	92,029	42,706	68,566	39,000	83,515
Stone	<sup>4</sup> 56,260	<sup>4</sup> 94,225	66,663	114,068	63,231	121,763	60,640	130,104
Zinc (recoverable content of ores, etc.)	11,378	4,039	5,280	2,169	4,104	2,947	W	W
Value of items that cannot be disclosed: Barite (1974-76), clay (fuller's earth), copper (1974), lime, natural gas liquids, silver, stone (dimension, 1972), tripoli, and values indicated by symbol W	XX	35,729	XX	45,306	XX	65,517	XX	74,937
Total	XX	769,737	XX	825,608	XX	1,147,650	XX	1,490,598
INDIANA								
Cement:								
Masonry	W	W	W	W	W	W	343	12,263
Portland	W	W	W	W	W	W	2,185	63,077
Clays	<sup>3</sup> 1,419	<sup>3</sup> 2,465	1,436	2,568	1,092	1,947	1,094	1,961
Coal (bituminous)	25,949	144,688	25,253	153,136	23,726	198,410	25,124	280,130
Natural gas	355	55	276	38	176	25	346	186

STATISTICAL SUMMARY

Peat	45	478	51	475	71	946	76	1,918
Petroleum (crude)	6,320	20,964	5,332	20,823	4,919	42,402	4,632	48,821
Sand and gravel	27,978	33,290	27,731	35,015	26,077	35,656	21,641	38,234
Stone	27,511	50,919	42,288	47,652	43,103	64,106	28,947	68,850
Value of items that cannot be disclosed: Abrasive stone, clay (fire, 1972), gypsum, lime, stone (sandstone, 1973-74), and values indicated by symbol W								
Total	XX	69,749	XX	81,698	XX	97,198	XX	29,211
	XX	322,608	XX	351,405	XX	440,690	XX	541,600

IOWA

Cement:								
Masonry	66	1,916	68	2,351	65	2,660	62	2,933
Portland	2,458	49,635	2,688	59,574	2,424	64,156	2,258	73,786
Clays	1,047	2,643	967	2,028	960	1,869	959	1,916
Coal (bituminous)	851	4,138	601	3,279	590	4,591	622	6,891
Gem stones	NA	1	NA	W	NA	W	NA	W
Gypsum	1,350	5,714	1,470	6,324	1,397	7,142	1,208	6,546
Sand and gravel	17,107	20,140	19,950	25,541	17,091	26,104	15,410	26,844
Stone	27,467	48,542	31,541	55,918	32,342	66,119	30,336	73,782
Value of items that cannot be disclosed: Lime, peat, and values indicated by symbol W								
Total	XX	1,667	XX	2,785	XX	4,079	XX	3,092
	XX	184,496	XX	158,800	XX	176,720	XX	195,740

KANSAS

Cement:								
Masonry	59	1,452	73	2,068	64	2,203	57	2,311
Portland	1,889	35,482	2,026	42,172	1,940	46,940	1,882	55,033
Clays	1,170	1,457	1,169	1,490	1,311	1,785	1,178	1,604
Coal (bituminous)	1,227	7,835	1,086	7,979	718	5,463	479	9,481
Helium:								
Crude	2,278	27,336	1,539	18,468	W	W	W	W
High-purity	384	8,064	416	8,736	499	11,477	497	11,928
Lime	9	172	10	199	28	535	W	W
Natural gas liquids:								
Natural gasoline	889,268	127,859	893,118	138,521	886,782	147,206	843,625	145,103
LP gases	5,505	13,170	5,993	17,685	6,630	24,810	6,295	25,062
Petroleum (crude)	95,099	43,170	24,463	53,819	24,402	78,818	23,563	71,632
Salt	73,744	259,578	66,227	281,465	61,691	490,984	59,108	561,508
Sand and gravel	1,369	20,562	1,397	23,460	1,367	27,007	1,448	31,214
Stone	11,591	10,920	13,261	12,660	11,687	13,368	10,866	13,467
Value of items that cannot be disclosed: Diatomite (1974-75), gypsum, pumice, salt (brine), stone (dimension, 1972-73), and values indicated by symbol W								
Total	XX	3,741	XX	3,973	XX	3,913	XX	6,418
	XX	584,597	XX	645,299	XX	889,398	XX	970,611

KENTUCKY

Clays	920	1,406	1,083	1,961	848	1,477	778	1,483
Coal (bituminous)	121,188	824,691	127,645	986,654	137,197	2,340,961	143,643	2,499,295

See footnotes at end of table.



Table 6.—Mineral production<sup>1</sup> in the United States, by State—Continued

Mineral	1972		1973		1974		1975	
	Quantity (thousands)	Value (thousands)	Quantity (thousands)	Value (thousands)	Quantity (thousands)	Value (thousands)	Quantity (thousands)	Value (thousands)
KENTUCKY—Continued								
Natural gas	63,648	\$15,976	62,396	\$21,839	71,876	\$35,938	60,511	\$32,676
Petroleum (crude)	9,702	32,599	8,657	34,515	7,887	68,340	7,556	84,520
Sand and gravel	8,485	11,987	10,331	14,627	8,710	12,887	8,994	14,466
Stone	4,34,279	4,59,690	4,38,205	4,70,912	34,542	66,632	31,734	67,966
Zinc (recoverable content of ores, etc.)	1,780	632	273	113	--	--	41	--
Value of items that cannot be disclosed: Cement, clay (ball), fluor-spar, lead (1975), lime, natural gas liquids, and stone (quartzite and sandstone, 1972-73)	XX	29,949	XX	34,141	XX	36,975	XX	38,481
Total	XX	976,910	XX	1,164,762	XX	2,563,210	XX	2,738,859
LOUISIANA								
Clays	1,000	1,454	979	1,329	770	1,425	531	1,132
Lime	1,908	19,614	897	16,801	796	17,665	485	12,484
Natural gas	7,972,678	1,626,426	8,242,423	1,846,303	7,753,631	2,380,365	7,090,645	2,999,179
Natural gas liquids:								
Natural gasoline and cycle products	52,842	167,768	47,906	167,037	35,860	234,954	31,808	178,930
LP gases	99,233	185,660	102,701	253,671	108,439	423,996	103,714	392,039
Petroleum (crude)	891,527	3,201,659	831,524	3,327,702	737,324	4,811,772	650,840	4,611,879
Salt	13,514	67,464	13,152	66,211	13,543	76,960	12,166	77,116
Sand and gravel	18,920	26,996	13,748	21,165	12,341	27,781	14,587	35,990
Stone	4,9,190	4,14,836	4,10,802	4,21,309	4,10,940	4,24,046	10,489	38,260
Sulfur (Frasch process)	3,765	W	3,329	W	3,426	W	2,672	W
Value of items that cannot be disclosed: Cement, gypsum, stone (miscellaneous, 1972-74), and values indicated by symbol W	XX	99,666	XX	98,082	XX	147,614	XX	166,266
Total	XX	5,411,543	XX	5,819,610	XX	8,146,578	XX	8,513,275
MAINE								
Clays	40	57	41	74	146	183	125	202
Copper	1,220	1,249	1,107	1,317	1,522	2,353	2,024	2,599
Gem stones	NA	W	NA	NA	NA	W	NA	W
Lead	85	26	204	66	279	126	364	157
Peat	2	99	5	177	4	194	4	207
Sand and gravel	11,818	7,535	13,533	10,304	8,755	10,673	9,875	11,403
Silver	16	27	W	W	W	W	W	W
Stone	1,078	2,996	1,212	3,329	1,491	4,255	4,126	4,374
Zinc (recoverable content of ores, etc.)	5,820	2,066	19,640	8,115	10,425	7,455	8,318	6,488
Value of items that cannot be disclosed: Cement, stone (dimension, 1975), and values indicated by symbol W	XX	8,867	XX	10,111	XX	11,079	XX	11,944
Total	XX	22,922	XX	33,493	XX	36,348	XX	36,741

MARYLAND									
Clays <sup>3</sup> .....	1,104	2,121	897	1,973	884	2,066	580	1,450	
Coal (bituminous).....	1,640	8,961	1,789	13,644	2,337	48,630	2,606	50,502	
Gem stones.....	NA	8	NA	8	NA	8	NA	NA	
Lime.....	W	W	W	W	23	527	15	484	
Natural gas.....	244	51	298	69	133	32	93	25	
Peat.....	3	29	2	29	3	45	2	39	
Sand and gravel.....	12,594	26,557	12,845	29,625	11,690	29,386	11,786	29,477	
Stone.....	19,431	41,973	18,585	46,732	18,072	47,630	14,796	43,110	
Value of items that cannot be disclosed: Cement, clay (ball), talc, soapstone, (1972-74), and values indicated by symbol W.....	XX	35,801	XX	39,827	XX	44,556	XX	39,882	
Total.....	XX	116,501	XX	131,907	XX	172,880	XX	164,919	
MASSACHUSETTS									
Clays.....	219	416	217	404	218	379	124	228	
Gem stones.....	NA	5	NA	5	NA	5	NA	W	
Lime.....	W	W	W	W	170	4,972	152	5,215	
Peat.....	W	W	2	78	3	85	W	W	
Sand and gravel.....	18,883	25,655	18,743	26,910	17,334	26,565	13,281	24,556	
Stone.....	7,990	23,500	8,580	28,738	8,103	30,103	7,170	28,681	
Value of items that cannot be disclosed: Nonmetals and values indicated by symbol W.....	XX	2,852	XX	3,547	XX	--	XX	166	
Total.....	XX	62,428	XX	69,682	XX	62,109	XX	63,846	
MICHIGAN									
Cement:									
Masonry.....	250	5,959	247	6,185	217	6,309	183	6,429	
Portland.....	5,901	111,410	6,242	123,442	5,908	140,513	4,573	131,324	
Clays.....	2,514	3,715	2,151	3,304	2,161	4,074	1,818	3,580	
Copper (recoverable content of ores, etc.).....	67,260	68,874	72,221	85,943	67,012	103,601	73,690	94,618	
Gem stones.....	NA	8	NA	8	NA	8	NA	8	
Gypsum.....	1,650	7,267	1,882	8,538	1,452	7,258	1,224	5,985	
Iron ore (usable).....	12,692	177,461	12,389	180,194	11,602	213,598	14,089	339,113	
Lime.....	1,509	22,753	1,545	26,055	1,528	30,036	1,434	36,540	
Magnesium compounds from seawater and brine (except for metal).....	377,675	31,484	455,501	41,790	503,281	53,302	W	W	
Natural gas.....	34,221	10,506	44,579	17,495	69,133	34,843	102,113	64,740	
Natural gas liquids:									
Natural gasoline.....	305	1,097	372	1,539	466	3,089	656	3,294	
LP gases.....	833	2,274	691	2,529	849	5,383	1,348	5,945	
Peat.....	219	2,190	232	2,172	244	3,811	245	3,206	
Petroleum (crude).....	12,990	41,556	14,614	59,413	18,021	154,746	24,020	262,552	
Salt.....	59,467	50,761	4,818	53,732	62,055	4,020	66,355	66,355	
Sand and gravel.....	785	69,445	62,497	73,977	60,027	82,617	41,061	75,397	
Silver (recoverable content of ores, etc.).....	39,754	1,323	850	2,175	643	3,028	632	2,795	
Stone.....	89,754	50,317	45,886	60,494	47,479	72,748	39,946	73,500	
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, iodine, and value of items indicated by symbol W.....	XX	40,367	XX	40,392	XX	54,411	XX	116,223	
Total.....	XX	694,767	XX	789,022	XX	1,035,430	XX	1,291,653	

See footnotes at end of table.

Table 6.—Mineral production<sup>1</sup> in the United States, by State—Continued

Mineral	1972		1973		1974		1975	
	Quantity (thousands)	Value (thousands)	Quantity (thousands)	Value (thousands)	Quantity (thousands)	Value (thousands)	Quantity (thousands)	Value (thousands)
MINNESOTA								
Clays	3 167	3 8251	3 156	3 8233	W	W	W	W
Gem stones	NA	14	NA	14	NA	\$14	NA	\$14
Iron ore (usable)	50,595	601,869	62,614	789,197	59,422	949,678	49,167	1,015,272
Manganiferous ore (5% to 35% Mn)	119,324	W	170,971	W	225,560	W	108,749	W
Peat	W	W	W	W	20	471	13	230
Sand and gravel	36,792	33,454	37,935	39,438	36,720	42,870	33,398	45,214
Stone	5,767	16,318	7,581	20,411	8,301	22,041	6,854	23,302
Value of items that cannot be disclosed: Abrasive stones, cement, clay (kaolin, 1972-73), lime, and values indicated by symbol W	XX	7,763	XX	10,492	XX	11,792	XX	13,056
Total	XX	659,669	XX	852,785	XX	1,026,366	XX	1,097,088
MISSISSIPPI								
Clays	1,919	7,837	2,075	9,082	2,013	10,468	1,592	10,605
Lime	W	W	W	W	70	1,393	53	1,060
Natural gas	103,989	22,670	99,706	22,846	78,787	23,242	74,345	36,875
Petroleum (crude)	61,100	192,465	56,102	213,747	50,779	309,763	46,614	310,346
Sand and gravel	13,419	16,133	14,251	17,383	14,939	19,487	14,872	23,098
Stone	1,135	1,199	4,760	4,809	1,719	2,572	1,629	2,730
Value of items that cannot be disclosed: Cement, magnesium compounds, natural gas liquids, stone (limestone, 1973), and values indicated by symbol W	XX	14,970	XX	17,871	XX	24,240	XX	25,295
Total	XX	255,274	XX	281,738	XX	391,155	XX	410,009
MISSOURI								
Barite	213	3,637	196	3,395	177	3,386	171	3,989
Cement:								
Masonry	80	1,859	84	2,400	75	2,434	65	2,110
Portland	4,277	80,898	4,582	99,858	4,229	106,985	3,962	116,260
Clays	3 2,571	3 9,096	2,551	11,626	3 2,565	3 13,214	3 2,168	3 13,214
Coal (bituminous)	4,551	23,667	4,658	24,999	4,623	29,383	5,638	48,054
Copper (recoverable content of ores, etc.)	11,509	11,785	10,273	12,224	12,665	19,580	14,258	18,308
Iron ore (usable)	2,695	W	2,630	W	1,866	W	2,273	W
Lead (recoverable content of ores, etc.)	489,397	147,113	487,143	158,711	562,097	252,944	515,958	221,862
Lime	W	W	1,626	23,534	1,901	36,369	1,606	40,630
Natural gas	9	W	33	8	33	10	30	10
Petroleum (crude)	60	W	60	W	56	W	57	W
Phosphate rock	W	W	42	W	35	W	35	W
Sand and gravel	10,082	14,806	10,879	16,950	10,933	19,462	9,526	18,216
Silver (recoverable content of ores, etc.)	1,972	3,322	2,058	5,264	2,387	11,244	2,524	11,161
Stone	42,473	43,219	49,304	79,921	50,626	90,204	46,988	95,535
Zinc (recoverable content of ores, etc.)	61,923	21,983	82,350	34,027	91,987	66,047	74,867	58,396



Table 6.—Mineral production<sup>1</sup> in the United States, by State—Continued

Mineral	1972		1973		1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEVADA—Continued								
Iron ore (usable) -----	W	W	119	W	139	W	109	\$1,017
Lead (recoverable content of ores, etc.) -----	( <sup>c</sup> )	\$177	698	\$200	1,785	\$809	2,976	1,280
Mercury -----	810	W	96	W	129	W	116	W
Petroleum (crude) -----	100	12,636	12,448	14,614	8,786	14,515	8,066	16,848
Sand and gravel -----	10,081	1,003	624	1,695	872	4,108	1,609	7,111
Silver (recoverable content of ores, etc.) -----	595	5,929	3,959	5,429	2,186	4,203	4,829	4,482
Stone -----	3,329	W	150	377	132	537	33	152
Tungsten ore and concentrate -----	157	W	--	--	3405	2,445	5,496	4,287
Zinc (recoverable content of ores, etc.) -----	--	--	--	--	--	--	--	--
Value of items that cannot be disclosed: Antimony (1972-74), cement, clay (common, 1975), diatomite, fluor spar, lime, lithium minerals, magnesite, molybdenum, perlite, pumice, salt, stone (dimension, 1975), talc, and values indicated by symbol W -----	XX	27,995	XX	35,949	XX	41,829	XX	48,820
Total -----	XX	181,702	XX	201,813	XX	257,876	XX	259,390
NEW HAMPSHIRE								
Clays -----	51	70	43	64	34	55	W	W
Gem stones -----	NA	42	NA	42	NA	42	W	W
Sand and gravel -----	6,020	6,266	7,795	8,697	6,126	8,223	5,150	9,077
Stone -----	528	3,743	1,836	5,416	590	5,371	1,519	7,938
Value of items that cannot be disclosed -----	--	--	--	--	--	--	XX	92
Total -----	XX	10,111	XX	14,119	XX	13,691	XX	17,107
NEW JERSEY								
Clays -----	212	866	183	666	104	524	67	372
Gem stones -----	NA	16	NA	16	NA	16	NA	16
Peat -----	W	W	44	514	31	603	29	686
Sand and gravel -----	17,679	38,020	19,040	43,098	17,924	47,292	13,012	39,640
Stone -----	15,223	42,044	15,902	45,585	16,749	52,456	11,821	42,381
Zinc (recoverable content of ores, etc.) -----	38,096	13,524	33,027	13,647	32,848	23,535	31,105	24,262
Value of items that cannot be disclosed: Lime (1972-73), magnesium compounds, manganese residuum, greensand marl, stone (dimension), titanium concentrate, and values indicated by symbol W -----	XX	8,261	XX	10,490	XX	16,272	XX	16,345
Total -----	XX	102,721	XX	114,016	XX	140,748	XX	123,702
NEW MEXICO								
Clays <sup>3</sup> -----	65	108	88	169	55	317	44	61
Coal (bituminous) -----	8,248	29,794	9,069	31,862	9,392	W	8,785	W
Copper (recoverable content of ores, etc.) -----	168,094	172,067	204,742	243,643	196,555	303,920	146,263	187,802

	NA	68	NA	70	NA	200	NA	200
Gem stones	14,897	873	13,864	1,356	15,427	2,464	15,049	2,464
Gold (recoverable content of ores, etc.)	W	W	255	1,220	157	532	W	W
Gypsum	W	W	W	W	W	W	W	W
Helium (high-purity)	W	W	W	114	6	135	W	W
Iron ore (usable)	3,852	1,077	2,556	833	2,364	1,674	1,981	850
Lead (recoverable content of ores, etc.)	28	W	44	793	58	1,679	W	W
Lime	27,837	W	32,084	W	47,848	W	49,976	W
Manganese ore (5% to 35% Mn)	14	W	10	82	12	60	W	W
Mica, scrap	1,216,961	225,420	1,218,749	287,889	1,244,779	390,861	1,217,430	493,059
Natural gas	10,338	29,970	9,848	32,449	9,713	53,545	9,194	45,292
Natural gasoline and cycle products	27,859	45,689	29,682	74,427	30,271	120,781	30,214	122,065
LP gases	2	46	3	60	4	111	W	W
Peat	476	5,688	478	5,024	480	6,306	429	6,400
Petrite	110,625	376,778	100,986	414,041	98,696	712,578	95,063	788,073
Petroleum (crude)	2,296	91,115	2,168	91,996	2,102	128,688	2,081	179,324
Potassium salts	311	809	339	1,001	471	1,466	397	1,280
Pumice	W	W	W	W	167	W	W	W
Salt	7,600	8,563	10,641	15,753	7,413	10,605	6,220	13,798
Sand and gravel	1,017	1,713	1,111	2,843	1,195	5,628	792	3,501
Silver (recoverable content of ores, etc.)	2,768	5,499	2,859	5,894	4,363	8,859	2,197	4,683
Stone	W	W	W	W	W	W	W	W
Tin	10,808	68,091	9,286	60,356	9,971	104,693	10,393	127,829
Uranium (recoverable content U <sub>3</sub> O <sub>8</sub> )	12,735	4,521	12,327	5,094	13,784	9,897	11,015	8,592
Zinc (recoverable content of ores, etc.)	W	W	W	W	W	W	W	W
Value of items that cannot be disclosed: Carbon dioxide, cement, clay (fire), fluorspar (except 1973), molybdenum, stone (dimension, 1974), vanadium, and values indicated by symbol W	XX	29,403	XX	29,631	XX	77,755	XX	104,674
Total	XX	1,097,292	XX	1,306,590	XX	1,941,644	XX	2,091,541

NEW YORK

Clays <sup>3</sup>	1,601	1,919	1,799	2,146	1,451	2,348	817	1,561
Emery	2,883	W	2,883	W	NA	W	W	W
Gem stones	NA	16	NA	16	NA	16	NA	16
Gypsum	486	3,079	525	3,369	364	2,942	W	W
Lead (recoverable content of ores, etc.)	1,089	327	2,304	751	3,076	1,384	3,027	1,302
Mercury	W	W	W	W	W	W	W	W
Natural gas	3,679	1,199	4,539	1,500	4,990	2,745	7,628	5,645
Natural gasoline and cycle products	15	200	11	166	18	181	22	377
Peat	1,018	4,897	967	5,412	896	9,598	875	10,693
Petroleum (crude)	5,604	43,866	5,202	42,364	6,494	57,706	5,978	57,344
Salt	26,722	36,952	29,544	41,386	30,614	46,662	22,168	44,064
Sand and gravel	25	42	54	139	56	304	56	248
Silver (recoverable content of ores, etc.)	38,138	77,825	44,393	94,698	38,207	87,724	31,713	80,929
Stone	60,749	21,566	81,455	33,657	93,077	66,829	76,612	59,767
Zinc (recoverable content of ores, etc.)	W	W	W	W	W	W	W	W
Value of items that cannot be disclosed: Cement, clay (ball), garnet (abrasive), iron ore, lime, talc, titanium concentrate, wollastonite, and values indicated by symbol W	XX	128,566	XX	150,167	XX	162,295	XX	185,792
Total	XX	320,454	XX	375,866	XX	440,573	XX	397,728

See footnotes at end of table.

Table 6.—Mineral production<sup>1</sup> in the United States, by State—Continued

Mineral	1972			1973			1974			1975		
	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)
NORTH CAROLINA												
Clays <sup>3</sup> -----	3,882	\$4,473	4,109	\$5,057	3,422	\$4,648	2,582	\$4,094	2,582	\$4,094	2,582	\$4,094
Feldspar-----	439,938	6,030	523,595	8,820	650,684	11,147	483,401	8,070	483,401	8,070	483,401	8,070
Gem stones-----	NA	32	NA	40	NA	50	NA	50	NA	50	NA	50
Mica:												
Scrap-----	91	2,942	106	4,423		3,679		3,265		3,265		3,265
Sheet-----						76		75		75		75
Sand and gravel-----	12,923	13,812	15,897	19,337	12,784	20,844	8,169	15,610	8,169	15,610	8,169	15,610
Stone-----	32,297	62,741	33,782	30,065	34,782	75,142	28,308	69,327	28,308	69,327	28,308	69,327
Talc and pyrophyllite-----	89,534	594	95,883	1,094	110,978	993	58,514	985	58,514	985	58,514	985
Value of items that cannot be disclosed: Asbestos, cement, clay (kaolin), iron ore (1972-74), lithium minerals, olivine, phosphate rock, and values indicated by symbol W-----	XX	24,896	XX	28,104	XX	39,366	XX	51,479	XX	39,366	XX	51,479
Total-----	XX	115,520	XX	146,930	XX	155,869	XX	162,880	XX	155,869	XX	162,880
NORTH DAKOTA												
Coal (lignite)-----	6,632	13,416	6,906	14,328	7,463	16,361	8,515	27,010	8,515	27,010	8,515	27,010
Gem stones-----	NA	2	NA	2	NA	2	NA	2	NA	2	NA	2
Natural gas-----	32,472	5,455	27,703	5,457	31,206	6,210	24,786	5,701	24,786	5,701	24,786	5,701
Peat-----					240	W		W		W		W
Petroleum (crude)-----	20,624	67,647	20,235	78,916	19,697	119,022	20,452	149,705	20,452	149,705	20,452	149,705
Sand and gravel-----	6,681	5,767	6,011	6,021	4,991	6,211	5,686	8,133	5,686	8,133	5,686	8,133
Stone-----	W	W	W	W	35	115	30	153	30	115	30	153
Value of items that cannot be disclosed: Clays, lime, natural gas liquids, pumice (1972), salt, and values indicated by symbol W-----	XX	5,809	XX	7,129	XX	11,516	XX	10,800	XX	11,516	XX	10,800
Total-----	XX	98,086	XX	111,863	XX	159,427	XX	201,504	XX	159,427	XX	201,504
OHIO												
Cement:												
Masonry-----	161	4,684	176	5,641	158	5,227	136	4,576	158	5,227	136	4,576
Portland-----	2,968	57,953	3,456	73,362	2,884	73,815	2,364	70,268	2,884	73,815	2,364	70,268
Clays-----	4,125	11,273	4,732	12,456	3,451	13,488	3,451	11,822	3,451	13,488	3,451	11,822
Coal (bituminous)-----	50,967	303,519	45,733	388,792	45,409	559,519	46,770	766,875	45,409	559,519	46,770	766,875
Gem stones-----	NA	8	NA	8	NA	8	NA	8	NA	8	NA	8
Lime-----	4,113	75,559	4,359	77,028	4,171	93,695	3,482	95,136	4,171	93,695	3,482	95,136
Natural gas-----	89,995	35,271	93,610	39,768	r 92,065	44,371	84,960	59,982	r 92,065	44,371	84,960	59,982
Peat-----					74	4		4		74		4
Petroleum (crude)-----	9,368	35,179	8,706	44,690	9,088	89,348	5,083	113,917	9,088	89,348	5,083	113,917
Salt-----	6,147	17,710	4,657	41,643	5,029	49,089	5,083	64,651	5,029	49,089	5,083	64,651
Sand and gravel-----	43,506	59,982	48,987	59,982	41,353	68,258	37,195	68,552	41,353	68,258	37,195	68,552
Stone-----	43,498	90,821	45,107	498,009	45,1709	4105,098	46,303	108,580	45,1709	4105,098	46,303	108,580
Value of items that cannot be disclosed: Abrasive stones, gypsum, stone (dimension, 1973-74), and values indicated by symbol W-----	XX	2,462	XX	5,518	XX	5,680	XX	1,996	XX	5,680	XX	1,996
Total-----	XX	724,748	XX	806,979	XX	1,107,670	XX	1,366,454	XX	1,107,670	XX	1,366,454

OKLAHOMA

Clays	3 988	3 1,398	3 1,298	3 1,871	1,289	2,105	995	1,701
Coal (bituminous)	2,624	19,112	2,133	16,779	2,856	24,769	2,872	47,946
Gypsum	1,196	3,888	1,429	5,796	1,225	5,622	1,023	4,835
Helium:								
High-purity	176	6,160	181	6,385	169	5,915	224	7,411
Crude	163	1,956	115	1,380	134	1,608	148	1,776
Lead (recoverable content of ores, etc.)					W	W		
Natural gas	1,806,887	294,523	1,770,980	394,110	1,638,942	458,904	1,605,410	513,781
Natural gasoline and cycle products	14,659	42,709	14,674	49,070	12,581	84,638	10,835	63,333
LP gases	27,148	57,011	29,044	95,264	31,231	166,481	29,640	140,197
Petroleum (crude)	207,633	709,033	191,204	723,273	177,785	1,277,076	163,123	1,389,164
Pumice	W	W	W	W	W	W	W	W
Salt	W	W	5	86	W	W	W	W
Sand and gravel	7,901	11,138	12,154	14,941	8,708	13,772	9,591	16,749
Stone	19,448	26,574	22,316	34,999	22,223	36,599	20,111	36,840
Zinc (recoverable content of ores, etc.)					W	W		
Value of items that cannot be disclosed: Cement, clay (benctonite, 1972-73), copper, feldspar (1974), lime, silver, tripoli, and values indicated by symbol W								
Total	XX	37,296	XX	39,772	XX	45,142	XX	43,362
	XX	1,210,798	XX	1,323,626	XX	2,122,601	XX	2,267,095

OREGON

Clays	151	238	168	291	140	243	120	214
Copper	W	W	W	W	W	W	W	W
Diatomite	W	W	W	W	W	W	W	W
Gem stones	NA	793	NA	700	NA	500	NA	500
Gold (recoverable content of ores, etc.)	W	W	W	W	W	W	W	W
Lead								
short tons								
Lime	96	2,129	106	2,552	98	2,818	96	3,281
Mercury								
76-pound flasks								
Nickel (content of ore and concentrate)	16,854	W	18,272	W	16,618	W	16,987	W
Pumice	W	W	1,171	2,013	915	1,887	1,470	3,937
Sand and gravel	24,469	34,981	22,802	32,751	18,568	30,948	16,527	29,596
Silver (recoverable content of ores, etc.)	2	4	1	3	9	42	W	W
Stone	10,915	18,380	13,411	21,843	23,363	43,406	21,275	40,321
Value of items that cannot be disclosed: Cement, emery (1973, 1975), talc and soapstone, tungsten (1972), and values indicated by symbol W								
Total	XX	19,991	XX	21,424	XX	24,076	XX	28,155
	XX	76,516	XX	81,577	XX	103,920	XX	106,004

PENNSYLVANIA

Cement:								
Masonry	451	12,401	490	14,443	404	14,642	357	14,640
Portland	8,214	166,008	8,563	171,663	7,448	151,594	5,819	163,220
Clays	2,682	15,829	3 2,975	3 16,664	3 2,752	3 16,496	3 1,945	3 13,672

See footnotes at end of table.



Table 6.—Mineral production<sup>1</sup> in the United States, by State—Continued

Mineral	1972		1973		1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
PENNSYLVANIA—Continued								
Coal:								
Anthracite	7,106	\$85,251	6,830	\$90,260	6,617	\$144,695	6,203	\$198,481
Bituminous	75,929	694,267	76,403	798,792	80,462	1,637,394	84,137	2,111,009
Copper (recoverable content of ores, etc.)	2,611	2,673	1,845	2,195				
Gem stones	NA	9	NA	9	NA		NA	9
Lime	1,891	33,892	2,260	40,949	2,080	50,147	1,940	60,047
Mica, scrap	W	W	W	W	W	W	W	W
Natural gas	73,958	22,359	78,514	32,976	82,657	36,390	84,676	57,156
Peat	22	320	28	411	30	515	27	488
Petroleum (crude)	3,441	16,414	3,282	18,440	3,478	36,220	3,264	39,647
Sand and gravel	18,757	36,804	20,576	42,830	18,071	45,181	17,401	48,742
Stone	67,307	124,340	78,564	150,346	73,082	189,615	60,177	143,670
Zinc (recoverable content of ores, etc.)	18,344	6,512	18,857	7,792	20,288	14,567	21,090	16,450
Value of items that cannot be disclosed: Clay (kaolin, except 1972), iron ore, natural gas liquids, tripoli, and values indicated by symbol W	XX	24,466	XX	26,140	XX	26,983	XX	29,607
Total	XX	1,231,435	XX	1,401,900	XX	2,374,423	XX	2,907,833
RHODE ISLAND								
Sand and gravel	2,079	3,336	2,429	3,095	2,784	4,605	2,910	5,070
Stone	4 329	4 23	W	W	W	W	293	1,125
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	932	XX	1,245	XX	1,377	XX	3
Total	XX	4,291	XX	4,340	XX	5,982	XX	6,198
SOUTH CAROLINA								
Clays	2,221	11,268	3 2,250	3 12,877	3 2,297	3 13,765	3 1,698	3 12,828
Gem stones	W	W	NA	5	NA	5	NA	5
Mica (scrap)	W	W	W	W	W	W	W	W
Peat	W	W	14	252	NA	252	7	318
Sand and gravel	7,916	12,121	8,179	12,628	7,850	13,054	7,363	14,128
Stone	12,462	21,819	14,985	24,280	4 12,242	4 21,719	13,836	30,082
Value of items that cannot be disclosed: Cement, clay (fuller's earth, 1973-75), feldspar (1972), stone (limestone, 1974), vermiculite, and values indicated by symbol W	XX	37,105	XX	38,571	XX	56,376	XX	58,106
Total	XX	82,313	XX	88,361	XX	105,171	XX	115,467
SOUTH DAKOTA								
Clays <sup>3</sup>	185	156	201	181	190	202	187	185
Feldspar	25,000	400	W	W	W	W	W	W
Gem stones	NA	42	NA	42	NA	42	NA	42

Gold (recoverable content of ores, etc.)	407,430	23,875	375,575	34,974	343,723	54,906	304,935	49,244
Gypsum	24	43	W	W	82	135	23	60
Lime	W	W	63	1,206	94	2,059	W	W
Mica (scrap)	W	W	275	988	494	3,283	472	5,996
Petroleum (crude)	219	574	13,963	16,587	9,028	9,720	6,481	8,668
Sand and gravel	12,748	14,793	72	184	62	294	68	929
Silver (recoverable content of ores, etc.)	100	168	2,745	11,607	2,968	14,231	2,647	15,350
Stone	2,665	10,364						
Value of items that cannot be disclosed: Beryllium concentrate (1972-1975), cement, clay (bentonite), iron ore (1974-75), natural gas liquids, (1974-75), uranium (1972), vanadium (1972), and values indicated by symbol W	XX	14,635	XX	15,370	XX	F 17,998	XX	21,977
Total	XX	65,450	XX	81,139	XX	F 102,310	XX	101,921

TENNESSEE

Barite	W	W	W	W	W	W	W	260
Cement:								
Masonry	176	4,104	201	7,908	154	4,706	138	4,778
Portland	1,695	37,176	1,711	42,402	1,525	43,339	1,136	37,866
Clays	7,179	9,083	9,083	9,083	1,638	9,775	1,310	9,008
Coal (bituminous)	11,260	81,386	8,219	66,827	7,541	135,874	8,206	140,293
Copper (recoverable content of ores, etc.)	11,310	11,581	8,600	10,115	6,304	9,745	10,041	12,893
Gold (recoverable content of ores, etc.)	176	10	68	7	18	7	W	W
Lime	W	W	W	W	136	3,443	106	3,735
Natural gas	25	8	20	6	17	27	27	12
Petroleum (crude)	198	10,732	201	12,790	760	7,256	682	7,849
Phosphate rock	2,154	10,732	2,512	12,790	2,411	13,465	2,291	28,503
Sand and gravel	10,329	16,328	12,010	20,145	10,702	19,476	10,909	22,102
Silver (recoverable content of ores, etc.)	83	141	73	187	20	94	84	238
Stone	35,942	55,512	42,742	71,116	41,720	75,547	39,938	83,437
Zinc (recoverable content of ores, etc.)	101,722	36,111	64,172	26,516	86,671	61,512	83,293	64,968
Value of items that cannot be disclosed: Clay (fuller's earth), pyrites, and values indicated by symbol W	XX	10,006	XX	8,579	XX	6,360	XX	8,526
Total	XX	269,314	XX	275,690	XX	395,608	XX	424,768

TEXAS

Cement:								
Masonry	217	5,812	234	6,606	195	6,438	181	7,089
Portland	7,813	171,642	8,320	189,368	7,739	207,706	7,195	224,804
Clays	5,175	11,554	5,657	13,115	5,315	13,677	4,248	13,411
Coal (lignite)	4,046	6,046	6,046	6,046	7,684	W	11,002	W
Gem stones	N/A	163	N/A	163	N/A	160	N/A	160
Gypsum	1,542	5,284	1,616	6,469	1,365	5,276	1,094	4,277
Helium, crude	W	12,312	904	10,948	35	420	36	432
Iron ore	W	W	W	W	W	W	W	W
Lime	1,631	22,181	1,677	26,867	1,835	39,644	1,735	46,179
Natural gas	8,657,840	1,419,886	8,513,350	1,735,221	8,170,798	2,541,118	7,485,764	3,885,112
Natural gas liquids:								
Natural gasoline	92,437	294,163	92,743	347,393	88,316	629,529	78,835	479,700
LP gases	226,624	425,319	221,686	589,685	213,756	1,004,653	212,635	965,363

See footnotes at end of table.



potassium salts, sodium sulfate, tungsten, and values indicated by symbol W	XX	57,391	XX	69,274	XX	105,664	XX	116,550
Total	XX	542,809	XX	674,354	XX	952,045	XX	966,407
VERMONT								
Peat	(5)	1	(5)	2	(5)	4	(5)	W
Sand and gravel	3,302	3,214	4,041	3,581	2,394	3,588	2,356	3,698
Stone	3,800	26,170	1,871	19,523	1,932	21,630	1,224	15,718
Talc	180,239	1,326	251,087	1,497	W	W	230,973	1,918
Value of items that cannot be disclosed: Asbestos, other nonmetals, and values indicated by symbol W	XX	4,157	XX	4,763	XX	4,723	XX	7,450
Total	XX	34,868	XX	29,366	XX	33,945	XX	23,770

VIRGINIA								
Clays	1,634	1,783	1,646	1,886	1,957	2,614	819	1,152
Coal (bituminous)	34,028	344,061	33,961	377,879	34,326	866,099	35,510	1,081,837
Gem stones	NA	13	NA	13	NA	13	NA	3
Lead (recoverable content of ores, etc.)	3,441	1,034	2,637	859	3,106	1,393	2,551	1,097
Lime	758	11,739	782	12,905	895	18,929	705	20,192
Natural gas	2,787	(5)	5,101	1,688	7,096	3,619	6,723	3,462
Petroleum (crude)	14,085	21,696	14,511	26,246	14,314	29,270	9,895	24,776
Sand and gravel	89,986	74,000	43,500	12	W	W	W	W
Soapstone	39,986	74,000	43,500	82,719	44,176	95,988	35,384	84,204
Stone (recoverable content of ores, etc.)	16,789	9,960	16,683	6,594	17,195	12,346	15,151	11,818
Value of items that cannot be disclosed: Aplite, cement, gypsum, kyanite, salt (1972), silver (1975), and values indicated by symbol W	XX	28,523	XX	35,201	XX	36,298	XX	33,873
Total	XX	489,791	XX	545,402	XX	1,056,569	XX	1,261,974

WASHINGTON									
Cement:	6	170	6	169	6	193	5	209	
Masonry	1,239	26,848	1,194	26,551	1,377	36,347	1,147	40,666	
Portland	264	584	287	664	287	698	290	778	
Clays	2,635	17,424	3,270	21,440	3,913	W	3,743	W	
Coal (bituminous)	NA	163	NA	160	NA	160	NA	160	
Gem stones	5	13	W	W	W	W	W	W	
Gypsum	2,567	772	2,217	722	1,299	585	W	98	
Lead (recoverable content of ores, etc.)	18	89	21	110	14	85	13	98	
Peat	W	W	1	1	(5)	1	1	1	
Pumice	23,065	26,069	27,935	30,132	23,842	35,030	19,069	32,990	
Sand and gravel	221	372	W	W	W	W	W	W	
Silver (recoverable content of ores, etc.)	14,712	4,23,764	11,384	19,284	15,095	24,483	7,920	18,754	
Stone (recoverable content of ores, etc.)	6,483	2,301	6,878	2,685	6,909	4,960	W	W	
Zinc (recoverable content of ores, etc.)	Values of items that cannot be disclosed: Clay (fire), copper, diatomite, gold, lime, olivine, stone (dimension, 1972), talc, tungsten, uranium, and values indicated by symbol W	XX	11,237	XX	12,695	XX	41,388	XX	64,850
Total	XX	109,806	XX	114,663	XX	149,930	XX	158,505	

See footnotes at end of table.

Table 6.—Mineral production<sup>1</sup> in the United States, by State—Continued

Mineral	1972		1973		1974		1975	
	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)	Quan- tity	Value (thousands)
WEST VIRGINIA								
Clays <sup>3</sup> .....	274	\$403	348	\$516	339	\$520	278	\$439
Coal (bituminous).....	123,743	1,275,813	115,448	1,340,338	102,462	2,218,418	109,253	3,206,951
Gem stones.....	NA	2	NA	2	NA	2	NA	2
Lime.....	W	W	W	W	123	2,315	W	W
Natural gas.....	214,951	64,485	208,676	64,481	202,306	66,356	154,484	57,005
Petroleum (crude).....	2,577	12,047	2,385	11,965	2,666	27,058	2,479	29,712
Salt.....	1,282	5,963	1,217	6,082	1,201	6,286	972	4,672
Sand and gravel.....	5,765	15,081	5,893	16,257	5,352	16,018	5,068	17,872
Stone.....	*11,549	*21,293	*11,732	*22,821	10,954	22,308	41,053	24,333
Value of items that cannot be disclosed: Cement, clay (fire), natural gas liquids, stone (dimension, 1972-73), and values indi- cated by symbol W.....	XX	35,595	XX	40,583	XX	r 43,886	XX	49,226
Total.....	XX	1,450,632	XX	1,503,045	XX	2,403,177	XX	3,390,212
WISCONSIN								
Clays.....	4	7	2	3	2	4	2	4
Gem stones.....	NA	1	NA	1	NA	1	NA	1
Iron ore (usable).....	387	W	956	W	899	W	791	W
Lead (recoverable content of ores, etc.).....	757	228	844	275	1,285	578	W	W
Lime.....	263	5,009	310	6,003	311	6,764	296	8,604
Peat.....	2	179	2	203	W	W	11	502
Sand and gravel.....	36,430	31,324	40,250	43,647	28,860	34,577	30,057	40,580
Stone.....	19,394	29,631	23,815	36,917	22,443	40,912	20,566	40,156
Zinc (recoverable content of ores, etc.).....	6,373	2,440	8,672	3,583	8,787	6,273	W	W
Value of items that cannot be disclosed: Abrasive stones, cement, copper (1974-75), silver (1974-75), and values indicated by sym- bol W.....	XX	20,484	XX	23,701	XX	25,654	XX	42,413
Total.....	XX	89,353	XX	114,339	XX	114,763	XX	132,260
WYOMING								
Clays.....	1,873	18,509	2,343	24,043	2,511	29,339	2,582	36,046
Coal (bituminous).....	10,923	40,898	14,866	60,939	20,703	103,915	23,804	160,447
Feldspar.....	W	W	2,588	56	W	W	W	W
Gem stones.....	NA	142	NA	142	NA	140	NA	140
Gypsum.....	W	W	312	1,348	315	960	271	902
Iron ore (usable).....	2,020	W	2,070	W	2,105	W	2,039	26,732
Lime.....	W	W	90	548	29	464	W	W
Natural gas.....	375,089	60,760	357,731	64,749	326,657	80,081	316,123	106,533
Natural gas liquids: Natural gasoline.....	3,015	8,951	3,351	10,647	2,993	18,577	2,909	17,694
L.P. gases.....	7,691	15,536	7,237	22,507	6,804	31,707	6,061	29,578
Petroleum (crude).....	140,011	432,071	141,914	541,820	139,997	914,360	135,943	983,785

Sand and gravel	9,098	14,916	6,201	11,635	5,532	9,508	4,828	10,746
Stone	3,549	5,768	3,191	6,716	2,384	4,599	2,882	7,618
Uranium (recoverable content (UsOs))	8,544	53,827	10,134	65,868	7,449	78,213	6,862	84,406
Value of items that cannot be disclosed: Cement, phosphate rock, pumice (1972-73), sodium carbonate, and values indicated by symbol W	XX	95,365	XX	117,565	XX	163,997	XX	179,751
Total	XX	746,743	XX	928,583	XX	1,437,200	XX	1,644,438

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 stones, included with "Value of items that cannot be disclosed."  
 5 Less than 1/2 unit.  
 6 Total of items listed.  
 7 Excludes salt in brine, included with "Value of items that cannot be disclosed."

Table 7.—Mineral production <sup>1</sup> in the islands administered by the United States

Area and mineral	1972		1973		1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
American Samoa:								
Pumice								
thousand short tons..	--	--	37	\$214	27	\$183	15	\$15
Stone .....	49	\$414	63	152	50	122	34	147
Total .....	XX	414	XX	366	XX	305	XX	162
Guam: Stone								
thousand short tons..	831	1,983	1,246	3,139	798	1,444	781	1,837
Virgin Islands: Stone								
do.....	726	2,255	664	2,860	638	3,869	253	1,813

XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).Table 8.—Mineral production <sup>1</sup> in the Commonwealth of Puerto Rico

(Thousand short tons and thousand dollars)

Mineral	1972		1973		1974		1975	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Cement .....	1,946	31,756	2,062	41,203	1,881	70,277	1,582	60,968
Clays .....	361	382	464	473	291	332	341	440
Lime .....	42	1,776	42	2,215	39	2,923	28	2,231
Salt .....	29	580	29	580	29	624	27	639
Sand and gravel .....	7,478	21,237	7,480	21,243	NA	NA	NA	NA
Stone .....	13,504	32,793	15,647	41,857	14,362	41,640	13,595	47,515
Total .....	XX	88,524	XX	107,571	XX	<sup>2</sup> 115,796	XX	<sup>2</sup> 111,793

NA Not available. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).<sup>2</sup> Total does not include value of items withheld or not available.

Table 9.—U.S. exports of principal minerals and products

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>METALS</b>				
<b>Aluminum:</b>				
Ingots, slabs, crude -----short tons..	207,829	\$155,817	185,850	\$134,064
Scrap -----do-----	80,158	33,043	65,747	29,085
Plates, sheets, bars, etc -----do-----	216,030	247,976	171,008	228,684
Castings and forgings -----do-----	5,933	19,623	5,008	18,813
Aluminum sulfate -----do-----	41,875	1,807	47,688	2,897
Other aluminum compounds -----do-----	816,293	109,063	835,920	131,726
Antimony, metals and alloys crude -----do-----	871	1,572	340	348
Bauxite, including bauxite concentrates thousand long tons..	16	1,218	19	1,651
Beryllium -----pounds-----	143,628	1,107	37,336	1,152
Bismuth, metals and alloys -----do-----	329,926	1,520	128,893	735
<b>Boron:</b>				
Boric acid -----short tons..	35,740	8,774	33,697	11,532
Sodium borates, refined -----do-----	218,107	33,836	212,266	42,486
<b>Cadmium</b> -----thousand pounds..	62	238	396	589
<b>Calcium:</b>				
Carbonate -----short tons..	11,073	1,541	4,640	705
Chloride -----do-----	30,866	1,700	28,359	2,314
Dicalcium phosphate -----do-----	29,196	6,864	21,053	6,270
<b>Chrome:</b>				
Ore and concentrates:				
Exports -----thousand short tons..	18	1,430	139	6,896
Reexports -----do-----	99	3,101	45	2,111
Ferrocchrome -----do-----	7	3,765	13	9,075
<b>Cobalt</b> -----thousand pounds..	3,679	10,979	4,237	14,881
<b>Columbium metals, alloys, other forms</b> -----do-----	33	563	53	787
<b>Copper:</b>				
Ore, concentrate, composition metal and unrefined (copper content) -----short tons..	23,381	28,819	16,451	14,454
Scrap -----do-----	41,342	46,413	45,002	40,793
Refined copper and semimanufactures -----do-----	202,203	448,584	258,165	465,553
Other copper manufactures -----do-----	8,332	17,583	9,518	14,158
Copper sulfate or blue vitriol -----do-----	1,815	2,138	1,248	2,067
Copper-base alloys -----do-----	169,521	284,839	130,254	179,838
<b>Ferroalloys:</b>				
Ferrosilicon -----do-----	6,575	3,338	39,712	15,732
Ferrophosphorus -----do-----	3,677	408	437	57
<b>Gold:</b>				
Ore and base bullion -----troy ounces..	308,081	49,410	393,970	63,654
Bullion, refined -----do-----	3,555,193	179,070	3,101,812	429,278
<b>Iron ore</b> -----thousand long tons..	2,323	35,148	2,537	60,071
<b>Iron and steel:</b>				
Pig iron -----short tons..	100,582	6,743	59,596	4,636
Iron and steel products (major):				
Semimanufactures -----do-----	4,757,829	1,373,496	1,690,956	633,502
Manufactured steel mill products -----do-----	2,234,200	1,638,541	2,284,043	2,336,341
Iron and steep scrap: Ferrous scrap, including reolling materials -----thousand short tons..	9,023	881,885	9,642	780,984
Slag -----short tons..	51,902	2,524	139,516	5,506
<b>Lead:</b>				
Pigs, bars, anodes, sheets, etc -----do-----	61,982	32,685	21,256	12,041
Scrap -----do-----	59,366	16,813	49,951	10,063
<b>Magnesium, metal and alloys, scrap, semimanu-   factured forms</b> -----do-----	46,398	48,511	32,591	48,191
<b>Manganese:</b>				
Ore and concentrate -----do-----	223,088	13,656	204,523	13,886
Ferromanganese -----do-----	7,011	2,204	32,800	10,601
Metal -----do-----	2,318	2,119	3,256	3,318
<b>Mercury:</b>				
Exports -----76-pound flasks..	466	270	339	152
Reexports -----do-----	--	--	155	68
<b>Molybdenum:</b>				
Ore and concentrates (molybdenum content) thousand pounds..	78,660	151,075	62,611	159,592
Metals and alloys, crude and scrap -----do-----	105	256	317	858
Wire -----do-----	415	4,210	270	2,863
Semifabricated forms, n.e.c -----do-----	251	1,670	312	1,790
Powder -----do-----	203	728	60	296
Ferromolybdenum -----do-----	4,094	7,094	2,241	4,798

See footnotes at end of table.



Table 9.—U.S. exports of principal minerals and products—Continued

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS—Continued				
Nickel:				
Alloys and scrap (including Monel metal), ingots, bars, sheets, etc. ....short tons....	22,355	\$94,980	23,118	\$102,400
Catalysts .....do.....	3,477	9,143	3,536	13,713
Nickel-chrome electric resistance wire ..do....	1,117	6,056	679	4,769
Semifabricated forms, n.e.c. ....do.....	3,493	23,319	2,788	20,420
Platinum:				
Ore, concentrate, metal and alloys in ingots, bars, sheets, anodes, and other forms, including scrap .....troy ounces....	474,494	78,142	376,450	56,412
Platinum-group metals:				
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys including scrap) .....do.....	361,260	39,279	283,435	31,102
Manufactures, except jewelry .....do.....	NA	3,753	NA	3,246
Rare earths; cerium ore, metal, alloys, lighter flints .....do.....pounds....				
192,144	503	100,279	300	
Silicon:				
Ferrosilicon .....short tons..	6,575	3,338	38,452	15,281
Silicon carbide, crude and in grains .....do....	13,612	5,813	12,970	6,839
Silver:				
Ore, concentrates, waste, sweepings .....do.....thousand troy ounces..	12,699	53,956	10,005	43,481
Bullion, refined .....do.....	5,691	27,695	22,621	104,086
Tantalum:				
Ore, metal, other forms .....thousand pounds..	704	6,813	531	5,545
Powder .....do.....	233	7,008	161	5,974
Tin:				
Ingots, pigs, bars, etc.:				
Exports .....long tons..	5,908	47,774	1,421	10,457
Reexports .....do.....	2,507	15,700	2,118	15,531
Tin scrap and other tin-bearing material except tinplate scrap .....do.....	7,325	5,950	5,062	4,343
Titanium:				
Ore and concentrate .....short tons..	3,264	727	3,147	505
Sponge (including iodide titanium and scrap) .....do.....	4,730	9,288	4,326	7,630
Intermediate mill shapes and mill products, n.e.c. ....do.....	1,719	19,600	1,900	24,726
Dioxide and pigments .....do.....	2 30,379	2 24,575	15,807	12,110
Tungsten: Ore and concentrates (tungsten content):				
Exports .....thousand pounds..	1,187	4,835	1,316	8,082
Reexports .....do.....	88	292	316	930
Uranium:				
Ore and concentrates (U <sub>3</sub> O <sub>8</sub> content)				
.....pounds..	--	--	122,663	1,840
Metal .....do.....	20,496	322	14,840	203
Compounds .....do.....	4,682,926	30,855	3,837,266	52,040
Isotopes (stable) and their compounds .....do.....	NA	2,786	NA	2,679
Radioactive materials .....thousand curies..	25,431,262	16,571	37,850,386	20,088
Special nuclear materials .....do.....	NA	158,267	NA	236,849
Vanadium:				
Ore and concentrate, pentoxide, etc. (vanadium content) .....pounds..	406,235	1,327	430,592	1,628
Ferrovandium .....do.....	2,670,321	7,863	2,035,851	7,952
Zinc:				
Slabs, pigs, blocks .....short tons..	19,062	16,511	6,897	5,870
Sheets, plates, strips, other forms, n.e.c. ....do.....	3,487	3,842	1,629	2,086
Waste, scrap, and dust (zinc content) ..do....	12,088	6,280	5,051	2,448
Semifabricated forms, n.e.c. ....do.....	28,456	27,343	14,196	9,379
Zirconium:				
Ore and concentrate .....pounds..	42,973,250	3,323	37,531,345	4,787
Metals, alloys, other forms .....do.....	1,650,695	18,195	2,649,694	25,829
NONMETALS				
Abrasives:				
Dust and powder of precious or semiprecious stones (including diamond dust and powder) .....thousand carats..				
14,005	34,822	12,802	32,088	
Crushing bort .....do.....	11	25	3	12
Industrial diamonds .....do.....	981	5,460	950	5,948
Diamond grinding wheels .....do.....	894	5,574	684	4,933
Other natural and artificial metallic abrasives and products .....do.....	NA	69,627	NA	59,868

See footnotes at end of table.

Table 9.—U.S. exports of principal minerals and products—Continued

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>NONMETALS—Continued</b>				
<b>Asbestos:</b>				
Exports:				
Unmanufactured .....short tons..	55,114	\$8,643	34,921	\$10,059
Products .....do.....	NA	60,256	NA	60,556
Reexports:				
Unmanufactured .....do.....	6,609	549	1,526	608
Products .....do.....	NA	140	NA	220
<b>Barite:</b>				
Natural barium sulfate .....do.....	61,245	2,518	57,386	1,868
Lithopone .....do.....	1,185	967	1,833	1,060
Boron, boric acid, borates (crude and refined) .....do.....	r 249,884	42,610	245,963	54,018
Cement .....do.....	289,844	14,860	494,132	28,409
<b>Clays:</b>				
Kaolin or china clay .....do.....	848,873	42,080	878,619	47,905
Fire clay .....do.....	224,110	5,983	219,431	7,191
Other clays .....do.....	1,376,888	66,148	1,216,088	65,202
Feldspar, leucite, nepheline and nepheline syenite .....do.....	r 249,884	42,610	245,963	54,018
thousand pounds..	289,844	14,860	494,132	28,409
Fluorspar .....do.....	36,638	662	19,087	507
short tons..	5,847	316	1,355	194
<b>Gem stones:</b>				
Diamond .....thousand carats..	284	r 304,639	265	236,988
Pearls .....do.....	NA	817	NA	413
Other .....do.....	NA	r 19,627	NA	25,480
Graphite .....short tons..	12,189	1,693	10,586	1,890
<b>Gypsum:</b>				
Crude (crushed or calcined) .....do.....				
thousand short tons..	132	3,910	75	4,505
Manufactures, n.e.c .....do.....	NA	6,934	NA	5,976
Lithium hydroxide .....thousand pounds..	1,198	1,118	1,226	1,593
Kyanite and allied minerals .....short tons..	135,982	8,205	150,369	9,355
Lime .....do.....	31,639	1,516	53,853	2,746
<b>Magnesium compounds:</b>				
Magnesite and dead burned .....thousand pounds..	102,533	7,749	165,309	14,146
Magnesite (crude, caustic calcined, lump or ground) .....do.....	21,465	5,088	18,195	4,538
Mica (sheet, waste and scrap and ground) .....do.....	16,842,858	3,085	10,977,353	3,154
pounds..	1,053,980	3,430	1,132,301	3,950
Mica (manufactured) .....do.....				
Mineral-earth pigments, iron oxide, natural and manufactured .....short tons..	15,585	9,437	13,231	7,710
Nitrogen compounds (major) .....thousand short tons..	r 3,757	r 566,533	4,684	841,710
Phosphate rock .....do.....	r 14,208	r 255,899	12,606	461,553
<b>Phosphatic fertilizers:</b>				
Superphosphates .....do.....	r 1,153	r 227,490	1,180	193,230
Ammonium phosphates .....do.....	1,992	358,807	2,422	532,274
Elemental phosphorus .....short tons..	r 33,691	r 20,119	35,845	36,659
Mixed chemical fertilizer .....thousand short tons..	474	53,476	324	40,695
<b>Pigments and compounds (lead and zinc):</b>				
<b>Lead oxides:</b>				
Pigment grade .....short tons..	3,395	1,926	1,695	901
Other grade .....do.....	1,684	1,511	580	490
<b>Zinc oxides:</b>				
Pigment grade .....do.....	9,237	4,021	2,389	1,867
Other grade .....do.....	3,008	2,417	715	496
Zinc compounds .....do.....	1,185	967	917	1,060
<b>Potash:</b>				
Fertilizer .....do.....	1,414,598	66,175	1,419,317	r 92,701
Chemical .....do.....	38,290	14,712	104,497	18,949
Pumice and pumicite .....thousand pounds..	5,821	1,211	2,504	1,027
Quartz (natural), quartzite, cryolite, chiolite .....do.....				
short tons..	3,002	808	1,767	1,106
<b>Salt:</b>				
Crude and refined .....thousand short tons..	521	4,276	1,332	9,070
Shipments to noncontiguous territories .....do.....	19	1,793	20	2,304
<b>Sand and gravel:</b>				
<b>Sand:</b>				
Construction .....short tons..	658,801	1,132	510,859	1,111
Industrial .....do.....	1,123,954	9,864	2,171,109	13,071
Gravel .....do.....	472,896	668	537,290	864

See footnotes at end of table.

Table 9.—U.S. exports of principal minerals and products—Continued

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>NONMETALS—Continued</b>				
<b>Sodium and sodium compounds:</b>				
Sodium sulfate -----short tons..	51	\$3,250	77	\$6,144
Sodium carbonate -----do.....	564	34,156	552	45,985
<b>Stone:</b>				
Dolomite (block) -----do.....	86	1,559	49	1,464
Limestone (crushed, ground, broken) ..do...	2,793	7,753	3,386	9,993
Marble and other building and monumental ..do...	NA	1,920	NA	2,449
Stone (crushed, ground, broken) thousand short tons..	625	4,850	896	5,843
Manufactures of stone -----do.....	NA	2,077	NA	2,376
<b>Sulfur:</b>				
Crude -----thousand long tons..	2,580	95,516	1,288	69,553
Crushed, ground, flowers of -----do.....	21	1,829	7	2,248
Talc (crude and ground) -----short tons..	182,706	6,711	157,681	6,338
<b>FUELS</b>				
Carbon black -----thousand pounds..	201,737	32,947	87,947	15,474
<b>Coal:</b>				
Anthracite -----thousand short tons..	735	16,577	640	25,801
Bituminous -----do.....	59,926	2,420,334	65,669	3,282,893
Briquets -----do.....	113	6,729	90	9,566
Coke -----do.....	1,278	43,564	1,273	74,732
Natural gas -----thousand cubic feet..	<sup>r</sup> 110,173,729	<sup>r</sup> 70,209	105,879,552	114,275
<b>Petroleum:</b>				
Crude -----thousand barrels..	1,072	13,565	19	187
Gasoline -----do.....	655	12,105	185	3,103
Jet -----do.....	655	7,637	326	3,459
Naphtha -----do.....	1,293	27,211	1,168	27,271
Kerosine -----do.....	33	525	28	437
Distillate oil -----do.....	307	5,518	92	1,156
Residual oil -----do.....	4,261	41,232	4,892	43,179
Lubricating oil -----do.....	<sup>r</sup> 11,307	321,951	8,827	300,873
Asphalt -----do.....	341	5,238	245	6,222
Liquefied petroleum gases -----do.....	9,033	94,464	9,432	100,041
Wax -----do.....	862	34,464	581	27,502
Coke -----do.....	40,790	181,171	36,949	315,239
Petrochemical feedstocks -----do.....	5,558	65,712	7,436	95,681
Miscellaneous -----do.....	1,194	44,433	1,088	43,976
<b>Total</b> -----do.....	<b>XX</b>	<b><sup>r</sup> 12,645,291</b>	<b>XX</b>	<b>14,381,190</b>

<sup>r</sup> Revised. NA Not available. XX Not applicable.

<sup>1</sup> Data shown pending clarification by source, subject to change, Bureau of the Census.

<sup>2</sup> Adjusted by the Bureau of Mines.

Table 10.—U.S. imports for consumption of principal minerals and products

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>METALS</b>				
<b>Aluminum:</b>				
Metal -----short tons----	508,643	\$312,479	434,119	\$316,873
Scrap -----do-----	74,743	42,569	54,806	27,586
Plates, sheets, bars, etc -----do-----	46,081	47,489	61,354	65,079
Aluminum oxide (alumina) -----do-----	3,627,024	270,617	3,507,415	370,039
<b>Antimony:</b>				
Ore (antimony content) -----do-----	14,655	20,866	8,320	14,595
Needle or liquated -----do-----	86	271	74	255
Metal -----do-----	2,203	7,550	2,112	5,677
Oxide -----do-----	6,269	15,580	9,908	12,588
<b>Arsenic:</b>				
White (As <sub>2</sub> O <sub>3</sub> content) -----do-----	13,742	2,449	12,013	4,426
Metallic -----do-----	707	3,651	483	2,716
<b>Bauxite (crude) -----thousand long tons----</b>	14,308	NA	10,782	NA
<b>Beryllium ore -----short tons----</b>	1,368	414	1,479	1,468
<b>Bismuth -----pounds----</b>	1,893,744	15,606	1,331,173	9,442
<b>Boron:</b>				
Carbide -----do-----	75,429	265	137,572	645,354
Boric acid -----do-----	844,811	149	345,237	59,339
Calcium borate (crude) -----do-----	42,427,527	852	55,282,329	1,559,662
<b>Cadmium:</b>				
Metal -----short tons----	1,985	14,674	2,618	13,902
Flue dust (cadmium content) -----do-----	166	603	346	1,489
<b>Calcium:</b>				
Metal -----pounds----	109,252	121	70,123	78
Chloride -----short tons----	3,599	156	12,021	598
<b>Chromate:</b>				
Ore and concentrates (Cr <sub>2</sub> O <sub>3</sub> content) -----thousand short tons----	481	28,532	559	60,651
Ferrochrome -----do-----	103	55,924	198	190,630
Metal -----do-----	2	5,388	2	6,630
<b>Cobalt:</b>				
Metal -----thousand pounds----	14,791	49,661	6,092	25,611
Oxide (gross weight) -----do-----	1,509	4,514	233	779
Salts and compounds (gross weight) -----do-----	2	12	41	74
<b>Columbium ore -----do-----</b>	3,129	3,207	1,542	2,012
<b>Copper (copper content):</b>				
Ore and concentrates -----short tons----	84,728	121,422	29,301	35,649
Regulus, black, coarse -----do-----	2,426	12,033	5,675	20,560
Unrefined, black, blister -----do-----	200,607	383,491	78,969	90,846
Refined in ingots, etc -----do-----	313,349	551,442	142,945	166,159
Old and scrap -----do-----	31,109	50,641	14,399	14,459
<b>Ferroalloys, n.e.c -----do-----</b>	81,709	38,102	62,125	36,991
<b>Gallium -----kilograms----</b>	6,536	4,107	6,830	3,555
<b>Gold:</b>				
Ore and base bullion -----troy ounces----	329,357	45,974	313,038	50,055
Bullion -----do-----	2,321,981	350,706	2,348,936	406,583
<b>Indium -----do-----</b>	492,978	1,906	113,800	629
<b>Iron ore -----thousand long tons----</b>	48,029	696,298	46,743	860,496
<b>Iron and steel:</b>				
Pig iron -----short tons----	342,348	41,038	478,106	69,316
Iron and steel products (major):				
Iron products -----do-----	49,524	29,328	47,535	32,299
Steel products -----do-----	16,696,509	5,553,378	12,440,326	4,475,191
Scrap -----do-----	188,480	26,166	293,082	24,464
Tinplate -----do-----	12,645	861	12,277	786
<b>Lead:</b>				
Ore, flue dust, matte (lead content) -----do-----	62,691	15,180	45,024	12,329
Base bullion (lead content) -----do-----	831	331	462	183
Pigs and bars (lead content) -----do-----	118,367	57,693	99,054	46,703
Reclaimed scrap, etc. (lead content) -----do-----	1,236	834	1,741	617
Sheet, pipe, shot -----do-----	196	138	147	99
<b>Magnesium:</b>				
Metallic and scrap -----do-----	4,815	3,518	6,787	9,299
Alloys (magnesium content) -----do-----	440	1,573	1,111	2,215
Sheets, tubing, ribbons, wire, and other forms (magnesium content) -----do-----	50	135	5	33
<b>Manganese:</b>				
Ore (35% or more manganese) (manganese content) -----do-----	592,818	45,091	765,530	77,103
Ferromanganese (manganese content) -----do-----	327,374	88,426	306,650	123,381
Metal -----do-----	2,506	1,379	4,378	4,041

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products—Continued

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>METALS—Continued</b>				
<b>Mercury:</b>				
Compounds ----- pounds..	62,807	\$153	5,122	\$40
Metal ----- 76-pound flasks..	52,180	13,948	43,865	7,599
Minor metals, selenium and salts ----- pounds..	841,259	10,611	889,320	10,265
<b>Molybdenum:</b>				
Ore (content) ----- do..	155,125	217	2,566,680	5,916
Waste and scrap ----- do..	100,159	218	44,672	101
Metal ----- do..	53,947	574	38,926	434
Compounds ----- do..	1,456,133	1,515	682,039	745
<b>Nickel:</b>				
Pigs, ingots, shot, cathodes ----- short tons..	137,314	450,342	107,084	406,894
Plates, bars, etc ----- do..	1,384	7,499	1,747	11,118
Slurry ----- do..	42,999	96,959	23,991	63,522
Scrap ----- do..	3,699	8,545	2,353	5,864
Powder and flakes ----- do..	9,371	33,545	9,772	39,413
Ferronickel ----- do..	102,430	87,255	65,046	67,818
Oxide ----- do..	6,449	15,081	5,063	15,172
<b>Platinum-group metals:</b>				
<b>Unwrought:</b>				
Grains and nuggets (platinum) ----- troy ounces..	71,154	13,626	19,253	2,941
Sponge (platinum) ----- do..	839,526	151,705	567,466	91,567
Sweepings, waste and scrap ----- do..	132,362	18,699	116,523	14,278
Iridium ----- do..	25,980	9,432	14,419	6,852
Palladium ----- do..	588,014	74,433	409,862	33,863
Rhodium ----- do..	97,053	39,957	80,197	34,400
Ruthenium ----- do..	63,884	3,673	16,535	926
Other platinum-group metals ----- do..	274,026	50,800	234,757	37,055
<b>Semimanufactured:</b>				
Platinum ----- do..	199,355	35,388	96,630	15,337
Palladium ----- do..	750,073	75,553	144,240	15,163
Rhodium ----- do..	1,549	898	1,832	675
Other platinum-group metals ----- do..	205,330	30,450	118,570	19,726
Radium: Radioactive substitutes ----- do..	NA	7,565	NA	8,297
<b>Rare earths, ferrocerium and other cerium alloys ----- pounds..</b>				
	57,519	238	33,852	187
<b>Silicon (silicon content):</b>				
Metal ----- short tons..	5,914	16,700	3,852	6,591
Ferrosilicon ----- do..	93,131	66,501	47,365	41,950
<b>Silver (general imports):</b>				
Ore and base bullion .. thousand troy ounces..	34,568	150,284	21,197	87,755
Bullion ----- do..	89,963	432,868	61,629	274,254
Sweepings, waste, dore ----- do..	8,864	40,642	7,596	32,527
Tantalum ore ----- thousand pounds..	1,897	7,169	1,624	7,149
<b>Tin:</b>				
Ore (tin content) ----- long tons..	5,877	35,999	6,314	44,114
Blocks, pigs, grains, etc ----- do..	39,602	289,592	43,665	312,346
Dross, skimmings, scrap, residues and tin alloys, n.s.p.f. ----- do..	1,761	1,186	2,429	2,452
Tinfoil, powder, flitters, etc ----- do..	NA	9,331	NA	7,257
<b>Titanium:</b>				
Ilmenite <sup>2</sup> ----- short tons..	318,720	13,715	334,692	15,903
Rutile ----- do..	246,489	38,773	224,499	46,362
Metal ----- pounds..	20,090,390	19,546	10,549,619	18,332
Ferrotitanium ----- do..	4,592,316	3,122	1,071,048	1,125
Compounds and mixtures ----- do..	70,868,757	25,216	53,964,945	19,654
<b>Tungsten (tungsten content):</b>				
Ore and concentrates ----- thousand pounds..	11,096	40,696	6,570	31,665
Waste and scrap ----- do..	179	711	71	317
Other alloys ----- do..	2,462	9,368	1,898	11,104
Ferrotungsten ----- do..	808	3,029	418	2,542
<b>Uranium and other uranium-bearing and nuclear materials:</b>				
Oxide U <sub>3</sub> O <sub>8</sub> ----- do..	3,670,678	30,284	2,451,538	24,481
Compounds, n.e.c. ----- do..	12,866,822	90,921	19,226,578	161,507
Isotopes (stable) and their compounds ----- do..	NA	1,007	NA	957
Radio isotopes, elements, etc. thousand curies..	24,246,498	7,565	35,346,036	8,297
<b>Vanadium (content):</b>				
Ferrovandium ----- thousand pounds..	288	1,142	273	1,435
Vanadium-bearing materials (vanadium pentoxide content) ----- do..	7,744	5,566	8,185	7,075

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products—Continued

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>METALS—Continued</b>				
<b>Zinc:</b>				
Ore (zinc content) -----short tons..	133,733	\$31,430	428,544	\$108,822
Blocks, pigs, slabs -----do.....	543,806	431,251	374,922	273,636
Sheets, etc -----do.....	640	568	236	507
Old, dross, skimmings -----do.....	3,863	1,786	3,158	1,238
Dust, powder, flakes -----do.....	9,131	9,799	5,739	5,744
Manufactures -----do.....	NA	563	NA	79
<b>Zirconium:</b>				
Ore (including zirconium sand) -----do.....	62,504	6,398	40,205	8,874
Unwrought, scrap, compounds -----do.....	2,702	4,365	2,013	5,991
<b>NONMETALS</b>				
<b>Abrasives:</b>				
Diamond (industrial) -----thousand carats..	18,417	62,920	14,291	53,383
Other abrasives -----do.....	NA	80,054	NA	68,481
Asbestos -----short tons.....	766,164	123,822	538,553	111,011
<b>Barite:</b>				
Crude and ground -----do.....	764,625	9,155	672,528	9,264
Witherite -----do.....	3,435	710	85	44
Chemicals -----do.....	43,383	13,033	10,937	4,443
Cement -----thousand short tons.....	5,732	101,734	3,702	70,620
<b>Clays:</b>				
Raw -----short tons.....	37,012	1,778	33,851	1,644
Manufactured -----do.....	5,806	415	4,143	303
Cryolite -----do.....	21,216	6,969	22,120	9,058
<b>Feldspar:</b>				
Crude -----do.....	30	( <sup>3</sup> )	1,209	17
Ground and crushed -----do.....	62	3	81	6
Fluorspar -----do.....	1,336,389	60,988	1,050,448	61,059
<b>Gem stones:</b>				
Diamond -----thousand carats.....	4,533	760,040	4,577	722,119
Emeralds -----do.....	371	34,046	806	40,348
Other -----do.....	NA	88,234	NA	87,963
Graphite -----short tons.....	82,636	5,677	65,663	5,698
<b>Gypsum:</b>				
Crude, ground, calcined thousand short tons..	7,426	17,709	5,450	16,193
Manufactures -----do.....	NA	4,180	NA	3,617
Iodine (crude) -----thousand pounds.....	7,970	14,849	5,309	11,721
Kyanite -----short tons.....	194	12	65	3
<b>Lime:</b>				
Hydrated -----do.....	48,284	1,311	44,637	1,392
Other -----do.....	367,917	6,368	214,311	4,867
<b>Lithium:</b>				
Ore -----do.....	3,165	323	4,548	538
Compounds -----do.....	84	249	11	107
<b>Magnesium compounds:</b>				
Crude magnesite -----do.....	19	1	10	1
Lump, ground, caustic calcined magnesia -----do.....	8,990	692	5,716	502
Refractory magnesite, dead-burned fused magnesite, dead-burned dolomite -----do.....	156,401	18,455	156,332	24,668
Compounds -----do.....	32,064	2,107	36,572	1,796
<b>Mica:</b>				
Uncut sheet and punch -----thousand pounds..	793	947	904	696
Scrap -----do.....	6,634	193	10,672	356
Manufactures -----do.....	6,564	4,928	5,075	2,935
<b>Mineral-earth pigments; iron oxide pigments:</b>				
Ocher (crude and refined) -----short tons.....	53	10	20	3
Siennas (crude and refined) -----do.....	1,309	264	521	107
Umber (crude and refined) -----do.....	7,790	565	4,251	350
Vandyke brown -----do.....	958	183	319	57
Natural, other -----do.....	2,162	376	1,001	223
Synthetic -----do.....	41,943	14,969	21,867	8,444
<b>Nepheline syenite:</b>				
Crude -----do.....	4,605	79	6,275	98
Ground, crushed, etc -----do.....	505,028	7,558	424,838	6,869
<b>Nitrogen compounds (major), including</b>				
urea -----thousand short tons.....	3,374	345,230	3,113	415,534
Phosphate (crude) -----do.....	182	1,899	37	1,604
Phosphatic fertilizers -----do.....	202	32,512	147	26,970
<b>Pigments and salts:</b>				
Lead pigments and compounds -----short tons..	14,384	10,001	15,337	7,470
Zinc pigments and compounds -----do.....	39,436	26,048	18,447	10,746
Potash -----do.....	7,265,222	256,082	6,292,329	285,272

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products—Continued

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS—Continued				
Pumice:				
Crude or unmanufactured -----short tons--	8,415	\$228	3,260	\$77
Wholly or partly manufactured -----do----	284,505	1,214	142,120	380
Manufactures, n.s.p.f -----do----	NA	80	NA	76
Quartz crystal (Brazilian pebble) -----pounds--	1,731,913	624	1,487,272	931
Salt -----thousand short tons--	3,358	14,428	3,215	15,272
Sand and gravel:				
Glass sand -----do----	51	486	45	475
Other sand and gravel -----do----	343	352	329	301
Sodium sulfate -----do----	375	10,332	285	12,624
Stone and whiting -----do----	NA	51,631	NA	45,625
Strontium:				
Mineral -----short tons--	38,431	1,145	21,613	826
Compounds -----do----	8,547	3,095	3,100	1,261
Sulfur and compounds, sulfur ore and other forms n.e.s -----thousand long tons--	2,150	51,124	1,897	70,848
Talc, unmanufactured -----short tons--	30,252	2,233	23,378	1,471
MINERAL FUELS				
Carbon black:				
Acetylene -----pounds--	7,749,624	2,814	5,839,266	2,578
Gas black and carbon black -----do----	29,615,297	4,329	33,034,187	4,284,281
Coal:				
Bituminous (slack and culm) and lignite -----short tons--				
Briquets -----do----	2,080,407	57,731	939,721	21,682
Coke -----do----	48,233	888	16,367	270
Coke -----do----	3,540,326	193,165	1,818,981	156,488
Natural gas, ethane, methane, and mixtures thereof -----thousand cubic feet--	967,116,135	503,277	944,352,390	1,070,539
Peat:				
Fertilizer grade -----short tons--	323,263	22,316	283,732	23,371
Poultry and stable grade -----do----	3,267	266	6,626	488
Petroleum:				
Crude petroleum -----thousand barrels--	1,362,453	15,252,724	1,581,129	18,290,012
Distillate -----do----	83,033	995,549	39,420	489,351
Residual -----do----	499,914	5,037,761	362,084	3,958,178
Unfinished oils -----do----	13,866	172,189	1,514	18,042
Gasoline -----do----	33,903	570,829	22,740	314,971
Jet fuel -----do----	56,667	649,685	44,368	619,102
Motor fuels, n.e.s -----do----	955	10,907	666	8,799
Kerosine -----do----	1,023	20,354	46	511
Lubricants -----do----	310	6,983	130	4,159
Wax -----do----	352	11,257	157	6,128
Naphtha -----do----	88,275	1,131,872	64,654	732,485
Liquefied petroleum gases -----do----	45,091	365,028	41,171	354,947
Asphalt -----do----	12,209	64,144	4,835	52,274
Miscellaneous -----do----	19,353	159,763	21,285	248,453
Total -----do----	XX	39,586,403	XX	45,389,660

<sup>1</sup> Revised. NA Not available. XX Not applicable.

<sup>2</sup> Adjusted by the Bureau of Mines.

<sup>3</sup> Includes titanium slag averaging about 70% TiO<sub>2</sub>, for details, see Titanium chapter.

<sup>4</sup> Less than ½ unit.

Table 11.—Comparison of world and U.S. production of principal mineral commodities  
(Thousand short tons unless otherwise specified)

Minerals	1974			1975 <sup>p</sup>		
	World production <sup>1</sup>	U.S. production	U.S. percent of world production	World production <sup>1</sup>	U.S. production	U.S. percent of world production
<b>MINERAL FUELS</b>						
Carbon black ---million pounds..	7,803	3,390	43	6,854	2,741	40
Coal:						
Bituminous .....	<sup>2</sup> 1,866,952	585,504	31	<sup>2</sup> 1,976,204	628,619	32
Lignite .....	919,495	15,496	2	948,265	19,819	2
Pennsylvania anthracite .....	193,686	6,617	3	195,195	6,203	3
Coke (excluding breeze):						
Gashouse <sup>3</sup> .....	20,009	--	--	19,285	--	--
Oven and beehive .....	404,898	61,581	15	398,152	57,207	14
Natural gas (marketable) million cubic feet..	47,171,491	21,600,522	46	47,207,325	20,108,661	43
Peat .....	220,695	731	( <sup>4</sup> )	223,327	772	( <sup>4</sup> )
Petroleum (crude) thousand barrels..	20,537,727	3,202,585	16	19,497,213	3,056,779	16
<b>NONMETALS</b>						
Asbestos .....	4,589	113	2	4,509	99	2
Barite .....	4,944	1,106	22	5,296	1,287	24
Cement .....	776,066	<sup>5</sup> 82,888	11	766,347	<sup>5</sup> 69,722	9
Clay, china .....	17,880	<sup>6</sup> 6,393	36	16,338	<sup>6</sup> 5,334	33
Corundum .....	9	--	--	9	--	--
Diamond ----thousand carats..	44,522	--	--	41,126	--	--
Diatomite .....	1,865	664	36	1,791	573	32
Feldspar .....	3,810	763	23	3,041	670	22
Fluorspar .....	5,847	201	4	5,114	140	3
Graphite .....	541	W	NA	485	W	NA
Gypsum .....	64,622	11,999	19	60,305	9,751	16
Lime (sold or used) .....	123,183	<sup>5</sup> 21,645	18	115,149	<sup>5</sup> 19,161	17
Magnesite .....	11,090	W	NA	10,995	W	NA
Mica (including scrap) thousand pounds..	515,410	273,952	53	515,616	269,775	52
Nitrogen, agricultural <sup>7</sup> .....	44,613	<sup>5</sup> 10,095	23	46,505	<sup>5</sup> 9,503	20
Phosphate rock .....	122,147	45,686	37	118,586	48,816	41
Potash (K <sub>2</sub> O equivalent) .....	26,432	2,552	10	27,423	2,501	9
Pumice <sup>8</sup> .....	15,377	3,937	26	14,900	3,892	26
Pyrites ----thousand long tons..	22,271	424	2	22,119	625	3
Salt .....	182,102	<sup>5</sup> 46,565	26	179,107	<sup>5</sup> 41,057	23
Strontium <sup>8</sup> .....	109	--	--	59	--	--
Sulfur, elemental thousand long tons..	49,362	11,419	23	49,164	11,259	23
Talc, pyrophyllite, soapstone .....	6,284	1,290	21	5,345	928	17
Vermiculite <sup>8</sup> .....	555	341	61	577	330	57
<b>METALS, MINE BASIS</b>						
Antimony (content of ore and concentrate) ----short tons..	79,232	661	1	74,802	886	1
Arsenic, white ----do.....	56,027	W	NA	51,289	W	NA
Bauxite ----thousand long tons..	76,810	<sup>9</sup> 1,949	3	73,939	<sup>9</sup> 1,772	2
Beryl ----short tons.....	3,472	--	NA	3,553	W	NA
Bismuth ----thousand pounds..	10,639	W	NA	7,888	W	NA
Chromite .....	8,187	--	--	8,741	--	--
Cobalt (contained) ----short tons..	35,791	--	--	36,282	--	--
Columbium-tantalum concentrate <sup>8</sup> thousand pounds.....	52,727	--	--	51,502	--	--
Copper (content of ore and concentrate) .....	8,063	<sup>10</sup> 1,597	20	7,679	<sup>10</sup> 1,413	18
Gold ----thousand troy ounces..	39,941	1,127	3	38,574	1,052	3
Iron ore ----thousand long tons..	881,244	<sup>11</sup> 84,355	9	880,364	<sup>11</sup> 78,866	9
Lead (content of ore and concentrate) .....	3,832	664	17	3,788	621	16
Manganese ore (35% or more Mn) .....	25,068	--	--	26,896	--	--
Mercury thousand 76-pound flasks..	261	2	1	251	7	3
Molybdenum (content of ore and concentrate) thousand pounds..	189,274	112,011	59	178,883	105,980	59
Nickel (content of ore and concentrate) .....	871	17	2	900	17	2

See footnotes at end of table.



Table 11.—Comparison of world and U.S. production of principal mineral commodities—Continued

(Thousand short tons unless otherwise specified)

Minerals	1974			1975 <sup>p</sup>		
	World production <sup>1</sup>	U.S. production	U.S. percent of world production	World production <sup>1</sup>	U.S. production	U.S. percent of world production
<b>METALS, MINE BASIS—Continued</b>						
Platinum-group metals thousand troy ounces--	5,774	13	( <sup>4</sup> )	5,767	19	( <sup>4</sup> )
Silver -----do-----	294,935	33,762	11	294,268	34,938	12
Tin (concentrate of ore and concentrate) -----metric tons--	233,747	W	NA	225,195	W	NA
<b>Titanium concentrates:</b>						
Ilmenite <sup>8</sup> -----	3,099	745	24	2,854	717	25
Rutile <sup>8</sup> -----	365	6	2	387	W	NA
Tungsten concentrate (contained tungsten) -----thousand pounds--	81,509	7,381	9	82,580	5,588	7
Uranium oxide (U <sub>3</sub> O <sub>8</sub> ) <sup>8</sup> -----short tons--	24,576	11,614	47	26,442	11,439	43
Vanadium (content of ore and concentrate) -----do-----	21,112	4,870	23	23,831	4,743	20
Zinc (content of ore and concentrate) -----	6,281	500	8	6,131	469	8
<b>METALS, SMELTER BASIS</b>						
Aluminum -----	14,528	4,903	34	13,273	3,879	29
Cadmium -----short tons--	19,038	<sup>12</sup> 3,333	18	16,906	<sup>12</sup> 2,193	13
Copper -----	3,111	<sup>13</sup> 1,570	19	7,780	<sup>13</sup> 1,447	19
Iron, pig -----	564,501	95,477	17	526,017	79,721	15
Lead -----	3,858	<sup>14</sup> 673	17	3,714	<sup>14</sup> 636	17
Magnesium -----	145	W	NA	142	W	NA
Selenium <sup>9</sup> -----thousand pounds--	2,709	644	24	2,508	358	14
Steel ingots and castings -----	780,007	<sup>15</sup> 145,720	19	712,588	<sup>15</sup> 116,642	16
Tellurium <sup>9</sup> -----thousand pounds--	447	191	43	328	131	40
Tin -----metric tons--	228,341	<sup>16</sup> 6,096	3	230,055	<sup>16</sup> 6,500	3
Zinc -----	6,022	555	9	5,557	496	9

<sup>p</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data.

<sup>1</sup> May not represent total world production because confidential U.S. data are excluded for some commodities. World totals include reported figures and reasonable estimates; however, for some commodities where data were not available, no reasonable estimates could be made and none have been included.

<sup>2</sup> Includes small quantities of lignite for the People's Republic of China and Pakistan, and anthracite for Colombia.

<sup>3</sup> Includes low- and medium-temperature and gashouse coke.

<sup>4</sup> Less than 1/2 unit.

<sup>5</sup> Includes Puerto Rico.

<sup>6</sup> Kaolin sold or used by producers.

<sup>7</sup> Year ended June 30 of year stated (United Nations).

<sup>8</sup> World total exclusive of the U.S.S.R.

<sup>9</sup> Dry bauxite equivalent of crude ore.

<sup>10</sup> Recoverable.

<sup>11</sup> Includes byproduct ore.

<sup>12</sup> Includes secondary.

<sup>13</sup> Smelter output from domestic and foreign ores, exclusive of scrap.

<sup>14</sup> Lead refined from domestic and foreign ores; excludes lead refined from imported base bullion.

<sup>15</sup> Data from American Iron and Steel Institute. Excludes production of castings by companies that do not produce steel ingot.

<sup>16</sup> Includes tin content of alloys made directly from ore.

# 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 James R. Boyle<sup>1</sup> and T. L. Neathery<sup>2</sup>

The value of mineral production increased 27% in 1975. The increase in fossil fuels accounted for almost all of the increased production value; most other commodities registered a decline in production and value. Unit values for most commodities increased; clays, bauxite, and iron ore were the notable exceptions. Alabama ranked second in the Nation in the production of bauxite and scrap mica, and fourth in kaolin. Coal, petroleum, cement, and stone accounted for most of the value of minerals during the year.

**International Trade.**—The international trade passing through the Mobile Customs District was valued at \$2,105 million in 1975, up 30% from that in the previous year. Of the total passing through the district in 1975, 51% of the total export value and 84% of the total import value were handled through the port at Mobile. Value of imports and exports handled at the

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Table 1.—Mineral production in Alabama<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>Cement:</b>				
Masonry ----- thousand short tons--	314	\$11,322	262	\$10,253
Portland ----- do-----	2,190	61,990	1,968	62,599
<b>Clays<sup>2</sup> ----- do-----</b>	<b>2,995</b>	<b>13,238</b>	<b>2,231</b>	<b>9,077</b>
Coal (bituminous) ----- do-----	19,824	432,036	22,644	600,767
Lime ----- do-----	1,054	22,346	985	29,404
Natural gas ----- million cubic feet	27,865	20,704	37,814	32,898
Petroleum (crude) ----- thousand 42-gallon barrels--	13,323	113,808	13,477	136,541
Sand and gravel ----- thousand short tons	12,454	19,120	9,232	17,376
Stone ----- do-----	<sup>3</sup> 23,773	<sup>3</sup> 60,231	22,252	61,515
<b>Value of items that cannot be disclosed:</b>				
Asphalt (native), bauxite, clay (bentonite), iron ore, mica (scrap), natural gas liquids, salt, stone (dimension) (1974), and talc -----	XX	9,891	XX	8,543
<b>Total -----</b>	<b>XX</b>	<b>764,746</b>	<b>XX</b>	<b>968,973</b>
<b>Total 1967 constant dollars -----</b>	<b>XX</b>	<b>361,572</b>	<b>XX</b>	<b>P 383,713</b>

<sup>P</sup> Preliminary. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes bentonite; included with "Value of items that cannot be disclosed."

<sup>3</sup> Excludes dimension stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Alabama, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Autauga	W	W	Sand and gravel.
Baldwin	W	W	Clays, sand and gravel.
Barbour	\$1,777	W	Clays, bauxite, sand and gravel.
Bibb	5,228	W	Coal, stone, clays.
Blount	W	\$20,055	Coal, sand and gravel, cement, stone.
Calhoun	W	3,099	Stone, clays, sand and gravel.
Cherokee	48	217	Coal.
Chilton	636	W	Sand and gravel, clays.
Choctaw	29,813	34,929	Petroleum, natural gas, natural gas liquids.
Clarke	W	W	Sand and gravel.
Clay	( <sup>2</sup> )	--	
Coffee	96	71	Sand and gravel.
Colbert	W	W	Stone, native asphalt, sand and gravel.
Conecuh	W	766	Petroleum, natural gas.
Crenshaw	W	31	Sand and gravel.
Cullman	15,383	13,891	Coal.
Dale	W	W	Sand and gravel, clays.
Dallas	W	W	Do.
De Kalb	W	W	Coal, stone.
Elmore	1,896	W	Sand and gravel, clays.
Escambia	W	74,057	Petroleum, natural gas, sand and gravel, clays.
Etowah	W	W	Stone, sand and gravel.
Fayette	W	W	Coal, stone, sand and gravel, natural gas.
Franklin	3,048	W	Stone, sand and gravel, coal, iron ore.
Geneva	W	W	Sand and gravel.
Hale	W	17	Do.
Henry	W	W	Bauxite, clays, stone.
Houston	W	W	Sand and gravel.
Jackson	W	W	Coal, stone.
Jefferson	221,957	W	Coal, cement, stone, clays.
Lamar	928	1,304	Natural gas, petroleum, coal.
Lawrence	15	10	Sand and gravel.
Lee	W	W	Stone.
Lowndes	W	W	Clays, sand and gravel.
Macon	1,681	1,477	Sand and gravel.
Madison	W	W	Stone, sand and gravel, clays.
Marengo	W	W	Cement, stone.
Marion	W	W	Coal, clays, sand and gravel.
Marshall	W	W	Stone, sand and gravel, clays.
Mobile	63,034	66,530	Petroleum, cement, stone, sand and gravel, natural gas liquids, natural gas, clays.
Monroe	1,342	1,033	Petroleum, natural gas, sand and gravel.
Montgomery	5,452	W	Sand and gravel, clays.
Morgan	W	W	Stone.
Randolph	W	761	Mica.
Russell	W	W	Sand and gravel, clays.
St. Clair	W	W	Cement, clays, coal, stone.
Shelby	58,612	72,153	Lime, stone, coal, cement, clays.
Sumter	W	W	Clays, sand and gravel.
Talladega	W	W	Stone, talc.
Tallapoosa	32	--	
Tuscaloosa	31,718	W	Coal, sand and gravel.
Walker	W	167,515	Coal, clays.
Washington	14,960	17,989	Petroleum, natural gas, natural gas liquids, stone, salt, sand and gravel.
Winston	14,673	19,943	Coal.
Undistributed <sup>3</sup>	292,417	473,128	
Total	764,746	4 968,973	

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

<sup>1</sup> The following counties are not listed because no production was reported: Bullock, Butler, Chambers, Cleburne, Coosa, Covington, Greene, Lauderdale, Limestone, Ferry, Pickens, Pike and Wilcox. Values for petroleum and natural gas were based on an average price per barrel for the State.

<sup>2</sup> Less than 1/2 unit.

<sup>3</sup> Includes some petroleum which cannot be assigned to specific counties and values indicated by symbol W.

<sup>4</sup> Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Alabama business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	1,415.0	1,440.0	+1.8
Unemployment -----do-----	78.0	111.0	+42.3
<b>Employment (nonagricultural):</b>			
Mining -----do-----	9.9	12.1	+22.2
Manufacturing -----do-----	350.0	319.8	-8.6
Contract construction -----do-----	71.4	68.0	-4.8
Transportation and public utilities -----do-----	62.0	59.6	-3.9
Wholesale and retail trade -----do-----	228.1	225.9	-1.0
Finance, insurance, real estate -----do-----	49.7	50.1	+8
Services -----do-----	163.9	168.1	+2.6
Government -----do-----	235.0	246.2	+4.8
Total nonagricultural employment -----do-----	1,170.1	1,149.8	-1.7
<b>Personal income:</b>			
Total -----millions--	\$15,313	\$16,779	+9.6
Per capita -----do-----	\$4,284	\$4,643	+8.4
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----	13,971	12,782	-8.5
Value of nonresidential construction -----millions--	\$323.6	\$311.0	-3.9
Value of State road contract awards -----do-----	\$174.0	\$133.0	-23.6
Shipments of portland and masonry cement to and within the State -----thousand short tons--	1,415	1,243	-12.2
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$764.7	\$969.0	+26.7
Value per capita, resident population -----do-----	\$213.91	\$263.04	+25.3
Value per square mile -----do-----	\$14,818.07	\$18,775.27	+26.7

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Alabama State Docks in Mobile increased 43%. The coal-handling facility of the Alabama State Docks at McDuffie Island coal terminal started handling coal early in the year. The State Docks reported that nearly 3.5 million tons of coal was exported during the year, of which 2.4 million used the new coal-handling facility. Coal imports amounted to 364,000 tons. In addition, nearly 5 million tons of iron ore, nearly 2 million tons of bauxite, 55,000 tons of rutile, and nearly 9,000 tons of ilmenite were imported for use in Alabama.

**Trends and Developments.**—In 1975, the State Oil and Gas Board issued 135 permits to drill, compared with 119 in 1974. Of the total, 83 permits were issued for tests in south Alabama and 52 for north Alabama. There were 129 wells completed, with 42 producers in south Alabama and 19 producers in north Alabama. Development of two discoveries, Chunchula and Hatter's Pond in Mobile County, progressed steadily during the year. Nine wells were completed in the Chunchula field and five wells in Hatter's Pond; both fields contain sour gas and require a cleaning plant. The limits and reserves of these fields were unknown at yearend. Four other fields were dis-

covered, the Barnett field in Escambia and Conecuh Counties, and the Mill Creek field, Silas field, and an unnamed field, all in Choctaw County.

Although there were no new discoveries in north Alabama, three fields began production, the Fairview and Henson Springs oilfields and the Dug Hill gasfield.

Louisiana Land & Exploration Co.'s oil refinery in the Jacintoport area near Chickasaw began operations late in the year. The \$19.2 million facility will refine 30,000 barrels per day of crude oil from the Jay oilfield in Alabama and Florida via the Exxon pipeline. Products include naphtha, kerosine, No. 2 fuel oil, residual oil, and liquefied petroleum gas (LPG).

Getty Oil Co. announced plans for a \$5 million gas-processing plant near Creola to handle condensates produced in the nearby gasfield. Capacity of the plant, scheduled for operation in 1976, is 15 million cubic feet per day of gas, to increase to 32 million cubic feet per day by 1978.

Exxon's share of natural gas from the Fanny Church field has been purchased by National Developers, Inc., with headquarters at Elba. The gas will be transported to the western part of the State via pipeline for use in the manufacture of chemicals.

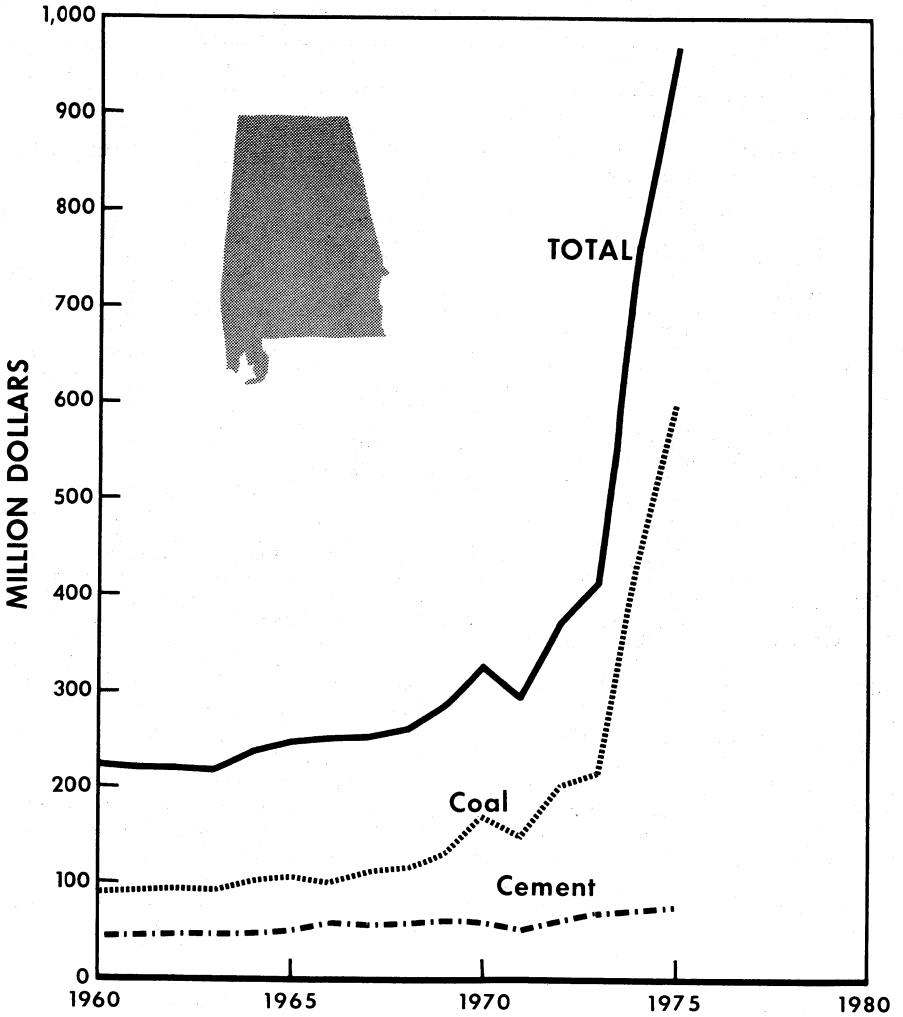


Figure 1.—Value of coal, cement, and total value of mineral production in Alabama.

In January, the first vessel loaded with coal from the new McDuffie Island coal terminal departed for Japan. Coal arrived from the Birmingham area by barge and rail. Although the terminal only recently began operation, expansion plans were announced for a new stacker reclaimer and more storage space to handle a greater volume of coal. The announced expansion was prompted by reports of increased Japanese tonnage requirements. Mobile River Coal Handling Facility, Inc., announced

plans for a \$35 million coal-handling facility at Jacintoport, 8 miles north of Mobile. The facility will allow for stockpiling coal, which can be transported to the McDuffie Island export terminal. The facility will be served by both railroad and barge, and will have an ultimate capacity of 10 million tons per year of coal.

The Economic Development Administration approved a grant of \$50,402 to the Alabama Tombigbee Rivers Regional Planning and Development Commission for

development planning of lignite as an energy source to stimulate economic growth in southwest Alabama. The director of the commission indicated strip mining should begin in the near future. Consolidation Coal Co. has leased considerable land in the area.

United States Steel Corp., Fairfield Works, with plans for a third Q-BOP (bottom-blown oxygen converter) and a new blast furnace underway, announced further plans for a new 57-oven coke battery. This battery, which is expected to go into operation in late 1977, will have an annual capacity of about 900,000 tons of coke. Environmental control systems are expected to cost \$10 million. Also included is a coal-preparation facility for sizing and blending coal.

Mobil Oil Co. has had a State lease on 20,000 acres of submerged land in Mobile Bay since 1969, but has not been able to obtain a drilling permit. A court decision will extend the lease for 3 years after a drilling permit is issued. Permits must be obtained from three agencies, Alabama Water Improvement Commission, U.S. Corps of Engineers, and the State Oil and Gas Board. Although numerous hearings have been held, no permit has been issued.

During the year, Republic Steel Corp. announced Project Dixie, a major expansion program at Gadsden, but then owing to economic conditions postponed the program indefinitely. The \$350 million program would have added about 1 million tons per year of raw steel capacity to the plant. It included a new blast furnace, an 85-oven coke battery, a continuous slab caster, a slab-steel heating furnace, improvements to the hot strip mill, an in-line annealing furnace, and a continuous pickling line. The two basic oxygen furnaces now in use have a greater steelmaking potential than can presently be utilized.

The University of Alabama's College of Engineering was awarded a \$341,300 grant by the National Science Foundation to study the feasibility of underground gasification of coal in the Warrior Coalfield. Preliminary work will be done on university lands; the university has extensive land holdings in Walker, Fayette, and Tuscaloosa Counties within the Warrior Coalfield. The Geological Survey will assist in finding a suitable location. Initial research will involve

heat effects on ground water and controls for the gas produced.

Plant expansion of the Longview Lime Div. at Saginaw will double its present production of 185,000 tons per year of high-calcium lime. Markets are served in a nine-State area and include the paper industry, municipal water-treatment plants, the steel industry, and stabilization of clay soils for construction of highways.

Construction continued on Alabama Power Co.'s (APC) James Miller, Jr., coal-fired steamplant in Jefferson County. The plant will consist of three 880-megawatt units, each of which will use 1.5 million tons per year of coal. The units were originally scheduled for operation in 1978, 1979, and 1980; however, owing to economic conditions, scheduled completion dates for the units are now 1978, 1980, and 1982.

Alabama Electric Cooperative (AEC) started construction on a \$265 million, 420-megawatt coal-fired steamplant on the Tombigbee River in Washington County. The plant will boost AEC's generating capacity by 300%. Coal will come from the company's lands in Kentucky and Tennessee. The two units will go on line in 1978 and 1979.

International Minerals and Chemical Corp. (IMC) and Allegheny Ludlum Industries, Inc., have joined to build a \$34 million ferrosilicon furnace facility at Bridgeport. The proposed facility will be adjacent to the existing plant of Tennessee Alloys Corp., which was purchased by IMC in 1974. Completion and startup of the new unit is scheduled for mid-1977.

Southern Railway Co. contracted with Harbert Construction Company of Birmingham to design and build a \$13 million coal transloading, storage, and blending facility at Pride on the Tennessee River in northwest Alabama. The facility will receive barged coal from mines along the Ohio-Mississippi River system when it is completed in late 1977. The coal will be distributed from the facility by Southern Railway unit trains to electric generating plants of the Georgia Power Co. The transloader will be able to handle 10 to 12 million tons of coal per year.

APC used 9.7 million tons of coal in 1975, and plans to purchase 10.2 million tons of coal in 1976 to meet expected demands for electricity. About 77% of the energy supplied to consumers is generated by coal-

burning plants with the balance by hydroelectric plants. Approximately 500,000 tons will be purchased on the spot market. Fuel costs in 1975 increased 40% over those in 1974 in spite of a 24% increase in hydroelectric power. Due to air quality standards in the Mobile area, the Chickasaw unit No. 3 was converted from coal to oil with permission of the Federal Energy Administration.

Alabama Gas Corp., with scheduled imports of Algerian natural gas postponed from 1976 to mid-1977, is increasing monitoring of oil and gas exploration in Alabama. Gas recovered from degasification of coal seams in the Warrior field is also being investigated as an energy source. In view of the increased development of deep mines in the area, the likelihood of using this gas is increasing.

**Legislation and Government Programs.**—In December, the State Department of Conservation and Natural Resources requested bids for oil and gas leases on approximately 3,100 acres of submerged lands in the Mobile River delta. Offset drilling would be required because no drilling would be permitted in the river, streams, or delta bay bottoms on the 36 tracts affected.

Alabama voters approved a proposal for a \$45 million State Docks bond issue, thereby enabling the dock facilities to embark on a 10-year expansion program that ultimately is expected to cost \$210 million. Of the total, \$9 million will be used to

improve and modernize the bulk-materials-handling plant at Three Mile Creek. Iron ore and bauxite are received and transhipped at this point.

The legislature passed a revised surface reclamation act, pertaining only to coal, which creates a commission to control coal surface mining and the restoration of land disturbed by coal surface mining. The commission has the power to adopt and enforce necessary rules and regulations to control coal surface mining. Until the commission is appointed and approved by the State Senate, the Department of Industrial Relations is interim administrator of the act. The act of 1969 will remain as the reclamation act for noncoal surface mining.

The Geological Survey of Alabama issued publications on various subjects during the year. A 5-year environmental, geologic, and hydrologic study of Huntsville and Madison Counties was completed. Other subjects covered in the publications included mineral laws, water laws, energy resources, gold, remote sensing, general geology, and a bibliography on Coastal Alabama.

By yearend, the Corps of Engineers had awarded 11 construction contracts totaling nearly \$157 million for work on the Tennessee-Tombigbee Waterway. Four contracts covered lock and dams; one covered the diversion channel; five, dredging; and one, test dewatering. Approximately 10% to 15% of the construction work is now under contract; scheduled completion for the waterway is March 1986.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

Mineral fuels accounted for 80% of the total value of mineral production, with bituminous coal value alone accounting for 62% of the total.

**Coal (Bituminous).**—Coal production in 1975 set a new record with an increase of 8% over that in 1926, the previous record year. In addition, production was 14% greater than in 1974, with an increase in value of 39% over that in 1974; average unit price increased from \$21.79 per ton to \$26.53 per ton.

The increased production of coal reflected not only an increase in domestic demand, but a continuing demand for the export market. Exploration activity continued

along with development of several underground mines. In addition, acquisition of smaller operations by local and out-of-State coal operators accelerated. With stronger environmental laws on water and reclamation, the trend was toward larger more controllable operations. Many of the smaller operations that went into business after the 1974 strike and the construction recession either went out of business or were purchased by larger operations.

Surface mines accounted for over 66% of the production, compared with 64% in 1974. Surface mine production increased nearly 2.3 million tons, while the number of operating mines increased from 116 to 216.

Underground production increased 561,000 tons, reflecting an increasing production from developing mines. Production from underground mines is expected to increase, with continued development of several new mines now underway and plans for more in the future.

Jefferson, Walker, and Tuscaloosa Counties continued to be the main producing counties, with 74% of the total tonnage (down from 81% in 1974). Production in Jefferson County decreased 5%, while that in Walker and Tuscaloosa Counties increased 9% and 30%, respectively. This is the second year that Tuscaloosa County has increased its production in double-digit percentage figures. This increase is expected to continue with several new underground mines now under development in Tuscaloosa County.

**Natural Gas.**—The increase in production was due to the Big Escambia Creek and Chatom fields being in operation the entire year. Development of two discoveries in Mobile County, Chunchula and Hatter's Pond, continued during the year and gave indication of increased gas production in the future.

**Petroleum.**—Oil production, although remaining relatively constant, is expected to decline in the future. Tax revenues from oil and gas increased 50% and reached \$8.1 million. Mineral-rights owners received approximately \$17.5 million in royalties. Bonuses, rentals, and royalties from State-owned lands amounted to nearly \$3 million.

#### NONMETALS

Nonmetals accounted for 20% of the State's total mineral production value.

**Cement.**—Portland cement was produced at seven plants in the State—three plants in Jefferson County, and one plant each in Shelby, Mobile, St. Clair, and Marengo Counties. Six plants produced both portland and masonry cement.

Portland cement shipments in 1975 totaled 1,967,597 tons, a decrease of 10%. Portland cement shipments were valued at \$62,598,659, an increase of about 1%. Unit value increased from \$28.31 per ton to \$31.81 per ton. Stocks of portland cement at yearend 1975 were 213,541 tons, an increase of 4%. Shipments of masonry cement during 1975 were 261,812 tons, a decrease of 17%, with value decreasing to \$10,253,451 or 9%.

The end uses for portland cement were as follows: Ready-mix concrete, 60%; concrete products, 15%; building materials, 6%; highway contractors, 8%; and other uses, 11%. The distribution is similar to that of 1974.

Raw materials used in making cement included 1,348,406 tons of cement rock, 138,845 tons of shale, 136,593 tons of sand, 45,362 tons of iron ore, plus limestone, oystershells, clay, sandstone, basic slag, and gypsum.

**Clays.**—With the recent recession in the building industry, the clay industry was seeking lower costs through energy conservation and quality control. The Tombigbee Lightweight Aggregate Co., Livingston, was installing coal burners and uncovering additional reserves in its pit. Henry Brick Co., Selma, has a new automatic tunnel kiln, which recovers heat from fired brick to reduce heat losses; operating capacity is about 200,000 brick per day. Fairhope Clay Products, Baldwin County, replaced one of the downdraft brick kilns with a structural steel kiln with fiber insulation to reduce heat loss.

Production of common clay and shale, kaolin, and fire clay decreased 26%, with value decreasing 32%. Common clay and shale was mined by 18 companies at 28 pits in 17 counties. Leading counties in terms of production were Jefferson, Sumter, Shelby, and Dallas. Major uses were in the manufacture of building brick, lightweight aggregates, cement, and other heavy clay products. Fire clay was mined by five companies at eight open pits in Calhoun, St. Clair, Shelby, and Henry Counties. Kaolin was mined by four companies from six pits in Barbour, Marion, and Henry Counties.

**Lime.**—Production of lime from five companies in Shelby County decreased 7% from the record high in 1974. The lime was used for paper manufacture, basic oxygen steel furnaces, water purification, and other uses. Leading companies were Martin Marietta Corp., Allied Products Co., and S. I. Lime Co.

**Mica.**—United States Gypsum Co. produced scrap mica at its Heflin operation from material mined in Randolph County. Alabama ranked second in the Nation in the production of scrap mica.

**Mullite.**—Harbison-Walker Refractories manufactured synthetic mullite at its Eu-faula operations from material mined in Henry County.



**Salt.**—The Olin Corp. produced salt from well brines in Washington County for use in chemical manufacture.

**Sand and Gravel.**—Sand and gravel production decreased 26%, while the value decreased 9% from that of 1974. Sand and gravel was produced at 73 operations in 33 counties, down from 84 operations in 36 counties in 1974. Nearly all the sand and gravel was used in construction, with only 9% used for industrial purposes. Of the total production, 67% was sold or used commercially; the balance was sold or used for publicly funded projects.

The major portion was shipped by truck, with smaller amounts transported by railroad and water. The top nine producing companies mined over 60% of the total tonnage produced. Leading counties were Montgomery, Mobile, Elmore, and Macon.

**Stone.**—Production of stone declined to 22.3 million short tons valued at \$61.5 million in 1975. Although production declined

6%, value increased 2%. Limestone and dolomite were quarried and crushed at 45 quarries in 17 counties. Major uses of crushed limestone and dolomite were in cement manufacture and concrete aggregate. Shelby and Jefferson Counties continued to be the major producers, with 52% of the tonnage. Of the total shipments, 69% was by truck; 13%, by rail; 6%, by waterway; and 12%, by other or unspecified means. During the year, 16 companies operating 38 quarries mined 90% of the stone produced. The balance was mined by 18 companies at 29 quarries.

Dimension limestone was quarried at 1 location, dimension marble at 1 location, and dimension sandstone at 12 locations. Crushed and broken marble was produced at four locations, and crushed sandstone, at four locations. Oystershell from ancient oysterbeds was dredged by one company from Mobile Bay.

Table 4.—Alabama: Crushed limestone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Bibb -----	1	W	W	1	468	W
Colbert -----	4	1,179	2,108	4	1,130	2,533
Jackson -----	3	W	W	5	1,060	2,173
Jefferson -----	7	4,961	8,582	6	4,366	8,167
Shelby -----	9	6,713	12,967	10	6,113	15,014
Talladega -----	1	106	212	1	W	W
Undistributed <sup>1</sup> -----	17	8,559	13,830	18	7,120	15,962
Total <sup>2</sup> -----	42	21,518	37,698	45	20,256	43,900

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

<sup>1</sup> Includes Calhoun, De Kalb, Etowah, Franklin, Henry (1975), Lee, Madison, Marengo, Marshall, Morgan, St. Clair, and Washington Counties.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 5.—Alabama: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	1,599	2,769	1,428	2,866
Concrete aggregate -----	3,052	4,731	3,316	5,786
Dense-graded roadbase stone -----	2,205	3,573	2,274	4,414
Macadam aggregate -----	W	W	583	1,252
Surface treatment aggregate -----	1,104	1,788	1,023	2,161
Other construction aggregate and roadstone -----	1,612	2,432	2,196	4,580
Railroad ballast -----	W	W	94	179
Riprap and jetty stone -----	W	W	432	1,023
Agricultural limestone -----	647	1,658	1,226	4,833
Cement manufacture -----	3,832	5,797	3,348	5,470
Flux stone -----	2,244	4,284	1,818	2,581
Lime manufacture -----	1,739	3,839	2,003	6,359
Other filler -----	W	W	111	W
Chemicals -----	W	W	398	W
Other uses <sup>1</sup> -----	3,485	6,827	507	2,395
Total <sup>2</sup> -----	21,518	37,698	20,256	43,900

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

<sup>1</sup> Includes refractory and chemical stone, stone sand, filter stone, asphalt filler (1974), dead-burned dolomite, mine dusting (1974), and uses indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

**Sulfur.**—Three companies recovered sulfur from sour-crude-oil-processing plants in Escambia and Washington Counties. Exxon Co., Mallard Exploration, Inc., and Phillips Petroleum Co. recovered over 200,000 long tons valued at more than \$8 million. This was an increase of 72% over 1974 production.

**Talc.**—American Talc Co., Inc., operated an open pit talc mine in Talladega County near Winterboro. The talc was ground for export and for use in toilet preparations.

#### METALS

**Aluminum.**—Production of primary alu-

minum decreased 30%, while value decreased 17%.

**Bauxite.**—Alabama continued to rank second in the Nation in the production of bauxite. Production and value were up 39% and 13%, respectively. To increase the reserve base, the Bureau of Mines is sponsoring research by the Mineral Resources Institute of the University of Alabama on reduction of iron content in clays.

**Iron Ore.**—Brown iron ore was mined by U.S. Pipe & Foundry Co. in Franklin County.

**Pig Iron.**—Pig iron production, which includes both foundry and basic pig iron, decreased 7%.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Alumina:</b>			
Aluminum Company of America.	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Plant -----	Mobile.
<b>Aluminum smelters:</b>			
Revere Copper & Brass, Inc	Box 191 Rome, N.Y. 13440	----do -----	Jackson.
Reynolds Metals Co -----	Reynolds Metals Bldg. Richmond, Va. 23218	----do -----	Colbert.
<b>Bauxite:</b>			
Eufaula Bauxite Milling Co.	Box 556 Eufaula, Ala. 36027	Mine and plant ---	Barbour.
United States Gypsum Co. <sup>1</sup>	Mexico, Mo. 65265 -----	----do -----	Do.
Wilson-Snead Mining Co --	Box 568 Eufaula, Ala. 36027	----do -----	Barbour and Henry.
<b>Cement:</b>			
Alpha Portland Industries, Inc.	15 South Third St. Easton, Pa. 18042	Plant -----	Jefferson.
Citadel Cement Corp -----	2625 Cumberland Parkway, NW. Atlanta, Ga. 30339	----do -----	Do.
Ideal Basic Industries, Inc. <sup>2</sup>	821 17th St. Denver, Colo. 80202	----do -----	Mobile.
Lone Star Industries, Inc. <sup>3</sup>	1 Greenwich Plaza Greenwich, Conn. 06830	Plants -----	Jefferson and Marengo.
Martin Marietta Corp. <sup>4</sup> ----	277 Park Ave. New York, N.Y. 10017	----do -----	Jefferson and Shelby.
National Cement Co -----	Box 3358 Birmingham, Ala. 35205	Plant -----	St. Clair.
<b>Clays:</b>			
American Colloid Co -----	5100 Suffield Court Skokie, Ill. 60076	Mine -----	Lowndes.
Donoho Clay Co -----	Box 843 Anniston, Ala. 36202	----do -----	Calhoun.
Dresser Industries -----	2 Gateway Center Pittsburgh, Pa. 15222	----do -----	Henry.
Riverside Clay Co -----	P.O. Box 551 Pell City, Ala. 35125	----do -----	St. Clair.
<b>Coal:</b>			
Alabama By-Products Corp. <sup>5</sup>	Box 354 Birmingham, Ala. 35210	Underground mines, strip mine, plant.	Jefferson.
Arch Minerals Corp -----	400 Mansion House Center St. Louis, Mo. 63100	Strip mine -----	Jackson.
Peabody Coal Co -----	301 North Memorial Dr. St. Louis, Mo. 63102	Strip mines and plant.	Tuscaloosa.
Southern Electric Generating Co.	600 North 18th St. Birmingham, Ala. 35203	Underground mine and plant.	Walker.
Coke: Empire Coke Co -----	2201 First Ave., North Birmingham, Ala. 35203	Plant -----	Tuscaloosa.
<b>Ferroalloys:</b>			
Airco Alloys and Carbide --	P.O. Box 368 Niagara Falls, N.Y. 14302	----do -----	Mobile.
Alabama Metallurgical Corp.	Box 348 Selma, Ala. 36701	----do -----	Selma.
Tennessee Alloys Corp ----	813 National Bank Bldg. Chattanooga, Tenn. 37402	----do -----	Jackson.
Tennessee Valley Authority- Union Carbide Corp -----	Muscle Shoals, Ala. 35660 -- Box 176 Marietta, Ohio 45750	----do -----	Colbert. Colbert and Jefferson.
Woodward Co. <sup>6</sup> -----	Woodward, Ala. 35189 ----	Plant -----	Jefferson.
<b>Iron ore:</b>			
U.S. Pipe and Foundry Co. <sup>7</sup>	3300 First Ave., North Birmingham, Ala. 35202	Mine and plant ---	Franklin.
<b>Lime:</b>			
Alabaster Lime Co -----	Siluria, Ala. 35144 -----	Plant -----	Shelby.
Allied Products Co -----	Drawer 1 Montevallo, Ala. 35115	----do -----	Do.
Cheney Lime & Cement Co. <sup>8</sup>	Allgood, Ala. 35013 -----	----do -----	Do.
S. I. Lime Co -----	500 Southland Dr. Birmingham, Ala. 35226	----do -----	Do.
<b>Natural gas:</b>			
Black Warrior Petroleum Co., Inc.	Box 1642 Mobile, Ala. 36601	Gasfield -----	Escambia.
<b>Natural gas liquids:</b>			
Cities Service Oil Co -----	Box 300 Tulsa, Okla. 74102	Plant -----	Mobile.
<b>Petroleum (crude):</b>			
Ancora Corp -----	1 Jackson Place, Suite 620 San Francisco, Calif. 94111	Wells -----	Do.
E. L. Erickson -----	1235 Petroleum Bldg. Jackson, Miss. 39201	----do -----	Choctaw.

See footnotes at end of table.

Table 6.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Petroleum (crude)—Continued</b>			
Humble Oil & Refining Co.	Box 2180 Houston, Tex. 77001	Wells -----	Escambia.
Louisiana Land & Exploration Co.	Box 60350 New Orleans, La. 70160	----do -----	Do.
Pruett & Hughes Co	390 Petroleum Bldg. Jackson, Miss. 39201	----do -----	Choctaw.
Sun Oil Co	Box 2880 Dallas, Tex. 75221	----do -----	Mobile.
<b>Petroleum refineries:</b>			
Alabama Refining Co	Mobile, Ala. 36600	Plant -----	Do.
Hunt Oil Co	Tuscaloosa, Ala. 35401	----do -----	Tuscaloosa.
Vulcan Asphalt Refining Co.	Cordova, Ala. 35550	----do -----	Walker.
Warrior Asphalt Co	Tuscaloosa, Ala. 35401	----do -----	Tuscaloosa.
<b>Pig iron:</b>			
Republic Steel Corp. <sup>5</sup>	1629 Republic Bldg. Cleveland, Ohio 44115	Furnaces and mills	Etowah and Jefferson.
United States Steel Corp. <sup>9</sup>	Box 599 Fairfield, Ala. 35064	----do -----	Jefferson.
<b>Salt:</b>			
Olin Corp	120 Long Ridge Rd. Stanford, Conn. 06904	Brine wells -----	Washington.
<b>Sand and gravel:</b>			
Dixie Sand & Gravel	Box 1128 Montgomery, Ala. 36102	Dredge and plant --	Montgomery.
Radcliff Materials, Inc. <sup>10</sup>	Mobile, Ala. 36601	Dredge -----	Mobile.
W. T. Ratliff Co., Inc	Box 1111 Knoxville, Tenn. 37901	Surface mine and plant.	Clarke.
Southern Industries Inc	61 St. Joseph Mobile, Ala. 36602	Pit and dredge ----	Elmore and Montgomery.
<b>Stone:</b>			
Southern Stone Co., Inc	2111 8th Ave., South Birmingham, Ala. 35233	Quarry -----	Bibb, Colbert, Lee, Shelby.
Trinity Stone Co., Inc	Drawer E Decatur, Ala. 35601	----do -----	Morgan.
Vulcan Materials Co. <sup>11</sup>	Box 7324-A Birmingham, Ala. 35223	Quarries -----	Calhoun, Colbert, Etowah, Franklin, Jackson, Madison, Shelby.
Wade Sand and Gravel Co., Inc.	P.O. Box 39048 Birmingham, Ala. 35208	Quarry -----	Jefferson.
<b>Talc:</b>			
American Talc Co., Inc	Alpine, Ala. 35014	Surface mine and plant.	Talladega.

<sup>1</sup> Also clay and scrap mica.<sup>2</sup> Also clay.<sup>3</sup> Also stone.<sup>4</sup> Also lime, stone, clay.<sup>5</sup> Also coke.<sup>6</sup> Also coal, coke, pig iron.<sup>7</sup> Also coke and pig iron.<sup>8</sup> Also cement.<sup>9</sup> Also cement, coal, coke, stone.<sup>10</sup> Also clay and shell.<sup>11</sup> Also clay and sand and gravel.



# The Mineral Industry of Alaska

By Alfred L. Service<sup>1</sup> and Donald P. Blasko<sup>2</sup>

Calendar year 1975 marked the second summer of construction of the trans-Alaska pipeline designed to deliver Prudhoe Bay oil to the terminus at Valdez. More than one-third of the pipeline project was completed by the end of the 1975 construction season. By November 2, 1975, the pipeline portion of the project was 52% complete and the first actual work on the 12 pump

stations, the Valdez terminal, and other support facilities was started. At the peak of the season more than 21,000 people were employed on the project; this was reduced to about 10,000 by midwinter.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Anchorage, Alaska.

<sup>2</sup> Petroleum engineer, Alaska Field Operations Center, Bureau of Mines, Anchorage, Alaska.

Table 1.—Mineral production in Alaska<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite -----thousand short tons--	20	\$401	2	\$30
Coal (bituminous) -----do-----	700	W	766	W
Gem stones -----	NA	57	NA	57
Gold (recoverable content of ores, etc.) --troy ounces--	9,146	1,461	14,980	2,419
Natural gas -----million cubic feet--	128,935	21,919	160,270	48,402
Petroleum (crude) -----thousand 42-gallon barrels--	70,603	347,408	69,834	364,630
Sand and gravel -----thousand short tons--	<sup>r</sup> 43,644	<sup>r</sup> 22,954	48,145	25,780
Silver (recoverable content of ores, etc.) thousand troy ounces--	1	3	W	W
Stone -----thousand short tons--	5,484	12,947	8,877	26,649
Tin -----long tons--	W	W	11	60
Value of items that cannot be disclosed:				
Copper (1974), mercury (1974), natural gas liquids, platinum-group metals, and values indicated by symbol W -----	XX	11,453	XX	12,718
Total -----	XX	<sup>r</sup> 418,603	XX	480,745
Total 1967 constant dollars -----	XX	197,915	XX	<sup>p</sup> 190,375

<sup>p</sup> Preliminary. <sup>r</sup> 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.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Alaska, by region<sup>1</sup>  
(Thousands)

Region	1974 <sup>2</sup>	1975	Minerals produced in 1975 in order of value
Alaska Peninsula -----	W	W	Sand and gravel.
Bristol Bay -----	\$3,515	\$965	Do.
Cook Inlet-Susitna -----	6,030	8,094	Sand and gravel, stone, gold.
Copper River -----	1,640	W	Stone, sand and gravel, gold.
Kenai Peninsula -----	W	<sup>3</sup> 412,966	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kodiak -----	W	696	Sand and gravel, stone.
Kuskokwim -----	1,452	W	Sand and gravel, platinum-group metals, gold.
Northwestern Alaska -----	W	--	
Seward Peninsula -----	W	W	Gold, tin, stone, sand and gravel, silver.
Southeastern Alaska -----	11,174	17,032	Stone, sand and gravel, barite.
Yukon River -----	<sup>r</sup> 9,502	W	Coal, stone, sand and gravel, gold, silver.
Undistributed <sup>4</sup> -----	<sup>r</sup> 385,291	40,992	
Total -----	<sup>5</sup> <sup>r</sup> 418,603	480,745	

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

<sup>1</sup> No production was reported in the Aleutian Islands, Bering Sea, and Northern Alaska Regions.

<sup>2</sup> Petroleum values for 1974 are not available by region; included with "Undistributed."

<sup>3</sup> Value of petroleum is based on average unit price for the State.

<sup>4</sup> Includes gem stones, and some sand and gravel, petroleum, and natural gas liquids (1975) that cannot be assigned to specific regions.

<sup>5</sup> Data do not add to total shown because of independent rounding.

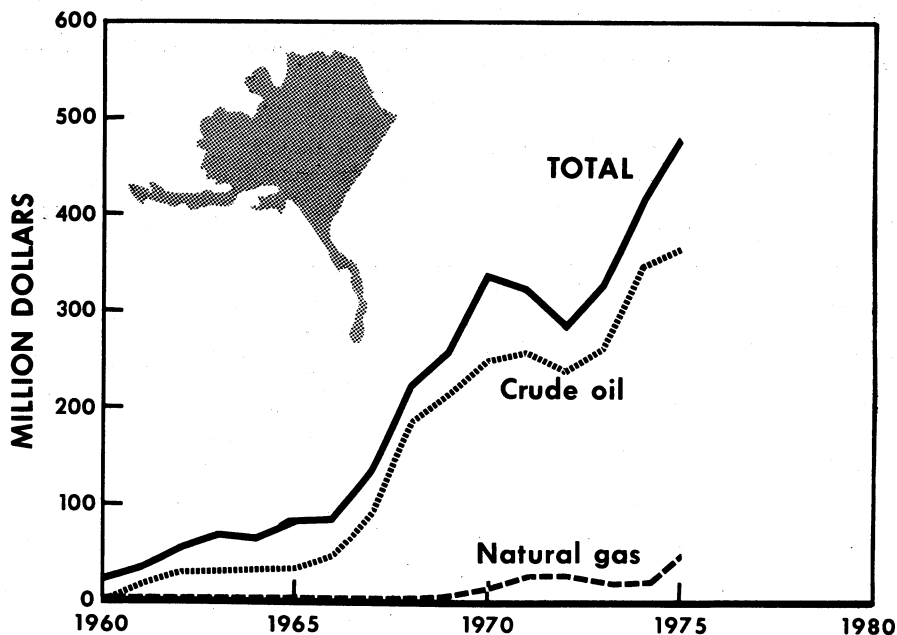


Figure 1.—Value of natural gas, crude oil, and total value of mineral production in Alaska.

Governor Hammond's nine-member Capital Site Selection Committee selected three possible sites for the proposed new capital of Alaska, for consideration by the voters on November 2, 1976. They included Larson Lake, Mount Yenlo, and Willow; all northwest of Anchorage near the new George Parks Highway.

Mineral exploration in Alaska in 1975 showed a slight gain over that of 1974. There were five very definite trends in the type of activity within the State: (1) Major mining companies shifted emphasis from disseminated deposits to volcanogenic massive-sulfide deposits, (2) petroleum exploration increased both onshore and offshore, (3) placer exploration increased, (4) uranium exploration increased, and (5) mining, oil, and public utility companies stepped up exploration activity for coal.<sup>3</sup> The exploration investment in Alaska in 1975 was more than \$15 million, an increase of 150% over that of 1974. As of November 28, 1975, there were filings for 11,383 new claims, 2,225 affidavits of labor had been filed, and there were 47,868 active claims in the State.

On March 27, 1975, the first welded pipe sections of the trans-Alaska pipeline were laid beneath the Tonsina River. By the end of the season there were 207 miles of buried pipe and 114 miles of river-crossing pipe in place. Other pipeline construction in 1975 included 588 miles of ditch excavation for buried pipe, 42,755 vertical support members installed, and 581 million cubic yards of gravel excavated, delivered, and installed as work pads. The Yukon River bridge was completed during the 1975 season. It was the first permanent span across the river and reached 2,280 feet from shoreline to shoreline. Limited vehicular traffic started immediately. Construction of the bridge was funded jointly by the State of Alaska and the Federal Government. It will become a part of the permanent State highway system, linking Prudhoe Bay and the North Slope with the rest of the State.

On March 5, 1975, Governor Hammond appointed Guy R. Martin as successor to Charles F. Herbert as Commissioner of the Alaska Department of Natural Resources. In May, Commissioner Martin appointed Dr. Ross Schaff as Alaska State Geologist. John R. Roderick, former Greater Anchorage Area Borough mayor, was named Deputy Commissioner of the Alaska Depart-

ment of Natural Resources, replacing William Fackler, who became Executive Director of the Alaska Royalty Oil and Gas Development Advisory Board.

The total estimated mineral production in Alaska in 1975 was valued at about \$481 million, an increase of about \$62 million over that of 1974. Oil, gas, and sand and gravel were the principal contributors to total mineral production of the State. There were 137 coal prospect permits covering 562,280 acres issued in 1975, increasing the total active lease area to 1,416,321 acres. A total of 147,240 acres was covered by offshore prospect permits issued in 1975; this increased the total active area to 1,325,809 acres. Approximately \$287,035 was received as rental from 52,205 acres filed under work permits. Five exploration programs were carried out on permits covering about 248,509 acres in the Goodnews Bay area and offshore from Sledge and Grantly Islands. There were no competitive oil and gas lease sales in 1975, and the total area held under lease decreased by 154,978 acres. A total of 254,636 acres was offered by the State for noncompetitive lease in 1975; only 189,300 acres were taken.

A report prepared for the Federal Power Commission (FPC) by an independent consulting firm indicated that the petrochemical industry is not interested in Alaskan natural gas in Alaska. The report stated that petrochemical, mining and other users of natural gas need it in the "Lower 48," not in Alaska.

Several regional Native corporations signed contracts with oil companies to drill exploratory wells on their lands. Louisiana Land and Exploration Co. has contracted with Doyon, Ltd., to drill four test wells in the Kandik Basin. The first well was planned to be drilled early in 1976. Standard Oil Co. of California (Socal), working with Koniag, Inc., was planning a wildcat well on the upper Alaska Peninsula. The Bristol Bay Native Corp. planned a well on the lower Alaska Peninsula; Phillips Petroleum Co. will drill the well. Phillips also is involved with the Chugach Natives, Inc., to drill an onshore well in the Gulf of Alaska.

**Legislation and Government Programs.**  
—The Joint Federal-State Land Use Plan-

<sup>3</sup> Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys. Biennial Report 1974-1975. Pp. 26-39.



ning Commission continued to function as advisor on the use of Federal lands withdrawn under the Alaska Native Claims Settlement Act (ANCSA) Public Law 92-203. A subcommittee of the Commission was organized in January 1975 to review national interest lands (ANCSA section 17 (d) (2)). This group recommended additions to the National Park, National Forest, National Wildlife Refuge, and National Wild and Scenic Rivers Systems and proposed new management concepts and a system of national land reserves for most of the remaining Federal domain in Alaska.

Recommendations made by the Commission cover several broad areas: (1) Additions to the existing Federal Management Systems, (2) a new management system where areas of multiple resource values are recognized and managed on a multipurpose basis, (3) broad State-Federal cooperative planning and management areas, (4) Naval Petroleum Reserve No. 4 containing valuable coal, petroleum, and natural gas resources, and (5) public interest lands (ANCSA section 17 (d)(1)). Under the proposed land plan there would be 7 national parks, national land reserves, 12 national wildlife refuges, 7 additions to national forests, and 2 special management areas in Petroleum Reserve No. 4. The State of Alaska covers about 375.6 million acres comprising 363.2 million acres of land and 12.4 million acres of water; expected Native withdrawals will total approximately 44.5 million acres, private lands total 966,000 acres, and State selections total 69.2 million acres; existing (November 1975) Federal domain covers 261.9 million acres. The total area covered by the Land Use Planning Commission proposal is approximately 98.8 million acres.

Governor Hammond also proposed a plan to manage the Federal domain in Alaska. He has designated about 99 million acres of Federal land for joint Federal-State management, of which 37 million acres would be designated as Alaska Resource Lands managed by the Joint Federal-State Land Use Planning Commission. The remaining 62 million acres would be classified within eight general Cooperative Management Areas (COMANS) administered by a joint Federal-State planning commission. The COMANS system would permit private land owners to voluntarily join with the Federal and State Governments in regional plan-

ning. Resource Lands under the COMANS system would be managed by a proposed Alaska Land Commission, a joint Federal-State group of six members. Hammond's plan includes 16.7 million acres in parks, preserves, and recreation areas; 15.3 million acres for wildlife refuges and ranges; and 4.6 million acres for the national forest system.

**Transportation.**—The Alaska Railroad (ARR) net profit for 1975 was \$5.8 million, compared with an operating loss of \$1.1 million in 1974. Operating revenues for fiscal year (FY) 1975 were 99% higher than in 1974: \$41.4 million as opposed to \$20.8 million. The ARR handled 1.9 million tons of freight in FY 1975 for a total of 466 million ton miles. Tonnage of iron and steel pipe fittings increased 605% over that of FY 1974, and machinery tonnage increased 177%. The Valdez rail yard was expanded to 60-car capacity to handle shipments of 80-foot welded pipe. Daily service to Seward was increased, and plans have been made to increase the load capability of barges to 100 cars.

The Alaska Hydro Train provided barge service between Seattle, Wash., and Whittier, Alaska. Its 8 barges were reduced to 3 in 1975, but the total railcars handled increased from 7,745 to 10,190. Hydro Train indicated six rail barges would be in service through 1976. Northland Marine of Seattle began regular barge service to Seward, interchanging container and bulk freight to ARR for destinations along the railbelt. The ARR owns and controls operations of a barge freight service on the Tanana and Yukon Rivers. The line, operating with Yutana Barge Lines, covers 1,112 miles. The railhead is at Nenana about 60 miles south of Fairbanks.

In September 1975 Totem Ocean Trailer Express (TOTE) inaugurated scheduled runs between Seattle and Anchorage. The 790-foot *Great Lander* is the largest roll-on, roll-off vessel in the world and has a deadweight of about 17,000 tons and a maximum speed of 24 knots. The carrying capacity is 386 40-foot trailers or equivalent and 126 motor vehicles. The ship can discharge and load in 12 to 15 hours. Service between Seattle and Anchorage averages about 2.5 days by TOTE, 3.5 days by Sealand Service, Inc., and 9 days by barge.

Transportation carriers serving Alaska are responsible for movement of a major

part of the freight leaving Seattle. About 43% of all outbound freight from Seattle-Tacoma International Airport is bound for Alaska, and nearly 90% of the water freight comes from Seattle. Alaska, Western, and Northwest Airlines are hauling up to 6 million pounds of cargo per month to Alaska. Alaska Hydro Train, Arctic Marine Freighters, Foss Alaska Line, Inc., Northland Marine Lines, and Sea-land Service, Inc., all serve Alaska from the port of Seattle. Truck transport over the Alaska Highway also contributes a major portion of the freight tonnage to Alaska. In 1975 there were 25,721 trucks licensed by the Alaska Transportation Commission.

Alaska's economy prospered in 1975 because of the trans-Alaska pipeline and accelerated State spending. The National Bank of Alaska reported its Alaska economic activity index expanded 22% during

1975, led by advances in the construction and petroleum industries. Alaska travel increased 12%. Supportive industries in the State supported the general growth with a 13% increase in employment. State Government employment increased 9%, and local government employment expanded about 14%, twice the 1974 rates. At mid-September 1975 Alyeska reported employment of 21,600 people involved in some phase of pipeline construction. The Alaska Department of Labor estimated that the addition of 1,000 workers in pipeline construction would impact State and local governments by an increase of 20 workers, other construction by 10, retail trade by 110, wholesale trade by 30, finance, insurance, and real estate by 30, transportation by 170, and services by 240 additional workers.<sup>4</sup>

<sup>4</sup> Alaska Economic Activity Index. Alaska Construction and Oil. V. 17, Nos. 2 and 4, p. 8.

Table 3.—Indicators of Alaska business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	147.4	179.9	+22.0
Unemployment -----do-----	14.9	14.5	-2.7
<b>Employment (nonagricultural):</b>			
Mining -----do-----	3.0	4.0	+33.3
Manufacturing -----do-----	9.6	9.0	-6.2
Contract construction -----do-----	14.1	28.0	+98.6
Transportation and public utilities -----do-----	12.4	16.2	+30.6
Wholesale and retail trade -----do-----	21.1	25.8	+22.3
Finance, insurance, real estate -----do-----	4.9	6.2	+26.5
Services -----do-----	19.3	26.1	+35.2
Government -----do-----	43.8	47.0	+7.3
Total nonagricultural employment -----do-----	128.2	162.3	+26.6
<b>Personal income:</b>			
Total -----millions--	\$2,402	\$3,324	+38.4
Per capita -----do-----	\$7,037	\$9,448	+34.3
<b>Construction activity:</b>			
Number of private and public residential units authorized	2,016	2,903	+44.0
Value of nonresidential construction -----millions--	\$51.5	\$75.4	+46.4
Value of State road contract awards -----do-----	\$80.0	\$93.0	+16.2
Shipments of portland cement to and within the State <sup>1</sup>			
thousand short tons--	86	131	+52.3
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$418.6	\$480.7	+14.3
Value per capita, resident population -----do-----	\$1,227.57	\$1,317.11	+7.3
Value per square mile -----do-----	\$713.84	\$819.81	+14.8

<sup>P</sup> Preliminary.

<sup>1</sup> Excludes data on masonry cement withheld to avoid disclosing individual company confidential data.

Source: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

## REVIEW BY MINERAL COMMODITIES

## MINERAL FUELS

**Coal (Bituminous).**—Coal production in 1975 was 766,000 short tons, an increase of 9% over the 1974 figure of 700,000 short tons. All production came from the Usibelli Coal Mining Co. mine near Healy. Low-sulfur, subbituminous coal from the Nenana field was used at military bases north of the Alaska Range, at electricity-generating plants in the Fairbanks area, at the University of Alaska, and by a mine-mouth plant near Healy. The Healy generating plant provides additional power to Fairbanks and also serves Nenana. AMAX Coal evaluated the coal deposits at Healy during the 1975 season.

The School of Mineral Industry, University of Alaska, Fairbanks and the Federal Energy Administration sponsored a coal symposium at the University of Alaska in mid-October. The theme of the conference was Focus on Alaska's Coal. Attendees included industry representatives, State and Federal Government officials, and staff from the University of Alaska.

A tentative agreement for exchange of State, Federal, and Native selection lands has been proposed. Legislation will be presented at the Ninth Alaska Legislature convening in January 1976. Under the agreement the State of Alaska would trade 490,000 acres of land, including about 315,000 acres of proven and potential coal lands in the Beluga field, to the Cook Inlet Regional Corp. In return the State will receive about 1.2 million acres including land at Points Campbell and Woronzof, a 4,000-acre Campbell tract, and prime fisheries areas near Lake Clark. The trade was proposed as a means of resolving Native, State, and Federal land conflicts and litigation involving the Anchorage Bowl area. No firm estimate of the total reserves of coal involved in the trade was available, but it could be in the tens of billions of tons. Known resources defined by drilling exceed 500 million tons.

There were 137 coal permits issued by the Alaska Division of Lands in 1975, a decrease of 33% from 1974 permits. The Beluga-Chuitna area, west of Anchorage, continued to be the area of greatest interest. Placer Amex, Inc., U.S. subsidiary of Placer Development Ltd., continued work-

ing on its leases in the Beluga field. AMAX Coal continued drilling and exploration in the Chuitna River area and carried out an extensive exploratory program including a marketing and transportation study to evaluate the Usibelli Coal Mining Co. properties at Healy. Joseph Usibelli has given Amax an option to purchase depending on results of 1974-75 work. Portland General Electric Co. did considerable coal exploration in the Peters Creek area.

Placer Amex (Beluga Coal Co.) and Starkey A. Wilson, Dallas, Tex., have filed for an industrial land lease of 3,170 acres on the west side of Cook Inlet. The lease will be the site of a coal complex which will be used in conjunction with commercial development of large reserves of subbituminous coal in the Beluga field. The complex will include a rail unloading station and stockpile area, a coal preparation and treatment plant, a reclaiming system for export, a deepwater dock and loading facilities, a coal-fired powerplant, and a coal liquefaction plant with related processing facilities. An environmental impact statement is being prepared. The company plans to develop the coal deposits by open-cut, and the production would be geared to supply bulk carriers of 75,000 to 150,000 deadweight tons. Proposed land swaps in the Beluga area may have some effect on the time frame for this operation.

**Petroleum and Natural Gas.**—Drilling activity in Alaska continued to increase for the second straight year. There were 70 permits issued by the Oil and Gas Conservation Committee in 1975, compared with 61 in 1974. A total of 122 permits was issued in 1969 when the industry was evaluating the Prudhoe Bay field. In December the Alaska Department of Natural Resources, Division of Oil and Gas released a report entitled "Prediction of Reservoir Fluid Recovery, Sadlerochit Formation, Prudhoe Bay Field." Oil recovery potentials evaluated in the report ranged from 6 to 8 billion barrels for the operating conditions studied. This recovery represented 32% to 43% of the original estimated oil in place.

There were no oil and gas lease sales in 1975, and the area held under competitive lease decreased from 2,624,991 acres to 2,470,013 acres. The area under noncompetitive lease decreased from 2,313,190 acres

Table 4.—Alaska: Annual production<sup>1</sup>

	Quantity	Total	
			Per day
Oil ----- barrels	71,980,167		197,206
Water ----- do	19,213,561		52,640
Casinghead gas ----- million cubic feet	115,702,322		316,993
Dry gas ----- do	138,907,917		380,570
Condensate ----- barrels	877		2
Natural gas liquids ----- do	764,957		2,096

<sup>1</sup> Compared with the 1974 figure, oil production declined 0.4%, natural gas liquids declined 3.5%, and gas production increased 10.1%.

Source: Alaska Division of Oil and Gas Statistical Report, 1976.

to 2,042,353 acres. Simultaneous applications increased from 6,451 in 1974 to 7,662 in 1975. A total of 254,636 acres was offered for noncompetitive lease in 1975. Federal lease activity declined from 3.9 million acres to 3.7 million acres in 1975.<sup>5</sup>

The State of Alaska received \$858,031 in Federal revenue payments for oil and gas rental and \$7,830,937 for oil and gas royalties in 1975. This was a loss and gain, respectively, of 51% and 32%, compared with the 1974 figures. Income from State lands for oil and gas rental was \$3.4 million, from gas royalties \$3.0 million, and from oil royalties \$40.3 million. Oil and gas bonus payments totaled \$2,524.00.<sup>6</sup>

Cities Service Oil Co. drilled a wildcat well on the west side of Cook Inlet. It was the first natural gasfield discovery in the area since 1968. Several other unsuccessful wells were drilled to explore for gas for west coast utility companies.

Kachemak Bay continued to hold the spotlight in a series of incidents which caused exploratory drilling to be delayed. Early in the year the jack-up drill rig George Ferris was damaged. It was being towed to Kachemak Bay where repairs could be made and in the process became entangled in commercial crab fishing gear, damaging an undetermined number of crab pots. Industry officials were, at the same time, testifying in Homer to convince fishermen and other interested citizens that oil exploration could be safely conducted in Kachemak Bay. The fishermen in the area filed suit asking that the State of Alaska invalidate the December 1973 sale of leases in Kachemak Bay. A Superior Court judge dismissed the suit, and the case is now in the hands of the Alaska Supreme Court. Shell Oil Co., after obtaining the necessary permits to drill, announced it will postpone drilling until the

Supreme Court comes to a decision on the legality of the sale. At yearend the George Ferris was still in Kachemak Bay and no court decision had been handed down. Governor Hammond indicated he was concerned about oil development in Kachemak Bay and might offer legislation to the Ninth Alaska Legislature that would nullify the 1973 lease sale.

The U.S. Supreme Court reversed two previous lower court rulings and awarded jurisdiction of offshore lands in the lower Cook Inlet to the Federal Government. The case was triggered in 1967 by a State auction of an offshore parcel below Kalgin Island in lower Cook Inlet; the Federal Government contested Alaska's title to the land in question. The State of Alaska based its ownership on the Historic Bay Principle, while the U.S. Government claimed ownership because the land was more than 3 miles offshore. This court decision placed the lower Cook Inlet in the status of Outer Continental Shelf, and the U.S. Department of the Interior called on industry for nominations of desirable lease tracts.

Tesoro-Alaskan Petroleum Corp. was forced to use imported Indonesian crude oil to maintain production levels at its Kenai refinery. Tesoro uses State royalty oil and oil from other producers as feed for the refinery. The company recently contracted with the military to supply aviation and diesel fuel to military bases in the State.

The Department of the Interior selected more than 1.8 million acres of offshore land in the Gulf of Alaska for proposed competitive oil and gas lease sales. Bid proceedings on the offshore lands between Middleton Island and Icy Bay were originally scheduled for December 1975 but were

<sup>5</sup> Alaska Department of Natural Resources, Division of Lands. 1975 Annual Report. Pp. 19-23.

<sup>6</sup> Work cited in footnote 5.

delayed until January 1976. The State of Alaska has indicated that it intends to delay or block leasing of Outer Continental Shelf lands in the gulf until various changes are made in the Federal Outer Continental Shelf program.

A consortium of oil companies contracted with Global Marine Co. to drill a stratigraphic test hole in the Gulf of Alaska. The hole could provide valuable information concerning prospective Department of the Interior lease sales. The *Glomar Conception*, a drilling ship, was scheduled to drill a 16,500-foot hole in nearly 80 fathoms of water. Storms with 60-foot waves at 8-second intervals caused the project to be aborted after only 5,500 feet of hole had been completed. The cost of the project approached \$12 million.

The FPC approved an application permitting Phillips-Marathon LNG Co. to supply Northwest Natural Gas Co., Portland, Oreg., with liquefied natural gas (LNG) from the Kenai plant. FPC later ruled it has authority to regulate interstate sales of LNG because the gas is pipeline quality when it enters the liquefaction plant as feed. FPC further ruled that liquefaction is not a form of processing and that the characteristics of the gas are changed only until regasification. The application was withdrawn after this FPC decision was handed down.

Socal drilled a well for the Northwest Alaska Native Association (NANA) about 50 miles southeast of Kotzebue. This was the first exploratory well drilled in north-west Alaska since 1960. The total depth of the well was 6,311 feet. The hole was plugged and abandoned. Socal later drilled another dry hole near Cape Espenberg southwest of Kotzebue. The exploration agreement calls for two additional wells to be drilled.

Early in 1975 the move to turn control of Naval Petroleum Reserve No. 4 (NPR-4) over to the Department of the Interior started. At the time it appeared the Navy Department would retain control, but Congressional actions during the year strengthened Interior's position. The Navy awarded a contract to Husky Oil NPR Operations, Inc., for a 7-year exploration program including 10,000 miles of geophysical surveys and 26 exploratory wells. Husky contracted with Parker Drilling Co. for an exploratory well near Teshekpuk Lake. This well will be drilled early in 1976.

The Navy drilled No. 1 Cape Halkett well to a final hole depth of 9,900 feet, the first deep well to be drilled on the reserve since 1952. The well was plugged and abandoned. A shallow 2,305-foot gas well, Iko No. 1, was drilled near Barrow.

Table 5.—Alaska: Principal natural gas and petroleum companies

Company	Address	Type of activity	Region
<b>Natural gas:</b>			
Phillips Petroleum Co	Anchorage, Alaska 99501	Gas production	Offshore Cook Inlet.
Standard Oil Co. of California.	do	do	Westside Cook Inlet.
Texaco, Inc	do	do	Do.
Union Oil Co. of California.	do	do	Offshore Cook Inlet, Kenai Peninsula.
<b>Petroleum—crude:</b>			
Amoco Production Co	do	Oil production	Offshore Cook Inlet, Kenai Peninsula.
Atlantic Richfield Co	do	do	Offshore Cook Inlet, North Slope.
BP Alaska, Inc	do	do	North Slope.
Marathon Oil Co	do	do	Kenai Peninsula.
Mobil Oil Corp	do	do	Offshore Cook Inlet.
Shell Oil Co	do	do	Do.
Standard Oil Co. of California.	do	do	Kenai Peninsula.
Texaco, Inc	do	do	Offshore Cook Inlet.
Union Oil Co. of California.	do	do	Do.
<b>Petroleum refining:</b>			
Atlantic Richfield Co	Prudhoe Bay, Alaska	Refinery	North Slope.
Standard Oil Co. of California.	Nikiski, Alaska	do	Kenai Peninsula.
Tesoro-Alaskan Petroleum Corp.	do	do	Do.
Union Oil Co. of California.	Anchorage, Alaska 99501	Refinery (asphalt)	Anchorage.

The State of Alaska filed a district court suit against the Navy Department disputing a change in the original NPR-4 boundaries. The Navy had previously remapped the reserve and enlarged it by more than 200 square miles. The State maintains Navy's interpretation is illegal and erroneous and that certain bays included in the reserve are in fact inland waters belonging to the State. Any decision is pending.

Socal and Mobil Oil Corp. announced a new discovery about 16 miles west-northwest of Prudhoe Bay. The well tested at 2,300 barrels of oil per day from the Sadlerochit Formation. Oil companies with interests in Prudhoe Bay are looking for early commitments of gas sales as a means of financing development of the field. Several companies announced agreements of sales for their share of the Prudhoe Bay natural gas.

Atlantic Richfield Co. (Arco) planned to increase crude oil throughput at its topping plant from 7,300 barrels per day to 13,000 barrels. This is the second such increase in 2 years. The plant was originally designed for a capacity of 5,000 barrels per day. Increasing demand for diesel fuel for pipeline and related construction activity in the Prudhoe Bay area is the reason for expansion.

The annual barge convoy for Prudhoe Bay left Houston, Tex., in June with nearly 170,000 tons of material for the oil and gas production facilities on the North Slope. A late breakup and prevailing winds kept the Bering Sea icepack close to shore, and the barge convoy was delayed for more than 13 weeks near the village of Wainwright on the northwest coast of Alaska. By early September, 10 of the 47 barges broke through and rounded Point Barrow for Prudhoe Bay. By October 1, 15 more barges made the trip to Prudhoe Bay; the rest of the convoy turned back and went to Seward where the equipment and material was off-loaded and shipped to Prudhoe Bay by air and surface transport. Barges that made the full trip were left at Prudhoe Bay, where they were unloaded at a later date. The first barge shipments to Prudhoe Bay in 1975 came from Mackenzie Bay, west to the Prudhoe industrial area. The September-October period in barge convoy traffic was most critical to the future of the Prudhoe field and its projected production schedule because of the nature of the 1975

shipment. Failure to make the complete trip could have seriously set back the initial production date for the field.

The Alaska Department of Natural Resources announced its intention to hold a competitive lease sale in the Beaufort Sea offshore from Prudhoe Bay. The question of ownership of the land between the shoreline and the offshore Barrier Islands caused a delay in the sale. An earlier ruling in the lower Cook Inlet case in favor of the Federal Government caused the postponement. At yearend no date had been set for the sale.

Construction on the trans-Alaska pipeline was sharply curtailed in November by severe weather conditions. Although construction started behind schedule, the line was more than 50% complete when the season ended. The first section of pipe was laid in late March at the Tonsina River crossing, and more than 400 miles of pipe had been set or welded and positioned for setting and 90% of the work pads had been completed when the season ended. Construction on the pump stations and the Valdez terminal was uninterrupted by winter weather. The latest cost estimate had escalated from the original \$900 million for a 600,000-barrel-per-day throughput to \$6.2 billion for 1.2 million barrels per day, partly because of increased labor, material, and equipment costs.

Construction of the Yukon River bridge was completed in October 1975, making it possible to travel from the Gulf of Alaska north to the Arctic Ocean by highway. Several groups are protesting the public use of the trans-Alaskan highway when pipeline construction is completed, but the Alaska Department of Transportation maintains it is illegal to close the road to the public. Nearly \$17 million in Federal grants has been used in construction of the highway; therefore, it should be accessible to the public.

The 48-inch pipe was fabricated in 40-foot lengths for ease in handling and storage prior to construction. Most of the pipe was welded in 80-foot lengths and placed along the pipeline right-of-way. The double-length pipe was hauled on extra-long, specially designed trailers. These long loads were difficult to maneuver, and there were several accidents.

El Paso Alaska Gas Co. and Alaskan-Arctic Gas Pipeline Co. continued to pub-

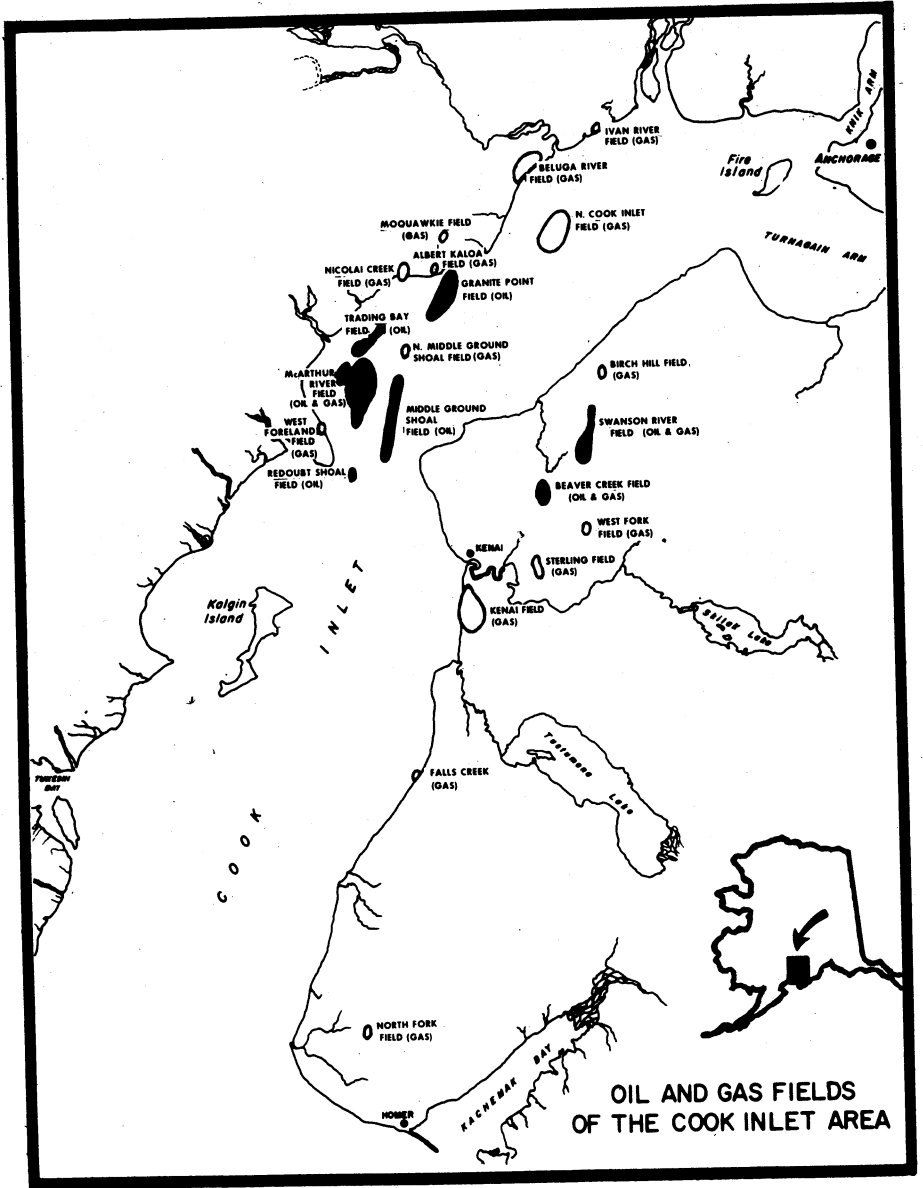


Figure 2.—Cook Inlet oilfields and gasfields.

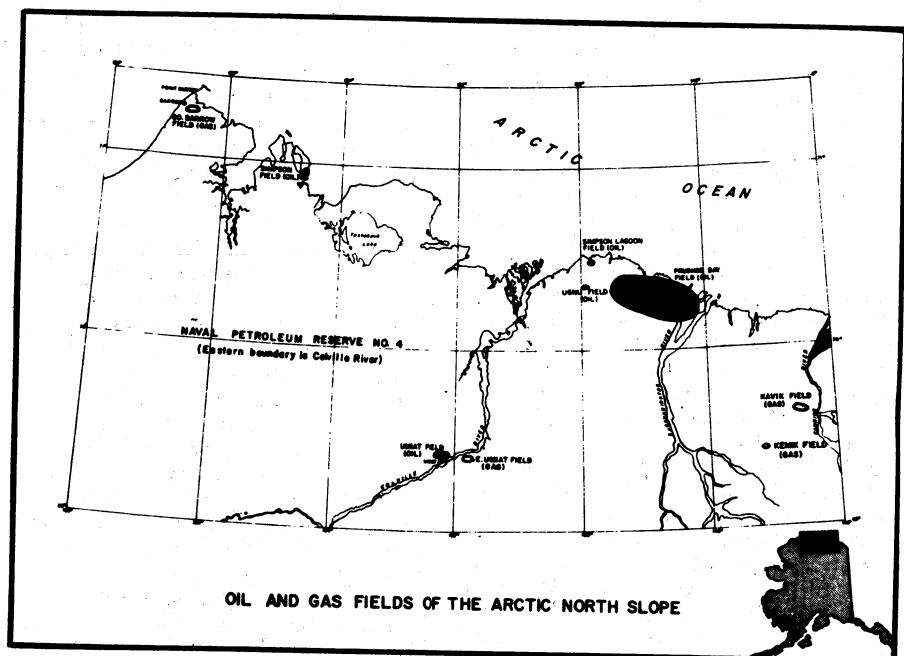


Figure 3.—Oilfields and gasfields of the Arctic North Slope.

licize their individual plans for a gas pipeline to the State of Alaska and the FPC. El Paso proposes an all-Alaska route, whereas Alaskan-Arctic proposes a route through Canada. The State is clearly in support of a trans-Alaska pipeline. A State of Alaska study of the merits of the two proposals showed the State would receive more revenue through taxes and employment from an all-Alaska route as opposed to a Canadian line.

#### METALS

**Antimony.**—A very limited amount of antimony was produced in 1975, all from the Fairbanks and Kantishna areas. Prospecting for gold-silver-lead-antimony continued on Eldorado and Caribou Creeks in the Kantishna area, Mount McKinley recording district. Exploration work also was conducted at an antimony prospect near the Tok River in the eastern Alaska Range.

**Copper.**—Copper continued to be one of the more active metals on the Alaskan exploration scene during 1975. The region north of the Brooks Range was particularly active, and the Ambler River, Survey Pass,

and De Long Mountains areas were the leaders. Bear Creek Mining Co. conducted a large drilling project at its Arctic copper prospect during the 1975 season and continued work at the Bornite property north of Kobuk. Noranda Mines, Ltd., had crews in the Ambler River and Survey Pass areas carrying on geophysical surveys and reconnaissance work. The Anaconda Co. and Sunshine Mining Co. were jointly involved in exploration of a large deposit in the Ambler River area. General Crude Oil Co. had crews working in the Ambler River-Survey Pass areas. Their work was primarily staking claims and conducting reconnaissance surveys. Other companies interested in the Brooks Range area included BP Alaska Exploration, Union Carbide Corp., United States Steel Corp., Placid Oil Co., and McIntyre Mines Ltd. The total expenditures for exploration in Arctic Alaska in 1975 exceeded the \$6 million estimated for 1974.

A buildup of activity also was noted in the eastern Alaska Range, the area between the Canadian Border and the Gakona River. The general areas of interest are the Chisana-Horsfeld, Nabesna-Orange Hill,



and Slana districts. Inspiration Development Co. continued drilling at Bond Creek near Nabesna, and Brown and Root Explorations continued its 1974 program at Orange Hill. Gulf Minerals Exploration, ASARCO, Rio Tinto Canadian Exploration, and Louisiana Land and Development Corp. also were active in the area.

Copper activity in southeast Alaska declined somewhat compared with that of 1974. The large and controversial nickel-copper deposit near Glacier Bay remained idle pending a ruling on permitting mining in a national monument. U.S. Borax and Chemical Corp. continued diamond drilling on its property east of Ketchikan during the 1975 season.

**Gold.**—Gold production in Alaska increased dramatically during 1975, mainly because of the efforts of the Alaska Gold Co., a subsidiary of UV Industries Inc. There were 14,980 troy ounces of gold produced valued at \$2.4 million, compared with 9,146 troy ounces valued at \$1.5 million in 1974. These totals do not reflect the true picture because many operators did not report their production. The total reported gold production from 1880 to 1975 was 30,050 million ounces.<sup>7</sup>

The Alaska Gold Co. activated dredge No. 5 on the Nome plain on July 11, 1975, and operated a total of 117 days through November; the company planned to use two more dredges in 1976-77. The dredge processed about 740,391 cubic yards of gravel and recovered 7,791 troy ounces of gold. The dredging activities and drilling in the Nome area indicate to Alaska Gold Co. that claims held by the company contain at least 1.2 million troy ounces of gold. Alaska Gold Co. also operated a dredge on the Hogatza River, a tributary of the Koyukuk River; this operation recovered 3,360 troy ounces of gold between May 14 and October 17, 1975.

ASARCO Inc. continued to explore the potential of gold deposits offshore from Nome and set up a washing plant on the beach west of the mouth of the Snake River. Using a dragline, ASARCO excavated beach sands and processed the material through the washing plant. Results of the work were not available at yearend.

Four Bear Enterprises, Houston, Tex., leased the Bartholomae mine at Ester, west of Fairbanks. The company started an exploration program including trenching, drilling, and sampling. Four Bear Enterprises reportedly plans to install a 300-ton-per-day mill at the mine.

Callahan Mining Corp. replaced Noranda Mines Ltd. as operator of the Little Squaw Lode gold mine, Chandalar mining district. Development work in 1974 indicated a 9- to 14-foot wide vein assaying more than 2 ounces per ton. A crew and mining equipment were flown to the mine in April, and work started immediately.

Several placer mines operated in the Kantishna district, and a lode gold mine was producing in the Willow area. No production details were available. Klondike Placer Gold, Inc., continued efforts in the Livengood area, and several small placer mines operated in the Circle-Central area.

**Nickel.**—The Nunatak nickel-copper deposit underlying Brady Glacier at Glacier Bay National Monument was idle pending decisions on mining and processing activities within national monuments. The National Park Service opposes any mineral activity on lands under its control, and Newmont Mining Corp., Cities Service Corp., and Union Pacific Minerals Corp. have postponed any activity until the controversy is settled. Inspiration Consolidated Copper Co. continued drilling to delineate

<sup>7</sup> Pages 32-33 of work cited in footnote 3.

Table 6.—Alaska: Placer production of gold

Year	Mines producing	Material treated <sup>1</sup> (thousand cubic yards)	Gold recovered		
			Troy ounces	Value (thousands)	Average value per cubic yard
1971 -----	27	1,060	12,327	\$508	\$0.479
1972 -----	25	902	8,639	506	.561
1973 -----	23	972	7,107	695	.715
1974 -----	21	975	9,146	1,461	1.498
1975 -----	23	1,751	14,980	2,419	1.381

<sup>1</sup> Excludes material treated primarily for the recovery of platinum.

a nickel-copper deposit on Yakobi Island in southeast Alaska.

**Platinum.**—The Goodnews Bay Mining Co. continued dredging activity at about the same level as in 1974. The placer mine is in the Salmon River area on the southwest coast of Alaska. Small placer operations in the State also produced minor quantities of platinum. Data on production of platinum in Alaska are not published.

**Silver.**—Exploration for silver and related metals continued at about the same level as in 1974. Several mining companies were actively engaged in exploration of lead, zinc, and silver deposits in Arctic Alaska. Rhinehart Berg continued drilling on an underground lead-silver prospect near Hannum Creek in the Kougarok area, Cape Nome district, in western Alaska. Activity in the Kantishna area, Mount McKinley district, increased. Exploration activity in southeastern Alaska continued at about the same level as in 1974.

**Tin.**—Drilling for lode tin continued on the Purkeypyle property southwest of Mount McKinley Park. The most recent evaluation of the property indicated a viable mining operation. The Purkeypyle property is within the proposed extension of Mount McKinley National Park and the area of ecological concern surrounding the proposed park addition.

#### NONMETALS

**Barite.**—An Anchorage consulting firm working under contract with the Federal Bureau of Mines to evaluate the mineral potential of a proposed d-2 (section 17 (d) (2), ANCSA) land withdrawal area in the Brooks Range discovered an area with significant lead, zinc, and silver in a barite host rock. The deposit, known as the Red Dog prospect, is north of the village of Noatak on the west side of Deadlock Mountain. Selected samples from outcroppings averaged about 86% barite, 6% to 7% zinc, 3% lead, and 1.25 ounces of silver per ton. High-grade samples ran 96% barite, 43% zinc, 9% lead, and 3.0 ounces of silver per ton. The status of the area has not been determined, and until a decision has been reached the deposit will be closed to all entry. No estimates of reserves will

be made until a detailed exploration program can be completed. The mineralized area appears to extend about 2 miles with a width of about  $\frac{1}{2}$  mile. Mineralization includes lead and zinc sulfides in rock containing mostly barite, lead, and zinc sulfides in siliceous rock; barite zones with little lead and zinc; abundant iron sulfides with minor lead-zinc in cherty brecciated rocks; and massive to semimassive veins or zones of lead, zinc, and iron sulfides in brecciated black chert.

**Chromalloy Mining**, a subsidiary of Chromalloy American Corp., Houston, Tex., reported barite production from southeastern Alaska. Chromalloy has taken over the Alaska barite offshore deposit in Duncan Canal, Kupreanof Island, southeastern Alaska.

**Fluorite.**—Lost River Mining Corp. signed a long-term agreement with Bering Straits Native Corp. in an effort to bring its proposed fluorite and tin-tungsten development to fruition. Lost River also received exploration and development rights on lands adjoining its claims which were selected by the Inalik Native Corp. Brevig Mission Native Corp. and Teller Native Corp. also are partners in the agreement. The plan is to lease land to Lost River for an airport, deepwater port facilities, and material sites. The Inalik Corp. also will lease land for mine support facilities, tailings disposal, water storage, and a town-site.

**Sand and Gravel.**—Production of sand and gravel in Alaska continued to increase in 1975, primarily because of pipeline and related construction activity. Consumption of sand and gravel in municipal areas and for general highway and airport use also increased. In 1975 48 million tons of sand and gravel was produced in Alaska, compared with 44 million tons in 1974.

**Stone.**—Production of stone in Alaska also increased as a direct result of pipeline construction and related activities. Most of the stone was used as riprap and for stone requirements at the 12 pump stations and Valdez terminal. Approximately 8.9 million tons of stone was produced in Alaska in 1975. The value of the stone was \$26.6 million.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	Region
Barite: Chromalloy American Corp	Box 1313 Kenai, Alaska 99611	Open pit	Southeastern Alaska.
Coal: Usibelli Coal Co	Box 3013 Fairbanks, Alaska 99701	do	Yukon River.
Gold: Alaska Gold Co	Nome, Alaska 99762	Dredge	Seward Peninsula.
Natural gas and petroleum—see table 5.			
Platinum-group metals: Goodnews Bay Mining Co	1411 4th Ave. Bldg. Room 720 Seattle, Wash. 98101	do	Kuskokwim.
Sand and gravel: Central Construction Co., Inc	428-117 2d Ave. Bldg., Seattle, Wash. 98101	Pit	Kuskokwim, Bristol Bay, Seward Peninsula.
Green Associated	Pouch 85 Fairbanks, Alaska 99707	Pit	Southeastern Alaska.
Rogers and Babler Inc	4607 East Tudor Rd. Anchorage, Alaska 99507	Pit	Cook Inlet.
Vast Construction Co., Inc	Box 4-GG Anchorage, Alaska 99509	Pit	Do.
Stone: Ketchikan Pulp Co	Box 1619 Ketchikan, Alaska 99901	Quarry	Southeastern Alaska.
Moore Construction Co., Inc	Ketchikan, Alaska 99901	do	Do.
Welborn Construction Inc	Box 634 Kodiak, Alaska 99615	do	Kodiak.
Tin: Lee Bros. Dredging Co., Inc	Box 816 Nome, Alaska 99762	Dredge	Seward Peninsula.

# The Mineral Industry of Arizona

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

By Joseph C. Arundale <sup>1</sup>

Arizona mineral production in 1975 was valued at nearly \$1.3 billion, 18% below the alltime high value in 1974. Arizona ranked 14th among the States in value of minerals produced in 1975.

Copper accounted for \$1.04 billion, 81% of the total value of minerals produced. Arizona continued as the leading copper-producing State, accounting for over 58% of the U.S. total. The State ranked second in molybdenum production with 25 million pounds and second in silver with 6 million troy ounces. Coal output continued to expand.

Reduced demand, lower prices, rising costs, accumulating inventories, production cutbacks, and layoffs all presented a rather dismal picture for the copper industry in Arizona during 1975. Even so, exploration, development, and expansions continued, all of which indicated a temporary recession, or a lower part of a cycle, but with recovery and growth in the outlook.

The Federal Bureau of Mines published a report documenting the leadtime required for exploration, mine development, and construction of beneficiation and support facilities for selected copper deposits in Arizona.<sup>2</sup> Time for major exploration was found to range from 1 to 15 years; time for open pit development (or construction) was 1 to 4 years; and time for underground development was 4 to 8 years. Construction of beneficiation plants required from 8 months to over 2 years. The data are supported by historical facts for each deposit during the leadtime stages from location of claims through explora-

tion, construction, expansion, and leaching. The sequence of development and factors contributing to differences in the timespans are discussed. Histories are detailed for the Miami, Castle Dome, Copper Cities, San Manuel-Kalamazoo, and Twin Buttes properties; the Pinto Valley, Miami-East, Esperanza-Sierrita, Pima, and Mineral Park properties are briefly summarized. Each mining operation had its own pattern of development, and together they present a source of planning information for the development of other properties.

The October 1975 issue of "Arizona Highways" magazine was a special edition dedicated to the Arizona copper industry. This edition summarized the history of copper mining in Arizona as well as its current significance and some of its problems.

The Arizona Bureau of Mines published a resume of coal resources on Black Mesa in its paper "Fieldnotes." According to the report, coal resources on the Navajo and Hopi Arizona reservations could amount to as much as 21 billion tons.

The Arizona Mining Association published a compilation of data on copper in Arizona designed to permit evaluation of the industry's contribution to Arizona's economy.<sup>3</sup>

<sup>1</sup> State Liaison Officer, Bureau of Mines, Phoenix, Ariz.

<sup>2</sup> Burgin, L. B. Time Required in Developing Selected Arizona Copper Mines. BuMines IC 8702, 1976, 144 pp.

<sup>3</sup> Arizona Mining Association. Arizona, Copper Capital, U.S.A. December 1975, 24 pp.

Table 1.—Mineral production in Arizona <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Asbestos -----short tons--	W	W	1,676	W
Clays -----thousand short tons--	199	\$622	129	\$483
Coal (bituminous) -----do----	6,448	W	6,986	W
Copper (recoverable content of ores, etc.) short tons--	858,783	1,327,678	813,211	1,044,162
Gem stones -----	NA	1,500	NA	5,000
Gold (recoverable content of ores, etc.) troy ounces--	90,586	14,470	85,790	13,854
Gypsum -----thousand short tons--	141	473	117	419
Lead (recoverable content of ores, etc.) short tons--	1,059	476	420	181
Lime -----thousand short tons--	422	9,071	512	12,444
Mica, scrap -----do----	2	82	2	65
Molybdenum (content of concentrate) thousand pounds--	28,346	57,067	25,030	61,411
Natural gas -----million cubic feet--	224	45	208	58
Petroleum (crude) thousand 42-gallon barrels--	740	3,885	635	3,332
Pumice -----thousand short tons--	846	865	856	1,294
Sand and gravel -----do----	23,417	41,906	17,222	36,490
Silver (recoverable content of ores, etc.) thousand troy ounces--	6,356	29,935	6,286	27,783
Stone -----thousand short tons--	4,932	11,479	3,404	11,030
Zinc (recoverable content of ores, etc.) short tons--	9,699	6,964	8,655	6,751
Value of items that cannot be disclosed: Cement, feldspar, helium, iron ore, mica (scrap), perlite, pyrites, salt (1975), tungsten, turquoise (1975), and values indicated by symbol W ----	XX	55,716	XX	63,666
Total -----	XX	1,562,234	XX	1,288,423
Total 1967 constant dollars -----	XX	738,624	XX	<sup>p</sup> 510,216

<sup>p</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Arizona, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Apache -----	\$5,557	\$5,124	Petroleum, pumice, helium, clays, sand and gravel, natural gas.
Cochise -----	50,608	W	Copper, lime, stone, gold, silver, sand and gravel.
Coconino -----	2,482	3,545	Sand and gravel, pumice, stone.
Gila -----	154,955	178,218	Copper, silver, gold, sand and gravel, lime, asbestos, stone, molybdenum, clays.
Graham -----	866	908	Copper, sand and gravel, stone, pumice.
Greenlee -----	179,599	W	Copper, silver, gold, lime, stone, sand and gravel.
Maricopa -----	23,694	21,454	Sand and gravel, lime, stone, salt, mica, clays.
Mohave -----	39,861	32,578	Copper, molybdenum, sand and gravel, silver, feldspar, zinc, stone, lead, gold.
Navajo -----	W	22,472	Coal, sand and gravel, iron ore, pumice, stone.
Pima -----	603,005	450,912	Copper, molybdenum, cement, silver, sand and gravel, stone, gold, lead, clays, zinc, mica, tungsten.
Pinal -----	413,867	297,750	Copper, molybdenum, gold, silver, stone, sand and gravel, lime, perlite, gypsum, lead, pyrites, clays.
Santa Cruz -----	W	W	Zinc, sand and gravel, lead, silver.
Yavapai -----	63,669	57,593	Copper, cement, zinc, lime, stone, sand and gravel, molybdenum, silver, gypsum, clays, gold, lead, pumice.
Yuma -----	W	W	Sand and gravel, stone, lead, silver.
Undistributed <sup>2</sup> -----	24,063	217,870	
Total <sup>3</sup> -----	1,562,234	1,268,423	

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

<sup>1</sup> Value of petroleum is based on an average price per barrel for the State.

<sup>2</sup> Includes value of mineral production that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

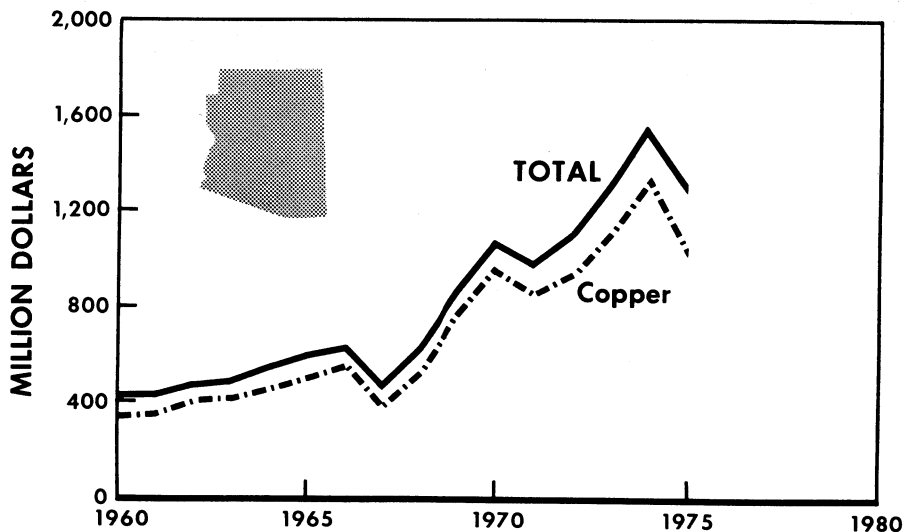


Figure 1.—Value of mine production of copper and total value of mineral production in Arizona.

Table 3.—Indicators of Arizona business activity

	1974	1975 P	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	872.0	877.0	+0.6
Unemployment -----do-----	49.2	82.6	+67.9
<b>Employment (nonagricultural):</b>			
Mining -----do-----	26.8	24.3	-9.3
Manufacturing -----do-----	111.9	97.7	-12.7
Contract construction -----do-----	57.0	41.8	-26.7
Transportation and public utilities -----do-----	39.8	38.6	-3.0
Wholesale and retail trade -----do-----	175.5	174.9	-.3
Finance, insurance, real estate -----do-----	42.8	41.8	-2.3
Services -----do-----	182.5	185.9	+2.6
Government -----do-----	161.0	169.3	+5.2
Total nonagricultural employment -----do-----	747.3	724.3	-3.1
<b>Personal income:</b>			
Total -----millions--	\$11,121	\$11,908	+7.1
Per capita -----do-----	\$5,152	\$5,955	+3.9
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----			
	31,357	18,504	-41.0
Value of nonresidential construction -----millions--	\$322.8	\$221.2	-31.5
Value of State road contract awards -----do-----	\$85.0	\$104.0	+22.4
Shipments of portland cement to and within the State <sup>1</sup> -----thousand short tons--	1,385	1,086	-21.6
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$1,562.2	\$1,288.4	-17.5
Value per capita, resident population -----do-----	\$723.26	\$582.47	-19.5
Value per square mile -----do-----	\$13,714.15	\$11,310.99	-17.5

P Preliminary.

<sup>1</sup> Excludes data on masonry cement; withheld to avoid disclosing individual company confidential data.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

**Trends and Developments.**—Output of most major mineral commodities in Arizona was down in 1975, a short-term trend reflecting a general recession in the Nation's economy. The long-term trend in both production and consumption of copper worldwide has been upward. Copper mine capacity in Arizona and the United States has been steadily expanding; mine production has been cyclical but generally increasing. Exploration, expansion, and new development continued in recognition of continued growth in demand for copper in the outlook.

Copper prices on the London Metal Exchange (on which foreign producer concentrate prices are based) reflected the world's deep recession in metal demand. For the four quarters of 1975, prices averaged 58, 57, 56, and 53 cents per pound; 56 cents per pound for the full year, compared with 93 cents per pound in 1974. The slide in prices resulted from an excess of copper supplies and a sharp fall in demand worldwide. Consumption declined to abnormally low levels for the year as a whole in the electric power generation, automotive, housing, and consumer durables industries.

Table 4.—Major sources of income in Arizona  
(Millions)

Source of income	1974	1975	Change, percent
Manufacturing (value added) -----	\$2,270	\$1,950	-14.1
Mining <sup>1</sup> -----	1,562	1,288	-17.5
Tourism -----	690	--	--
Livestock -----	629	505	-19.7
Crops -----	603	581	-3.6

<sup>1</sup> U.S. Bureau of Mines.

Source: Valley National Bank Research Department, Phoenix, Ariz.

Table 5.—Valuation on centrally assessed groups of property in Arizona  
(Millions)

Group	1974	1975	Change, percent
Utilities -----	\$2,293.9	NA	--
Mines -----	863.3	\$1,170.5	+36
Pipelines -----	356.7	344.0	-4
Railroads -----	172.8	146.6	-15
Airlines -----	35.6	27.5	-23
Oil and gas -----	2.7	3.5	+30

NA Not available.

Source: Pay Dirt. No. 432, June 30, 1975, p. 3.

**Employment, Health and Safety.**—Figures issued by the State of Arizona showed that mining employment averaged 24,200, a decrease of 9% from the 1974 average. Final statistics for 1974 on employment and injuries in the minerals industries, excluding petroleum and natural gas operations, and preliminary data for 1975 compiled by the Mining Enforcement and Safety Administration are given in table 6.

Central Arizona College officials in Casa Grande announced in January that the college had taken over operation of the Papago Mining Institute located in the Jack Rabbitt area, 25 miles south of Casa Grande, near Hecla Mining Co.'s Lakeshore copper mine. The institute was set up to train Indians for work in the mines. The president of the college said the U.S. Department of the Interior asked the college to operate the institute after the Federal Government terminated an agreement with a New York firm that had been operating the school. During 1974-75 the institute trained about 180 persons, many of whom had found jobs in the mining industry.

#### Legislation and Government Programs.

—Full cash valuation of Arizona's producing mining properties for tax purposes for the 1975-76 fiscal year was set at a record \$1.1 billion, according to the Division of Property and Special Taxes of the Arizona Revenue Department. This was a 36% increase from the \$862.8 million set for 1974.

On February 20, 1975, an action was brought by the Federal Government, in its own right and on behalf of the Papago Indian Tribe and individual Indian allottees of land on the San Xavier Indian Reservation, in the U.S. District Court for the District of Arizona against the Anaconda Co., Anamax Mining Co., and

others, in connection with the alleged withdrawal of large amounts of surface and ground water from lands within the Santa Cruz River Basin in derogation of the rights of the plaintiff and the Papago Indians. Plaintiff asked that the court enter a decree to the effect that plaintiff has a priority with respect to the use of such amounts of surface and ground water of the basin as are necessary for the purpose of the reservation; that the court permanently enjoin the defendants from using the ground water of the basin in such manner as to interfere with the rights of the plaintiff and its Indian wards; and that the court award money damages to plaintiff in an unspecified amount to compensate plaintiff and the Indians for losses sustained as a result of excessive water withdrawals by defendants near the reservation.

#### Exploration, Geologic Studies, Mapping.

—The U.S. Geological Survey awarded the Arizona Bureau of Mines a grant to investigate the uranium potential of sandstones exposed along the Mogollon Rim between Oak Creek Canyon and the Fort Apache Indian Reservation in east-central Arizona. The study was to determine the source and distribution of the coarse-grained rocks in the area, and the origin and significance of the uranium mineralization in these rocks.

Following closely on the closing of Phelps Dodge Corp.'s Lavender pit in December 1974, was an announcement by Occidental Minerals Corp. (OxyMin), a division of Occidental Petroleum Corp., that it was launching large-scale copper exploration in the Bisbee area. The land included in the project runs from downtown Bisbee for several miles to the north and the east.



Table 6.—Arizona: Worktime and injury experience in the mineral industries<sup>1</sup>

Year and Industry	Men employed	Man-hours worked	Fatal injuries	Fatal frequency rate <sup>2</sup>	Nonfatal disabling injuries	Nonfatal disabling frequency rate <sup>2</sup>
1974:						
Copper:						
Underground -----	5,479	10,586,813	10	0.94	703	66.03
Surface -----	7,993	15,174,100	2	.13	395	24.19
Mills -----	5,803	10,463,171	--	--	119	8.89
Total -----	19,274	36,224,084	12	.33	1,217	32.00
Other metals:						
Underground -----	34	15,940	--	--	--	--
Surface -----	5	216	--	--	--	--
Mills -----	1	175	--	--	--	--
Sand and gravel:						
Surface -----	817	1,119,946	--	--	18	14.29
Other nonmetals: <sup>3</sup>						
Underground -----	3	30	1	33,333.33	--	--
Surface <sup>4</sup> -----	274	374,576	--	--	6	16.02
Mills -----	412	754,027	--	--	33	43.76
Coal:						
Surface -----	255	580,891	1	1.72	13	22.38
Mills -----	35	66,466	--	--	1	15.05
1975:						
Copper:						
Underground -----	4,996	9,633,025	3	.31	479	48.89
Surface -----	7,030	13,320,560	2	.15	266	19.97
Shops -----	93	33,360	--	--	1	--
Mills -----	5,187	9,630,628	1	.10	191	19.73
Subtotal -----	17,306	32,617,473	6	.18	937	28.42
Office -----	1,838	3,462,406	--	--	4	1.16
Total -----	19,144	36,079,879	6	.17	941	25.80
Other metals:						
Underground -----	58	27,771	--	--	--	--
Surface -----	8	2,172	--	--	--	--
Mills -----	13	4,724	--	--	--	--
Subtotal -----	79	34,667	--	--	--	--
Office -----	5	1,401	--	--	--	--
Total -----	84	36,068	--	--	--	--
Sand and gravel:						
Surface -----	1,034	1,132,147	3	2.65	10	8.83
Office -----	72	73,084	--	--	--	--
Total -----	1,106	1,205,231	3	2.49	10	8.30
Other nonmetals:						
Underground -----	7	6,337	--	--	--	--
Surface -----	197	262,550	--	--	7	26.66
Mills -----	8	8,620	--	--	--	--
Subtotal -----	212	277,507	--	--	7	25.22
Office -----	11	9,830	--	--	--	--
Total -----	223	287,337	--	--	7	24.36
Coal:						
Underground -----	--	--	--	--	--	--
Surface -----	350	742,480	--	--	27	36.36
Mills -----	33	63,626	--	--	--	--
Total -----	383	806,106	--	--	27	33.49

<sup>1</sup> All data are preliminary.<sup>2</sup> All injuries and all man-hours reported and in file will be tabulated, but when computing injury-frequency rates only those injuries for which man-hours are reported and in file will be used; frequency rate is per million man-hours.<sup>3</sup> Includes cement, lime, limestone, granite, marble, sandstone, miscellaneous stone, clay, feldspar, fluorspar, gypsum, mica, pumice, and miscellaneous nonmetals.<sup>4</sup> Includes underground mining of fluorspar for which no fatalities or injuries were recorded.

Source: Mining Enforcement and Safety Administration.

**Energy.**—The serious shortages of natural gas and petroleum products and their rapidly escalating costs caused the cement industry to search for viable energy alternatives. Amcord, Inc., converted its Clarkdale cement plant to coal from natural gas as a primary fuel (and oil being a backup only when gas supplies were not available).

Because supplies of natural gas had become increasingly uncertain and limited, Magma Copper Co. installed equipment in 1975, including storage facilities, that permits greater use of oil as smelter fuel during periods of natural gas scarcity. However, the cost of oil had risen to such an extent that it also became necessary to consider coal as an alternative, cheaper fuel. Consequently, Magma initiated engineering of installations for using coal as the primary fuel for smelting, and an adequate source of coal was under investigation.

**Environment.**—The Environmental Protection Agency (EPA) proposed new regulations on October 22, with hearings conducted at smelter towns in December. As a result of these actions, the Air Quality Control Bureau of the Arizona Department of Health was expected to issue new State regulations. The public hearings were held preparatory to adopting new regulations. The Federal Agency was allowing the closed-loop system and was crediting tall stacks, but was proposing stiff regulations based on each smelter's capability to remove sulfur. Two smelters that were removing 90% of the sulfur emissions and approved by the State might be expected to remove 95% to 98% of the sulfur oxides, whereas others might only have to remove 60% to 70%. The principal problem discussed in these hearings was how to cope with the sulfur in aerosol mist emissions. At yearend, the smelter emission problems were still unsettled.

The State Legislature was expected to pass a measure that would authorize legal and administrative machinery for issuing temporary operating permits to sources of air pollution, such as smelters, which hold operating permits. The temporary permits would be used when the smelters are faced with extraordinary circumstances during which they cannot, for the moment, meet air quality standards. The bill would allow the director of the State Health Depart-

ment to issue a temporary, conditional permit for operating over an initial 120-day period or less, which could be extended. The measure was designed to prevent the economic repercussions of a complete shutdown due to circumstances beyond the operators' control.

Magma Copper Co. inaugurated its \$40 million air quality maintenance system for the San Manuel smelter January 25. The system, which began startup operations in September 1974, includes a sulfuric acid plant for control of sulfur oxide gases, electrostatic precipitators for control of particulates, and an air monitoring system to continuously measure ambient air quality.

Inspiration Consolidated Copper Co. was granted an unconditional operating permit for its electric smelter by the State which, along with Kennecott Copper Corp., Ray Mines Div. smelter at Hayden, were the only smelters to receive such permits. The other five smelters in the State received extensions to operate until early in 1976.

An extensive planting program at Twin Buttes was transforming tailings dikes into terraced hillsides with plantings of trees, bushes, and grass. Trickle irrigation, through a network of hoses, provides needed moisture. A microanalytical laboratory for environmental evaluations was established at Anamax's Tucson headquarters.

The Cyprus Metallurgical Processes Corp., operated and 90% owned by Cyprus Mines Corp., continued to develop the "Cymet" process. Its objective was to create a pollution-free process that will economically produce copper from sulfide concentrates. Testing, modification, and improvement of the Cymet process continued during the year at a demonstration plant near Tucson. New equipment was in operation and a small amount of high-purity copper had been produced. According to the company, the modified operation eliminated the electrolytic cells and the electrorefining circuit, and is yielding high-purity copper using a much simplified process. The previously high power consumption has been reduced from 3.5 to less than 1 kilowatt-hour per pound of copper produced.

According to Cyprus, preliminary engineering and economic studies indicated

that the process might result in significant savings in capital and operating costs compared with conventional pyrometallurgical processes. Development and operations were being directed toward compiling engineering and operating data necessary to evaluate the process for full-scale commercial use.

Phelps Dodge's three copper smelters in Arizona operated throughout 1975 under interim permits issued by Arizona authorities, each conditioned upon completion by the end of that year of a program to bring the smelter into compliance with the Arizona regulations restricting particulate and sulfur dioxide emissions. However, developments during 1975 at both Federal and State levels had, by yearend, left unresolved the final regulations with which those smelters were expected to comply. As a consequence, the smelters were in an indefinite status with respect to compliance.

A further uncertainty was created by the issuance in October 1975 by EPA of proposed new SO<sub>2</sub> control regulations for each of the seven copper smelters in Arizona, intended to replace the Arizona regulations on which control programs had been based since 1972. If adopted, the EPA proposals would adversely affect all Arizona smelters. Phelps Dodge testified at hearings held in December on the EPA proposals, and offered an alternative plan for the Douglas smelter which the company said would achieve substantially the same degree of control as that proposed by EPA, but at a cost which the smelter operation could afford. At the same time

Arizona was revising its own SO<sub>2</sub> regulations, in an effort to make them acceptable to EPA.

During 1975, Phelps Dodge had the following capital and related research expenditures on air quality control programs at its three Arizona smelters: \$1,208,000 at Ajo, \$4,516,000 at Douglas, and \$9,608,000 at Morenci.

The Smelter Control Research Association (SCRA) continued to operate a pilot plant at the San Manuel smelter of Magma Copper Co. The plant was designed to test an ammonia double-alkali scrubbing system for the removal of sulfur dioxide from reverberatory furnace gas. According to Magma, tests had demonstrated the technique's basic effectiveness, but more work was required on certain problem areas and to determine the economic feasibility of the process.

Arizona smelting companies participated in the activities of the Smelter Environmental Research Association, Inc. (SERA), a nonprofit group, formed in 1975 to engage in scientific studies of the environmental and occupational health effects of emissions and effluents from smelting, refining, and other metal and mineral processing operations.

The Ray smelter of Kennecott Copper Corp. was producing under its second annual State operating permit with respect to sulfur dioxide standards. An agreement was reached with the nearby ASARCO, Inc., smelter concerning joint operation of a supplementary control system to meet ambient air quality standards.

## REVIEW BY MINERAL COMMODITIES

### METALS

Metals accounted for 90% of the total value of Arizona mineral production. Copper alone represented 81% of the total State mineral value. Nearly all the metals showed decreases in output in 1975.

**Copper.**—Arizona continued as the leading producer of copper in the Nation. Despite the decrease in copper output in 1975, the percentage of the U.S. total increased significantly to continue its steady capture of an even greater portion of the national total.

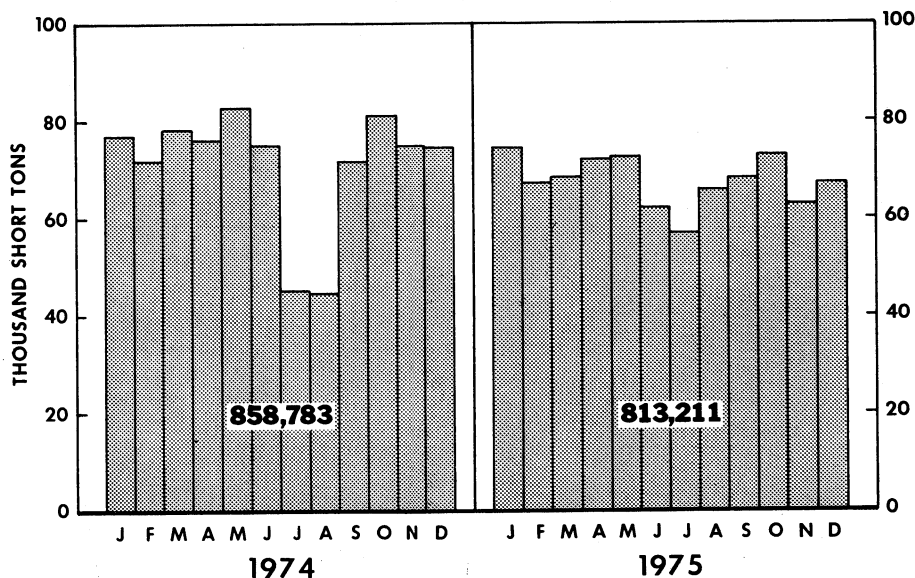


Figure 2.—Mine production of copper in Arizona, by month, in terms of recoverable metal.

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

Year	Arizona			U.S. copper production		Arizona	
	Total value of mineral production (thousands)	Copper production		Quantity (short tons)	Value (thousands)	Percent of U.S. copper production	Percent of world copper production
		Quantity (short tons)	Value (thousands)				
1971	\$981,020	820,171	\$852,978	1,522,183	\$1,583,071	53.9	12.3
1972	1,091,004	908,612	930,419	1,664,840	1,704,796	54.6	12.4
1973	1,304,988	927,271	1,103,453	1,717,940	2,044,346	54.0	11.8
1974	1,562,234	858,783	1,327,678	1,597,002	2,468,964	53.8	10.7
1975	1,288,423	813,211	1,044,162	1,413,366	1,814,763	57.5	10.6

r Revised.

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

Rank in 1975	Rank in 1974	Mine	County	Operator	Source of copper in 1975
1	2	Morenci -----	Greenlee --	Phelps Dodge Corp -----	Copper ore, copper precipitates, copper tailings.
2	1	San Manuel ---	Pinal -----	Magma Copper Co -----	Copper ore.
3	5	Sierrita -----	Pima -----	Duval Sierrita Corp -----	Do.
4	4	Pima -----	-----do -----	Cyprus Pima Mining Co --	Do.
5	3	Ray -----	Pinal -----	Kennecott Copper Corp --	Copper ore and copper precipitates.
6	18	Pinto Valley --	Gila -----	Cities Service Co -----	Do.
7	6	Inspiration ----	-----do ----	Inspiration Consolidated Copper Co.	Do.
8	10	Magma -----	Pinal -----	Magma Copper Co -----	Copper ore.
9	--	Metcalf -----	Greenlee --	Phelps Dodge Corp -----	Copper ore and copper precipitates.
10	8	New Cornelia -	Pima -----	-----do -----	Copper ore and gold ore.
11	9	Mission -----	-----do -----	ASARCO, Inc -----	Copper ore.
12	19	Sacaton -----	Pinal -----	-----do -----	Do.
13	14	Bagdad -----	Yavapai ---	Cyprus Bagdad Copper Co --	Do.
14	11	Silver Bell ----	Pima -----	ASARCO, Inc -----	Copper ore and copper precipitates.
15	12	Mineral Park -	Mohave ---	Duval Corp -----	Do.

Table 9.—Arizona: Material handled and copper produced at fifteen leading copper mines

Mine	Ore mined (thousand short tons)		Waste material re- moved <sup>1</sup> (thousand short tons)		Material placed in leach dumps (thousand short tons)		Total copper produced <sup>2</sup> (short tons)	
	1974	1975	1974	1975	1974	1975	1974	1975
OPEN PIT								
Morenci	16,786	16,174	15,029	5,447	15,877	15,823	115,718	98,083
Sierrita	30,497	31,431	51,209	44,340	1,368	--	9,594	93,864
Pima	20,018	19,631	55,825	39,818	--	--	6,575	70,775
Ray	11,221	6,868	--	--	33,731	24,356	90,355	59,465
Pinto Valley	3,330	13,093	--	--	12,279	23,987	9,361	55,803
Inspiration	8,453	6,297	8,600	10,409	9,929	7,139	3 44,897	3 44,897
Metcalf	--	5,556	--	5,414	--	10,094	--	35,748
New Cornelia	9,039	7,270	13,845	6,860	--	4,045	44,138	33,495
Mission	7,589	5,690	17,122	7,578	--	--	40,332	26,946
Sacaton Unit	2,861	3,605	7,256	22,544	--	--	40,332	26,946
Bagdad	2,171	2,082	9,876	2,423	--	--	9,516	21,918
Silver Bell	3,848	2,542	10,506	5,101	2,472	949	19,113	18,960
Mineral Park	6,380	5,574	3,214	887	2,539	2,887	23,475	18,267
UNDERGROUND								
San Manuel	19,624	16,683	67	27	--	--	124,423	97,031
Magma	733	956	--	135	--	--	30,469	40,393

<sup>1</sup> Excluding material placed in leach dumps.

<sup>2</sup> Gross metal content.

<sup>3</sup> Recoverable content.

Table 10.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing <sup>1</sup>	Material sold or treated <sup>2</sup>			Gold		Silver		Total value
		Locde	Placer	(short tons)	Troy ounces	Value	Troy ounces	Value	
1973, total	40	1	181,506,076	102,848	\$10,059,561	7,199,251	\$18,415,683		
1974, total	48	--	179,095,767	90,586	14,470,208	6,365,528	29,984,537		
1975:									
Cochise	8	--	2,856,052	7,575	1,223,287	195,041	862,081		
Gila	8	--	33,057,363	8,155	1,316,952	412,887	1,822,750		
Graham	1	--	21,752,870	13,432	2,169,134	685,019	3,081,763		
Greenlee	9	--	73,996,691	16,438	2,651,393	3,507,851	14,178,612		
Pima	9	--	28,276,235	33,628	6,339,826	1,382,509	6,110,639		
Pinal	4	--	2,177,324	671	92,211	109,411	483,597		
Yavapai	3	--	5,627,141	11	1,776	292,766	1,293,963		
Undistributed <sup>3</sup>	39	--	169,244,487	85,790	13,854,229	6,285,854	27,783,473		
Total									
Copper									
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Total value
1973, total	927,271	\$1,108,452,687	763	\$248,480	8,427	\$8,482,017		\$1,135,658,428	
1974, total	858,783	1,327,678,300	1,059	476,453	9,699	6,964,223		1,379,523,721	
1975:									
Cochise	13,001	16,692,652	--	--	--	--	--	--	18,778,020
Gila	133,702	171,673,488	--	--	--	--	--	--	174,813,190
Graham	504	647,650	--	--	--	--	--	--	647,650
Greenlee	134,714	172,972,953	--	--	--	--	--	--	178,173,850
Pima	280,440	360,085,422	223	96,024	22	17,014			377,028,415
Pinal	212,138	272,385,492	42	18,264	--	--			284,913,971
Yavapai	21,907	23,128,804	2	656	8,367	6,525,063			35,231,331
Undistributed <sup>3</sup>	16,804	21,575,907	153	65,643	267	207,977			23,145,286
Total <sup>4</sup>	813,211	1,044,162,368	420	180,587	8,655	6,751,054			1,092,731,713

<sup>1</sup> Operations at miscellaneous cleanups not counted as mines.

<sup>2</sup> Does not include gravel washed.

<sup>3</sup> Includes Mohave, Santa Cruz, and Yuma Counties combined to avoid disclosing individual company confidential data.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Table 11.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by class of ore or other source material

Source	Number of mines <sup>1</sup>	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
<b>Lode ore:</b>							
Gold, gold-silver, and silver <sup>2</sup>	5	340,261	2,692	62,466	225	2	( <sup>3</sup> )
Copper	29	168,655,544	82,385	6,155,669	748,352	223	92
Copper-zinc	1	90,598	974	26,196	3,137	--	8,326
Lead and lead-zinc <sup>2</sup>	3	3,130	11	7,106	--	188	267
Total <sup>4</sup>	33	168,753,282	82,770	6,197,911	751,489	412	8,655
<b>Other lode material:</b>							
Gold-silver, tailings	1	65,216	320	24,286	80	--	--
Copper tailings, silver cleanup and lead cleanup <sup>2</sup>	1	2,558	8	1,191	5,568	7	--
Copper precipitates	14	85,170	--	--	55,848	--	--
Total	15	150,944	328	25,477	61,496	7	--
Grand total <sup>4</sup>	39	169,244,487	85,790	6,285,854	813,211	420	8,655

<sup>1</sup> Detail will not add to total because some mines produce more than one class of material.

<sup>2</sup> Combined to avoid disclosing individual company confidential data.

<sup>3</sup> Less than 1/2 unit.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

<sup>5</sup> Excludes newly generated tailings.



**Table 12.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by type of material processed and method of recovery**

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
<b>Lode:</b>					
Cyanidation -----	2,591	60,346	--	--	--
Acid leaching (vat, tank, heap) <sup>1</sup> ----	--	--	73,500	--	--
Smelting of concentrates -----	77,788	6,063,510	677,158	412	8,655
<b>Direct smelting of—</b>					
Ore -----	5,083	136,521	6,623	2	( <sup>2</sup> )
Precipitates -----	--	--	55,848	--	--
Cleanup -----	8	1,191	1	7	--
Tailings -----	320	24,286	80	--	--
Total <sup>3</sup> -----	5,411	161,998	62,552	8	( <sup>2</sup> )
<b>Grand total <sup>3</sup> -----</b>	<b>85,790</b>	<b>6,285,854</b>	<b>813,211</b>	<b>420</b>	<b>8,655</b>

<sup>1</sup> Includes copper recovered by electrowinning process.

<sup>2</sup> Less than ½ unit.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

In 1975, Phelps Dodge Corp. produced about 169,000 tons of copper in concentrates, ores, and precipitates from open pit mines at Ajo, Metcalf, and Morenci, and from underground mines at Bisbee. These mines produced 183,000 tons in 1974. The decrease reflected the closing of the Lavender open pit mine and concentrator at Bisbee on December 14, 1974, and the Bisbee underground mines on June 13, 1975, and reduced work schedules in 1975, compared with 1974, at the other mines. These factors more than offset new production from the Metcalf mine near Morenci, where operations began in January 1975.

Reflecting decreased demand for copper, work schedules at the Ajo, Metcalf, and Morenci mines and concentrators were reduced on January 9, 1975, from the equivalent of a 5½-day to a 5-day week and on February 20 to a 4-day week; the latter reduction also included the Bisbee underground mines. During the week of July 13, operating schedules equivalent to a 5-day week were resumed and continued the rest of the year.

Smelter production at Ajo, Douglas, and Morenci totaled 336,107 tons in 1975, a little less than the 348,813 tons produced in 1974. These tonnages included, in addition to copper from their own mines, copper smelted under contract for others and copper from purchased scrap smelted at Douglas. Except from February 20 to the middle of July, and during the 3-week vacation shutdowns at Ajo and Morenci,

operations at the smelters were generally on a 7-day-week basis throughout the year.

In 1975, capital expenditures at Phelps Dodge mines, concentrators, and smelters in Arizona totaled about \$62 million compared with about \$141 million in 1974. Of the 1975 expenditures, \$39.1 million was spent at Morenci (\$56.4 million in 1974), \$13.1 million at Metcalf (\$64.0 million in 1974), \$3.5 million at Ajo (\$6.0 million in 1974), and \$6.2 million at the Douglas smelter (\$13.7 million in 1974). These amounts included a total of \$15.3 million for air quality control at facilities at the Morenci, Ajo, and Douglas smelters (\$45.2 million in 1974), and \$21.6 million for related tailings leach program at Morenci (\$21.6 million in 1974). Other capital expenditures at the mines, concentrators, and smelters were mainly for equipment to maintain and improve operating efficiencies.

Total capital investment in the Metcalf project, which was begun in 1969 and ready for production by the end of 1974, was \$194 million, including preoperating mine development expenses of \$28.5 million. The project involved the removal of 75.6 million tons of overburden, construction of primary and secondary crushing plants, a concentrator, powerplant and related facilities, housing of employees, and acquisition of mining and other equipment. The Metcalf concentrator was designed to treat 30,000 tons of ore per day; operations in 1975 showed that its capacity was in the range of 40,000 tons of ore daily. How-

ever, mainly because of reduced operating schedules, production in 1975 of 29,195 tons of copper in concentrates was well below capacity. The addition of the Metcalf concentrator to the installations at Morenci gave added flexibility in the processing of ores from the Metcalf and Morenci mines.

Development of Phelps Dodge's deep ore body at Safford, estimated to contain 400 million tons of ore with an average grade of 0.72% copper, continued throughout 1975. This development program was begun in February 1974 and was expected to continue in 1976, but at a slower pace. Expenditures in 1975 amounted to \$13.3 million, compared with \$6.7 million in 1974; a total of \$34.4 million had been invested in this project at yearend.

In 1975, the existing No. 1 shaft was deepened about 240 feet to a final depth of 2,150 feet and the new No. 2 shaft reached a depth of 1,439 feet at yearend. Construction of underground and surface installations and other development work continued. No decision had been made on when to proceed with the extensive additional construction and other work that would be required to bring this property into production.

No further development work was carried out in 1975 on Phelps Dodge's Copper Basin property southwest of Prescott. Applications to the U.S. Forest Service and the Bureau of Land Management, to exchange land owned elsewhere for certain land that would facilitate the development of the Copper Basin property, were pending.

Underground copper mining at Phelps Dodge Corp.'s Copper Queen branch at Bisbee ended in mid-June. The mines, operated since 1880, had been producing at reduced rates since the adjacent Lavender pit and concentrator were closed in December 1974. The combination of high labor and supply costs, low copper prices, and depletion of ore that could be mined efficiently made it impossible for the underground mines to produce copper at a profit, the company said.

The Cyprus Mines Corp. operation, located 102 miles northwest of Phoenix, consisted of an open pit mine, a 5,800-ton-per-day concentrator producing copper and molybdenum concentrates, an oxide dump-leaching system with a solvent-extraction,

electrowinning plant producing high-purity copper cathodes, and a town for its 550 employees and their families.

In 1975, Cyprus Bagdad mined 2.1 million tons of sulfide ore containing 0.70% copper, compared with 2.2 million tons and 0.74% in 1974. From its 1975 concentrate production and concentrate stocks, the company sold 14,573 tons of copper. Cathode copper sales totaled 7,538 tons. Byproduct sales of 217 tons of molybdenum and 68,000 ounces of silver were also made. Average prices received in 1975 were \$0.635 per pound for wirebar copper, \$0.633 per pound for cathode copper, \$2.44 per pound for molybdenum, and \$4.57 per ounce for silver. With the exception of molybdenum, these prices were much lower than those received in 1974.

An important milestone in 1975 was certification of Cyprus Bagdad electrowon cathodes for New York Commodity Exchange contracts, the first electrowon cathodes to receive such certification.

Progress was made on the major expansion program authorized in 1974. Cyprus Mines was in the process of spending nearly \$0.25 billion on the Cyprus Bagdad expansion project, which was expected to increase "about seven times" the previous mining and processing activity at Bagdad. Site preparation for the primary crusher and concentrator was completed by yearend of 1975. Similar work for the overland conveyor, water reservoir, and tailings dam sites was nearing completion. At the end of December, 11 of the 20 new 170-ton trucks on order were assembled and operating, one of the 4 planned 20-cubic-yard shovels was in operation, and about one-third of preproduction stripping was done. Contract personnel for construction of the primary crusher, primary mill feed tunnels, concentrator, autogenous and ball-mill foundations, and ancillary buildings numbered about 400 and was expected to double by the end of 1976. The new mine maintenance and machine shop and warehouse facilities were finished and occupied in July. All major construction was on schedule.

Completion of construction and the start of expanded operation at the rate of 40,000 tons a day were scheduled for the end of 1977. The operation was designed to yield about 70,000 tons of copper a year as well as significant amounts of molyb-

denum and silver. The huge orebody, with proven reserves of over 300 million tons of copper ore averaging 0.49% copper and very large probable and inferred reserves, may furnish enough material to permit operations well into the 21st century. Meanwhile, detailed drilling was being done in the surrounding area of mineralization with the intent of developing ore for further expansions and extended life.

Cyprus Pima Mining Co., near Tucson, was primarily a producer of copper concentrate, with molybdenum sulfide concentrate and silver in the copper concentrate as byproducts. In 1975, 19,631,000 tons of ore averaging 0.48% copper were mined, compared with 20,018,000 tons and 0.50% in 1974. From concentrate production and stocks, the company sold 86,379 tons of copper, 769 tons of molybdenum, and 920,000 ounces of silver. Average prices received were \$0.599 per pound for copper, \$1.93 per pound for molybdenum, and \$4.42 per ounce for silver.

Delivery of 15 new 170-ton capacity trucks ordered in 1974 to replace smaller old vehicles was completed in October. The use of these big and more efficient units, together with the addition of a third 20-cubic-yard shovel was scheduled for delivery to help offset increased operating costs.

Cyprus Bruce Copper & Zinc Co. near Bagdad consisted of a small, high-grade underground copper and zinc mine with concentrating and related facilities. In 1975, 94,600 tons of ore was mined containing an average of 3.73% copper and 12.5% zinc, compared with 93,000 tons with an average of 3.86% copper and 13.6% zinc in 1974. A new, large mobile drilling machine was placed in service during the year which resulted in more efficient operation at reduced costs.

Cyprus Bruce sold 4,848 tons of copper, 8,976 tons of zinc, 58,987 ounces of silver, and 468 ounces of byproduct gold. Average prices were \$0.637 per pound for copper, \$0.367 per pound for zinc, \$4.37 per ounce for silver, and \$167.46 per ounce for gold.

Intensive underground exploration activity throughout the year, which continued into 1976, thus far had not developed any additional ore. Proven re-

serves of 195,000 tons were sufficient for a little more than 2 years of operation at the 1975 rate.

Cyprus Johnson Copper Co., 65 miles east of Tucson, consisted of a small oxide-copper open pit mine with a solvent-extraction, electrowinning plant and related facilities. Production began in March 1975. Most of the usual initial production difficulties were solved and 1.7 million tons of ore containing 0.42% acid-soluble copper were mined. High-quality electrowon copper cathodes totaling 3,067 tons, with chemical quality equal to those of the Cyprus Bagdad cathodes, were produced by yearend, and 2,180 tons were sold at an average price of 63.3 cents per pound. It was expected that the scheduled annual production of about 5,000 tons of copper cathodes at planned cost would be achieved in 1976. Cyprus Johnson's ore reserves of nearly 13 million tons of oxide-copper ore with 0.50% acid-soluble copper content would assure an operating life of 9 years at the planned mining rate.

Anamax Mining Co., a partnership between The Anaconda Copper Company and AMAX, Inc., produced copper concentrates from the Twin Buttes mine south of Tucson. Refined copper was produced at the Twin Buttes oxide ore leaching electrowinning plant.

At Twin Buttes, the 40,000-ton-per-day sulfide mill was shut down in March 1975 to permit an intensified overburden removal program. Twin Buttes produced 29,900 tons of copper concentrates in 1975 before the mill shut down. Milling operations were resumed at yearend at a reduced rate.

Startup of the Twin Buttes oxide plant began in August 1975. The oxide plant had a capacity for treating 10,000 tons of oxide ore per day and producing 100 tons per day of commercial-quality cathode copper. Ore from a 25-million-ton stockpile was being treated. Approximately 6,700 tons of refined electrowon copper cathodes were produced in 1975.

Anaconda and AMAX participated in a program to delineate and evaluate zones of copper concentrations in the Twin Buttes mine amenable to economic extraction by underground mining methods.

ASARCO, Inc., began development of the underground portion of the copper deposit at its Sacaton Unit near

Casa Grande. Sinking of a 2,000-foot circular shaft began. The \$41.5 million original Sacaton project came on-stream in the first quarter of 1974, with the new open pit mine feeding the 9,000-ton concentrator. Mining from the underground portion by block caving was scheduled to begin in 1980.

Magma Copper Co.'s sales of copper declined to 129,000 tons from 147,900 tons in 1974; copper produced by Magma in 1975 was 133,000 short tons, compared with 149,600 tons in 1974. Magma's inventory of unsold finished copper, which was 20,446,000 pounds at the end of 1974, rose during the year to a peak of 78,500,000 pounds in August, but declined thereafter to 53,500,000 pounds at year-end.

The average price received by Magma Copper Co. in 1975 for copper produced and sold in the United States was 65 cents per pound, including a premium on sales of continuous cast rod, which represented 66% of Magma's copper sold. In 1974 the corresponding price was 77 cents per pound.

Weak copper markets made it necessary to reduce production at the San Manuel mine by 23% in 1975. As a partial consequence, operating costs per pound of copper in 1975 were about 21% higher than those of 1974. At the smaller Magma mine, increased production of 33% kept unit costs in 1975 practically the same as those of 1974. Increased costs of labor, fuel and environmental controls, lower rates of production, and a decrease of nearly 8% in the grade of ore mined at San Manuel were the major influences affecting the company's unit operating costs. The ore grade at San Manuel was expected to be higher in 1976.

Ray Mines Div. of Kennecott Copper Corp. produced 42,000 tons of copper compared with 74,700 in 1974. Ray was shut down for 12 weeks during the summer. High smelting and sulfuric acid production rates were achieved following a rebuilding of the reverberatory furnace completed during the shutdown. An expansion project to increase silicate copper leaching capacity by 40% continued during the year but at a reduced pace, with completion scheduled for early 1976.

Kennecott Copper Corp. was experimenting with a solution mining process at

its copper deposit about 9 miles north of Safford in the Gila Mountains. A Kennecott research and development team was considering a \$5 million program of at least five injection and solution recovery holes. Leach solutions would be forced several thousand feet deep under high pressure in the injection holes to penetrate copper-bearing rock and attack copper minerals. The recovery wells in the leach area would establish a circulation system returning to the surface, similar to oilfield hydrofracturing techniques. The wells at Safford go as deep as 5,000 feet, and if the system is successful, low-grade ores may be recovered that would not be economically accessible by conventional open pit or underground methods. It is anticipated that the technique could be used on sulfide as well as oxide ores. The system is attractive because it would substantially increase copper reserves, would not pollute the air, and would create relatively little surface disturbance. How the method would affect underground water supply has not been determined.

Previously, Kennecott had considered a possible nonvented subsurface nuclear explosive experiment jointly with the Atomic Energy Commission (AEC) to break a small portion of a 2-billion-ton copper deposit lying at great depth near Safford. Kennecott has not permanently shelved the possibility of using a nuclear explosion to establish an underground leaching cavity. A contract signed with the AEC in 1973 called for a joint study of such a technique. However, this study focused not on the Safford deposit but on a theoretical ore body having the characteristics of several Kennecott copper deposits. The study was completed and is being reviewed.

Continental Oil Co. continued evaluation of a potential open pit copper mine and recovery plant at Florence. The deposit is estimated to contain 800 million tons of reserves of 0.4% copper. A proposed project costing \$600 million would comprise an open pit and ore processing facilities. Underground work at a test mine to obtain bulk samples, accumulate rock mechanics data, and confirm ore reserves estimates was completed. In addition, all major operations were completed at a pilot recovery plant where performance and design criteria for oxide and

sulfide ore treatment processes were determined. Large tonnage samples recovered by shaft sinking and drilling in the ore body were being tested in a 100-ton-per-day oxide and a 50-ton-per-day sulfide pilot plant.

A comprehensive engineering and economic analysis of a commercial mine and plant was being prepared from data obtained during operation of the test mine and pilot recovery plant, ongoing environmental studies, and industry marketing forecasts. This analysis, scheduled for completion by mid-1976, was to serve as a basis for deciding whether to undertake commercial development. The decision also depended upon resolving accommodations with adjacent landowners to allow dewatering of the minesite.

Occidental Minerals Corp. applied to the city of Miami for a permit to use liquid explosive to fracture a copper-bearing zone about 1,900 feet below the surface. The copper would be leached by sulfuric acid introduced through a drill hole, and pregnant solutions would be recovered from another hole some distance away.

The Pinto Valley mine and mill facilities of Cities Service Co. went into production in mid-1974 and achieved the design level of 40,000 tons of ore per day during much of 1975. The average operating rate was 90% of capacity for the year. Pinto Valley is expected to produce 125 million pounds of copper per year. Costs incurred for smelting and refining Pinto Valley concentrates were higher in 1975 than had been anticipated.

Ore reserves were depleted at the Copper Cities and Diamond H open pit mines, and they were shut down, although some copper will continue to be recovered by leaching operations for several years at these mines.

Construction of a solvent extraction-electrowinning plant to produce cathode copper directly from leaching solutions was nearing completion. Its operation will eliminate toll smelting-refining for a major part of the copper recovered by leaching.

Startup of the Miami-East underground mine, originally scheduled in 1976, was postponed because of escalated costs and depressed copper market conditions. Underground development work to verify mining conditions was conducted in 1975, and a drilling program to assist in detailed

planning for ore extraction was to be completed early in 1976. It was planned to then put the mine on a standby basis until economic conditions warrant the resumption of development.

Hecla Mining Co. and El Paso Natural Gas Co. were equal partners in the Lakeshore copper project, with Hecla as the operator. The mine was leased from the Papago Indian Tribe on a royalty basis. A completely integrated mining and metallurgical operation had been under development since 1969. At the end of 1975, pre-production mine development and plant construction were 95% completed, and startup of the operation was imminent.

The Lakeshore ore body consists essentially of three parts. The central core is a thick sulfide zone of typical porphyry-type mineralization. Tactite sulfide ore occurs at the base and marginal to the thick sulfide zone, and an oxide ore zone, formed by oxidation of a secondarily enriched chalcocite blanket, overlies the thick sulfide zone and is marginal to it on the northwest. In the early stages of the operation the thinner tactite sulfide ore was being prepared for mining, while the thick sulfide ore will be developed for mining in later stages. The oxidized ore will be mined concurrently with the tactite sulfide ore and later with the thick disseminated porphyry ore.

Sulfide ore is mined by a continuous panel-caving method and transported to an underground primary crusher. After coarse crushing, the sulfide ore is moved to the surface coarse ore stockpile on a 42-inch, 7,200-foot belt conveyor installed in one of two parallel 15° declines. The other decline is equipped with a hoist and is used to transport men and supplies into the mine. Oxide ore is also being mined by a panel-caving method, but is hoisted to the surface through a 14-foot circular shaft. On the surface the ore is passed through a primary crusher, then hauled by truck to the coarse ore stockpile area.

The oxide ore and the sulfide ore are alternately reclaimed from the coarse ore storage stockpiles and then further reduced in particle size in a 17,500-ton-per-day fine crushing plant. The oxide ore is treated in a 6,450-ton-per-day vat leaching plant, in which it is leached with sulfuric acid followed by precipitation with sponge iron.

The sulfide ore is treated in an 11,000-ton-per-day flotation concentrator, producing approximately 430 tons per day of copper sulfide flotation concentrate. This concentrate is treated in a roasting, leaching, and electrowinning plant to produce 30,000 tons per year of electrowon cathode copper at full production rates. This product is shipped to plants of the Southwire Co., where it is used in the manufacture of copper rod and wire. The sulfide roasting operation also produces 200 tons per day of byproduct sulfuric acid, which is all consumed in leaching operations. The 250 tons per day of iron-bearing leach residue from sulfide concentrate treatment is filtered and converted to sponge iron for use in precipitating copper from vat leaching solutions. The mine is being developed to produce 11,000 tons per day of sulfide ore and 6,450 tons per day of oxide ore.

The 55,000 tons of copper precipitate which will be produced each year at full production rates, containing 35,000 tons of copper, is pelletized and shipped to smelters of ASARCO, Inc., for further processing and sale. Sixty percent of this copper will be sold to ASARCO under a long-term agreement, and 40% will be returned on toll and marketed.

In 1975 the crushing facilities, flotation concentrator, and vat-leach-cementation plants had all been through production trials with development ore. The roast-leach-electrowinning facilities and associated acid plant had been through initial production trials with a mixture of Lakeshore and purchased flotation concentrate. The reduction side of the sponge iron plant had been operated on purchased iron ore pellets, and the pelletizing facilities for Lakeshore leach residues were being tested. These tests failed to reveal any serious operational deficiencies and the metallurgical facilities were put in operation at a reduced rate matching that of mine production.

The first shipment of copper cathodes from the Lakeshore property was being prepared at the end of 1975.

Management of the Lakeshore mine said that at present copper prices the operation will not realize a profit, and is expected to generate only a nominal cash flow at full production rates.

Total expenditures on the Lakeshore project to December 31, 1975, were \$177.8 million, including working capital and startup costs. The total project costs to April 1, 1976, at which time the project was expected to be placed on operational status, were estimated at approximately \$195 million, including startup costs and \$8.3 million of working capital. It was estimated that additional working capital of approximately \$10 million would be required to finance inprocess and intransit materials and accounts receivable. Costs at Lakeshore were being shared equally by Hecla and El Paso Natural Gas.

**Gold.**—Output of 85,790 troy ounces of gold in 1975 was slightly less than the quantity produced in 1974. Most of the gold reported was recovered from copper concentrates, although there were smaller quantities from various other sources in several areas of the State. Prices for gold, although down slightly from the record highs reached at the end of 1974, were still historically high and this greatly stimulated prospecting and exploration activities.

**Iron Ore.**—CF&I Steel Corp. mined a small tonnage of iron ore from development work at the Apache open pit in Navajo County. The ore was shipped to the company's steel plant at Pueblo, Colo.

**Lead.**—Lead output in the State, although quite small, dropped sharply to less than one-half that in 1974. Most of the lead produced in Arizona was a byproduct of copper ore processing.

**Molybdenum.**—The State ranked second in the Nation in output of molybdenum, although production decreased slightly in 1975. Molybdenum and molybdenum compounds were recovered as a byproduct of copper ore mining and processing. Total value of molybdenum sales were up because of higher prices.

**Silver.**—Output of silver was about 6.3 million ounces valued at nearly \$28 million, down only slightly from output and value in 1974. Nearly all the silver recovered in the State came from smelting of copper ores and this largely accounts for the small decline in 1975. Occasionally some small quantities of silver were produced in the State from lead-zinc and lead ores and from small operations primarily recovering silver.

**Tungsten.**—Although tungsten ore has been reported produced sporadically in Arizona, activity in 1975 was negligible.

**Zinc.**—Output of zinc declined slightly in 1975. Most of the zinc produced in the State came from the Bruce mine of Cyprus Bruce Copper & Zinc Co. near Bagdad in Yavapai County. The mine was reported to be nearing exhaustion.

### NONMETALS

Production of nonmetals in the State mostly decreased during 1975, but total value of nonmetals output increased.

**Asbestos.**—The quantity of chrysotile asbestos sold in 1975 was up but value remained about the same as in 1974. Jaquays Mining Corp., operating an underground mine in Gila County north of Globe, accounted for the total State production. Asbestos activity in Arizona has been significantly restricted by environmental regulations on processing procedures and prohibitions in various consumer uses.

**Cement.**—Production of portland cement decreased substantially in 1975 because of lessened activity in the building and construction industries. Two companies produced all the cement in the State in 1975: Arizona Portland Cement Co., a division of California Portland Cement Co., with a plant at Rillito in Pima County near Tucson; and Phoenix Cement Co., a division of Amcord, Inc., operating a plant at Clarkdale in Yavapai County.

**Clays.**—Eight companies produced 129,000 tons of clay from nine operations in Apache, Gila, Maricopa, Pima, Pinal, and Yavapai Counties. Total production of clays was down considerably from 1974 output. Several kinds of clay, including common clay for brick, bentonite, fire clay, and ball clay, were produced.

**Feldspar.**—Production of feldspar dropped 28% from that of 1974. The Arizona Feldspar Corp. operated the Taylor mine near Kingman in Mohave County, producing ground potash feldspar for use in porcelain, pottery, and glass manufacture.

**Gypsum.**—In 1975, an unprecedented combination of inflation, recession, unemployment, and high cost of money depressed the building industry and residential construction in particular, resulting in the fewest number of housing starts in 30 years. This situation caused gypsum

production, largely for use in building products, to drop for the second straight year. Superior Companies, National Gypsum Co., and Pinal Mountain Gypsum Co. mined 17,000 tons of gypsum in Pinal and Yavapai Counties. Output decreased 17% from 1974, and was 26% below the 1973 record. National Gypsum Co. calcined gypsum at Phoenix; output decreased 2% and was 29% below the 1973 record.

**Lime.**—Eight companies produced lime at seven plants in six counties. Output of lime increased 21% in tonnage and 37% in value over 1974. Lime was produced in Cochise, Gila, Greenlee, Maricopa, Pinal, and Yavapai Counties. The bulk of the lime was used in copper ore processing but some was used for sugar refining, soil stabilization, in pulp and paper manufacturing, and in neutralizing water and acids.

**Mica.**—About 2,000 tons of scrap and flake mica was produced at the Buckeye mine in Maricopa County and the San Antonio mine in Pima County. Much of the material was ground for use in roofing, well-drilling fluids, and paint.

**Perlite.**—An area near Superior in Pinal County was a major source of perlite. The material was mined, crushed, and sized by three companies—Guzman Construction Co.; Filters International, Inc.; and Harborlite Corp. The product was shipped mostly out-of-State for use in various filtering activities and for expanding and use as a lightweight aggregate. Output in 1975 was down about 6% from that of 1974.

**Pumice and Pumicite.**—Volcanic cinders and pumice production continued to be a significant industry in the State, one of the few nonmetals activities that increased its output during 1975. Seven companies, two county highway departments, the State Highway Department, and the U.S. Forest Service operated 44 mines and 3 plants to produce volcanic cinders and pumice. Total output was up only slightly, but total value increased nearly 50%.

**Sand and Gravel.**—Production of sand and gravel continued to decrease. Tonnage sold or used in 1975 was down 6.2 million tons from 1974, which in turn, was down 4 million tons from 1973. The decrease was attributed to the nationwide recession and lessened building and construction activity. After copper and its byproduct molybdenum, sand and gravel had the highest total value, \$36.5 million, of min-

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

County	1974			1975			
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of companies
Apache -----	3	29	128	4	37	275	3
Cochise -----	15	442	1,190	14	312	667	11
Coconino -----	4	749	1,378	9	1,031	2,792	6
Gila -----	5	273	1,157	12	294	1,185	6
Graham -----	5	158	244	3	176	207	3
Greenlee -----	4	187	378	5	173	359	4
Maricopa -----	36	14,251	22,761	38	9,897	19,671	24
Mohave -----	11	861	2,652	14	620	1,773	9
Navajo -----	9	748	1,248	9	624	872	7
Pima -----	17	2,456	4,531	26	2,286	4,844	16
Pinal -----	7	1,105	1,399	10	482	1,505	6
Santa Cruz -----	4	93	304	3	55	125	3
Yavapai -----	19	1,540	3,879	17	603	1,202	13
Yuma -----	8	525	657	9	631	1,012	8
Total <sup>1</sup> -----	147	23,417	41,906	173	17,222	36,490	119

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 14.—Arizona: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	6,413	12,666	5,049	11,512
Gravel -----	14,281	25,339	10,478	22,146
Unprocessed: Sand and gravel -----	2,544	3,001	1,694	1,640
Industrial:				
Sand -----	179	397	W	W
Gravel -----	--	--	W	W
Total -----	23,417	41,903	<sup>2</sup> 17,222	35,298

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.



**Table 15.—Arizona: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ---	6,566	11,285	4,170	10,184
Highway and bridge construction -----	633	1,107	327	749
Other construction (dams, waterworks, airports, etc.) -----	211	616	343	1,016
Concrete products (cement blocks, brick, pipe, etc.) -----	790	1,769	1,441	3,896
Bituminous paving (asphalt and tar paving) -----	1,522	2,384	1,602	2,893
Roadbase and subbase -----	3,246	4,535	3,472	6,636
Fill -----	817	1,530	624	1,429
Other -----	114	309	196	436
<b>Unprocessed:</b>				
Roadbase and subbase -----	304	241	504	342
Fill -----	849	1,236	625	764
Other -----	--	--	9	17
Industrial sand and gravel -----	179	897	W	W
<b>Total <sup>1</sup></b> -----	<b>15,229</b>	<b>25,909</b>	<b>13,314</b>	<b>28,363</b>

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 16.—Arizona: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ---	634	907	318	573
Highway and bridge construction -----	658	965	210	537
Other construction (dams, waterworks, airports, etc.) -----	W	W	W	W
Concrete products (cement blocks, brick, pipe, etc.) -----	W	W	W	W
Bituminous paving (asphalt and tar paving) -----	2,478	6,367	1,603	3,887
Roadbase and subbase -----	2,830	5,969	1,134	2,267
Fill -----	194	266	86	117
Other -----	W	W	W	188
<b>Unprocessed:</b>				
Roadbase and subbase -----	W	W	453	513
Fill -----	1,392	1,524	96	46
Other -----	--	--	1	( <sup>1</sup> )
<b>Total <sup>2</sup></b> -----	<b>8,188</b>	<b>15,998</b>	<b>3,908</b>	<b>8,127</b>

W Withheld to avoid disclosing individual company confidential data; included with "Bituminous paving"; "Unprocessed roadbase" included with "Unprocessed fill."

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

eral products produced in Arizona. Unit value of sand and gravel in 1975 was about \$2.12, compared with about \$1.79 in 1974.

**Stone.**—Production of stone decreased but the total value remained nearly the

same as in 1974. Dimension stone comprised only about 5,000 tons and \$148,000 of the total. Crushed and broken stone totaled about 3.4 million tons valued at \$10.9 million.

Table 17.—Arizona: Stone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Apache -----	4	57	169	--	--	--
Cochise -----	2	W	W	4	540	2,048
Coconino -----	20	337	537	9	102	185
Gila -----	5	W	W	4	141	326
Graham -----	--	--	--	1	27	44
Maricopa <sup>1</sup> -----	7	338	522	8	117	274
Navajo -----	1	W	10	1	W	W
Pima -----	8	1,707	4,300	4	903	3,608
Pinal -----	6	556	1,040	9	538	1,773
Santa Cruz -----	1	W	W	--	--	--
Yavapai <sup>1</sup> -----	11	1,088	2,686	10	641	1,199
Undistributed <sup>2</sup> -----	7	851	2,214	5	393	1,571
Total <sup>3</sup> -----	72	4,932	11,479	55	3,404	11,030

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

<sup>1</sup> To avoid disclosing individual company confidential data, total was incomplete for 1975; the portion not included has been included with "Undistributed."

<sup>2</sup> Includes Greenlee, Mohave, and Yuma Counties, and counties indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 18.—Arizona: Stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Dimension:</b>				
Irregular-shaped stone -----	( <sup>1</sup> )	1	W	W
Rubble -----	1	24	( <sup>1</sup> )	1
Flagging -----	1	19	1	20
Other uses <sup>2</sup> -----	2	73	4	129
Total <sup>3</sup> -----	4	116	5	148
<b>Crushed and broken:</b>				
Bituminous aggregate -----	162	886	48	144
Concrete aggregate -----	221	417	82	133
Dense-graded roadbase stone -----	349	545	116	166
Surface treatment aggregate -----	194	459	85	180
Other construction aggregate and roadstone -----	281	590	54	179
Agricultural purposes <sup>4</sup> -----	W	W	5	42
Lime manufacture -----	146	323	465	1,602
Flux stone -----	778	2,055	962	3,175
Riprap and jetty stone -----	206	419	--	--
Other uses <sup>5</sup> -----	2,591	5,669	1,581	5,260
Total <sup>3</sup> -----	4,928	11,363	3,399	10,882
Grand total -----	4,932	11,479	3,404	11,030

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

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Includes data for rough blocks, dressed architectural stone, and monumental stone.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

<sup>4</sup> Includes agricultural limestone, poultry grit, and mineral food.

<sup>5</sup> Includes stone used for manufactured fine aggregates, filter stone, terrazzo and exposed aggregate, cement manufacture, refractory stone, acid neutralization (1975), roofing aggregates, chips and granules, and a minor amount of fill (1975).

**Sulfur.**—Huge quantities of sulfur, in the form of sulfuric acid, were produced in Arizona as a byproduct of copper smelting. The sulfur, which occurs as sulfur dioxides in various smelter gases, is recovered as sulfuric acid in plants installed in recent years to help meet the air quality standards promulgated by State and Federal agencies. Fortunately, much of this sulfuric acid can be used in nearby copper mining areas to leach copper from low-grade ores and tailings. Some acid must be neutralized and discarded.

Magma Copper Co.'s recently completed acid plant produced 303,000 tons of sulfuric acid from converter gas in 1975. Some of this acid was sold on the open market, but the bulk of it was sold under a long-term contract to a nearby Arizona mining operation. A small tonnage of acid was neutralized and discarded during infrequent short periods when production exceeded shipments and storage capacity.

At the Ajo smelter of Phelps Dodge, 59,897 tons of sulfuric acid resulting from the operation of its air quality control installations were sold in 1975, compared with 57,087 tons in 1974. At Morenci, the second of two units was put in operation in November which together were expected to dispose of a substantial part of the sulfuric acid produced at the smelter

by using it to leach Morenci and Metcalf concentrator tailings.

#### MINERAL FUELS

**Coal (Bituminous).**—Coal output continued to rise slowly as Peabody Coal Co. tried to expand output at the only two coal mines in the State—Black Mesa mine and Kayenta mine. These two surface mines are on lands leased from the Navajo and Hopi Tribes. Coal from these mines is rated at about 11,000 Btu with an ash content of 8% and sulfur content of about 0.5%. Coal from the Kayenta mine goes by electric unit train to the Navajo powerplant at Page, operated by the Salt River Project. Black Mesa mine coal is pumped through a 273-mile pipeline to the Mohave Generating Station on the Colorado River in southern Nevada.

**Natural Gas.**—A small quantity of natural gas from wells in Apache County was sold to El Paso Natural Gas Co. and fed into its pipeline.

**Petroleum.**—Output of petroleum continued its steady decline in the State. A total of 635,000 barrels was produced in 1975 compared with 740,000 barrels in 1974 and 804,000 in 1973. Only two wells (exploratory and dry) were drilled in the State in 1975.

Table 19.—Arizona: Oil and gas well drilling completions in 1975, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Apache .....	--	--	--	--	--	2	2	13,089

<sup>1</sup> Development wells as defined by American Petroleum Institute.  
Source: American Petroleum Institute.

Table 20.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos: Jaquays Mining Corp.	1219 South 19th Ave. Phoenix, Ariz. 85009	Underground mine, crushing, screening, air-separation plant.	Gila.
Cement:			
Arizona Portland Cement Co., a division of California Portland Cement Co.	800 Wilshire Blvd. Los Angeles, Calif. 90017	Dry process, 3-rotary-kiln plant.	Pima.
Phoenix Cement Co., a division of Amcord, Inc.	610 Newport Center Dr. Newport Beach, Calif. 92660	----do -----	Yavapai.
Clays:			
American Cement Corp., Phoenix Div.	2404 Wilshire Blvd. Los Angeles, Calif. 90051	Open pit mine ----	Do.
Filtrol Corp -----	5959 W. Century Blvd. Suite 918 Los Angeles, Calif. 90045	----do -----	Apache.
McCarrell & Gurley -----	Box 1377 Gallup, N. Mex. 87301	----do -----	Do.
Phoenix Brick Yard -----	1814 South 7th Ave. Phoenix, Ariz. 85007	----do -----	Maricopa and Pima.
Tucson Pressed Brick Corp.	Box 17176 Tucson, Ariz. 85710	----do -----	Do.
Coal: Peabody Coal Co -----	Box 605 Kayenta, Ariz. 86033	----do -----	Navajo.
Copper:			
ASARCO, Inc.:			
Hayden unit -----	Hayden, Ariz. 85235	Smelter -----	Pima.
Mission unit -----	Box 111 Sahuarita, Ariz. 85629	Open pit mine and mill.	Do.
Sacaton unit -----	Box V Casa Grande, Ariz. 85222	----do -----	Pinal.
San Xavier unit -----	Box 111 Sahuarita, Ariz. 85629	Open pit mine ---	Pima.
Silver Bell unit -----	Silver Bell, Ariz. 85270	Open pit mine, mill, leach dumps, precipitation plant.	Do.
Anamax Mining Co., Twin Buttes mine.	Box 127 Sahuarita, Ariz. 85629	Open pit mine and mill.	Do.
Cities Service Co., Miami Copper Co. Div.	Box 100 Miami, Ariz. 85539	Open pit mine, mill, leach dumps, in place leaching, and precipitation plants.	Gila.
Cyprus Bagdad Copper Co.	Box 245 Bagdad, Ariz. 86321	Open pit mine and mill.	Yavapai.
Cyprus Bruce Copper & Zinc Co.	Box 457 Bagdad, Ariz. 86321	Underground mine and mill.	Do.
Cyprus Johnson Co -----	Drawer R Benson, Ariz. 85602	----do -----	Cochise.
Cyprus Pima Mining Co --	Box 7187 Tucson, Ariz. 85713	----do -----	Pima.
Duval Corp.:			
Esperanza property --	Box 125 Sahuarita, Ariz. 85629	Open pit mine, mill, leach dumps, and precipitation plant.	Do.
Mineral Park property.	Box 1271 Kingman, Ariz. 86401	----do -----	Mohave.
Duval Sierrita Corp -----	Box 125 Sahuarita, Ariz. 85629	Open pit mine and mill.	Pima.
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	Open pit mine, mill, vat leaching plant, electrowinning plant, in place leaching, heap leaching, precipitation plant, rod plant, rolling mill, custom smelter, electrolytic refinery.	Gila.
Kennecott Copper Corp., Ray Mines Div.	Hayden, Ariz. 85235	Open pit mine, leach dumps, in place leaching, precipitation plant. Mill, vat leaching plant, electrowinning plant, smelter.	Pinal and Gila.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Copper—Continued</b>			
McAlester Fuel Co -----	Rt. 1 Kirkland, Ariz. 86332	In situ leaching --	Yavapai.
Magma Copper Co.:			
Magma Div -----	Box 37 Superior, Ariz. 85273	Underground mine and mill.	Pinal.
San Manuel Div -----	Box M San Manuel, Ariz. 85631	Underground mine, mill, smelter, refinery.	Do.
Phelps Dodge Corp.:			
Copper Queen branch --	Drawer K Bisbee, Ariz. 85603	Open pit mine, underground mine, mill, leach dumps, in place leaching, precipi- tation plant.	Cochise.
Douglas Reduction Works.	Drawer E Douglas, Ariz. 85607	Smelter -----	Do.
Morenci and Metcalf branches.	Morenci, Ariz. 85540 -----	Open pit mine, mill, leach dumps, precipi- tation plant.	Greenlee.
New Cornelia branch --	Drawer 9 Ajo, Ariz. 85321	Open pit mine, mill, smelter.	Pima.
Ranchers Exploration & Development Corp.:			
Bluebird mine -----	Box 880 Miami, Ariz. 85539	Open pit mine ----	Gila.
Old Reliable mine ----	Box 518 Mammoth, Ariz. 85618	In situ leaching --	Pinal.
Diatomite: Superior Companies.	Box 6497 Phoenix, Ariz. 85005	Open pit mine and plant.	Do.
<b>Gold:</b>			
Magma Copper Co.:			
Magma Div -----	Box 37 Superior, Ariz. 85273	----do -----	Do.
San Manuel Div -----	Box M San Manuel, Ariz. 85631	See Copper -----	Do.
Phelps Dodge Corp.:			
Copper Queen branch --	Drawer K Bisbee, Ariz. 85603	----do -----	Cochise.
Morenci branch -----	Morenci, Ariz. 85540 -----	----do -----	Greenlee.
New Cornelia branch --	Drawer 9 Ajo, Ariz. 85321	----do -----	Pima.
<b>Gypsum:</b>			
National Gypsum Co -----	325 Delaware Ave. Buffalo, N.Y. 14202	Open pit mine and plant.	Maricopa and Pinal.
Superior Companies:			
Verde Div -----	Box 6497 Phoenix, Ariz. 85005	----do -----	Yavapai.
Winkelman Div -----	----do -----	----do -----	Pinal.
<b>Helium:</b>			
Kerr-McGee Corp., Gas Processing Department.	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	6 wells and plant; Pinta Dome field.	Apache.
Iron ore: CF&I Steel Corp ----	Box 316 Pueblo, Colo. 81002	Open pit mine ----	Navajo.
<b>Lime:</b>			
Paul Lime Plant, Inc ----	Douglas, Ariz. 85607 -----	5 rotary-kiln plants.	Cochise.
Phelps Dodge Corp., Morenci branch.	Morenci, Ariz. 85540 -----	1 rotary-kiln, 1 fluidized bed- kiln plant.	Greenlee.
The Flintkote Co., U.S. Lime Div.	Box 197 Peach Springs, Ariz. 86434	Quarries and plant.	Yavapai.
<b>Mica:</b>			
Buckeye Mica Co -----	Box 416 Buckeye, Ariz. 85326	Open pit mine and grinding plant.	Maricopa.
San Antonio Mica Co ----	Box 397 Ajo, Ariz. 85321	Open pit mine ---	Pima.
<b>Molybdenum:</b>			
ASARCO, Inc.:			
Mission unit -----	120 Broadway New York, N.Y. 10005	See Copper -----	Do.
Silver Bell unit ----	----do -----	----do -----	Do.
The Anaconda Co -----	Box 127 Sahuarita, Ariz. 85629	----do -----	Do.
Cities Service Co., Miami Copper Co. Div.	Box 100 Miami, Ariz. 85539	----do -----	Gila.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Molybdenum—Continued</b>			
Cyprus Bagdad Copper Co.	Box 245 Bagdad, Ariz. 86321	See Copper -----	Yavapai.
Cyprus Pima Mining Co.	Box 7187 Tucson, Ariz. 85713	---do -----	Pima.
<b>Duval Corp.:</b>			
Esperanza property	Box 125 Sahuarita, Ariz. 85629	---do -----	Do.
Mineral Park property	Box 1271 Kingman, Ariz. 86401	---do -----	Mohave.
Duval Sierrita Corp.	Box 125 Sahuarita, Ariz. 85629	Open pit mine, mill, roaster.	Pima.
Inspiration Consolidated Copper Co.	Inspiration, Ariz. 85537	See Copper -----	Gila.
Kennecott Copper Corp., Ray Mines Div.	Hayden, Ariz. 85235	---do -----	Pinal.
Magma Copper Co., San Manuel Div.	Box M San Manuel, Ariz. 85631	---do -----	Do.
Pima Mining Co.	Box 7187 Tucson, Ariz. 85713	---do -----	Pima.
<b>Perlite:</b>			
Filters International, Inc.	10 South LaSalle St. Chicago, Ill. 60603	Open pit mine	Pinal.
Harborlite Corp.	Box 458 Escondido, Calif. 92025	---do -----	Do.
<b>Petroleum:</b>			
Kerr-McGee Corp.	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Crude oil; Dineh bi Keyah field.	Apache.
<b>Pumice:</b>			
Apache County Highway Dept.	Box 428 St. Johns, Ariz. 85936	Open pit mine	Do.
Atchison Topeka & Santa Fe Railway.	Winslow, Ariz. 86047	Open pit mine and plant.	Coconino.
Superlite Builders Supply, Inc.	5201 North 7th St. Phoenix, Ariz. 85014	Open pit mine	Do.
Pyrites: Magma Copper Co., Magma Div.	Box 37 Superior, Ariz. 85273	See Copper -----	Pinal.
<b>Salt:</b>			
Southwest Salt Co.	Box 1237 Litchfield Park, Ariz. 85340	Brine from wells	Maricopa.
<b>Sand and gravel:</b>			
Arizona Sand & Rock Co.	Box 20067 Phoenix, Ariz. 85036	Pits and plants	Do.
Johnson-Stewart and Materials.	1901 N. Alma School Rd. Mesa, Ariz. 85201	---do -----	Do.
Tempe Equipment & Contracting Co.	8200 East Pima St. Tempe, Ariz. 85281	---do -----	Do.
Union Rock & Materials Corp., Bentson Contract- ing Co.	2800 South Central Ave. Phoenix, Ariz. 85040	---do -----	Maricopa and Pima.
United Metro, Inc.	Box 13309 Phoenix, Ariz. 85002	---do -----	Maricopa, Pima, Pinal, Yuma.
<b>Silver:</b>			
<b>ASARCO, Inc.:</b>			
Mission unit	Box 111 Sahuarita, Ariz. 85629	See Copper -----	Pima.
Sacaton unit	Box V Casa Grande, Ariz. 85222	---do -----	Pinal.
San Xavier unit	Box 111 Sahuarita, Ariz. 85629	---do -----	Pima.
Silver Bell unit	Silver Bell, Ariz. 85270	Open pit mine and mill.	Do.
Anamax Mining Co.	Box 127 Sahuarita, Ariz. 85629	See Copper -----	Do.
Cyprus Pima Mining Co.	Box 125 Sahuarita, Ariz. 85629	---do -----	Do.
<b>Duval Corp.:</b>			
Esperanza property	Box 7187 Tucson, Ariz. 85713	---do -----	Do.
Mineral Park property	Box 1271 Kingman, Ariz. 86401	---do -----	Mohave.
Duval Sierrita Corp.	Box 125 Sahuarita, Ariz. 85629	---do -----	Pima.
<b>Magma Copper Co.:</b>			
Magma Div.	Box 37 Superior, Ariz. 85273	---do -----	Do.
San Manuel Div.	Box M San Manuel, Ariz. 85631	---do -----	Do.
Phelps Dodge Corp.:			
Copper Queen branch	Drawer K Bisbee, Ariz. 85603	---do -----	Cochise.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Silver—Continued			
Phelps Dodge Corp—			
Continued			
Morenci branch -----	Morenci, Ariz. 85540 -----	See Copper -----	Greenlee.
New Cornelia branch --	Drawer 9	-----do -----	Pima.
	Ajo, Ariz. 85321		
71 Minerals, Ltd -----	Box 458	Heap leaching ----	Cochise.
	Tombstone, Ariz. 85638		
Stone:			
American Cement Corp.,	Box 423	Quarry and plant.	Yavapai.
Phoenix Div.	Clarkdale, Ariz. 86324		
Arizona Portland Cement	Rillito, Ariz. 85246 -----	-----do -----	Pima.
Co.			
New Pueblo Constructors --	Box 12765	Quarry -----	Do.
	Tucson, Ariz. 85711		
Paul Lime Plant, Inc ----	Drawer T	Quarry and plant -	Cochise.
	Douglas, Ariz. 85607		
Zinc:			
Cyprus Bruce Copper &	Box 457	See Copper -----	Yavapai.
Zinc Co.	Bagdad, Ariz. 86321		
Sunrise Mining Co.,	Amado, Ariz. 85640 -----	Underground mine-	Santa Cruz.
Glove mine.			

# The Mineral Industry of Arkansas

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Arkansas Geological Commission, under a memorandum of understanding for collecting information on all minerals except fuels.

By Raymond B. Stroud<sup>1</sup>

The Arkansas mineral industry produced crude ores, mineral fuels, and industrial minerals and rocks that were valued at \$436.4 million in 1975. The mineral output value set a new record high and was \$30 million above that of 1974.

Mineral fuels, although down in volume of production with the exception of coal, accounted for the major share of the value increase. Arkansas ranked 25th in the United States in terms of mineral production value and continued to lead the Nation in output of bauxite, bromine, and vanadium. Crude petroleum, valued at \$143.3 million, was the State's most important mineral product. Bromine continued to be the most significant nonmetallic mineral produced, and bauxite led among metallic minerals.

Production of 17 additional mineral commodities contributed to the State's total mineral value; of these, 9 minerals gained in value and losses occurred in 7 compared with 1974 data. Phosphate rock output was recorded for the first time since 1966. Carbon black, gallium, and elemental sulfur were also produced, but values of these minerals were not included in the overall total value of the State's mineral output.

Fuel minerals, comprising bituminous coal, natural gas, natural gas liquids, and petroleum, had a value of \$203.4 million, 46.6% of the State's total mineral value in 1975, as this sector regained the lead as the largest contributor to the mineral economy. Lignite, a coal with low heat value, was under geologic investigation by State and private concerns, and commercial

development was predicted in the foreseeable future.

Although bromine output decreased slightly, the commodity ranked second in value among all minerals produced in the State. Value gains were registered in production of abrasive stone, barite, clays (including kaolin), gem stones, lime, and soapstone. Production and value of other nonmetallic minerals, including cement, gypsum, sand and gravel, stone, and tripoli, decreased in 1975. A small tonnage of phosphate rock was produced for the first time in several years and was shipped out-of-State for manufacture of elemental phosphorus.

Bauxite ore and vanadium were the two principal metals produced in 1975. A very small tonnage of iron ore concentrate, from ore mined in former years, was shipped to out-of-State markets. Gallium output was reported in conjunction with the processing of bauxite ores at one of the State's two alumina plants. The metal is used principally in electronic applications. Exploration in north Arkansas for zinc ore was reported, but apparently no economic concentrations were found. Vanadium ore was mined and processed in Garland County for the eighth consecutive year.

**Trends and Developments.**—Arkansas Power and Light Co., which had begun construction of two coal-fired steam-electric generating units near Redfield in Jefferson County in 1974, recessed its building program about mid-August. Earlier, the utility

<sup>1</sup> State Liaison Officer, Bureau of Mines, Little Rock, Ark.



Table 1.—Mineral production in Arkansas<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Bauxite ----- thousand long tons--	1,731	\$23,597	1,543	\$22,956
Clays ----- thousand short tons--	984	1,597	995	2,232
Coal (bituminous) ----- do--	455	9,673	488	16,000
Gem stones -----	NA	60	NA	70
Iron ore (usable) ----- thousand long tons, gross weight--	4	W	( <sup>2</sup> )	14
Lime ----- thousand short tons--	187	3,189	170	3,848
Natural gas ----- million cubic feet--	123,975	32,234	116,237	40,334
Natural gas liquids:				
Natural gasoline and cycle products				
thousand 42-gallon barrels--	199	1,344	196	1,360
LP gases ----- do--	418	2,491	407	2,377
Petroleum (crude) ----- do--	16,527	122,817	16,133	143,336
Sand and gravel ----- thousand short tons--	14,878	29,922	12,415	25,794
Stone ----- do--	20,381	38,905	17,419	38,796
Value of items that cannot be disclosed:				
Abrasive stone, barite, bromine, cement, gypsum, phosphate rock (1975), soapstone, tripoli, vanadium, and values indicated by symbol W -----	XX	r 140,589	XX	139,324
Total -----	XX	r 406,418	XX	436,441
Total 1967 constant dollars -----	XX	192,154	XX	p 172,831

<sup>p</sup> Preliminary. <sup>r</sup> 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.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Less than ½ unit.

Table 2.—Value of mineral production in Arkansas, by county<sup>1</sup>

(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Ashley -----	\$115	\$81	Sand and gravel.
Baxter -----	936	W	Stone, sand and gravel.
Benton -----	W	W	Do.
Boone -----	W	404	Stone.
Bradley -----	13	11	Sand and gravel.
Calhoun -----	1,350	1,733	Do.
Carroll -----	206	W	Sand and gravel, stone.
Chicot -----	W	W	Sand and gravel.
Clark -----	1,136	W	Stone, sand and gravel, clays.
Clay -----	258	111	Sand and gravel.
Cleburne -----	492	W	Stone, sand and gravel.
Cleveland -----	4	1	Sand and gravel.
Columbia -----	W	W	Bromine, natural gas liquids, sand and gravel.
Conway -----	502	W	Stone, sand and gravel.
Craighead -----	W	W	Sand and gravel, clays.
Crawford -----	W	W	Stone, sand and gravel.
Crittenden -----	88	W	Clays, sand and gravel.
Cross -----	589	W	Sand and gravel, stone.
Dallas -----	2	W	Sand and gravel.
Desha -----	W	---	---
Drew -----	90	236	Sand and gravel.
Faulkner -----	847	1,234	Sand and gravel, stone.
Franklin -----	2,315	W	Coal, sand and gravel, stone.
Fulton -----	W	W	Stone, sand and gravel.
Garland -----	r 17,229	20,359	Vanadium, abrasive stone, tripoli, stone, sand and gravel.
Grant -----	182	195	Sand and gravel.
Greene -----	W	125	Do.
Hempstead -----	W	W	Sand and gravel, clays.
Hot Spring -----	2,671	3,762	Barite, stone, sand and gravel, clays, abrasive stone.
Howard -----	12,907	13,073	Cement, stone, gypsum, clays, sand and gravel.
Independence -----	4,881	W	Stone, lime, sand and gravel.
Izard -----	7,681	W	Sand and gravel, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Arkansas, by county<sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Jackson -----	\$604	W	Sand and gravel.
Jefferson -----	W	W	Do.
Johnson -----	W	W	Coal, stone, clays.
Lafayette -----	2,313	W	Natural gas liquids, sand and gravel.
Lawrence -----	2,196	W	Stone, sand and gravel.
Lincoln -----	125	\$316	Sand and gravel.
Little River -----	W	21,368	Cement, stone, clays, sand and gravel.
Logan -----	902	W	Coal, stone, sand and gravel.
Lonoke -----	W	W	Stone, clays.
Madison -----	W	W	Stone, sand and gravel.
Marion -----	559	W	Sand and gravel, stone.
Miller -----	2,619	W	Sand and gravel, clays.
Mississippi -----	W	3	Sand and gravel.
Monroe -----	W	W	Do.
Montgomery -----	W	W	Barite, stone, sand and gravel.
Nevada -----	550	W	Sand and gravel, iron ore.
Newton -----	2	W	Stone, sand and gravel.
Quachita -----	W	W	Sand and gravel, clays.
Perry -----	W	W	Stone, sand and gravel.
Phillips -----	292	211	Sand and gravel.
Pike -----	W	W	Gypsum, sand and gravel, abrasive stone.
Poinsett -----	484	W	Sand and gravel, stone.
Polk -----	670	320	Sand and gravel.
Pope -----	W	1,007	Sand and gravel, stone.
Prairie -----	W	W	Sand and gravel.
Pulaski -----	15,934	W	Stone, clays, sand and gravel, bauxite.
Randolph -----	W	W	Stone, sand and gravel.
St. Francis -----	869	260	Sand and gravel.
Saline -----	26,667	25,298	Bauxite, lime, sand and gravel, stone, talc, clays.
Scott -----	167	--	
Searcy -----	W	W	Stone, sand and gravel.
Sebastian -----	6,021	10,435	Coal, stone, sand and gravel, clays.
Sevier -----	W	W	Sand and gravel.
Sharp -----	W	307	Stone.
Stone -----	W	W	Sand and gravel, stone.
Union -----	W	W	Bromine.
Van Buren -----	W	W	Phosphate rock, stone.
Washington -----	W	W	Stone, sand and gravel.
White -----	W	W	Do.
Woodruff -----	W	W	Sand and gravel.
Yell -----	W	W	Sand and gravel, stone.
Undistributed <sup>2</sup> -----	290,949	335,545	
Total <sup>3</sup> -----	\$ 406,418	436,441	

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

<sup>1</sup> Arkansas and Lee Counties were not listed because no production was reported.

<sup>2</sup> Includes value of petroleum and natural gas production that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Arkansas business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	839.6	838.5	- 0.1
Unemployment -----do-----	39.9	69.4	+ 73.9
<b>Employment (nonagricultural):</b>			
Mining -----do-----	4.2	4.2	--
Manufacturing -----do-----	202.4	175.6	- 13.2
Contract construction -----do-----	35.5	30.5	- 14.1
Transportation and public utilities -----do-----	38.3	36.8	- 3.9
Wholesale and retail trade -----do-----	130.7	133.4	+ 2.1
Finance, insurance, and real estate -----do-----	27.5	27.8	+ 1.1
Services -----do-----	86.2	89.8	+ 4.2
Government -----do-----	117.2	121.9	+ 4.0
Total nonagricultural employment -----do-----	642.0	620.0	- 3.4
<b>Personal income:</b>			
Total -----millions--	\$9,054	\$9,775	+ 8.0
Per capita -----do-----	\$4,379	\$4,620	+ 5.5
<b>Construction activity:</b>			
Number of private and public residential units authorized--	6,639	6,867	+ 3.4
Value of nonresidential construction -----millions--	\$97.5	\$79.2	- 18.8
Value of State road contract awards -----do-----	\$125.0	\$123.0	- 1.6
Shipments of portland and masonry cement to and within the State -----thousand short tons--	949	866	- 8.7
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$406.4	\$436.4	+ 7.4
Value per capita, resident population -----do-----	\$196.53	\$206.84	+ 5.2
Value per square mile -----do-----	\$7,653.25	\$8,218.61	+ 7.4

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

had requested from the Arkansas Public Service Commission a rate increase of \$38.6 million, of which only \$20.2 million was granted. In 1975, the utility filed for an additional rate increase of \$37.3 million; at yearend, approval of this increase was still pending. The utility company requested the rate hikes in order to continue construction of the coal-fired plant and to complete construction of a second generating unit at its Russellville nuclear plant. The coal-fired units would have an installed generating capacity of 1,400 megawatts. Construction was expected to resume when appropriate finances became available; scheduled dates of completion of the two units in 1980 and 1981 will probably not be met. The utility company's nuclear plant generated in excess of 5 million megawatt-hours of electric power in 1975, ranking it sixth in output among 52 nuclear generating units in the United States. Nuclear unit 2 at the Russellville installation was 53% complete at yearend.

Southwestern Electric Power Co. and Arkansas Electric Cooperative Corp., in a joint effort, began initial construction phases of the Flint Creek No. 1 coal-fired steam-electric generating plant near Gentry,

Ark. The 528 net-megawatt-capacity plant will be built at a cost of \$101 million and was scheduled for operation in 1978. Final approval by State agencies of pertinent air and water pollution control systems to be incorporated into the operations required 1 year and delayed the start of construction.

The U.S. Army Corps of Engineers reported that barge traffic on the Arkansas River Navigation System decreased to about 5.2 million tons in 1975, compared with the record 6.1 million tons of 1974. More than three-fourths of the tonnage was attributed to the transport of minerals and mineral products. Major decreases in movements of bauxite, crushed stone, and petroleum products accounted for much of the tonnage reduction. Reduced tonnage of bauxite imported for processing in Arkansas occurred because of the cutback in aluminum production. Transport of sand and gravel and stone was less than 2.5 million tons, compared with 3 million tons of these commodities shipped in 1974. Fertilizer shipments increased 54% to about 287,000 tons in 1975.

The Arkansas State Chamber of Commerce and the State Industrial Development Commission reported that industrial ex-

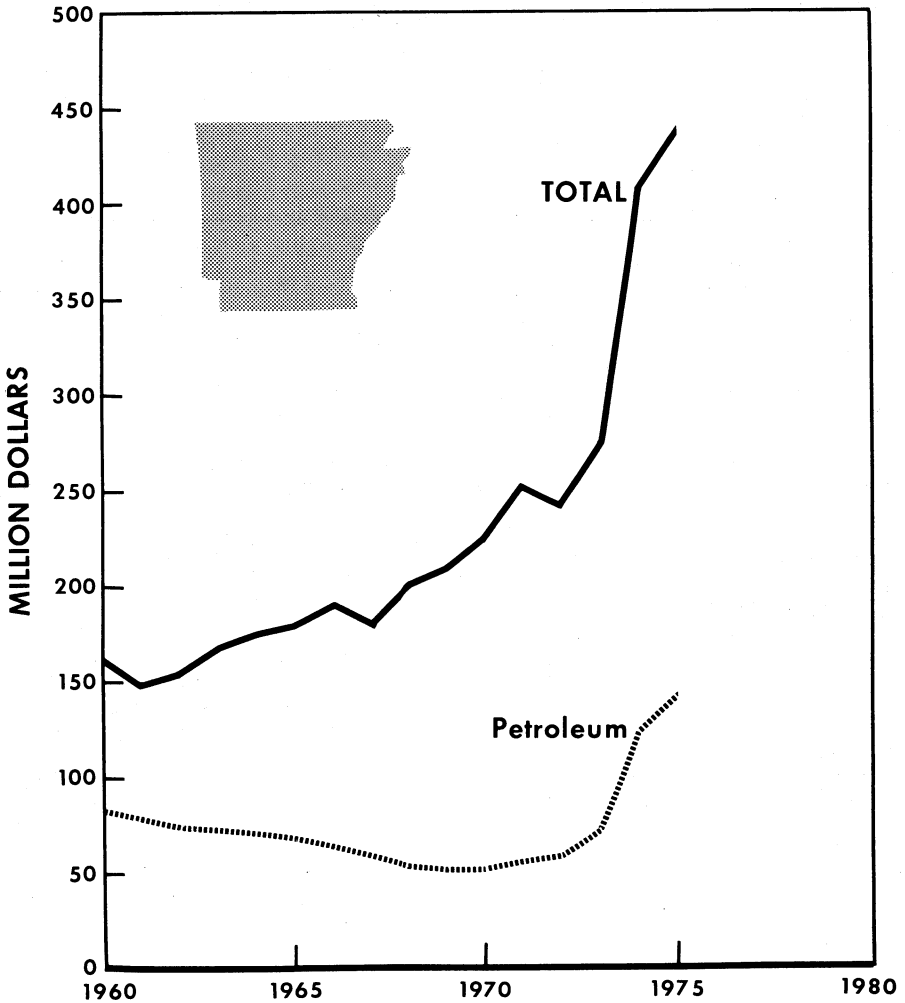


Figure 1.—Value of petroleum and total value of mineral production in Arkansas.

pansions and new industry and business developments in Arkansas in 1975 decreased substantially compared with 1974 data, reflecting the downturn in the economy of the State and the Nation.

The 25th Annual Inventory of Arkansas Industrial Growth published by the State Chamber of Commerce indicated that a capital outlay of \$509 million was programed by industry in 1975, down 34.5% from \$777.3 million in 1974. The utilities, transportation, and communications indus-

tries had expenditures of \$330.4 million, up about \$27.4 million from 1974 expenditures. New manufacturing and processing plants utilizing minerals or mineral products had total capital investments of about \$13.3 million. Expansions to existing plants that utilize minerals or mineral products in manufacturing were at an announced level of about \$41.7 million in 1975. Important among these industries were a \$12 million expansion announced by Great Lakes Chemical Corp. and a \$9 million planned ex-

pansion announced by Michigan Chemical Corp.; both companies produce bromine and bromine compounds.

Agrico Chemical Co., a subsidiary of The Williams Cos., completed construction of a \$31 million urea production facility at its Blytheville, Ark., plant about midyear. Initial construction was begun on a new \$30 million photochemical plant by Arkansas Eastman Co. near Batesville, Ark.

Southwest Atomic Energy Associates, a group of 17 electric power companies, gave its Southwest Experimental Fast Oxide Reactor (SEFOR) property and plant to the University of Arkansas. The fast oxide breeder reactor was designed, built, and operated primarily to demonstrate safety, feasibility, and economy of a liquid metal fast breeder nuclear reactor. The \$32 million facility began its first experiments in 1969 and operated successfully until 1972. The university will continue to conduct scientific and educational research programs and will monitor the still-radioactive facility.

Three U.S. Army Corps of Engineers dam and reservoir projects in southwest Arkansas were nearing completion at yearend. The Dierks, Gillham, and DeQueen projects will provide for flood control, water supply, water quality control, fish and wildlife habitats, and recreation facilities. Cost of the projects was an estimated \$32 million.

The State of Arkansas received nearly \$105,000 in 1975 from the Bureau of Land Management, U.S. Department of the Interior, as its share of funds from Federal mineral leasing receipts. Much of this money was realized from the leasing of land for exploration and production of natural gas in National Forest areas in north Arkansas.

The Arkansas Department of Pollution Control and Ecology administers the State's mined-land reclamation act. The regulations became effective July 1, 1971. Since inception of the act, the department has issued 103 permits to 39 mining operations. Permit fees for 2,378 acres have been col-

lected and deposited in the State Treasury. Bond and escrow agreements totaled \$1,888,000. At the end of fiscal year 1976, 155 acres of mined land had been reclaimed satisfactorily and reclamation was in progress on an additional 1,395 acres. In 1975, permits were issued covering 296 acres for mining of various commodities. During 1975, 45 acres of coal-mined land was reclaimed and released from bond.

In 1975, the State Department of Pollution Control and Ecology issued 13 permits to the mineral industry to install air pollution control equipment costing an estimated \$7.6 million. The department also issued 16 permits to mineral producers for installation of water pollution control equipment costing an estimated \$2.5 million.

Arkansas residential construction contracts increased to \$373.4 million in 1975, a 5.2% increase over contracts recorded in 1974. Nonresidential contracts totaled \$281.7 million in 1975, a \$9.2 million increase over those of 1974. Personal income in Arkansas in 1975 was \$9.2 billion, compared with \$8.8 billion in 1974, according to data furnished by the University of Arkansas, Bureau of Business and Economic Research.

**Employment.**—Data on employment and injury statistics for 1975, compiled by the Mining Enforcement and Safety Administration, excluding the petroleum industry, are shown in table 4.

The Employment Security Division, Arkansas Labor Department, reported that the mineral industry payroll totaled \$50.3 million for 4,432 covered workers in 1975. Total weekly wages paid to people employed in mineral production increased 17.2%, and 187 more employees were reported than in 1974. In 1975, workers in metal mining received \$247.21 per week; coal miners received an average \$410.23 per week; \$217.61 per week was paid to workers producing crude oil and natural gas; and persons employed in production of nonmetallic minerals and in quarry operations received an average of \$181.03 per week.

Table 4.—Arkansas: Employment and injury statistics in 1975<sup>1</sup>

Industry	Men	Man-hours	Fatal injuries	Fatal frequency rate (per million man-hours)	Nonfatal disabling injuries	Nonfatal disabling frequency rate (per million man-hours)
<b>Metal and nonmetal:</b>						
Underground -----	142	267,677	--	--	11	37.36
Surface -----	1,987	3,019,249	--	--	46	12.59
Mills -----	2,607	3,411,668	--	--	23	6.74
Office -----	927	1,313,853	--	--	--	--
Total -----	5,663	8,012,447	--	--	80	8.86
<b>Coal:</b>						
Underground -----	--	--	--	--	--	--
Surface -----	166	389,434	--	--	1	2.57
Mills -----	5	11,101	--	--	--	--
Total -----	171	400,535	--	--	1	2.49

<sup>1</sup> All data are preliminary.

Source: Mining Enforcement and Safety Administration, U.S. Department of the Interior.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

The total value of mineral fuels, petroleum, natural gas, bituminous coal, and natural gas liquids, was \$203.4 million. The \$35 million gain over comparable value in 1974 was the result of increased prices. Petroleum continued to account for the largest segment of the State's total mineral value, but production continued to drop. Natural gas output again decreased, but value was up more than \$8 million. Production and value of natural gas liquids, including natural gasoline and cycle products and liquefied petroleum gas, diminished in 1975. Bituminous coal output increased to 488,438 short tons, the largest output in nearly 20 years. Value of the mined coal was more than 65% over the value of coal produced in 1974.

**Carbon Black.**—Columbian Carbon Division of Cities Service Co. reported production of carbon black from its plant at El Dorado for the 24th consecutive year. Output from the State's only plant was about 6% greater than that of 1974, but value was about 5% lower.

**Coal (Bituminous).**—Coal output increased 7.2% over that of 1974, and total value gained \$6.33 million as the unit value rose to \$32.76 per short ton from \$21.26 per short ton in 1974. Eight mines recorded production greater than 1,000 tons annually, one more mine than was reported in 1974. Coal was strip mined from operations in Sebastian, Johnson, Franklin, and Logan Counties, listed in order of output.

Sugar Loaf Mining Co., a subsidiary of National Steel Corp., began development of an underground coal operation in southern Sebastian County in late 1975. The company also operated strip mines in the county as well as a coal-washing plant. Garland Coal & Mining Co., operator of a strip mine in Franklin County, announced plans to open a new mine in Sebastian County in the near future.

Interest in Arkansas coal resources increased substantially in 1975. Reportedly much of the available land underlain by bituminous coal and semianthracite was leased, and tentative plans were made for future development by private industry.

The Arkansas Geological Commission completed initial phases of an investigation of lignite in selected areas in southern Arkansas. The agency made plans to continue investigations in other counties.

Three major companies intensified exploration drilling for lignite in more than 20 south Arkansas counties. Several thousand acres of land were leased as the potential for lignite development and utilization advanced. Resources of lignite were reportedly sufficient to warrant tentative planning for utilization as boiler fuel as well as for projects leading to gasification and liquefaction and petrochemicals manufacture.

**Natural Gas.**—Marketed production of natural gas decreased from 123,975 million cubic feet in 1974 to 116,237 million cubic feet in 1975; the lower output marked the

**Table 5.—Arkansas: Bituminous coal production in 1975**

(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines (strip)	Production (short tons)	Value (thousands)
Franklin -----	2	W	W
Johnson -----	3	W	W
Logan -----	2	34,584	W
Sebastian -----	1	W	W
Undistributed --	--	453,854	W
Total ----	8	488,438	\$16,000

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

fifth successive year of decrease from the record year of 1970, when production was 181.3 billion cubic feet. Natural gas produced in conjunction with crude oil in eight contiguous south Arkansas counties was treated in five gas-cleaning plants to recover liquid hydrocarbons and sulfur as byproducts. Dry natural gas was again produced in 10 northwest Arkansas counties in the Arkansas Valley area of the Arkoma Basin. The greater volume of gas was produced in northwest Arkansas, and Franklin County led the State in output. In 1975, exploration drilling of wildcat wells and field wells resulted in discovery of one new field in north Arkansas. At yearend, 64 gasfields existed in the region, of which 4 fields were not connected to a pipeline outlet. One new gasfield was found in south Arkansas.

Proved reserves of natural gas in Arkansas, according to the American Gas Association, Inc. (AGA), declined 5.7% from 2,113,404 million cubic feet in 1974 to 1,993,273 million cubic feet.

**Natural Gas Liquids.**—Output of natural gas liquids, comprised of natural gasoline and cycle products and liquefied petroleum gases, totaled 603,000 barrels in 1975, valued at \$3.7 million. Combined production and value of both commodities were down about 2.5% compared with 1974 data. The five plants in south Arkansas that processed wet natural gas were Arkla Chemical Corp.'s Hamilton plant in Columbia County; H. A. Chapman's plant in the Walker Creek field, Columbia County; Phillips Petroleum Co.'s McKamie plant in Lafayette County; O. B. Mobley, Jr.'s plant in the Lewisville field, Lafayette County; and American Petrofina's plant in Miller County.

Proved reserves of natural gas liquids, including condensate, natural gasoline, and LP gases, according to AGA, were 3.9 million barrels at yearend, compared with 4.7 million barrels in 1974, a decline of nearly 20%.

**Petroleum.**—Production of petroleum decreased in 1975, but unit value increased to \$8.88 per barrel from \$7.43 per barrel in 1974. Total value of petroleum accounted for 32.8% of the State's mineral output value. Crude oil production was registered in eight south Arkansas counties—Miller, Lafayette, Nevada, Columbia, Union, Ouachita, Calhoun, and Bradley. In 1975, 7,308 wells in 168 oilfields accounted for the oil output, according to the Arkansas Oil and Gas Commission. Seventy secondary-recovery projects were in operation during the year, and these accounted for 37% of the State output. The Smackover, Walker Creek, Chalybeat, Midway, and Days Creek fields continued as leading producers in 1975.

**Table 6.—Arkansas: Gross withdrawals and disposition of natural gas**  
(Million cubic feet)

	Gross withdrawals <sup>1</sup>			Disposition			
	From gas wells	From oil wells	Total	Marketed production <sup>2</sup>		Repressuring	Vented and wasted <sup>3</sup>
				Quantity	Value (thousands)		
1971 -----	120,454	54,429	174,883	172,154	\$29,426	995	1,784
1972 -----	125,319	43,852	169,171	166,522	28,808	--	2,649
1973 -----	120,068	39,408	159,476	157,529	28,985	--	1,947
1974 -----	92,265	33,426	125,691	123,975	32,234	--	1,716
1975 -----	91,270	30,248	121,518	116,237	40,334	3,963	1,318

<sup>1</sup> Marketed production plus quantities used in repressuring, and vented and wasted.

<sup>2</sup> Comprises gas sold or consumed by producers, including losses in transmission, quantities added to storage, and increases in gas in pipelines.

<sup>3</sup> Includes direct waste on producing properties and residue blown to air.

**Table 7.—Arkansas: Crude petroleum production, indicated demand, and stocks in 1975, by month**  
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End-of-month stocks originating within Arkansas
January	1,308	1,363	798
February	1,239	1,253	784
March	1,263	1,305	742
April	1,319	1,240	821
May	1,364	1,484	701
June	1,322	928	1,095
July	1,459	1,638	916
August	1,342	1,524	734
September	1,310	1,291	753
October	1,458	1,509	702
November	1,329	728	1,303
December	1,420	1,283	1,440
Total:			
1975	16,133	15,546	XX
1974	16,527	16,168	XX

XX Not applicable.

Disposal of saltwater produced in conjunction with crude oil was accomplished through 395 wells operated in 1975. The secondary recovery projects utilized 31,394,633 barrels of water, and 177,349,765 barrels of saltwater was injected into underground disposal reservoirs.

According to the American Petroleum Institute (API), reserves of recoverable crude oil totaled 95.7 million barrels at

yearend, a 10% decrease from reserves tabulated at the end of 1974.

*Petroleum and Natural Gas Exploration and Development.*—The API tabulated 321 wells drilled in 1975, 4 more than in 1974. Total footage was 1,639,150 feet. Of the wells drilled, 147 were oil productive, 23 produced natural gas, and 151 were dry holes. Overall success ratio was nearly 53%, a 9% improvement over the success ratio of 1974. Ten of 78 exploratory wells were producers of natural gas or oil, a 1-to-8 ratio. Wells drilled in proved fields were very successful; of 243 such wells, 160 were productive of oil or gas. The Arkansas Oil and Gas Commission reported discovery of eight new fields in south Arkansas (seven oil and one gas); the commission also listed one rediscovery oilfield and four new pools. Two of the new fields were found in Columbia County, one new field each was found in Lafayette, Miller, and Nevada Counties, and three new fields were found in Union County. Discovery of one new gasfield in Pope County in north Arkansas was reported by the Oil and Gas Commission. The commission reported 1,163 wells as gas productive from 24 fields in the north Arkansas region.

*Petroleum Refineries.*—Four companies operated refineries in Arkansas in 1975—Lion Oil Co., a division of the Oil Shale Corp., at El Dorado, Union County; MacMillan Ring-Free Oil Co., Inc., at Norphlet,

**Table 8.—Arkansas: Oil and gas well drilling completions in 1975, by county**

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Ashley	--	--	--	--	--	1	1	100
Bradley	--	--	--	--	--	1	1	4,964
Calhoun	--	--	--	--	--	4	4	13,149
Columbia	26	6	19	3	--	12	66	545,622
Crawford	--	2	--	--	--	1	3	15,269
Franklin	--	1	2	--	--	--	3	18,659
Hempstead	--	--	1	--	--	1	2	12,738
Hot Spring	--	--	--	--	--	1	1	1,327
Johnson	--	7	10	--	--	3	20	80,317
Lafayette	13	--	3	2	--	4	22	125,697
Little River	--	--	--	--	--	2	2	6,156
Madison	--	--	--	--	--	1	1	803
Miller	9	--	6	1	--	12	28	175,304
Nevada	6	--	7	1	--	4	18	50,216
Ouachita	17	--	9	--	--	5	31	118,142
Perry	--	--	--	--	--	1	1	13,900
Pope	--	2	--	--	1	2	5	25,962
Sebastian	--	4	3	--	--	--	7	53,651
Union	67	--	23	2	--	11	103	360,566
White	--	--	--	--	--	2	2	16,608
Total	138	22	83	9	1	68	321	1,639,150

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.



Table 9.—Arkansas: Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

Commodity	Proved reserves Dec. 31, 1974	Changes in proved reserves due to revisions, extensions, and discoveries in 1975	Proved reserves Dec. 31, 1975 (production deducted)	Change from 1974 (percent)
Crude oil ----thousand barrels--	106,336	4,916	95,662	-10.0
Natural gas liquids ----do----	4,748	-131	3,852	-18.9
Natural gas million cubic feet--	2,113,404	-1,778	1,993,273	-5.7

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

Union County; Cross Oil & Refining Co. of Arkansas at Smackover, Union County; and Berry Petroleum Co., a division of Crystal Oil and Land Co., at Stephens, Ouachita County. Capacity of the refineries totaled 59,000 barrels per day, of which 2,000 barrels per day was shut down at the end of 1975. Collectively, the companies produced gasoline, kerosine, diesel fuel, motor oil, asphalts, lubricating oils, naphtha, jet fuels, fuel oils, wax distillates, and protective coatings. The four refineries processed a total of 19,211,541 barrels of crude oil in 1975, a decrease of 250,998 barrels from the 1974 total. An average of 52,634 barrels of crude oil was processed on a daily basis in 1975.

Lion Oil Co. placed onstream in late 1975 a multimillion-dollar fluid catalytic cracking unit having a throughput capacity of 14,000 barrels per day and also added an asphalt emulsion plant to manufacture water-thinned paving materials. At yearend the company was adding other improvements to refinery facilities that were scheduled for completion in 1977. Lion Oil participated with nine other companies in construction of a new 30-inch-diameter crude oil pipeline completed in 1975. The line, which cost \$124 million and is 468 miles long, extends from the Texas coast into central Oklahoma, and the El Dorado, Ark., refinery is served by connection with the line in east Texas.

#### NONMETALS

Production of 13 diversified nonmetallic minerals in 1975 contributed a major part of the total mineral value in Arkansas. This segment of the mineral industry employed about one-third of the total working force engaged in mining activities in the State. The widespread distribution of industrial minerals and rocks as well as wide utilization resulted in mineral outputs in several

counties that are devoid of metallic and fuel minerals. Many of these nonmetallics showed increases in production; notable decreases occurred in outputs of stone and sand and gravel used in construction and building.

**Abrasive Stone.**—Output of Arkansas novaculite, used almost entirely for oil-stone and whetstone manufacture, was more than double the 1974 production, and the value was more than triple the 1974 value. Production of the unique rocks was reported in Garland, Hot Spring, and Pike Counties. Seven companies were involved in the mining and processing of the nearly pure-silica rock.

**Barite.**—Production of barite ore increased substantially and was more than double that recorded in 1974. The Baroid Division, NL Industries, Inc., mined crude barite from an underground mine in Hot Spring County and from an open-cut mine in southeast Montgomery County. The ore was processed in a company-owned flotation plant in Hot Spring County. The Milwhite Co., Inc., processed barite mined in Missouri at a company plant at Bryant, Ark. All of the barite produced in the State was used in manufacture of drilling muds.

**Bromine.**—Production and value of bromine decreased slightly from the record output and value registered in 1974. A total of five plants had a combined capacity rated at 425 million pounds annually, according to the Chemical Marketing Reporter. One new plant, constructed by Great Lakes Chemical Corp., and scheduled for initial operation in early 1976, would add about 45 million pounds in annual capacity. The new facility would cost an estimated \$15 to \$20 million. At yearend, Michigan Chemical Corp. announced a \$9 million expansion at its plant in El Dorado, of which about \$1 million would be spent for pollution control equipment. The Dow Chemical Co.

**Table 10.—Arkansas: Bromine compounds sold or used by primary producers**  
(Thousand pounds and thousand dollars)

Year	Quantity		Value
	Gross weight	Bromine content	
1973	266,815	222,819	52,015
1974	290,055	242,859	84,200
1975	255,416	212,139	83,334

made plans for adding 35 million pounds to its plant capacity at Magnolia by 1977. Ethyl Corp. became the sole owner of the Bromet Co. plant, also in Columbia County. Bromine production in the State was second only to petroleum in terms of value. Arkansas again led the Nation in bromine output, and about one-half of the world's supply was produced in the State.

**Cement.**—Combined shipments of portland and masonry cement declined slightly in 1975 as compared with comparable 1974 data, and related value of cement shipments also declined. Ready-mix concrete companies, highway contractors, and concrete product manufacturers continued to be principal markets. Both Arkansas Cement Corp. and Ideal Basic Industries, Inc., made plans to substitute coal for natural gas as a fuel source. Ideal Basic Industries, Inc., began construction of coal-firing facilities at an estimated cost of \$2 to \$2.5 million. Arkansas Cement scheduled coal-fired facilities for operation in 1977; the change in fuels would cost an estimated \$6 million.

**Clays.**—Total clay output, including kaolin, and corresponding value increased about 1% and 40%, respectively, from 1974 figures as reported by 12 producing companies. Clay production, including clays used in cement manufacture, was recorded in 14 counties from 23 operations. Clay for lightweight aggregate was produced in two counties, clay used in cement manufacture was recorded in two counties, and kaolin was produced in two counties. Clay used for common brick was mined at 1 location, for face brick at 11 operations, and for sewer pipe at 1 location. The five leading clay-producing counties (Hot Spring, Lonoke, Crittenden, Pulaski, and Johnson) accounted for about 76% of the total clay output.

**Gem Stones.**—Crater of Diamonds State Park near Murfreesboro was the site of 698 diamond finds by tourists as reported

by park officials. Although most of the diamonds were less than one-half carat in weight, two finds were exceptions—one was a 4.32-carat white diamond, and the other was a 16.37-carat white diamond, the value of which reportedly could exceed \$100,000 when cut.

Production of quartz crystals, wavelite, and jasper added substantially to the value of gem stone output. Some quartz crystal output was used in production of synthetic quartz in electronic applications.

**Gypsum.**—Production and value of crude gypsum declined 25% and 23%, respectively, from 1974 figures. A major part of the sharp drop was attributed to marked decreases in calcined gypsum demand and gypsum use in cement manufacture. Arkansas Gypsum Co. succeeded Dulin Bauxite Co., Gypsum Division, as the crude gypsum producer in Pike County; and Weyerhaeuser Co. in Howard County mined and processed gypsum for use in wallboard manufacture. Temple Gypsum, Inc., manufactured wallboard at its West Memphis plant using crude gypsum mined in Oklahoma.

**Lime.**—Rangaire Corp. produced lime in Independence County for the paper and pulp industries and for soil stabilization, water purification, and other uses. Reynolds Metals Co. and Aluminum Co. of America were primary producers of lime used in converting bauxite to alumina in Saline County. Both companies used limestone that was mined in Izard County. Total lime output in 1975 decreased to about 170,000 tons, but the value of the commodity increased to \$3.8 million, a gain of about 21% over the value reported in 1974. Most of the lime output was consumed in Arkansas, but Tennessee, Louisiana, and other States utilized some of it.

**Phosphate Rock.**—Jon-T Phosphates, Inc., acquired control of the Peyton Creek phosphate rock deposits in Searcy and Van Buren Counties that were productive from 1963 through 1966. The new operator began mining phosphate rock that was largely shipped out-of-State for manufacture of elemental phosphorus. Small tonnages were used for direct soil application as a fertilizer material.

**Sand and Gravel.**—Production of 12.4 million tons of sand and gravel from 65 counties was down about 2.5 million tons from output recorded in 1974. Attendant value of the 1975 production decreased

about \$4.1 million compared with 1974 value. The number of sand and gravel operations decreased by 50 to 226 in 1975. Miller, Calhoun, Ouachita, Crawford, and Izard Counties had outputs ranging from about 500,000 to over 1 million tons each. Combined, the counties accounted for about 31.5% of the State's total output of sand and gravel and correspondingly contributed 46.2% of the total value. Izard County alone was credited with \$5.4 million for sand and gravel production from 12 operations. Sand and gravel was used mainly for highway construction and building. The Arkansas Highway Department was a major user of sand and gravel in the State. Silica sand was produced in Izard County by Silica Products Co. for the 55th successive year.

**Stone.**—Production of eight types of stone in 1975 totaled 17.4 million tons valued at \$38.8 million. The total value was slightly less than the 1974 value; however, a 14.5% decrease in tonnage was recorded in 1975. Stone output was the fourth most important contributor to the Arkansas mineral economy. Chalk, limestone, dolomite, syenite (classified as granite), slate, novaculite, quartzite, and sandstone (including both crushed and dimension sandstone) were quarried at various locations in the State. A total of 95 mining operations were reported in 40 separate counties. The five leading counties were Pulaski, Independence, Izard, Little River, and Clark. Collectively, these counties accounted for 57.9% of the total stone output. Pulaski County

**Table 11.—Arkansas: Construction aggregate and industrial sand and gravel sold or used in commercial and government operations**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Commercial operations:</b>				
<b>Construction aggregate:</b>				
Nonresidential and residential construction	5,247	10,535	2,792	6,102
Highway and bridge construction	452	879	450	1,107
Other uses (dams, waterworks, airport, etc.)	234	480	192	458
Concrete products (cement blocks, bricks, pipe, etc.)	1,388	2,738	1,482	2,869
Bituminous paving (asphalt and tar paving)	1,558	2,739	1,119	2,431
Road base and subbase	378	570	488	871
Fill	264	285	314	458
Other uses	577	6,681	53	174
Unprocessed aggregate	797	528	880	719
Industrial sand and gravel	W	W	477	5,558
<b>Government operations:</b>				
Publicly funded projects (construction aggregate and fill)	3,983	4,487	4,167	5,046
<b>Total</b> <sup>1</sup>	<b>14,878</b>	<b>29,922</b>	<b>12,415</b>	<b>25,794</b>

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."  
<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 12.—Arkansas: Sand and gravel sold or used by producers**  
(Thousand short tons and thousand dollars)

Year	Commercial		Government		Total <sup>1</sup>	
	Quantity	Value	Quantity	Value	Quantity	Value
1971	9,850	13,993	1,779	1,611	11,630	15,603
1972	10,004	15,045	1,571	1,514	11,574	16,558
1973	11,103	19,623	1,361	1,002	12,465	20,625
1974	10,895	25,435	3,983	4,487	14,878	29,922
1975	8,248	20,748	4,167	5,046	12,415	25,794

<sup>1</sup> Data may not add to totals shown because of independent rounding.

alone with 12 quarries reported in excess of 6.3 million tons.

Of the three major stone types, syenite was produced only in Pulaski County, major quantities of limestone were produced in Independence and Izard Counties, and a large tonnage of sandstone was produced in Clark and Sebastian Counties. Dimension sandstone was produced in Sebastian, Logan, and Independence Counties. Limestone production remained the State's most important stone category, and output was tabulated from 16 counties. Slate was produced in Montgomery County for roofing granule manufacture. Novaculite was produced in Hot Spring County for refractory use.

Arkansas stone production was widely used and found markets in more than 35 use categories. Major uses included road-base stone, riprap and jetty stone, cement, roofing granules, bituminous and concrete aggregate, railroad ballast, and lime manufacture.

**Sulfur (Recovered Elemental).**—Arkla Chemical Corp. in Columbia County, Phillips Petroleum Co. in Lafayette County, and Lion Oil Co. in Union County recovered elemental sulfur from processing wet, sulfur-bearing natural gas in south Arkansas. The Ethyl Corp. (formerly Bromet Co.) in Columbia County led in sulfur recovery from the processing of brines used in bromine extraction. Total output of sulfur from the four operations was 18,181 long tons valued at \$677,072, compared with 24,632 long tons valued at \$553,081 in 1974.

**Talc and Soapstone.**—The Milwhite Co., Inc., the only producer of soapstone in Arkansas, mined and processed soapstone in Saline County for the 23d consecutive year. Tonnage and corresponding value rose substantially above those reported in 1974. Most of the material was ground for use in roofing, insecticide, and rubber compounds.

**Tripoli.**—The Garland County operation of Malvern Minerals Co., the only tripoli producer in Arkansas, reported a decrease of about 14% in quantity and a corresponding value decrease was recorded. The tripoli was sold and used as a filler in several compounds and as a polishing agent in manufacture of metal parts.

**Vermiculite.**—W. R. Grace & Co. in Pulaski County and Strong-Lite Products in Jefferson County processed crude vermiculite that was mined outside Arkansas. The exfoliated product was used in con-

crete aggregate, plaster aggregate, insulation, fireproofing compounds, horticulture, and other applications.

## METALS

Bauxite, the principal ore of aluminum, and vanadiferous clays, a major source of vanadium oxide, were the chief metallic minerals produced in the State. A substantial quantity of gallium metal was extracted in connection with bauxite conversion operations at one alumina plant in Arkansas. A small tonnage of iron ore was shipped from stockpiled concentrate that was mined in earlier years in Nevada County.

**Aluminum.**—Production of aluminum in Arkansas dropped significantly in 1975 because Reynolds Metals Co. shut down its Jones Mills reduction plant early in the year and simultaneously reduced aluminum output at its Gum Springs operation and decreased production of alumina at its Hurricane Creek facility. The cutbacks were necessitated by decreases in demand for aluminum by the building and automobile industries.

Reynolds Metals Co. and Aluminum Co. of America (Alcoa) produced alumina at their plants in Saline County but at a reduced level as compared with 1974 output. Alcoa increased output of gallium in expanded extractive and refining facilities operated in connection with alumina production at its plant near Benton.

**Bauxite.**—Arkansas again led among three States reporting bauxite outputs with 87.1% of the total tonnage produced in the United States. However, bauxite production in Arkansas decreased to 1,542,766 long dry tons, the lowest output since 1963. Alcoa, Reynolds Mining Corp., and American Cyanamid Co. produced bauxite in Saline County. Except for one underground mine, all bauxite was extracted from open pits. Processing plants producing alumina, alumina chemicals, and activated and calcined bauxite were operated throughout the year by Alcoa, Reynolds Metals Co., American Cyanamid Co., Porocel Corp., and Stauffer Chemical Co. Reynolds Metals Co. significantly reduced imports of bauxite from that shipped into the State in 1974.

**Vanadium.**—Production of vanadium-bearing ore and resultant concentrates of vanadium oxide was registered for the

eighth successive year by Union Carbide Corp. in Garland County. The operation is the largest of its kind in the United States, and Arkansas continued to lead the country in vanadium output. Union Carbide Corp. began initial development phases

of a vanadiferous ore body in the Magnet Cove district of Hot Spring County. The deposit was examined as a potential source of titanium by the Federal Bureau of Mines in the late 1940's, and a significant vanadium content was noted.

Table 13.—Arkansas: Mine production of bauxite and shipments from mines and processing plants to consumers in the United States

(Thousand long tons and thousand dollars)

Year	Mine production			Shipments from mines and processing plants to consumers		
	Crude	Dry equivalent	Value <sup>1</sup>	As shipped	Dry equivalent	Value <sup>1</sup>
1971 -----	2,157	1,781	24,979	r 2,067	r 1,818	r 26,483
1972 -----	1,973	1,634	21,010	r 2,127	r 1,844	r 25,085
1973 -----	2,040	1,686	23,884	r 2,076	r 1,780	r 26,708
1974 -----	2,098	1,731	23,597	r 2,130	r 1,810	r 26,737
1975 -----	1,862	1,543	22,956	1,883	1,599	25,486

<sup>r</sup> Revised.

<sup>1</sup> Computed from selling prices and values assigned by producers and from estimates of the Bureau of Mines.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Abrasives:</b>			
Malvern Minerals Co -----	Box 1246 Hot Springs, Ark. 71901	Mine -----	Garland.
Norton-Pike Co -----	Littleton, N.H. 03561 -----	----do -----	Do.
<b>Barite:</b>			
NL Industries, Inc -----	Box 1675 Houston, Tex. 77001	Mine and plant.	Hot Spring and Montgomery.
<b>Bauxite:</b>			
Aluminum Co. of America <sup>1</sup> ---	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	----do -----	Saline.
American Cyanamid Co -----	Berdan Ave. Wayne, N.J. 07470	----do -----	Do.
Reynolds Metals Co. <sup>2</sup> -----	Box 398 Bauxite, Ark. 72011	----do -----	Do.
<b>Bromine:</b>			
Arkansas Chemicals, Inc ----	Route 6, Box 98 El Dorado, Ark. 71730	Brine wells and plant.	Union.
The Dow Chemical Co -----	Midland, Mich. 48640 -----	----do -----	Columbia.
Ethyl Corp. <sup>3</sup> -----	451 Florida St. Baton Rouge, La. 70801	----do -----	Do.
Great Lakes Chemical Corp --	Box 2200 West Lafayette, Ind. 47901	----do -----	Union.
Michigan Chemical Corp -----	351 East Ohio St. Chicago, Ill. 60611	----do -----	Do.
<b>Carbon black:</b>			
Cities Service Co -----	3200 West Market St. Akron, Ohio 44313	Furnace -----	Do.
<b>Cement:</b>			
Arkansas Cement Corp. <sup>4</sup> -----	Foreman, Ark. 71836 -----	Pit and plant.	Little River.
Ideal Basic Industries, Inc. <sup>4</sup> ---	420 Ideal Cement Bldg. Denver, Colo. 80202	----do -----	Howard.
<b>Clays:</b>			
Acme Brick Co -----	Box 425 Fort Worth, Tex. 76101	----do -----	Hot Spring and Sebastian.
Arkansas Lightweight Aggregate Corp.	El Dorado, Ark. 71730 -----	----do -----	Crittenden and Lonoke.
W. S. Dickey Clay Manufacturing Co.	Texarkana, Ark. 75501 -----	----do -----	Miller.
<b>Coal:</b>			
Crown Construction Co., Inc --	Fort Smith, Ark. 72901 -----	Strip mine --	Johnson.
Garland Coal & Mining Co -----	----do -----	----do -----	Franklin and Johnson.
Peabody Coal Co -----	St. Louis, Mo. 63102 -----	----do -----	Johnson.
Sugar Loaf Mining Co -----	P.O. Drawer 2045 Fort Smith, Ark. 72901	Underground and strip mine.	Sebastian.

See footnotes at end of table.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Gypsum:</b>			
Weyerhaeuser Co -----	Route 4, Box 78 Nashville, Ark. 71852	Mine and plant.	Howard.
<b>Iron ore:</b>			
Leber Mining Co -----	36 South Market St. Elizabethtown, Pa. 17022	----do ----	Nevada.
<b>Lime:</b>			
Rangaire Corp. <sup>5</sup> -----	Box 1311 Batesville, Ark. 72501	Plant -----	Independence.
<b>Natural gas liquids:</b>			
Arkla Chemical Corp. <sup>3</sup> -----	Magnolia, Ark. 71753 -----	----do ----	Columbia.
Phillips Petroleum Co. <sup>3</sup> -----	Stamps, Ark. 71860 -----	----do ----	Lafayette.
<b>Petroleum refineries:</b>			
Berry Petroleum Co -----	Magnolia, Ark. 71753 -----	Refinery ----	Ouachita.
Cross Oil & Refining Co. of Arkansas.	Smackover, Ark. 71762 -----	----do ----	Union.
Lion Oil Co. <sup>3</sup> -----	El Dorado, Ark. 71730 -----	----do ----	Do.
MacMillan Ring-Free Oil Co., Inc.	Norphlet, Ark. 71759 -----	----do ----	Do.
<b>Roofing granules:</b>			
Bird and Son, Inc -----	East Walpole, Mass. 02032 ---	Plant -----	Montgomery.
Minnesota Mining & Manu- facturing Co.	Little Rock, Ark. 72203 -----	----do ----	Pulaski.
<b>Sand and gravel:</b>			
Arkholia Sand & Gravel Co. <sup>5</sup> --	323 Merchants Bank Bldg. Fort Smith, Ark. 72901	Pit -----	Crawford.
Gifford-Hill & Co., Inc -----	Box 47127 Dallas, Tex. 75247	Pits -----	Lafayette and Miller.
Jeffrey Sand Co., Inc -----	Fort Smith, Ark. 72901 ----	Dredge -----	Pulaski.
<b>Stone:</b>			
Freshour Construction Co ----	Box 77 Sweet Home, Ark. 72164	Quarries ----	Sharp, Van Buren, White.
Ben M. Hogan Co., Inc -----	Box 2860 Little Rock, Ark. 72203	----do ----	Lawrence and Pope.
McClinton Brothers Co -----	Box 1367 Fayetteville, Ark. 72701	----do ----	Benton, Madison, Washington.
McGeorge Contracting Co ----	Box 248 Pine Bluff, Ark. 71601	Quarry -----	Pulaski.
Midwest Lime Co -----	Box 608 Batesville, Ark. 72501	----do ----	Independence.
Minnesota Mining & Manu- facturing Co.	Little Rock, Ark. 72203 -----	----do ----	Do.
<b>Talc and soapstone:</b>			
The Milwhite Co., Inc. <sup>5</sup> -----	Box 15038 Houston, Tex. 77020	Mine and plant.	Saline.
<b>Vanadium:</b>			
Union Carbide Corp -----	Route 2, Box 563 Hot Springs, Ark. 71901	Mine and mill	Garland.
<b>Vermiculite (exfoliated):</b>			
Strong-Lite Products -----	Pine Bluff, Ark. 71601 -----	Plant -----	Jefferson.

<sup>1</sup> Also lime and cement.<sup>2</sup> Also lime.<sup>3</sup> Also recovered sulfur.<sup>4</sup> Also clay and stone.<sup>5</sup> Also stone.



# The Mineral Industry of California

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

By William H. Kerns<sup>1</sup>

The total value of output of the mineral industry of California in 1975 increased to \$3.2 million, a 13% increase over that of 1974. This resulted from increased prices received for mineral commodities produced and marketed during 1975. Production, in terms of quantity of output, for the most significant commodities actually declined compared with that of 1974. Production quantities declined for each of the State's five leading mineral commodities—petroleum, natural gas, portland cement, sand and gravel, and boron minerals, listed in descending order of value of output—which together accounted for 86% of the State's total value of mineral production in 1975.

Petroleum (crude) output again was by far the most important mineral product in California, in terms of output value, accounting for 62% of the State's total value of minerals produced. Natural gas, whose value of output accounted for an additional 7% of the State's total, ranked second, and natural gas liquids supplied another 2% of the total.

Among the nonmetals produced, value of output of portland cement, sand and gravel, and stone supplied 7%, 5%, and 2% of the State's total value of mineral production and ranked second, fourth, and seventh, respectively. Other important nonmetal minerals produced included boron, sodium carbonates and sulfates, and diatomite which ranked fifth, ninth, and tenth in value of output in the State in 1975. Other important nonmetals produced were

clays, lime, postassium salts, magnesium compounds, and salt.

Among the metals produced, iron ore (usable), rare-earth metals, and tungsten output continued to contribute significantly to the State's total value of minerals produced in 1975. Together the value of production of the fuels, nonmetals, and metal mineral commodities mentioned above accounted for 99% of the total value of mineral production in the State in 1975.

One of the Nation's principal asbestos-producing mines in past years, located near Copperopolis, Calaveras County, formerly operated by Pacific Asbestos Co., was reopened by Calaveras Asbestos, Ltd. The State's major boron producer, U.S. Borax & Chemical Corp., began a \$54 million expansion program at its boron open pit mine and plant, Kern County. Another large boron producer, Kerr-McGee Chemical Corp., was progressing on a \$100 million soda ash plant begun in 1974 at its Trona operation, San Bernardino County. The trend in the cement industry to convert to coal as a fuel or alternate fuel in cement manufacturing continued at the California Portland Cement Co. plants at Colton and Mojave and at the Calaveras Cement Division plants at San Andreas and Redding. Kaiser Steel Corp. announced plans for a \$150 million program to modernize steelmaking facilities at its Fontana mill, contingent upon securing financing commitments and per-

<sup>1</sup> State Liaison Officer, Bureau of Mines, Sacramento, Calif.



Table 1.—Mineral production in California<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Asbestos -----short tons--	58,331	\$5,697	W	W
Barite -----thousand short tons--	4	W	1	W
Boron minerals -----do----	1,185	128,306	1,172	\$158,772
Cement:				
Masonry -----do----	2	42	1	34
Portland -----do----	8,262	210,478	7,326	232,550
Clays -----do----	2,497	7,626	<sup>2</sup> 2,387	<sup>2</sup> 7,373
Copper (recoverable content of ores, etc.)				
-----short tons--	194	300	344	441
-----thousand short tons--	W	W	354	31,186
Gem stones -----do----	NA	220	NA	220
Gold (recoverable content of ores, etc.)				
-----troy ounces--	5,049	807	9,606	1,551
Gypsum -----thousand short tons--	1,716	6,642	1,446	6,332
Lead (recoverable content of ores, etc.)				
-----short tons--	35	16	66	28
Lime -----thousand short tons--	600	14,877	595	18,626
Magnesium compounds --short tons MgO equivalent--	163,847	18,356	W	W
Mercury -----76-pound flasks--	1,311	370	W	W
Natural gas -----million cubic feet--	365,354	160,756	318,308	222,816
Natural gas liquids:				
Natural gasoline and cycle products				
-----thousand 42-gallon barrels--	5,709	26,104	4,847	29,543
-----do----	5,095	29,296	4,451	20,568
LP gases -----do----	14	322	W	W
Peat -----thousand short tons--	323,003	1,710,350	322,199	1,943,048
Petroleum (crude) -----thousand 42-gallon barrels--	909	3,219	348	2,762
Pumice -----thousand short tons--	34,284	15,798	W	W
Rare-earth metal concentrates -----short tons--	105,191	176,213	88,445	168,248
Sand and gravel -----thousand short tons--				
Silver (recoverable content of ores, etc.)				
-----thousand troy ounces--	42	197	80	353
Stone -----thousand short tons--	45,709	91,891	33,152	72,740
Talc -----short tons--	<sup>r</sup> 163,841	<sup>r</sup> 1,676	152,978	1,598
Zinc (recoverable content of ores, etc.) -----do----	8	6	206	161
Value of items that cannot be disclosed:				
Bromine, calcium-magnesium chloride, carbon dioxide, clay (ball clay and kaolin), feldspar, iron ore, lithium minerals, molybdenum, perlite, potassium salts, salt, sodium carbonates and sulfates, tungsten, and values indicated by symbol W -----do----	XX	<sup>r</sup> 187,684	XX	233,987
Total -----do----	XX	<sup>r</sup> 2,797,249	XX	3,152,937
Total 1967 constant dollars -----do----	XX	1,322,539	XX	<sup>p</sup> 1,248,563

<sup>p</sup> Preliminary. <sup>r</sup> 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.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes ball clay and kaolin; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in California, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Alameda -----	W	W	Sand and gravel, salt, stone, petroleum, clays, talc.
Alpine -----	W	\$217	Gold, silver, sand and gravel, zinc, lead, copper.
Amador -----	W	W	Clays, sand and gravel, stone.
Butte -----	W	5,936	Sand and gravel, natural gas, stone.
Calaveras -----	\$18,624	20,031	Cement, stone, sand and gravel, clays.
Colusa -----	4,084	W	Natural gas, sand and gravel, stone.
Contra Costa -----	14,518	12,869	Natural gas, stone, sand and gravel, petroleum, lime, clays.
Del Norte -----	912	1,274	Stone, sand and gravel, gold.
El Dorado -----	W	W	Stone, lime, sand and gravel, talc.
Fresno -----	77,397	80,789	Petroleum, sand and gravel, natural gas, natural gas liquids, asbestos, stone, gold, clays, tungsten, silver.
Glenn -----	W	W	Natural gas, sand and gravel, lime, stone.
Humboldt -----	W	3,527	Sand and gravel, natural gas, stone.
Imperial -----	W	W	Gypsum, lime, sand and gravel, clays, salt.
Inyo -----	34,566	26,397	Tungsten, boron minerals, talc, stone, sand and gravel, copper, perlite, silver, pumice, zinc, molybdenum, clays, lead, gold.
Kern -----	780,112	920,874	Petroleum, boron minerals, cement, natural gas, natural gas liquids, stone, sand and gravel, gypsum, sodium sulfate, clays, salt, carbon dioxide, pumice, tungsten.
Kings -----	8,575	8,803	Natural gas, natural gas liquids, petroleum.
Lake -----	2,262	W	Sand and gravel, pumice, stone, mercury.
Lassen -----	W	67	Sand and gravel, pumice, stone.
Los Angeles -----	565,267	646,238	Petroleum, natural gas, sand and gravel, natural gas liquids, stone, lime, clays, gold, tungsten, silver.
Madera -----	10,247	3,011	Natural gas, sand and gravel, stone, pumice, tungsten.
Marin -----	3,749	W	Stone, clays.
Mariposa -----	103	54	Sand and gravel, stone.
Mendocino -----	1,291	562	Do.
Merced -----	1,888	1,810	Sand and gravel, natural gas, stone, gold, silver.
Modoc -----	W	W	Peat, sand and gravel, pumice, stone.
Mono -----	W	1,757	Pumice, clays, stone, sand and gravel, gold, silver, copper, lead, zinc.
Monterey -----	91,228	118,271	Petroleum, magnesium compounds, lime, stone, sand and gravel, feldspar, natural gas.
Napa -----	2,897	2,665	Stone, salt, clays, mercury, sand and gravel, pumice.
Nevada -----	W	W	Sand and gravel, stone, clays.
Orange -----	201,648	216,681	Petroleum, sand and gravel, natural gas, natural gas liquids, clays, lime, stone.
Placer -----	W	W	Sand and gravel, clays, stone.
Plumas -----	W	638	Sand and gravel, stone, gold, pumice, copper, silver.
Riverside -----	95,761	W	Iron ore, cement, sand and gravel, stone, clays, petroleum, natural gas.
Sacramento -----	24,619	23,203	Natural gas, sand and gravel, stone, petroleum, gold, clays, silver.
San Benito -----	7,461	9,217	Asbestos, stone, sand and gravel, clays, petroleum, natural gas.
San Bernardino -----	189,900	225,865	Cement, boron minerals, potassium salts, sodium sulfate, rare-earth minerals, stone, sodium carbonate, sand and gravel, lime, salt, clays, petroleum, magnesium chloride, pumice, gold, lithium minerals, talc, bromine, feldspar, iron ore, silver, natural gas, gypsum, copper, tungsten, lead, zinc.
San Diego -----	20,923	22,384	Sand and gravel, stone, salt, magnesium compounds, clays, tungsten.
San Francisco -----	W	W	Sand and gravel.
San Joaquin -----	W	14,870	Natural gas, sand and gravel, lime, peat, gold, stone, silver.
San Luis Obispo -----	W	11,568	Petroleum, stone, natural gas, sand and gravel, clays.
San Mateo -----	10,144	9,141	Magnesium compounds, stone, salt, petroleum, sand and gravel, natural gas.
Santa Barbara -----	155,086	156,212	Petroleum, stone, natural gas, sand and gravel, natural gas liquids, lime, stone.
Santa Clara -----	46,005	W	Cement, stone, sand and gravel, mercury, clays.

See footnotes at end of table.

Table 2.—Value of mineral production in California, by county <sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Santa Cruz -----	W	W	Cement, sand and gravel, stone, clays.
Shasta -----	\$10,063	\$9,511	Cement, sand and gravel, stone, clays, pumice, gold, barite, silver.
Sierra -----	W	212	Gold, stone, sand and gravel, silver.
Siskiyou -----	W	1,137	Sand and gravel, stone, pumice.
Solano -----	26,304	34,643	Natural gas, stone, petroleum, clays, sand and gravel.
Sonoma -----	6,926	5,915	Sand and gravel, stone.
Stanislaus -----	W	W	Sand and gravel, gold, clays, silver.
Sutter -----	W	W	Natural gas, sand and gravel, clays.
Tehama -----	W	W	Natural gas, sand and gravel, stone, pumice.
Trinity -----	W	W	Stone, sand and gravel, gold.
Tulare -----	W	3,596	Sand and gravel, natural gas, stone, petroleum, gold, clays, tungsten, silver.
Tuolumne -----	W	W	Lime, stone.
Ventura -----	148,428	164,987	Petroleum, natural gas, natural gas liquids, sand and gravel, clays, stone, pumice.
Yolo -----	12,626	19,214	Natural gas, sand and gravel, lime, stone.
Yuba -----	W	W	Sand and gravel, gold, stone, clays.
Undistributed <sup>2</sup> -----	r 223,751	369,393	
Total <sup>3</sup> -----	r 2,797,249	3,152,937	

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

<sup>1</sup> Value of petroleum is based on an average price per barrel for the State.

<sup>2</sup> Includes Federal offshore petroleum, some sand and gravel and mercury that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of California business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	9,180.0	9,330.0	+2.2
Unemployment -----do-----	669.0	925.0	+38.3
<b>Employment (nonagricultural):</b>			
Mining -----do-----	31.7	32.0	+ .9
Manufacturing -----do-----	1,687.5	1,585.1	-6.1
Contract construction -----do-----	517.9	233.7	-10.8
Transportation and public utilities -----do-----	475.5	465.4	-2.1
Wholesale and retail trade -----do-----	1,760.9	1,777.3	+ .9
Finance, insurance, real estate -----do-----	451.4	452.5	+ .2
Services -----do-----	1,536.2	1,573.6	+2.4
Government -----do-----	1,571.3	1,645.7	+4.7
Total nonagricultural employment -----do-----	7,832.4	7,815.3	-.2
<b>Personal income:</b>			
Total -----millions--	\$126,948	\$139,337	+9.8
Per capita -----do-----	\$6,089	\$6,593	+8.3
<b>Construction activity:</b>			
Number of private and public residential units authorized--	129,045	131,248	+1.7
Value of nonresidential construction -----millions--	\$2,566.8	\$2,470.0	-3.8
Value of State road contract awards -----do-----	\$435.0	\$338.0	-22.3
Shipments of portland and masonry cement to and within the State -----thousand short tons--	7,780	6,848	-12.0
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$2,797.2	\$3,152.9	+12.7
Value per capita, resident population -----do-----	\$133.99	\$148.74	+11.0
Value per square mile -----do-----	\$17,626.80	\$19,868.15	+12.7

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

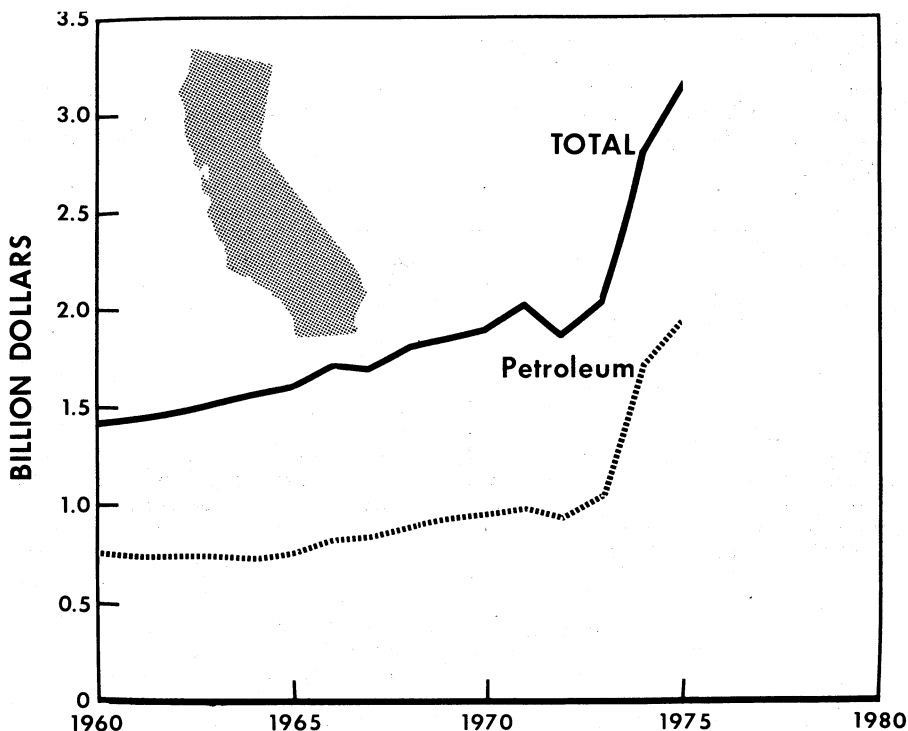


Figure 1.—Value of petroleum and total value of mineral production in California.

mits from regulatory agencies. Molycorp, Inc., the Nation's major producer of rare earths, was installing equipment for a 50% expansion in its chemical plant at Mountain Pass, San Bernardino County.

Several significant events occurred in the mineral industry during the year. The California Surface Mining and Reclamation Act of 1975 was passed, creating a new California Mining and Geology Board which will represent the State's interest in governing surface mining operations and in providing reclamation of mined lands. The California Coastal Plan was transmitted by the California Coastal Zone Conservation Commission to the Governor and State Legislature in December as mandated by the Coastal Initiative (Proposition 20) which was approved by California voters.

Ten exploratory geothermal wells were drilled, nine in Imperial County and one in Mendocino County. The Pacific Gas

and Electric Co. generating unit 11 began producing electricity in May, bringing the total electricity generating capacity at The Geysers to 521 megawatts. Four additional units requested had not received final permits by yearend.

**Legislation and Government Programs.**—The California Legislature convened December 2, 1974, for the first year of the 1975-76 biennial session. The advantage of this new 2-year session system is that it allows the legislators more time to consider complex and highly technical legislation. Any bills that were not passed during 1975 may be carried over and heard when the legislature reconvenes January 5, 1976, but they must clear the House of origin by January 30, 1976.

When the legislature adjourned, the 1975 portion of the 1975-76 biennial session on September 12, 1975, for interim study, 4,331 bills had been introduced; of these, 1,343 were signed by Governor

Brown; 78 became law without his signature; 160 were vetoed; and 2,750 remained to be considered. The following summarizes those bills that may have an impact on the mineral industry in California.

*Senate Joint Resolution (SJR) 32.*—Requests that the President and Congress of the United States take all steps necessary to prevent strip mining or open pit mining in the Los Padres National Forest. SJR 32 was tentatively scheduled to be heard in the Senate Natural Resources and Wildlife Committee in January 1976.

*Senate Bill (SB) 345 (Chapter 1255, Statutes of 1975).*—Opens oil, gas, and geothermal well records to public inspection. The well records may remain confidential for specific periods of time upon the request of the owner or operator. No well records will be open to public inspection prior to July 1, 1976. SB 345 was signed by the Governor October 1, 1975, and became effective January 1, 1976.

*SB 517.*—Would have given specific duties in regard to the regulation, research, and development of geothermal resources to the California Energy Resources Conservation and Development Commission. SB 517 was vetoed by the Governor October 1, 1975.

*SB 756 (Chapter 1131, Statutes of 1975).*—Created a new Mining and Geology Board with prescribed composition and organization which will represent the State's interest in mineral resources and the reclamation of mined lands and shall determine, establish, and maintain a surface mining and reclamation policy utilizing local government entities. The bill also creates the Geologic Hazards Technical Advisory Committee to advise the board and the State Geologist. The bill included the Surface Mining and Reclamation Act of 1975 to govern surface mining operations and provide for the reclamation of mined lands. It provided that persons engaging in surface-mining operations must submit reclamation plans to local government agencies and for issuance of permits by those agencies. SB 756 was signed by the Governor September 28, 1975, and became effective January 1, 1976.

*SB 811 (Chapter 316, Statutes of 1975).*—Permits the sale of mineral deposits by any State agency only with the approval of the State Lands Commission. SB 811 was signed by the Governor August

22, 1975, and became effective January 1, 1976.

*SB 932.*—Would have required the State Geologist to make an annual report of mineral deposits in urban areas identified by the State Office of Planning and Research. SB 932 was vetoed September 28, 1975, by Governor Brown with the message that the purpose of the bill will be accomplished in a more comprehensive manner by SB 756 which he had already signed into law.

*Assembly Bill (AB) 1496.*—Would transfer geothermal resources development operations from the State Division of Oil and Gas to the State Energy Resources Conservation and Development Commission. It would also abolish the Geothermal Resources Board and transfer its functions to the commission. It would provide that geothermal resources be developed in the State as rapidly as possible in a manner consistent with sound conservation and environmental protection. AB 1496 was scheduled to be heard in the Assembly Energy and Diminishing Materials Committee in January 1976.

*SB 78.*—Would abolish the Department of Conservation and establish the Department of Land and Energy Resources. The Division of Mines and Geology, Division of Oil and Gas, Division of Resource Conservation, Division of State Lands, and the State Lands Commission would be transferred to the new department. The bill would also abolish the Division of Forestry and create the Department of Forestry. SB 78 was tentatively scheduled to be heard in the Assembly Resources and Land Use Committee in January 1976.

*SB 1255.*—Would transfer the State Lands Commission from the Department of Conservation to the Resources Agency. The Divisions of Mines and Geology, Oil and Gas, and State Lands would be transferred from the Department of Conservation to the Resources Agency under the administration of the State Lands Commission. The Division of Forestry and Resource Conservation would remain in the Department of Conservation. SB 1255 was tentatively scheduled to be heard in the Senate Governmental Organization Committee in January 1976.

*SB 1009 (Chapter 773, Statutes of 1975).*—Changed the makeup of the Geothermal

Resources Board in the Department of Conservation to consist of the director of the Department of Conservation (chairman), the State Geologist (secretary), the State Oil and Gas Supervisor, the Executive Office of the State Lands Commission, the chairman of the State Water Resources Control Board, the director of the Department of Water Resources, the president of the Public Utilities Commission, and the director of the Department of Fish and Game. SB 1009 was signed by the Governor September 16, 1975, and became effective January 1, 1976.

The California Solid Waste Management and Recovery Act of 1973 created the Solid Waste Management Board and required that it prepare a proposed State Policy for Solid Waste Management and Minimum Standards for Solid Waste Handling and Disposal. After public hearings and modifications, the proposed policy was formally adopted late in December 1974. The Act further required that each county submit a solid waste management plan with concurrence of a majority of the cities in that county to the board by January 1, 1976. In addition, preliminary drafts of the county plans must be sent to regional planning agencies, the Regional Water Quality Control Board, and the Air Pollution Control Districts for review for local compliance.

Four bulletins in a continuing technical information series to provide technical assistance to those persons and agencies in California involved in solid waste management were published by the California Solid Waste Management Board in 1975: No. 4, Resource Recovery of Special Wastes; No. 5, Current Status of Resource Recovery Systems and Processes; No. 6, Financing for Solid Waste Management; and No. 7, Cost Analysis of Resource Recovery Systems.

Accomplishments of the California Division of Mines and Geology (CDMG), July 1, 1974 through June 30, 1975, were published in the Sixty-Eighth Report of the State Geologist.<sup>2</sup> The minerals program was greatly expanded in fiscal year 1974-75, largely through Federal Bureau of Mines grants totaling \$174,000. CDMG staff in the minerals program totaled 14 people. Of the Bureau of Mines grant money, \$100,000 was funded for statewide studies of chromite and manganese,

\$50,000 for a study of the aggregate resources of the five-county area of greater Los Angeles, and the remaining \$24,000 for a statewide investigation of California's nickel resources. The minerals program was further augmented by the assignment of one geologist in each of the three CDMG districts in Sacramento, San Francisco, and Los Angeles with principal duties of collecting information on the mineral industry.

A report<sup>3</sup> was published of an investigation made between 1962 and 1967 by the CDMG on the Ione area, Amador County, which contains important resources of clay, silica sand, and lignite. The study was made to provide basic data on geology and to assist in the exploration for mineral commodities. During the investigation, three core holes were drilled in the Ione basin area by the Bureau of Mines in 1967 in a cooperative program with CDMG.

A report<sup>4</sup> by the CDMG was submitted to the California Legislature on December 1, 1975, in accordance with the Alquist-Priolo Special Studies Zone Act of 1972, describing the accomplishments on the 10-year active-fault mapping and evaluation program to implement the act. Two other important reports were published on faulting<sup>5</sup> and earthquakes.<sup>6</sup>

The California Coastal Plan was transmitted by the California Coastal Zone Conservation Commissions to Governor Brown, the members of the California Legislature, and the people of California on December 1, 1975, as mandated by the Coastal Initiative (Proposition 20) approved by the California voters on November 7, 1972. The plan was designed to meet two principal objectives: To protect the California coast as a great natural re-

<sup>2</sup> California Division of Mines and Geology. Sixty-Eighth Report of the State Geologist (1974-1975). 1975, 56 pp.

<sup>3</sup> Chapman, R. H., and C. C. Bishop. Geophysical Investigations in the Ione Area, Amador, Sacramento, and Calaveras Counties, California. Div. Mines and Geol., Spec. Rept. 117, 1975, 27 pp.

<sup>4</sup> California Division of Mines and Geology. Active Fault Mapping and Evaluation Program. Spec. Pub. 47, 1975, 42 pp.

<sup>5</sup> Kennedy, M. P., S. S. Tan, R. H. Chapman, and G. W. Chase. Character and Recency of Faulting, San Diego Metropolitan Area, Calif., Calif. Div. Mines and Geol. Spec. Rept. 123, 1975, 33 pp.

<sup>6</sup> Sherburne, R. W., and C. J. Hauge. Oroville, California, Earthquake, 1 August 1975. Calif. Div. Mines and Geol., Spec. Rept. 124, 1975, 151 pp.

source for the benefit of present and future generations, and to use the coast to meet human needs in a manner that protects the irreplaceable resources of coastal lands and waters. In addition to preparing the plan, the State Coastal Commission and six Regional Commissions acted on more than 16,000 permit applications since early 1973 as required by the Coastal Initiative as an interim measure. Submission of the plan to the Governor and the California Legislature put the California coast in their hands for enactment of legislation; under present law the Coastal Commissions will go out of exist-

ence on December 31, 1976. Under the plan, as submitted, mining shall not be allowed in sensitive areas such as marshes, lagoons, living dunes, some streams, and other coastal water areas and landforms that are fragile, valuable, or highly scenic natural environments. Mining shall be allowed in other areas if the mining extraction will not have a substantial or long-lasting adverse impact upon coastal resources and, in the case of sand mining, if the sand supply of a particular watershed is sufficient or alternative sand supply is provided to allow mining without significant adverse impact.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Coal (Lignite).**—With its output of lignite from the McGuire pit near Ione, Amador County, the Interpace Corp. continued to be the only producer of coal in California. The modest quantity of lignite produced by Interpace was used solely to recover montan wax by solvent extraction. The wax is marketed for use in polishes, carbon paper, and insulating compositions.

A number of cement producers in California have acquired out-of-State coal supplies through contracts, and others have purchased Utah mines to insure long-term fuel sources. California Portland Cement Co. completed coal-handling facilities at its Colton and Mojave cement plants to use coal from its Soldier Creek mine near Price, Utah. Calaveras Cement Division of the Flintkote Co. made plans for the installation of coal handling, storage, and burning facilities at its San Andreas and Redding cement plants. Riverside Cement Co., a subsidiary of Amcord, Inc., completed the conversion to coal at its cement plants at Ora Grande and Crestmore.

**Geothermal.**—The number of new wells drilled for geothermal exploration and development declined 10% compared with that of 1974. The number of new wells completed to production declined 16%, but total depth drilled was about the same.

The total number of notices filed for new wells and reworks increased from 49 in 1974 to 110 in 1975.

Ten exploratory wells were drilled in the State in 1975—9 in Imperial County and 1 in Mendocino County. Although exploration and development drilling were down slightly, temperature-gradient and heat-flow well drilling increased nearly threefold over 1974 activity; 308 notices were filed in 1975, compared with 108 in 1974. The drilled depth of these holes also increased markedly, from the 200- to 500-foot depth range in 1974 to the 1,000-foot range in 1975; several holes were deeper than 3,000 feet.

In The Geysers field, the number of development wells drilled decreased from 21 in 1974 to 17 in 1975. Of these, 15 were completed as potential producers and 2 were abandoned. Environmental, legal, and permitting problems continued to slow development drilling. However, steam capacity of wells already drilled exceeds the present generating capacity by over 300 megawatts.

A new depth record at The Geysers was established when Union Oil Co. of California drilled DX State 4596 24 to a total depth of 10,000 feet. The well was completed to steam production during July 1975.

Table 4.—California: Geothermal operations in 1975<sup>1</sup>

	New wells			Total drilled (feet)			Notices filed		
	Drilled	Completed to production	Abandoned	New wells	Reworks	New wells	Reworks	Producers	Dry wells
WITHIN GEOTHERMAL FIELDS									
The Geysers field:									
Lake County	4	4	--	11,249	--	4	1	--	--
Sonoma County	13	11	2	39,947	1,470	30	24	3	4
Lake	--	1	--	--	--	--	--	--	--
Total	17	16	2	51,196	1,470	34	25	3	4
OUTSIDE GEOTHERMAL FIELDS									
Imperial County	9	5	--	17,604	--	33	4	--	3
Lake County	--	--	--	--	--	7	--	--	--
Mendocino County	1	--	1	2,134	--	--	--	--	1
Modoc County	--	--	--	--	--	1	--	--	1
Sonoma County	--	--	--	--	--	6	--	--	--
Total	10	5	1	19,738	--	47	4	--	5
State total	27	21	3	70,934	1,470	81	29	3	9

<sup>1</sup> California Division of Oil and Gas. 61st Annual Report of the State Oil and Gas Supervisor. Report PRO 6, 1975, pp. 149-150.



Table 5.—California: Exploratory wells drilled outside geothermal fields in 1975

Operator	Well	Date started	Total depth (feet)
<b>Imperial County:</b>			
Union Oil Co. of California -----	Veysey 1	1/75	8,386
Do -----	Veysey 2	3/75	5,925
Chevron Oil Co -----	GTW-1	3/75	3,458
Republic Geothermal, Inc -----	Silzle 1	3/75	11,014
Chevron Oil Co -----	GTW-2	4/75	3,914
Do -----	GTW-3	4/75	3,002
Union Oil Co. of California -----	H.B. Tow 1	4/75	5,030
Republic Geothermal, Inc -----	30-38	9/75	9,009
Do -----	16-19	11/75	8,022
<b>Mendocino County:</b>			
Sun Oil Co -----	Macci-State 1	10/74	7,001

Pacific Gas and Electric Co. (PG&E) generating unit 11 began producing electricity in May, bringing the total electricity-generating capacity at The Geysers to 521 megawatts (502 megawatts net capacity). At yearend none of the next four units currently in the permitting process had received its final permit. PG&E has the capability of building all four units simultaneously and hoped to have at least three of them on line in late 1978. The four additional units have a net design capacity of 406 megawatts of electric power production.

In the Salton Sea field, following extensive testing of separators and heat exchangers in 1973 and 1974, the San Diego Gas and Electric Co. (SDG&E) entered into a joint project with Imperial Magma (formerly Magma Power Co.) and the U.S. Energy Research and Development Administration (ERDA). At yearend they were constructing a 10-megawatt geothermal loop experimental facility in the area where Magma had drilled six wells in 1972 and 1973. Construction costs of the plant, estimated to be \$8 million, will be shared equally by SDG&E and ERDA. SDG&E will operate the plant while ERDA will provide technical support and environmental impact studies. ERDA will also construct a facility on the location for general research and development by various governmental and industrial researchers.

During 1975, the Lawrence Livermore Laboratory (LLL) continued its investigations into the development of the Salton Sea field geothermal resources. Its aim is to develop the technology necessary to convert the high-temperature, high-salinity geothermal brines into usable electric

power. The LLL approach to the problem is the total flow concept, which utilizes the total effluent of the well by passing both the steam and water through a mixed-phase expander in order to drive a turbine and a generator. At yearend LLL was moving to the site of Sinclair 4, two trailers that contained a complete chemical materials testing laboratory and associated equipment. There was no drilling activity in the Salton Sea field during 1975.

About 1,200 members of the international scientific, engineering, and industrial community from 50 countries participated in the Second United Nations Geothermal Energy Symposium held in San Francisco in May. It was the first such gathering held in the United States under joint U.S. and U.N. sponsorship and was part of an effort to foster international cooperation in developing new and alternative sources of energy. Abstracts of the papers given at the Symposium were published.<sup>7</sup> The Symposium was organized by the United Nations Secretariat in cooperation with the U.S. Department of the Interior, U.S. National Science Foundation, U.S. Atomic Energy Commission, California Resources Agency, and University of California. In addition, the Geothermal Resources Council, the American Association of Petroleum Geologists, and public and private development corporations provided assistance. Proceedings of the Symposium, including the nearly 500 papers given, were to be published in 1976.

A comprehensive assessment of the magnitude, distribution, and recoverability of

<sup>7</sup> Lawrence Berkeley Laboratory, University of California, Berkeley, Calif. Abstracts, Second United Nations Symposium on the Development and Use of Geothermal Resources, San Francisco, Calif., May 20-29, 1975. 1975, 200 pp.

various categories of geothermal resources within the United States was published.<sup>8</sup>

Work was completed on Special Report 122, Engineering Geology of The Geysers Geothermal Resource Area of Lake, Mendocino, and Sonoma Counties, Calif., by C. Forrest Bacon and others of the California Division of Mines and Geology, and publication was scheduled for early 1976. The findings of a CDMG geophysical study of the Clear Lake region were published.<sup>9</sup> The study revealed a prominent, nearly circular, negative gravity anomaly which is believed to be a hot intrusive mass, possibly a magma chamber, that may underlie the Clear Lake volcanic field and vicinity and may serve as a source of heat for the geothermal phenomena in the area.

**Natural Gas.**—Marketed production of natural gas, as reported by the Bureau of Mines, was 318,308 thousand cubic feet (Mcf), a decline of 13% compared with that of 1974, but value of output increased 39% to \$223 million because prices rose from 44 cents per Mcf to 70 cents per Mcf. Compared with that of 1974, the decrease in the gas production from oil

zones was about equal to the decrease in the production from dry gas zones. Of the total gross withdrawal of natural gas, 87% was marketed, 13% was used in repressuring wells, and less than 1% was vented or flared. Net interstate receipts declined 2%, and consumption was virtually the same as in 1974.

Total proved reserves of natural gas including offshore reserves increased from 5.2 billion Mcf as of December 31, 1974, to 5.5 billion Mcf as of December 31, 1975.

Thirty-seven percent of the total natural gas deliveries went to residential consumers, 34% to individual users, 16% to electric utilities, and 13% to commercial users. The number of residential consumers increased 2%, and the number of commercial users increased 3% above that of 1974.

<sup>8</sup> White, D. F., and D. L. Williams (eds.). Assessment of Geothermal Resources of the United States—1975. U.S. Geol. Survey, Circ. 726. 1975, 155 pp.

<sup>9</sup> California Division of Mines and Geology. Geophysical Study of the Clear Creek Region, Calif. Spec. Rept. 116, 1975, 23 pp.

Table 6.—California: Salient statistics of natural gas  
(Million cubic feet unless otherwise specified)

	1974	1975
<b>Gross withdrawals:</b>		
From gas wells -----	222,673	173,499
From oil wells -----	204,301	194,154
Total <sup>1</sup> -----	426,974	367,653
<b>Disposition:</b>		
Marketed production -----	365,354	318,308
Repressuring -----	60,060	47,808
Vented and flared <sup>2</sup> -----	1,560	1,537
<b>Marketed production:</b>		
Quantity -----	365,354	318,308
Value -----	\$160,756	\$222,816
Average wellhead value -----per million cubic feet--	\$0.44	\$0.70
<b>Interstate movement:</b>		
Receipts -----	1,598,378	1,569,946
Deliveries -----		
Net receipts (+) or deliveries (-) -----	+ 1,598,378	+ 1,569,946
Change in underground storage -----	79,534	4,066
Unaccounted for -----	32,584	36,118
Consumption -----	1,851,614	1,848,070
Value of consumption -----	\$1,703,800	\$2,320,191

<sup>1</sup> Marketed production plus quantities used in repressuring and vented and flared.

<sup>2</sup> Partly estimated; includes direct losses on producing properties and residue blown to the air.

Source: Figures are based on reports received from State agencies and Bureau of Mines estimates.

Table 7.—California: Consumption of natural gas by use

		1974	1975
Delivered to consumers:			
Quantity	million cubic feet	1,743,734	1,727,729
Value	thousands	\$1,654,969	\$2,254,494
Extraction loss:			
Quantity	million cubic feet	17,201	15,221
Value	thousands	\$9,461	\$11,583
Lease and plant fuel:			
Quantity	million cubic feet	71,686	84,843
Value	thousands	\$30,824	\$44,543
Pipeline fuel:			
Quantity	million cubic feet	18,993	20,277
Value	thousands	\$8,546	\$9,571
Total:			
Quantity	million cubic feet	1,851,614	1,848,070
Value	thousands	\$1,703,800	\$2,320,191

Table 8.—California: Estimated total proved reserves of natural gas <sup>1</sup>

(Million cubic feet—14.73 psia at 60° F)

Reserves as of Dec. 31, 1974	5,194,592
Changes in reserves during 1975:	
Revisions	390,881
Extensions	194,169
New field discoveries	11,100
New reservoir discoveries in old fields	29,515
Net change in underground storage <sup>2</sup>	-4,285
Production <sup>3</sup>	331,945
Reserves as of Dec. 31, 1975:	
Total gas	5,484,027
Nonassociated	2,249,260
Associated-dissolved	2,906,497
Underground storage <sup>4</sup>	328,270
Net change in reserves	289,435

<sup>1</sup> Includes offshore.<sup>2</sup> The net difference between gas stored in and gas withdrawn from underground storage reservoirs, inclusive of adjustments and native gas transferred from other reserve categories.<sup>3</sup> Preliminary net production.<sup>4</sup> Proved recoverable gas contained in underground gas storage reservoirs, including native and net injected gas (first reported on a recoverable basis in 1973).

Source: Committee on Natural Gas Reserves, American Gas Association.

Table 9.—California: Natural gas delivered to consumers, by type of consumer

		1974	1975
Residential:			
Quantity	million cubic feet	580,009	631,398
Value	thousands	\$800,412	\$993,820
Number of consumers	thousands	6,064	6,181
Commercial:			
Quantity	million cubic feet	219,622	232,911
Value	thousands	\$221,818	\$301,853
Number of consumers	thousands	379	389
Industrial: <sup>1</sup>			
Quantity	million cubic feet	641,929	581,609
Value	thousands	\$442,931	\$646,168
Electric utilities: <sup>2</sup>			
Quantity	million cubic feet	292,808	274,433
Value	thousands	\$184,469	\$304,951
Other consumers: <sup>3</sup>			
Quantity	million cubic feet	9,366	7,328
Value	thousands	\$5,339	\$7,702
Total:			
Quantity	million cubic feet	1,743,734	1,727,729
Value	thousands	\$1,654,969	\$2,254,494

<sup>1</sup> Includes refinery fuel use.<sup>2</sup> Data from Federal Power Commission.<sup>3</sup> Includes deliveries to municipalities and public authorities for institutional heating, street lighting, etc.

The trend of increased development activity for oil and gas continued. In 1975, 3,158 notices of intention to drill new wells were received by the California Division of Oil and Gas, compared with 2,509 notices in 1974. The number of new wells completed to production in 1975 was 1,938, compared with 1,854 in 1974. The number of notices to abandon wells decreased from 1,059 in 1974 to 934 in 1975.

Although exploratory drilling declined, 4 new fields were discovered and 15 fields were extended in 1975. The emphasis on deeper production continued. One well drilled in Yowlumne field reached a depth of 22,029 feet, making it the second deepest well drilled in California.

According to the Conservation Committee of California Oil Producers,<sup>10</sup> there was a decrease in development drilling for natural gas. Sixty gas wells were completed in dry gas fields in 1975, compared with 81 in 1974. Fields having the most extensive development were McDonald Island with 18 new wells and Kirby Hill and Winchester Lake, each with 5 new wells. Exploratory drilling was also active for dry gas in the Sacramento Valley; two new field discoveries of record were made, and two new pools were found in existing fields.

Natural gas utility service to over 6,567,000 domestic and commercial meters (end-of-year)—over 123,000 more than in 1974—reflected the continuing growth of the California population. Decreases in gas

usage were noted in the volumes consumed both by industrial customers and by steam-electric generating plants. The gas volume available to California steam-electric plants in 1975 was only 39% of the quantity used by such plants in the peak year of 1968. Imports of natural gas from Canada, the Permian and Delaware Basin (west Texas and southeast New Mexico) fields, the Anadarko Basin fields, the San Juan Basin (northwest New Mexico and southwest Colorado) fields, and the Paradox Basin (southeast Utah and northeast Arizona) fields for 1975 averaged 4,177 million cubic feet per day. The total gas volume received from out-of-State sources was 2% below that of 1974 and marked the third consecutive year of decline for such supplies. Several applications for new out-of-State gas supply projects for California were filed with the Federal Power Commission.

**Natural Gas Liquids.**—Total output of natural gas liquids, including natural gasoline and cycle products and liquid petroleum gases, declined 14% compared with that of 1974, but value of these products declined only 10% because of increased prices. The California Division of Oil and Gas reported<sup>11</sup> that 112,018 barrels of condensate was produced from California dry gas fields onshore and 37,594 barrels from dry gas fields on State-owned offshore lands in 1975.

<sup>10</sup> Conservation Committee of California Oil Producers. Annual Review of California Oil and Gas Production. 1975, pp. 60-68.

<sup>11</sup> Page 122 of work cited in footnote 10.

Table 10.—California: Salient statistics of natural gas liquids

	1974	1975
<b>Production:</b>		
Quantity -----thousand 42-gallon barrels..	10,804	9,328
Value -----thousand dollars..	55,400	50,111
Price, average -----dollars per barrel..	5.13	5.37
<b>Reserves:</b>		
Reserves as of Dec. 31, 1974 -----thousand barrels..	XX	98,232
Reserves during 1975 -----do..	XX	+ 17,991
Reserves as of Dec. 31, 1975 -----do..	XX	107,502
Revisions from 1975 -----percent..	XX	9.4

XX Not applicable.

**Peat.**—Output declined slightly, but value of production increased significantly owing to the advanced price. Moss peat was produced by Radel, Inc., near Likely in Modoc County, and reed-sedge peat was produced by Delta Humas Co. near Holt in San Joaquin County.

**Petroleum.**—California ranked third among the States, below Texas and Louisiana, in crude oil (including lease condensate) production and accounted for 11% of the total production in the United States in 1975. Production in the State declined less than 1%, from 323 million 42-gallon barrels in 1974 to 322 million 42-gallon barrels in 1975, and value of

production increased 14%, from \$1.7 billion to \$1.9 billion, because of the increased price per barrel. Twenty-five percent of the crude oil production in California in 1975 came from State and Federal offshore lands. Thirty-six crude petroleum refineries were operated, two fewer than in 1974. Major crude-oil-producing counties, listed in descending order of output, were Kern, Los Angeles, Orange, Ventura, Santa Barbara, Monterey, and Fresno. Crude oil reserves as of December 31, 1975, were 3.6 billion barrels, 2.5% greater than on December 31, 1974.

Table 11.—California: Salient statistics of crude petroleum

	1974	1975	
<b>Crude petroleum production:</b>			
Quantity .....	thousand barrels..	323,003	322,199
Total value at wells .....	thousand dollars..	1,710,350	1,943,048
Average value per barrel .....		\$5.30	\$6.03
Approximate number of wells producing Dec. 31 .....		40,479	41,029
Average production per well per day <sup>1</sup> .....	barrels..	22.4	41,029
<b>Offshore crude petroleum production (thousand barrels):</b>			
Federal .....		16,779	15,435
State .....		67,139	64,236
Total offshore .....		83,918	79,671
Leased condensate production <sup>2</sup> .....	thousand barrels..	200	150
<b>Crude petroleum refineries:</b>			
Operating Jan. 1 .....		38	36
Shut down Jan. 1 .....		--	--
<b>Crude oil throughput capacity (barrels per calendar day):</b>			
Operating .....		1,846,722	1,820,742
<b>Shutdown:</b>			
Operable .....		27,900	61,700
Inoperable .....		4,000	--
Building .....		364,273	363,273
<b>Gasoline output capacity (barrels per calendar day): <sup>3</sup></b>			
Operating .....		1,017,295	1,019,604
<b>Shutdown:</b>			
Operable .....		4,750	4,750
Inoperable .....		2,600	2,600
Building .....		20,700	5,000

<sup>1</sup> Based on average number of wells during year.

<sup>2</sup> All leased condensate produced in California in the East Central District.

<sup>3</sup> Output expressed in terms of gasoline production.

Table 12.—California: Production of crude petroleum, by month <sup>1</sup>  
(Thousand barrels)

Month	1974	1975
January -----	28,011	27,247
February -----	25,370	24,616
March -----	27,715	27,213
April -----	26,600	26,567
May -----	27,419	27,497
June -----	26,293	26,765
July -----	27,175	27,493
August -----	27,379	27,476
September -----	26,332	26,491
October -----	27,210	27,273
November -----	26,463	26,349
December -----	27,036	27,212
Total -----	323,003	322,199

<sup>1</sup> Based on average number of wells during year.

Table 13.—California: Production of crude petroleum and natural gas in 1975, by county <sup>1</sup>

County	Number of producing wells		Production		
	Oil (average)	Dry gas (maximum)	Petroleum (thousand barrels)	Natural gas (net)	
				Oil zones (million cubic feet)	Dry gas zones (million cubic feet)
Alameda -----	9	--	97	--	--
Butte -----	--	20	--	--	2,516
Colusa -----	--	99	--	--	10,783
Contra Costa -----	45	45	250	1,699	<sup>2</sup> 4,678
Fresno -----	2,546	4	10,334	6,345	514
Glenn -----	--	99	--	--	11,966
Humboldt -----	--	25	--	--	1,840
Kern -----	23,276	48	114,661	48,851	1,161
Kings -----	137	4	344	6,116	44
Los Angeles -----	6,067	2	93,065	75,601	79
Madera -----	--	12	--	--	3,677
Merced -----	--	3	--	--	227
Monterey -----	949	--	13,928	160	--
Orange -----	3,201	--	32,349	9,394	--
Riverside -----	13	3	69	32	136
Sacramento -----	--	98	--	--	<sup>3</sup> 18,739
San Benito -----	34	--	50	17	--
San Bernardino -----	42	--	148	47	--
San Joaquin -----	--	148	--	--	15,814
San Luis Obispo -----	247	--	1,540	1,062	--
San Mateo -----	13	--	28	1	--
Santa Barbara -----	1,755	8	17,058	17,946	<sup>4</sup> 3,723
Santa Clara -----	--	--	--	--	--
Solano -----	--	192	--	--	<sup>5</sup> 52,678
Sonoma -----	--	--	--	--	--
Stanislaus -----	--	147	--	--	19,732
Sutter -----	--	41	--	--	2,430
Tehama -----	--	14	40	--	733
Tulare -----	2,615	5	22,432	20,900	1,103
Ventura -----	--	83	--	--	20,926
Yolo -----	--	--	--	--	--
Total <sup>6</sup> -----	40,972	1,100	306,941	188,170	173,500

<sup>1</sup> Includes State offshore but not Federal offshore production.

<sup>2</sup> Also produced 14,318 barrels of condensate.

<sup>3</sup> Also produced 8,690 barrels of condensate.

<sup>4</sup> Also produced 33,617 barrels of condensate.

<sup>5</sup> Also produced 76,186 barrels of condensate.

<sup>6</sup> Data may not add to totals shown because of independent rounding.

Source: California Department of Conservation, Division of Oil and Gas.

Table 14.—California: Offshore oil and gas production in 1975, by field <sup>1</sup>

Field or area	Number of producing wells	Production	
		Oil (thousand barrels)	Gas (million cubic feet)
<b>State:</b>			
Algeria -----	1	30	78
Belmont -----	76	2,457	601
Carpinteria -----	61	1,452	1,731
Coal Oil Point -----	1	14	44
Elwood (offshore area) -----	14	42	198
Elwood, South -----	11	1,196	17
Huntington Beach (offshore area) -----	313	13,439	1,787
Montalvo, West (offshore area) -----	6	86	--
Newport, West (offshore area) -----	15	105	39
Point Conception (offshore area) -----	4	76	39
Rincon (offshore area) -----	69	399	210
Summerland -----	22	259	1,328
Torrance (offshore area) -----	42	458	617
Venice Beach (offshore area) -----	2	117	49
Wilmington (offshore area) -----	921	44,105	9,843
Total -----	1,558	<sup>2</sup> 64,236	16,581
<b>Federal:</b>			
Carpinteria -----	47	1,761	963
Dos Cuadras -----	123	13,673	5,021
Total -----	170	15,434	5,984
Grand total -----	1,728	79,670	22,565

<sup>1</sup> Includes production from offshore portions of onshore fields.<sup>2</sup> Data do not add to total shown because of independent rounding.

Source: California Department of Conservation, Division of Oil and Gas.

Table 15.—California: Oil and gas well drilling completions in 1975, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Butte -----	--	--	--	--	--	1	1	2,532
Colusa -----	--	--	2	--	--	--	2	12,956
Contra Costa -----	--	--	1	--	--	2	3	17,755
Fresno -----	24	--	4	1	--	8	37	157,510
Glenn -----	--	2	1	--	1	6	10	52,566
Humboldt -----	--	--	--	--	--	1	1	2,917
Kern -----	1,409	1	69	20	5	37	1,541	2,650,669
Kings -----	1	--	--	--	--	3	4	25,968
Los Angeles -----	58	--	2	--	--	5	65	225,711
Madera -----	--	--	--	--	--	1	1	5,889
Monterey -----	33	--	--	--	--	4	37	82,053
Orange -----	64	--	1	--	--	4	69	172,367
Riverside -----	3	--	10	--	--	--	4	6,494
Sacramento -----	--	3	10	--	1	6	20	112,261
San Bernardino -----	--	--	--	--	--	1	1	1,150
San Joaquin -----	--	1	1	--	1	5	8	68,008
San Luis Obispo -----	3	--	2	--	--	2	7	15,270
San Mateo -----	1	--	--	--	--	--	1	1,908
Santa Barbara -----	109	--	4	7	--	1	121	446,642
Solano -----	1	6	19	--	3	13	42	245,912
Stanislaus -----	--	--	--	--	--	1	1	7,121
Sutter -----	--	--	3	--	--	2	5	33,070
Tehama -----	--	--	1	--	--	3	4	18,271
Tulare -----	1	--	--	--	--	2	3	4,407
Ventura -----	54	--	4	6	--	6	70	359,011
Yolo -----	--	16	25	--	6	34	81	438,493
Other: Federal offshore -----	57	--	2	2	--	4	65	152,426
Total -----	1,818	29	152	36	17	152	2,204	5,319,337

<sup>1</sup> As defined by the American Petroleum Institute.

Source: American Petroleum Institute.

**Table 16.—California: Estimated proved recoverable reserves of crude oil**  
(Thousand barrels)

Reserves as of Dec. 31, 1974 -----	3,557,086
Revisions during 1975 -----	+ 394,411
Reserves as of Dec. 31, 1975 -----	3,647,537
Revisions from 1975 (percent) -----	2.5

Sources: American Petroleum Institute and American Gas Association.

According to the Annual Review of California Oil and Gas Production, 1975,<sup>12</sup> by the Conservation Committee of California Oil Producers, development oil and gas well drilling increased from 1,414 new wells completed in 1974 to 1,871 new wells completed in 1975. A combined total of 4.8 million feet of well was drilled in 1975. The average depth per well was 2,320 feet, reflecting a preponderance of shallow drilling. There were 205 exploratory wells drilled during 1975—30 fewer than in 1974. This compares with a peak of 651 in 1955. All wildcat drilling for 1975 accounted for 36 oil and 15 gas discoveries, including new fields, new pools, and outposts, compared with 27 oil and 12 gas for 1974.

In December the Federal Government opened bids for OCS (Outer Continental Shelf) tracts off southern California in the first offshore petroleum lease sale on the Pacific Coast since February 1968. Originally, 1,554,820 acres were scheduled for this oil and gas lease sale, but 295,240 acres in Santa Monica Bay and in an area seaward of San Miguel Island were withdrawn for environmental reasons. High bids totaled \$438 million for 70 of the 231 tracts offered, but high bids totaling \$21 million for 14 tracts were rejected, leaving a total of \$417 million accepted on 56 tracts encompassing 316,000 acres. Several significant exploratory wells were drilled on the Outer Continental Shelf during the year. Three delineation wells and a deeper pool test were drilled in the Santa Barbara Channel, and a stratigraphic test was drilled on the southeast end of Cortez Bank. No new-field wildcats were announced.

The moratorium on offshore drilling on State-owned land, in effect since 1969, was relaxed late in 1973 to permit drilling from existing facilities. Most of 1974 was spent in fulfilling specific conditions and

obtaining required government approvals. During 1975, one well was drilled and five wells were redrilled from offshore sites on State-owned land. The new well and one redrilled well are in Belmont offshore field, Orange County, and the remaining four redrilled wells are on piers in the offshore area of Rincon field, Ventura County.

Under the supervision of the California Division of Oil and Gas, the number of oilfield sumps hazardous or immediately dangerous to wildlife in California has been reduced from 4,065 in 1971 to 185 as of December 31, 1975. In addition, during the past 5 years, oil operators have cleaned up and filled hundreds of sumps considered nonhazardous to wildlife.

The Federal Environmental Protection Agency contracted with the California Division of Oil and Gas to make 600 spill prevention and countermeasure compliance inspections in California. Four college students were used by the Division to make the inspections and write the reports on oil storage facilities.

Exxon Corp. continued with the development phase of the Federal Hondo field of the Santa Ynez Unit. The first section of the conventional platform to be placed in 850 feet of water was scheduled for delivery to the Santa Barbara Channel in the spring of 1976, and the first production from the field was planned for 1977.

#### NONMETALS

**Asbestos.**—Production in 1975, all from two mines, compared with four active mines in 1974, was 3% below that of 1974, but value of output increased 6%. Atlas Asbestos Co., operating the Santa Cruz mine in Fresno County, and Union Carbide Corp., operating the Santa Rita mine in San Benito County, together supplied more than half of the State's output of crude asbestos in 1975. One of the Nation's principal asbestos-producing mines in past years, located near Copperopolis, Calaveras County, formerly operated by Pacific Asbestos Co. and closed since April 1974, was reopened late in 1975 by Calaveras Asbestos, Ltd. Following some rehabilitation work on the mill, debris dams, and settling basins, "shake down" operations got underway in mid-December 1975,

<sup>12</sup> Pages 41-51 of work cited in footnote 10.



and full production of grades 4, 5, 6, and 7 was expected by April 1976.

**Barite.**—Industrial Minerals Co., with operations at the Castella mine in Shasta County, continued to be the only producer of crude barite in the State. Output in 1975 was less than a quarter of that of 1974. A total of 38,396 tons of crude barite, valued at \$970,000, was processed by four companies: Wilbur Ellis Co., Fresno plant, Fresno County; Calcite Corp., Rosamond plant, Kern County; Industrial Minerals Co., Florin plant, Sacramento County; and FMC Corp., Industrial Chemical Division, Modesto plant, Stanislaus County. Of the crude barite processed, 32% was used for chemicals, 48% for well drilling, and the remaining 20% for other unspecified uses.

**Boron.**—All of the boron produced in the United States was supplied by operations in California, and as in past years, a large part of the output came from Kern County, with lesser quantities from San Bernardino and Inyo Counties. The State's total output was virtually the same as that of 1974, but the value of output increased 24% because of an increased demand which resulted in price rises during the year.

The State's major producer, U.S. Borax & Chemical Corp., which operates an open pit mine and a processing plant at Boron, Kern County, and which continued to be the world's largest source of boron, began a \$54 million expansion program at its Boron mine and plant to provide a 30% to 35% increase in output of its primary products, pentahydrate and decahydrate borax. The expansion program, which includes substantial changes to increase capacity in the ore mining and handling and the processing facilities, is planned for completion by mid-1977.

Kerr-McGee Chemical Corp. continued to produce boron minerals from Searles Lake brines at its plants at Trona and Westend, San Bernardino County. The company had purchased the plant at Westend late in 1974 from Stauffer Chemical Co. Work was progressing on a \$100 million, 1.3-million-ton-per-year soda ash plant at Trona begun in 1974.

Tenneco Oil Co. continued to produce colemanite and ulexite from an open pit mine, Kern Borate, in the Death Valley

National Monument near the site of the old U.S. Borax town of Ryan, Inyo County. The colemanite ore was trucked 30 miles to a company calcining plant just over the border at Lathrop Wells, Nev. The ulexite ore from the mine was trucked 100 miles to a railroad siding at Dunn, Calif., where it was upgraded and marketed.

No commercial progress was reported by the Hooker Chemical Corp., a subsidiary of the Occidental Petroleum Corp., on its feasibility study of recovery of boron minerals principally by solar evaporation from brines from the south end of Searles Lake.

**Bromine.**—Bromine output, all recovered by Kerr-McGee Chemical Corp. as a coproduct along with other minerals from Searles Lake brines at its Trona plant, San Bernardino County, declined 12% below that of 1974. It was used as elemental bromine and as methyl bromide.

**Calcium Chloride.**—National Chloride Co. of America and Leslie Salt Co. produced calcium chloride from wells in San Bernardino County. National Chloride's production was from its Bristol Lake plant and Leslie Salt's from its Amboy plant. Total output in 1975 was 13% below that of 1974, but value of production declined only 5% below that of 1974.

**Cement.**—Portland cement sales (shipments from mills) decreased 11%, and value of sales increased 10%, compared with the 1974 figures. Of the total sales, 69% was used by ready-mix concrete companies, 13% by concrete products manufacturers, 10% by building material dealers, 4% by highway contractors, 2% by other contractors, and the remaining 2% by Government agencies and other miscellaneous customers. Of the total shipments of finished portland cement, 89% was shipped in bulk, and 11% in containers. Of the 12 cement plants operated, four used the wet process, seven used the dry process, and one used both the wet and dry process in feeding the kilns. Natural gas was the predominant fuel used, but because of the possibility of an interruption in the supply of natural gas, at least five companies were experimenting with coal as a source of heat in their kilns. Raw materials consumed in manufacturing cement included 10,046,000 tons

Table 17.—California: Portland cement salient statistics  
(Short tons)

	Northern California		Southern California		California total	
	1974	1975	1974	1975	1974	1975
Number of active plants	4	4	8	8	12	12
Production	2,723,219	2,214,020	5,473,649	4,996,633	8,201,868	7,210,653
Shipments from mills:						
Quantity	2,906,897	2,362,202	5,355,058	4,963,671	8,961,055	7,395,873
Value	\$73,704,463	\$77,072,946	\$136,773,573	\$156,277,133	\$210,478,056	\$232,560,069
Stocks at mills, Dec. 31	233,577	217,768	281,079	271,123	514,666	486,591

Table 18.—California: Masonry cement salient statistics  
(Short tons)

	Northern California		Southern California		California total	
	1974	1975	1974	1975	1974	1975
Number of active plants	--	--	1	1	1	1
Production	--	--	2,579	299	2,579	299
Shipments from mills:						
Quantity	174	157	1,695	986	1,969	1,093
Value	\$5,221	\$6,575	\$36,506	\$27,307	\$41,727	\$33,876
Stocks at mills, Dec. 31	47	37	884	247	931	284

Table 19.—California: Portland cement shipments, by type of customer  
(Thousand short tons)

	Northern California		Southern California		California total	
	1974	1975	1974	1975	1974	1975
Building material dealers -----	247	184	543	440	790	624
Concrete product manufacturers --	363	266	746	628	1,109	894
Ready-mixed concrete -----	2,059	1,697	3,651	3,369	5,710	5,066
Highway contractors -----	180	94	206	264	336	358
Other contractors -----	70	101	113	190	183	291
Federal, State, and other government agencies -----	3	4	20	16	23	20
Miscellaneous, including own use.-----	34	17	77	57	111	74
Total <sup>1</sup> -----	2,907	2,362	5,355	4,964	8,262	7,327

<sup>1</sup> Data may not add to totals shown because of independent rounding.

of limestone, 212,000 tons of clay, 459,000 tons of shale, 69,000 tons of silica sand, 71,000 tons of iron ore, 350,000 tons of gypsum, and other miscellaneous materials.

California Portland Cement Co., which operates two cement-manufacturing plants in southern California, one at Colton and one at Mojave, and a third plant at Rillito, Ariz., completed coal-handling facilities at all three plants at a total expenditure of \$9.6 million. This enables the company to burn the lowest cost fuel available among natural gas, oil, petroleum coke, and coal. The company projects that by 1980 nearly 80% of the kiln fuel burned by the cement industry will be coal. The coal production from the company-owned Soldier Creek mine near Price, Utah, will be sufficient to supply all of the fuel requirements of the company's three cement plants and still have coal available for sale to other users. Cement is shipped in bulk from the Mojave plant to a newly acquired bulk distribution plant at Redwood City that serves the San Francisco Bay area. Cyanide mill tailings from the well-known Golden Queen mine near Mojave are used as a silica source for the cement manufactured at the Mojave plant.

Calaveras Cement Division of The Flintkote Co. made plans for the installation of coal handling, storage, and burning facilities at its two California cement plants at San Andreas and Redding. The projects, which will cost over \$4 million, will provide flexibility in fuel-burning facilities to enable the plants to use the most economical fuel available. At the San Andreas plant an extensive maintenance and improvement program was completed

in 1975 which will result in efficiencies and cost savings, according to company reports.

**Clay and Shale.**—Clay and shale output of 2.6 million tons valued at \$25 million was produced by 46 companies at 75 mines in 30 California counties in 1975. Unit value of production was \$9.48 per ton, compared with \$3.05 per ton in 1974. Of the total clay and shale sold or used, 84% was common clay, 9% kaolin, 4% fire clay, 3% bentonite, and less than 1% ball clay. Major uses of clay were in manufacturing cement, common brick, face brick, sewer pipe, roof tile, and pottery, and to produce lightweight aggregate for concrete block, structural concrete, or other products. A major quantity of kaolin and smaller quantities of bentonite and fire clay were exported. Seven companies, Lightweight Processing Co., Interpace Corp., Homestake Mining Co. (Port Costa), The Flintkote Co. (Calaveras Cement), Crestite Aggregate, Inc., Amcord, Inc. (River-side Cement), and Pacific Clay Products Co., operated 26 of the State's clay and shale mines and accounted for 59% of the State's total output.

Kaolin Corp. began shipping kaolin in slurrified form from its open pit clay mine in Ione, to the papermills of the Pacific Northwest, marking the first such application of this technique in that area. Prior to Kaolin Corp.'s Ione operation, the only domestic sources for the clay were Georgia and South Carolina. The much closer deposits in Ione have made practical the transport of this more usable and convenient form of kaolin.

During the year Interpace curtailed operations at its 100-year-old Lincoln plant to concentrate future production at the newer Corona plant. Plans were made to sell the Lincoln plant early in 1976.

**Diatomite.**—Production of diatomite, all from four operations in Santa Barbara County in 1975, decreased 16% in output tonnage and 15% in output value compared with 1974 production. Johns-Manville Products Corp.'s Celite Division and GREFCO, Inc., both in operation at Lompoc, continued to be the major producers. Airox, Inc., and Excel Minerals Co., with operations in Santa Barbara County, produced smaller quantities. Basalt Rock Co., Inc., and Pacific Clay Products Co., former producers in Napa and Tuolumne Counties, respectively, were inactive in 1975. Of the State's total production in 1975, 66% was sold for use for filtration, 19% as fillers, 5% as insulation, and 10% for other miscellaneous uses.

**Feldspar.**—Feldspar production was reported from two operations—Calspar Corp.'s Ord Mountain mine in San Bernardino County and Owens-Illinois, Inc.'s Pacific Grove mine in Monterey County. Output increased 21% in tonnage and 30% in value compared with that of 1974. Calspar mines feldspathic quartzite intermittently from several small open pits and trucks it 140 miles to the company's grinding plant at Santa Fe Springs in Los Angeles. The material has excellent ceramic properties and is marketed throughout southern California for use in making sanitary and enamel ware.

**Graphite (Manufactured).**—Output was 24% below that of 1974, but value of output was 3% above the 1974 figure. The producers included Great Lakes Carbon Corp. at its Rosamond and Antelope Valley plants, HITCO Co. at its Gardena plant, and Polycarbon, Inc., at its North Hollywood plant.

**Gypsum.**—California ranked first among the States in production of both crude and calcined gypsum. However, crude gypsum output declined 16% to 1.4 million tons and 5% in total value to \$6.3 million. Calcined gypsum output declined 8% to 1 million tons and 2% in total value to \$15.8 million. Crude gypsum was produced by four operations: United States Gypsum

Co. (Plaster City), Imperial County; Fannin-Superior Gypsum Co. (C. L. Fannin) and H. M. Holloway, Inc. (Lost Hills), Kern County; and Victor Material Co. (Amboy), San Bernardino County. Calcined gypsum was produced by seven operations: California Gypsum Products, Inc. (Pabco), Alameda County; The Flintkote Co. (Fremont), Butte County; Kaiser Gypsum Co., Inc. (Antioch) and National Gypsum Co. (Richmond), Contra Costa County; United States Gypsum Co. (Plaster City), Imperial County; and Kaiser Gypsum Co., Inc. (Long Beach) and National Gypsum Co. (Long Beach), Los Angeles County. Byproduct gypsum was marketed by four companies: Collier Carbon and Chemical Corp. (Nichols), Contra Costa County; Valley Nitrogen Products, Inc. (Helm), Fresno County; California Industrial Minerals (Taylors), Madera County; and Occidental Petroleum Corp. (Lathrop), San Joaquin County.

Byproduct gypsum from the manufacture of phosphoric acid continued to be used in California as a soil conditioner.

**Hydrogen Sulfide.**—Two companies, Phillips Petroleum Co. at its Avon petroleum refinery near Martinez and Shell Oil Co. at its Wilmington manufacturing complex near Carson, recovered and marketed hydrogen sulfide in 1975.

**Iodine.**—Deepwater Chemical Co. Ltd., used imported crude iodine to produce potassium, calcium, silver, and ammonium iodate, silver iodide, and resublimed iodine at its Compton plant, Los Angeles County. Total output of iodine products was considerably less than that of 1974.

**Iron Oxide Pigments.**—Pfizer, Inc., Mineral Pigments Div. produced both natural and manufactured iron oxide pigments at its Emeryville plant, Alameda County.

**Lime.**—Output of lime in 1975 was virtually the same as in 1974, but the value of output increased 25%. Ten firms operated 15 lime plants located in 12 counties. The leading producers with two-thirds of the total output were Kaiser Aluminum and Chemicals Corp., Natividad plant in Monterey County; Holly Sugar Co., Hamilton plant, in Glenn County, Brawley plant in Imperial County, Santa Ana plant in Orange County, and Tracy plant in San

Joaquin County; and Kerr-McGee Chemical Corp., Westend plant, in San Bernardino County. The Flintkote Co., U.S. Lime Division, operated lime plants at Richmond in Contra Costa County and at the City of Industry in Los Angeles County. Amstar Corp. produced lime at its Spreckels plant in Monterey County and at its Woodland plant in Yolo County. Ninety percent of the lime was produced as quicklime, and the remainder was produced as hydrate. Lime was used for precipitating magnesia from seawater, sugar refining, soil stabilization, refractories, and other miscellaneous minor applications.

**Lithium Compounds.**—Kerr-McGee Chemicals Corp., the State's only lithium producer, recovered lithium carbonate by flotation from dilithium sodium phosphate from Searles Lake brines at Trona, San Bernardino County. Output in 1975 was 41% above that of 1974. Although the Searles Lake operation is undergoing considerable expansion, there has been no increased capacity for lithium carbonate.

**Magnesium Compounds.**—Output declined 5% compared with that of 1974, but value of output increased 52% because of increased prices. The major producer, Kaiser Aluminum and Chemical Corp., Refractories Division, continued to recover magnesium from seawater and dolomite at its Moss Landing plant in Monterey County. Dead-burned dolomite from its Natividad quarry and plant was used to precipitate magnesium from seawater. Products from the Moss Landing plant were caustic-calcined magnesia, refractory magnesia, and magnesium hydroxide. Merck & Co., Inc., produced magnesium extra-light to heavy oxide, carbonate, hydroxide, and trisilicate from seawater bitterns in San Mateo County; FMC Corp., Inorganic Chemical Div., produced magnesium chloride crystal and brines in San Diego County.

**Perlite.**—Crude perlite production, sold or used, increased 62% compared with that of 1974. American Perlite Co., with operations at the Fish Springs quarry near Big Pine, Inyo County, continued to be the sole producer in the State. Six companies, four with plants in Los Angeles County and one each with plants in San Diego and Sonoma Counties, expanded

perlite. Of the total quantity of expanded perlite sold or used, 35% was used as a filter aid, 27% in horticultural uses, 12% as a cement and asphalt binder, 10% as plaster aggregate, and 16% for other miscellaneous uses.

**Phosphate Rock.**—An economic evaluation of the Pine Mountain phosphate deposit in the Los Padres National Forest, Ventura County, was completed and slated for publication in the December 1976 California Geology by the California Division of Mines and Geology. Phosphate rock mining from this deposit has been under consideration by the U.S. Bureau of Land Management (BLM) since the mid-1960's. The area of the deposit is environmentally sensitive, and governmental agencies and citizens are concerned because (1) the endangered California condor in the Sespe Condor Sanctuary may be disturbed, (2) haul trucks from the mine will increase traffic on State Highway 33, and (3) mining may affect the scenic beauty of the area. A 2-year prospecting permit for phosphates was issued to the United States Gypsum Co. in November 1964 by the BLM and extended for 3 years in October 1966. In April 1969 the company filed an application for a preference right lease. A draft environmental impact statement (EIS) on the proposed mining was submitted to the President's Council on Environmental Quality by the BLM in July 1971. A final EIS was prepared and scheduled for release in June 1976. Public hearings were held at each stage of the process.

A conditional permit for phosphate mining in Santa Barbara County was awarded in 1975 by BLM to the Cuyama Phosphate Corp. on a 40-acre site within a 1,609-acre leased area near New Cuyama in the foothills on the inner edge of the Los Padres National Forest. The company planned to sell the phosphate rock as mined without processing to farmers in the region as a soil supplement or additive.

**Potassium Salts.**—Output in 1975, all from the Kerr-McGee Chemical Corp. operation at Trona, San Bernardino County, was virtually the same as in 1974. Marketed products were potassium sulfate, which contained 51.4%  $K_2O$  equivalent, and standard, coarse, and chemical muriate, which contained 61.1%, 61.2%, and 63.1%  $K_2O$  equivalent, respectively.

**Pumice.**—Combined output of crude and prepared pumice, pumicite (volcanic ash), and scoria (volcanic cinder) decreased 62% compared with that of 1974, and value of output decreased 14%. Production was recorded from 14 counties. More than three-quarters of the output of crude and prepared pumice, pumicite, and scoria came from four counties, Lake, San Ber-

nardino, Shasta, and Siskiyou. Other major producing counties were Inyo, Modoc, Mono, and Plumas. The material was consumed for road construction (33% of the total), landscaping (25%), concrete aggregate (23%), concrete admixtures (7%), railroad ballast (3%), abrasives (1%), and other miscellaneous uses (8%).

Table 20.—California: Pumice sold or used by producers in 1975, by county<sup>1</sup>

County	Crude		Prepared		Total	
	Quantity (short tons)	Value	Quantity (short tons)	Value	Quantity (short tons)	Value
Inyo	--	--	25,000	\$187,500	25,000	\$187,500
Kern	--	--	1,825	W	1,825	W
Lake	--	--	W	W	W	W
Lassen	180	\$180	--	--	180	180
Madera	--	--	W	W	W	W
Modoc	26,524	18,919	--	--	26,524	18,919
Mono	--	--	W	W	W	W
Napa	300	900	--	--	300	900
Plumas	7,175	9,686	--	--	7,175	9,686
San Bernardino	--	--	W	W	W	W
Shasta	W	W	W	W	W	W
Siskiyou	27,531	34,273	42,236	152,082	69,767	186,305
Tehama	W	W	--	--	W	W
Ventura	W	W	--	--	W	W
Undistributed	22,317	56,249	194,799	2,302,612	217,116	2,358,861
Total	84,027	120,207	263,860	2,642,144	347,887	2,762,351

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

<sup>1</sup> Includes pumicite, scoria, volcanic cinder, and tuff.

**Salt.**—Salt output declined 11%, and value of output increased 7% compared with that of 1974. All of the salt sold or used in California in 1975 was produced as evaporated salt except for a small quantity of rock salt produced by Leslie Salt Co. in San Bernardino County and small quantities produced as brine in Imperial and San Bernardino Counties. All of the salt produced by evaporation was recovered by using the solar evaporation process except for a small quantity recovered by the vacuum pan process by Leslie Salt in Alameda County. Leslie Salt, with salt recovery operations in Alameda, Napa, San Bernardino, and San Mateo Counties, was the State's leading salt producer. Other major salt producers were Western Salt Co. with operations in San Diego and Kern Counties and Occidental Petroleum Chemical Co., Pacific Salt and Chemical Co., and Standard Salt Co. with operations in San Bernardino County. Other smaller producers were Oliver Brothers Salt Co. in Alameda County and

the Metropolitan Water District in San Bernardino County.

**Sand and Gravel.**—California continued to be the Nation's leading sand and gravel producer by a large margin with an output nearly 90% greater than that of Michigan, the second largest producer. Output in California in 1975 declined 16% in tonnage produced and 5% in total value compared with the 1974 figures. Production was reported from 55 of the State's 58 counties, from a total of 389 mines, and by 301 companies. The greatest activity continued to be in major urban expansion areas of Los Angeles (Los Angeles, Orange, San Bernardino, and Riverside Counties), San Francisco (Alameda, Contra Costa, and Santa Cruz Counties), Sacramento (Sacramento and Yolo Counties), San Diego (San Diego County), and Ventura-Santa Barbara (Ventura and Santa Barbara Counties). These 12 counties accounted for 72% of the State's total sand and gravel production in 1975. Output from the State's six leading producing

**Table 21.—California: Construction and industrial sand and gravel sold or used by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand .....	41,035	64,373	35,006	60,809
Gravel .....	52,371	90,012	45,414	82,331
Unprocessed: Sand and gravel .....	9,600	9,046	6,772	6,680
Industrial:				
Sand .....	2,185	12,231	1,238	8,552
Gravel .....	--	--	15	41
Total .....	105,191	175,662	88,445	158,463

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

**Table 22.—California: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction .....	29,346	49,079	23,995	49,697
Highway and bridge construction .....	5,727	9,165	2,897	5,337
Other construction (dams, waterworks, airports, etc.) .....	2,643	4,274	2,672	4,319
Concrete products (cement blocks, brick, pipe, etc.) .....	5,942	9,954	6,426	11,123
Bituminous paving (asphalt and tar paving) .....	11,148	18,659	11,361	22,576
Roadbase and subbase .....	8,150	12,993	8,158	13,712
Fill .....	4,970	6,525	3,634	4,538
Other .....	725	1,292	1,825	4,123
Unprocessed:				
Roadbase and subbase .....	3,394	4,874	1,926	2,856
Fill .....	3,612	2,904	3,192	2,844
Other .....	--	--	323	237
Industrial sand and gravel .....	2,185	12,231	1,252	8,592
Total <sup>1</sup> .....	77,842	131,951	67,669	129,953

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 23.—California: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction	1,769	2,815	1,510	3,175
Highway and bridge construction	2,386	3,696	1,742	3,344
Other construction (dams, waterworks, airports, etc.)	446	939	1,098	2,356
Concrete products (cement blocks, brick pipe, etc.)	740	1,123	144	288
Bituminous paving (asphalt and tar paving)	7,585	13,587	7,457	15,942
Roadbase and subbase	10,988	19,700	6,735	11,511
Fill	718	923	681	753
Other	123	211	82	198
Unprocessed:				
Roadbase and subbase	749	235	837	495
Fill	1,845	1,033	302	201
Other	--	--	186	77
Total	27,349	44,262	1 20,776	38,295

<sup>1</sup> Data do not add to total shown because of independent rounding.

Table 24.—California: Industrial sand and gravel sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Sand:				
Abrasives	W	W	W	W
Molding	W	W	W	W
Glass	1,554	9,087	902	6,742
Blast	297	989	243	1,038
Grinding and polishing	14	88	W	W
Engine	W	W	W	W
Filter	W	W	--	--
Filtration	W	W	W	W
Foundry	W	W	--	--
Oil (Hydrofrac)	W	W	--	--
Other uses	320	2,117	93	772
Gravel: Other	--	--	14	41
Total	2,185	12,231	1,252	1 8,592

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

<sup>1</sup> Data do not add to total shown because of independent rounding.



Table 25.—California: Construction sand and gravel aggregate sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Alameda	12	10,106	16,267	10	7,835	15,109
Alpine	1	4	3	1	--	--
Amador	4	708	3,660	4	650	4,500
Butte	7	942	1,563	9	1,054	2,433
Calaveras	W	W	W	3	100	W
Colusa	W	W	W	2	W	W
Contra Costa	6	1,480	3,336	6	1,073	2,035
Del Norte	2	174	298	2	76	172
El Dorado	4	86	141	5	56	151
Fresno	8	4,851	6,897	9	3,652	6,297
Glenn	5	805	983	5	558	1,118
Humboldt	8	481	763	10	749	2,173
Imperial	8	617	467	18	548	440
Inyo	5	147	250	5	153	441
Kern	12	2,249	3,788	13	1,965	4,217
Lake	9	2,170	1,709	8	265	572
Lassen	6	292	425	2	33	87
Los Angeles	20	20,310	31,047	19	17,245	28,179
Madera	--	--	--	1	W	W
Mariposa	3	27	46	2	18	45
Mendocino	8	354	1,291	6	230	533
Merced	18	1,161	1,826	12	856	1,605
Modoc	4	57	59	4	70	90
Mono	5	76	109	3	W	W
Monterey	9	794	1,665	11	616	1,613
Napa	3	45	89	2	W	W
Nevada	4	762	1,761	4	668	1,572
Orange	14	8,322	12,078	13	6,206	10,215
Placer	4	575	1,227	4	506	1,380
Plumas	4	104	195	4	121	341
Riverside	15	4,705	7,129	13	3,636	5,065
Sacramento	9	5,616	12,736	8	4,435	7,649
San Benito	4	287	661	6	487	964
San Bernardino	17	5,096	7,441	18	5,477	8,337
San Diego	31	7,311	16,137	34	7,712	18,711
San Francisco	W	W	W	1	W	W
San Joaquin	5	2,794	5,624	7	1,908	4,384
San Luis Obispo	4	276	704	4	134	481
San Mateo	W	W	W	1	W	W
Santa Barbara	8	1,554	2,693	9	1,770	4,012
Santa Clara	5	1,247	1,585	8	963	2,301
Santa Cruz	6	2,646	3,306	6	2,294	3,869
Shasta	14	795	1,146	14	736	1,179
Sierra	--	--	--	1	5	13
Siskiyou	13	740	1,580	5	293	661
Solano	1	5	1	1	W	1
Sonoma	9	3,315	5,581	9	2,249	4,719
Stanislaus	9	1,574	2,527	12	1,965	3,297
Sutter	1	66	83	1	54	78
Tehama	4	91	163	6	171	160
Trinity	6	111	269	4	W	W
Tulare	4	1,337	1,498	4	1,291	2,526
Tuolumne	1	51	W	--	--	--
Ventura	8	3,784	4,916	8	3,943	6,117
Yolo	7	2,829	5,131	8	2,453	4,565
Yuba	3	600	1,138	3	441	1,180
Various	--	--	--	1	15	4
Undistributed	9	1,209	2,271	--	708	2,179
Total <sup>1</sup>	386	105,191	176,213	389	88,445	168,248

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

<sup>1</sup>Data may not add to totals shown because of independent rounding.

counties, Los Angeles, Alameda, San Diego, Orange, San Bernardino, and Sacramento, listed in descending order of output, accounted for 55% of the State's total sand and gravel output in 1975.

More than three-quarters (76.5%) of the total quantity of construction and industrial sand and gravel sold or used by producers in California in 1975 was sold or used commercially by producers. The remainder was sold or used by producers for publicly funded projects. Processed sand and gravel was sold or used for concrete aggregate, bituminous paving, roadbase and subbase, fill, and other miscellaneous uses. Unprocessed material was sold or used for roadbase and subbase, fill, and other miscellaneous uses. Industrial sand was sold or used by producers principally as glass and blast sand. Twelve companies with a total of 65 operations produced 51% of the construction sand and gravel output in the State in 1975. Five leading producers of construction sand and gravel—Conrock Co. (19 operations), Kaiser Sand and Gravel Co. (6), Livingston-Graham, Inc. (4), Owl Rock Products Co. (7), and Lone Star Industries (10) in descending order of output—accounted for 36% of the State's construction sand and gravel output in 1975. Five leading producers of industrial sand and gravel—Owens-Illinois, Inc. (2 operations), Ottawa Silica Co. (1), Monterey Sand Co., Inc. (2), Santa Cruz Aggregate Co., Inc. (1), and Lone Star Industries (2), in descending order of output—accounted for 81% of the State's industrial sand and gravel output in 1975.

Five counties, Los Angeles, Alameda, San Diego, Orange, and San Bernardino, were the leading producers, in descending order of output, of sand and gravel produced and sold or used in the State in 1975 and together accounted for over 50% of the State's total output.

**Sodium Compounds.**—Combined production of sodium carbonate (soda ash) and sodium sulfate (salt cake) increased only 2%, but value of output increased 51% compared with that of 1974 because of increased prices. Kerr-McGee recovered both of these products from Searles Lake brines at its Trona and Westend plants in San Bernardino County. U.S. Borax and Chemical Corp. recovered salt cake at its Boron plant in Kern County.

**Stone.**—Output of stone in 1975 decreased 27% and value decreased 21% compared with the 1974 figure. The number of quarries operated increased from 462 in 1974 to 536 in 1975. Stone was produced from 52 of the State's 58 counties. San Bernardino, Santa Clara, Kern, Alameda, Contra Costa, Sacramento and Riverside Counties, in descending order of output, were the leading stone-producing counties. Virtually all of the stone output was produced as crushed and broken stone. The remainder was dimension stone produced principally as rough blocks and as dressed architectural stone.

About half of the crushed and broken stone output was limestone and dolomite, with the balance about equally divided between granite, traprock, sandstone, and other types of stone. About one-third (34%) of the crushed and broken stone output was used for cement manufacturing. Other major uses included uses as dense-graded roadbase (21% of the total), bituminous aggregate (11%), concrete aggregate (8%), other construction aggregate and roadstone (7%), fill (4%), riprap and jetty stone (3%), and miscellaneous (12%). Together, 19 quarries, each with output greater than 500,000 tons for the year, produced 53% of the State's total stone output. Most (81%) of the stone produced was shipped to the market by truck. The remainder was transported by railroad, waterway, and other unspecified methods.

Table 26.—California: Stone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975			Kind of stone produced in 1975
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Alameda	6	3,551	4,487	5	1,689	2,496	Sandstone, traprock.
Butte	6	197	865	7	644	1,353	Other stone.
Colusa	1	222	178	2	8	20	Sandstone, other stone.
Contra Costa	4	2,025	4,929	5	1,485	3,722	Sandstone, traprock, other stone.
Del Norte	6	372	814	6	463	1,103	Do.
El Dorado	5	361	1,861	6	366	2,068	Limestone, other stone.
Glenn	—	—	—	2	116	115	Other stone.
Humboldt	3	—	—	26	124	221	Granite.
Imperial	1	(1)	(1)	11	285	715	Dolomite, other stone.
Inyo	8	220	1,389	11	255	4,564	Limestone, quartzite, other stone.
Kern	7	2,594	4,660	9	2,236	4,564	Other stone.
Lassen	2	(1)	(1)	1	(1)	1,926	Granite, other stone.
Los Angeles	86	697	1,818	43	357	1,926	Do.
Madera	19	2,861	7,962	3	—	—	Slate, sandstone, other stone.
Mariposa	3	2	51	4	(1)	9	Other stone.
Mendocino	—	—	—	1	3	29	Limestone, traprock.
Merced	2	(1)	(1)	6	23	59	Sandstone, traprock.
Modoc	5	12	17	7	19	17	Other stone.
Mono	5	22	43	1	19	45	Dolomite, granite, other stone.
Monterey	3	—	—	9	810	1,880	Sandstone, quartzite, other stone.
Nevada	10	12	24	18	146	376	Granite, other stone.
Placer	7	5	—	8	—	—	Granite, marble, other stone.
Plumas	13	46	197	9	67	269	

Riverside	15	1,509	2,859	19	1,097	2,885	Other stone.
Sacramento	6	W	W	18	1,406	3,889	Limestone, granite.
San Bernardino	99	8,207	17,308	128	7,184	15,618	Dolomite, limestone, granite, quartz, quartzite, traprock, other stone.
San Diego	21	1,259	3,594	15	810	2,592	Granite, other stone.
San Joaquin	1	W	W	1	2	2	Other stone.
San Mateo	7	954	2,155	6	421	946	Limestone, granite, sandstone, traprock, other stone.
Santa Barbara	12	16	98	13	87	265	Limestone, sandstone, granite, sandstone, other stone.
Santa Clara	10	5,904	9,250	12	4,194	7,177	Limestone, granite, sandstone, traprock, other stone.
Santa Cruz	6	1,015	2,141	6	908	1,912	Limestone, granite.
Sierra	7	156	274	2	27	61	Do.
Siskiyou	7	W	W	4	123	290	Sandstone, traprock.
Solano	10	627	1,345	7	1,095	1,695	Sandstone, shell, traprock, other stone.
Sonoma	7	81	93	10	594	1,196	Other stone.
Tehama	4	W	W	8	110	136	Limestone, traprock, other stone.
Tulare	4	W	W	8	189	341	Dolomite, granite, marble, sandstone, other stone.
Tuolumne	17	536	1,706	18	258	513	Do.
Ventura	8	249	678	6	97	321	Granite, sandstone, traprock, other stone.
Yolo	1	W	W	2	13	37	Other stone.
Yuba	5	174	422	3	82	94	Traprock.
Undistributed <sup>2</sup>	65	11,643	22,322	64	5,194	12,275	
Totals	482	45,709	91,891	536	33,152	72,740	

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

<sup>1</sup> Less than 1/2 unit.

<sup>2</sup> Includes Anaador, Calaveras, Fresno, Lake, Marin, Napa, Orange, San Benito, San Luis Obispo, Shasta, and Trinity Counties, and counties indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 27.—California: Stone sold or used by producers, by kind  
(Thousand short tons and thousand dollars)

Kind of stone	1974		1975	
	Quantity	Value	Quantity	Value
<b>Dimension:</b>				
Limestone and dolomite -----	W	W	3	W
Granite -----	45	946	6	377
Sandstone, quartz, and quartzite -----	1	16	( <sup>1</sup> )	11
Slate -----	W	W	( <sup>1</sup> )	9
Traprock -----	( <sup>1</sup> )	3	( <sup>1</sup> )	1
Other stone <sup>2</sup> -----	321	1,207	5	93
<b>Total<sup>3</sup> -----</b>	<b>368</b>	<b>2,172</b>	<b>11</b>	<b>490</b>
<b>Crushed and broken:</b>				
Limestone and dolomite -----	19,926	38,191	16,576	36,532
Granite -----	7,634	16,694	4,300	10,378
Marble <sup>4</sup> -----	107	400	15	174
Sandstone, quartz, and quartzite -----	4,854	10,497	3,451	7,856
Traprock -----	6,101	11,174	4,390	8,617
Other stone -----	6,718	12,763	4,409	8,693
<b>Total<sup>3</sup> -----</b>	<b>45,341</b>	<b>89,719</b>	<b>33,141</b>	<b>72,251</b>

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

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Data also include limestone, dolomite, and slate.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

<sup>4</sup> Data include shell.

Table 28.—California: Stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Dimension:</b>				
<b>Rough stone:</b>				
Rough blocks -----	5	391	3	224
Construction -----	356	1,453	4	80
Flagging -----	3	60	W	W
Other rough stone -----	( <sup>1</sup> )	1	<sup>2</sup> 1	<sup>2</sup> 15
<b>Dressed stone:</b>				
Architectural -----	2	164	2	124
Construction -----	( <sup>1</sup> )	2	--	--
Flagging -----	W	W	( <sup>1</sup> )	14
Roofing slate (architectural) -----	W	30	--	--
Flooring slate -----	( <sup>1</sup> )	1	--	--
Other dressed stone <sup>3</sup> -----	2	70	1	34
Total <sup>4</sup> -----	368	2,172	11	490
<b>Crushed and broken:</b>				
Bituminous aggregate -----	6,208	12,496	3,525	9,483
Concrete aggregate -----	4,546	7,052	2,633	5,162
Dense-graded roadbase stone -----	7,690	12,948	6,971	13,982
Macadam aggregate -----	254	720	299	763
Surface treatment aggregate -----	193	295	124	213
Other construction aggregate and roadstone -----	3,246	7,114	2,164	4,395
Agricultural purposes <sup>5</sup> -----	155	884	150	1,057
Bedding material -----	--	--	103	185
Cement manufacture -----	13,716	21,340	11,238	18,801
Fill -----	3,637	8,404	1,460	2,283
Glass manufacture -----	363	2,371	292	2,128
Lime manufacture -----	607	1,598	441	1,025
Mineral fillers, extenders, whiting <sup>6</sup> -----	385	3,048	381	3,200
Riprap and jetty stone -----	1,945	4,713	1,126	2,752
Filter stone -----	388	1,076	73	206
Sugar refining -----	180	729	262	1,047
Terrazzo and exposed aggregate -----	103	727	110	781
Roofing aggregates, chips, granules -----	741	1,405	677	1,852
Other uses <sup>7</sup> -----	983	2,799	1,112	3,437
Total <sup>4</sup> -----	45,341	89,719	33,141	72,251
Grand total <sup>4</sup> -----	45,709	91,891	33,152	72,740

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

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Data include flagging.

<sup>3</sup> Includes stone for monumental purposes and curbing (1975).

<sup>4</sup> Data may not add to totals shown because of independent rounding.

<sup>5</sup> Includes agricultural limestone, agricultural marl and other soil conditioners, and poultry grit and mineral food.

<sup>6</sup> Includes whiting or whiting substitute and other fillers or extenders. No production for asphalt filler reported in this category.

<sup>7</sup> Includes stone used for railroad ballast, manufactured fine aggregate (stone sand), dead-burned dolomite, ferrosilicon, flux stone, refractory stone, building products, chemicals, and drain fields (1975).

**Sulfur.**—Byproduct sulfur was recovered at 14 petroleum refineries—4 in Contra Costa County, 9 in Los Angeles County, and 1 in Solano County. The Union Oil Co. of California Oleum refinery in Contra Costa County was the leading producer, followed by the Mobil Oil Corp. Torrance refinery, the Standard Oil Co. of California El Segundo refinery, and the Texaco Inc. Long Beach refinery, all in Los Angeles County. Production of sulfur was 395,000 long tons in 1975 compared with 394,000 long tons in 1974. Sales totaling 375,000 long tons valued at \$6.9 million were recorded.

**Talc, Soapstone, and Pyrophyllite.**—Mine production declined 7% in total tonnage and 5% in value of output, compared with that of 1974. Production was reported from 14 mines—1 in El Dorado County, 8 in Inyo County, and 5 in San Bernardino County. Major producers in the State were the Johns-Manville Warm Springs mine; the Cyprus Mines Corp. Panamint mine, and the Pfizer, Inc., Death Valley, Eclipse, and Bonnie mines—all located in the Death Valley National Monument in Inyo County. These five mines accounted for 87% of the State's total talc output in 1975. Other smaller talc pro-

ducers were the Pfizer, Inc., Acme and Apex mines and the American Olean Tile Co. Yucca Grove mine—all in San Bernardino County. Interpace Corp. produced pyrophyllite from its Victorite mine in San Bernardino County, and Commercial Minerals Co. produced soapstone from the Doc's mine in El Dorado County. Mined material was sold to grinders or consumers, or used by producers for grinding. Ground and prepared material was used in ceramics, paints, refractories, paper, and other miscellaneous uses. Some of the products were exported.

**Vermiculite.**—Production and sales of exfoliated vermiculite, derived from crude out-of-State vermiculite produced in Montana and South Carolina, declined 36%, but total value of the product increased 16% because of the unit price increase. W. R. Grace & Co. with exfoliation plants at Newark (Alameda County), Los Angeles (Los Angeles County), and Santa Ana (Orange County) and La Habra Products, Inc., with a plant at Anaheim (Orange County) were the State's producers in 1975.

Consumption by end use was 41% for concrete aggregate, 22% for fertilizer car-

rier, 13% for fireproofing, 5% each for plaster aggregate and soil conditioning, 2% for loose fill insulation, and the remaining 12% for other miscellaneous uses.

#### METALS

**Copper.**—Copper production was reported from seven mines in five counties, but most of it was produced by the Union Carbide Corp. as a byproduct of mining tungsten ore at the Pine Creek mine in Inyo County. Smaller quantities were recovered from zinc ore produced from the Darwin mine in Inyo County by Montecito Mining Co., from copper ore produced from Plumas County by R. Clark and M. Gavard, from gold ore produced from the Boomerang dump in San Bernardino County by Great Western Gold Co., from gold ore and copper precipitate produced from the Bagdad Chase mine in San Bernardino County by Clark Mining & Exploration Co., from gold-silver ore produced from the Eva Belle mine in Mono County by Bordon Lavigne & Sons, and from gold-silver ore produced from the Zaca mine in Alpine County by Claude B. Lovestedt.

Table 29.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing <sup>1</sup>			Material sold or treated <sup>2</sup> (short tons)		Gold		Silver	
	Lode	Placer	7	6,941	Troy ounces	Value	Troy ounces	Value	Total value
1978, total	8	7	3,647	\$356,712	55,837	\$142,969			
1974, total	10	4	5,049	806,528	41,894	197,324			
1975:									
Del Norte	--	1	7	1,130	--	--	--	--	--
Fresno	--	--	320	51,676	45	189	--	--	--
Merced	--	--	86	5,652	2	9	--	--	--
Plumas	2	--	298	13,242	237	1,048	--	--	--
San Joaquin	--	--	133	21,478	10	44	--	--	--
Shasta	1	--	3,000	129,838	329	1,454	--	--	--
Sierra	2	--	1,02	137,106	215	951	--	--	--
Stanislaus	--	--	54	87,850	48	212	--	--	--
Trinity	--	2	15	2,422	--	--	--	--	--
Tulare	--	--	121	19,540	14	62	--	--	--
Undistributed <sup>3</sup>	5	3	25,800	1,081,336	78,857	348,543	--	--	--
Total	10	6	29,200	1,551,270	79,757	352,527	--	--	--
		Copper		Lead		Zinc		Total	
Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1973, total	\$439,696	44	\$14,320	20	\$8,229	961,944			
1974, total	299,800	35	15,706	8	5,530	1,324,988			
1975:									
Del Norte	--	--	--	--	--	1,130	--	--	--
Fresno	--	--	--	--	--	51,676	--	--	51,875
Merced	--	--	--	--	--	5,652	--	--	5,661
Plumas	4,432	--	--	--	--	13,242	--	--	18,722
San Joaquin	--	--	--	--	--	21,478	--	--	21,522
Shasta	--	--	--	--	--	129,838	--	--	131,292
Sierra	--	--	--	--	--	137,106	--	--	138,057
Stanislaus	--	--	--	--	--	87,850	--	--	88,062
Trinity	--	--	--	--	--	2,422	--	--	2,432
Tulare	--	--	--	--	--	19,540	--	--	19,602
Undistributed <sup>3</sup>	438,719	56	28,186	206	160,763	2,055,352			
Total	441,151	66	28,186	206	160,763	2,533,897			

<sup>1</sup> Operations from which gold and silver are recovered as byproducts from sand and gravel operations not counted as producing mines.

<sup>2</sup> Does not include gravel washed.

<sup>3</sup> Alpine, Inyo, Los Angeles, Mono, Sacramento, San Bernardino, and Yuba Counties combined to avoid disclosing individual company confidential data.

<sup>4</sup> Data do not add to total shown because of independent rounding.



Table 30.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
<b>Lode:</b>					
Amalgamation -----	999	248	--	--	--
Cyanidation -----	29	8	--	--	--
Smelting of concentrates <sup>1</sup> -----	3,480	73,780	337	51	202
Direct smelting of ore and copper precipitates <sup>2</sup> -----	238	5,570	6	14	4
Total lode material <sup>3</sup> -----	4,746	79,606	344	66	206
<b>Placer</b> -----	4,860	151	--	--	--
<b>Grand total<sup>3</sup></b> -----	<b>9,606</b>	<b>79,757</b>	<b>344</b>	<b>66</b>	<b>206</b>

<sup>1</sup> Includes byproduct recovery from tungsten ore.

<sup>2</sup> Combined to avoid disclosing individual company confidential data.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 31.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by class of ore or other source material

Source	Number of mines <sup>1,2</sup>	Material sold or treated <sup>3</sup> (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Gold and gold-silver <sup>4</sup>	8	26,816	4,650	35,654	6	24	9
Copper, zinc, and tungsten <sup>4</sup>	2	2,883	96	48,952	338	42	197
Total <sup>6</sup>	10	29,199	4,746	79,606	343	66	206
Other lode material: Copper precipitates	1	1	--	--	(7)	--	--
Total lode material <sup>6</sup>	10	29,200	4,746	79,606	344	66	206
Placer	6	--	4,860	151	--	--	--
Grand total	16	29,200	9,606	79,757	344	66	206

<sup>1</sup> Operations from which gold and silver are recovered as byproduct from sand and gravel operations and copper recovered as byproduct from tungsten operations are not counted as producing mines.  
<sup>2</sup> Detail will not necessarily add to totals because some mines produce more than one class of material.  
<sup>3</sup> Does not include gravel washed.  
<sup>4</sup> Combined to avoid disclosing individual company confidential data.  
<sup>5</sup> Excludes tungsten ore tonnage.  
<sup>6</sup> Data may not add to totals shown because of independent rounding.  
<sup>7</sup> Less than 1/2 unit.

**Gold.**—Gold production increased 90% and total value of output rose 92% compared with that of 1974. About half of the reported gold production came from lode mines and half came from placer mines. Most of the gold produced from lode mines came from gold ore produced from the Boomerang dump in San Bernardino County by Great Western Gold Co., from gold-silver ore produced from the Zaca mine in Alpine County by Claude B. Lovestedt, from gold ore produced from the Washington mine in Shasta County by American Primary Resources Co., and from gold ore produced from the Oriental mine in Sierra County by Dickey Exploration Co. Most of the gold was recovered from the ore by smelting of concentrates, but some was recovered by amalgamation, by cyanidation, by direct smelting of ore, and from copper precipitates.

A large part of the State's placer gold production in 1975 was recovered by bucketline dredging at Hammonton near Marysville in Yuba County by Yuba Goldfields, Inc. The old No. 21 dredge, which was one of several dredges operated on this 10,460-acre property along the Yuba River by Yuba Consolidated Goldfields, Inc., during the period 1905 to 1968 when more than \$100 million of gold was recovered, was renamed "Lisa" and placed back in operation in April 1975 by the new owners, Yuba Goldfields, Inc. It was operated by Yuba Goldfields as a test throughout the remainder of the year. Most of the remainder of the State's placer gold production in 1975 was recovered from 11 operations in 8 counties which produced gold as a byproduct of washing sand and gravel to produce aggregate. Smaller quantities of gold were recovered from stream and bench gravel by numerous individuals using small suction dredges and hydraulic equipment. An undetermined quantity of unreported gold is produced by individuals working full time or by amateur weekend prospectors who retain the gold or sell it to brokers who in turn sell it to tourists as souvenirs.

**Iron Ore and Concentrate.**—Usable iron ore shipments to consumers, which include direct-shipping ore, concentrates, and agglomerates, declined 16% compared with those of 1974, but total value of shipments increased 7% because of increased prices. The major producer was Kaiser Steel

Corp. at its Eagle Mountain mine in Riverside County. According to the company's annual report to the stockholders, 2.9 million tons of concentrates and agglomerates was shipped from the mine to the company's steelwork at Fontana, San Bernardino County. In addition, California Portland Cement Co. produced a small quantity of direct-shipping ore at the Baxter mine in San Bernardino County for use in cement manufacturing. Standard Slag Co. produced concentrates from ore from the Beck mine in San Bernardino County for export to Japan.

**Iron and Steel.**—Consumption of pig iron in California in 1975 was 1,969,000 tons, including molten pig iron used for molds and direct castings. Raw steel production was 3,351,000 tons, a 22% decline compared with that of 1974.

In midyear Kaiser Steel Corp. announced plans for a \$150 million program to modernize steelmaking facilities at its Fontana mill contingent upon securing financing commitments of \$100 million and gaining the necessary permits from regulatory agencies. The program calls for a new basic oxygen steelmaking shop to replace the open hearth shop which began operations in 1943. The new basic oxygen steelmaking shop will contain two 200-ton vessels with an annual capacity of 2.3 million ingot tons, which will result in a capacity increase of 200,000 tons annually, or about 6%. The present basic oxygen shop, which began operations in 1958, will be operated at a lower rate of production in order to utilize the new low-cost oxygen shop to capacity. Ingot capacity will be limited by the availability of hot metal from the blast furnaces and the rolling capacity of the finishing facilities.

**Lead and Zinc.**—Production of lead and zinc, amounting to a combined value of \$189,000, was relatively insignificant to the State's total value of mineral production in 1975. Most of the lead-zinc production came from the Montecito Mining Co. operation at Darwin, Inyo County; the Gordon Lavine and Sons operation at the Eva Belle mine, Mono County; the Great Western Gold Co. operation at the Boomerang dump, San Bernardino County; and the Claude B. Lovestedt operation at the Zaca mine, Alpine County.

**Mercury.**—Mercury production in 1975 declined drastically compared with that of

1974. Production was reported from eight mines: Wall Street (operated by Austin-Kinyon) in Lake County; Aetna Extension (L. Lindblom), Knoxville (Morgan North Mine Management), Manhattan-One Shot (One-Shot Mining), and Oat Hill (W. T. Kritikos) in Napa County; Buena Vista (Buena Vista Mines, Inc.) in San Luis Obispo County; and Guadalupe (Guadalupe Mining Co.) and New Almaden (Santa Clara Quicksilver Co.) in Santa Clara County.

Mercury price instability plagued the industry during 1975. As the year began, the New York price ranged from \$190 to \$225 per flask and the London price from \$165 to \$185 per flask. By yearend, average prices had plummeted to about \$123 per flask in New York and about \$77 per flask in London.

**Molybdenum.**—Production, recorded as shipments of combined molybdenum oxide and sulfide concentrates, recovered as a byproduct of treating tungsten ore from the Pine Creek mine near Bishop, Inyo County, by Union Carbide Corp., was about one-third that of 1974. This resulted from a lower quantity of tungsten ore being mined and treated, a lower content of molybdenum in the ore treated in 1975, and greater stocks remaining at the mine at the close of 1975 compared with 1974 yearend stocks.

**Rare-Earth Minerals.**—Molycorp, Inc., produced more than 96% of the Nation's output of rare-earth oxides (REO) contained in concentrates at its bastnäsite mine at Mountain Pass, San Bernardino County. Output declined 24%, but value of production increased 4%. Bastnäsite is mined from a carbonatite open pit deposit and milled to produce three grades of bastnäsite concentrate: 60% REO unleached, 70% REO leached, and 90% REO calcined.

During 1975, Molycorp, Inc., was installing equipment for a 50% expansion in its chemical plant at Mountain Pass. The company expects to spend about \$1 million for enlargement of the lanthanum-cerium chemical facility to give the plant the capability of processing 30 million pounds per year of rare-earth oxides.

Bastnäsite concentrate is processed in the chemical plant at Mountain Pass to produce concentrates of cerium (65%–70%  $CeO_2$ ) and lanthanum (75%  $La_2O_3$ ) for shipment. An electronic nuclear-phosphor

grade of pure europium oxide is also produced at Mountain Pass. The Molycorp operation can also provide concentrates of neodymium-praseodymium and gadolinium-samarium when required by new markets.

Lanthanum and cerium chemicals produced are used mainly in oil-refining catalysts, container glass, ductile iron, and glass-polishing compounds. A samarium-gadolinium-europium concentrate is a byproduct of producing the two chemicals. Samarium is used in permanent magnets; gadolinium is a nuclear reactor control material; europium oxide is used for color television phosphors; and europium hexaboride is being researched as a longer lived absorber for fast breeder reactors.

The Mountain Pass location supplies rare-earth concentrates to other Molycorp chemical plants at York, Pa., and Louviers, Colo., and the Rare Earth Metals Co. of America (Remcoa) plant at Arnold, Pa., owned jointly with Alcoa, for electrolytic reduction to mischmetal.

**Silver.**—Silver production (recoverable content) nearly doubled compared with that of 1974. The leading five producers, listed in descending order of output, were the Union Carbide Corp. Pine Creek mine (Inyo County), the Claude B. Lovestedt Zaca mine (Alpine County), the Montecito Mining Co. Darwin mine (Inyo County), the Great Western Gold Co. Boomerang dump (San Bernardino County), and the Gordon Lavigne & Sons Eva Bell mine (Mono County). A small quantity was recovered as a byproduct of gold placer mining operations.

**Tungsten.**—Nearly two-thirds of the recorded U.S. production of tungsten ore and concentrate (shipments) came from California mines, and most of this came from the Pine Creek mine, Inyo County, operated by Union Carbide Corp. Small tonnages of ore were mined and shipped from 15 other mines in the State in 1975. These mines were located in the Counties of Fresno, Inyo, Kern, Los Angeles, Madera, San Bernardino, and San Diego. In addition, small tonnages of ore mined in years prior to 1975 were reported shipped from four other mines in 1975. Most of the ore and concentrate produced (shipped) in the State in 1975 was sent to the Union Carbide plant at Pine Creek near Bishop, Inyo County, Calif., or to

the Kennametal, Inc., plant, Churchill County, Nev., for upgrading to a marketable product.

**Uranium.**—A moderate amount of uranium exploration and development activity was continued in the State in 1975. Most of the larger energy companies have been involved in property appraisal or acquisition in California within the past 5 years. The principal areas of interest are the Petersen Mountains, Lassen County; Sonora Pass, Tuolumne County; Coso Range, Inyo County; the Taft-McKittrick area, Kern County; and the Mojave Desert, Kern County, San Bernardino, and Riverside Counties. The principal com-

panies involved in exploration and development in California are Rocky Mountain Energy Co., Utah International, Inc., Exxon Corp., and Federal Resources, Inc.

The California Division of Mines and Geology had plans for four publications in 1976 relative to uranium activity in the State: Uranium in California, a special report by John S. Rapp; The Eagle Peak Uranium District, a paper within another special report by Eugene H. Boudreau; The Chilcoot Quadrangle, a 15-foot geologic map by Melvin C. Stinson; and The Haiwee Reservoir Quadrangle, a 15-foot geologic map by Melvin C. Stinson.

Table 32.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos: Atlas Asbestos Co	Box 805 Coalinga, Calif. 93210	Open pit mine	Fresno.
Barite: Industrial Minerals Co.	1057 Commercial St. San Carlos, Calif. 94070	do	Shasta.
Boron minerals and compounds: U.S. Borax and Chemical Corp. <sup>1</sup>	Box 75128 Sanford Station Los Angeles, Calif. 90005	do	Inyo and Kern.
Bromine: Kerr-McGee Chemical Corp. <sup>2</sup>	OMB-508, Kerr-McGee Bldg. Oklahoma City, Okla. 73102	Lake brines	San Bernardino.
Calcium chloride: National Chloride Co. of America.	615 South Flower St. Suite 803 Los Angeles, Calif. 90017	do	Do.
Carbon dioxide (natural): Standard Oil Co. <sup>3</sup>	225 Bush St. San Francisco, Calif. 94120	Plant	Kern.
Cement: Amcord, Inc. <sup>4</sup>	610 Newport Center Dr. Newport Beach, Calif. 92660	Plants	Riverside and San Bernardino.
California Portland Cement Co. <sup>6</sup>	800 Wilshire Blvd. Los Angeles, Calif. 90017	do	Kern and San Bernardino.
The Flintkote Co. <sup>5</sup>	San Francisco, Calif. 94104.	do	Calaveras and Shasta.
General Portland, Inc	3810 Wilshire Blvd. Los Angeles, Calif. 90005	Plant	Kern.
Kaiser Cement and Gypsum Corp. <sup>8</sup>	300 Lakeside Dr. Oakland, Calif. 94612	Plants	San Bernardino and Santa Clara.
Monolith Portland Cement Co.	3326 San Fernando Rd. Los Angeles, Calif. 90065	Plant	Kern.
Southwestern Portland Cement Co. <sup>4</sup>	1034 Wilshire Blvd. Los Angeles, Calif. 90017	do	San Bernardino.
Clays: Wilbur Ellis Co	Box 1286 Fresno, Calif. 93715	Pit	San Benito.
Interpace Corp	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	Pits	Amador, Placer, Riverside, Sutter, Yuba.
Lightweight Processing Co.	650 South Grand Ave. Los Angeles, Calif. 90017	Pit	Ventura.
NL Industries	Box 218 Newberry Springs, Calif. 92365	Pit	San Bernardino.
Copper: Union Carbide Corp. <sup>7</sup> .	270 Park Ave. New York, N.Y. 10017	Underground mine.	Inyo.
Diatomite: GREFCO, Inc	630 Shatto Pl. Los Angeles, Calif. 90005	Open pit mine	Santa Barbara.
Johns-Manville Products Corp. <sup>8</sup>	Lompoc, Calif. 93436	do	Do.

See footnotes at end of table.

Table 32.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Feldspar: Owens-Illinois, Inc.	Box 1035 Toledo, Ohio 43601	Open pit mine ----	Monterey.
Gold:			
Great Western Gold Co ---	Vanderbilt Star Rte. Nipton, Calif. 92366	Underground mine.	San Bernardino.
Santoni & Santoni -----	5073 West Shields Fresno, Calif. 93705	Placer mines -----	Various.
Gypsum:			
H. M. Holloway, Inc -----	714 6th St. Wasco, Calif. 93280	Open pit mine ---	Kern.
United States Gypsum Co -	101 South Wacker Dr. Chicago, Ill. 60606	Open pit mine and plant.	Imperial.
Iron ore: Kaiser Steel Corp ---	Box 153 Eagle Mountain, Calif. 92241	-----do -----	Riverside.
Lime:			
Amstar Corp -----	50 California St. San Francisco, Calif. 94106	Plants -----	Monterey and Yolo.
Holly Sugar Corp -----	Box 1052 Colorado Springs, Colo. 80901	-----do -----	Glenn, Imperial, Orange, San Joaquin.
Magnesium compounds:			
FMC Corp -----	Box 344 Newark, Calif. 94560	Plant -----	San Diego.
Kaiser Aluminum & Chemical Corp.	Moss Landing, Calif. 95039	-----do -----	Monterey.
Merck & Co., Inc -----	Rahway, N.J. 07065	-----do -----	San Mateo.
Mercury:			
Guadalupe Mining Co -----	14900 Guadalupe Mine Rd. San Jose, Calif. 95120	-----do -----	Santa Clara.
W. T. Kritikos -----	1036 Reislung Dr. Pleasanton, Calif. 94566	-----do -----	Napa.
Santa Clara Quicksilver Co.	21731 Almaden Rd. San Jose, Calif. 95120	-----do -----	Santa Clara.
Natural gas liquids:			
Atlantic Richfield Co. <sup>9</sup> ---	445 South Figueroa St. Los Angeles, Calif. 90054	Plants -----	Kern, Santa Barbara, Ventura.
Union Oil Co. of California. <sup>9</sup>	Box 7600 Los Angeles, Calif. 90054	-----do -----	Various.
Peat:			
Delta Humus Co -----	Box 89 Holt, Calif. 95234	Bog -----	San Joaquin.
Peter J. Gambetta -----	Route 1, Box 78 Brentwood, Calif. 94513	Bog -----	Contra Costa.
Radel, Inc -----	Box 7075 Reno, Nev. 89502	Bog -----	Modoc.
Perlite (crude): American Perlite Co.	11831 Vose St. North Hollywood, Calif. 91605	Open pit mine ----	Inyo.
Perlite (expanded):			
Harborlite Corp -----	Box 458 Escondido, Calif. 92025	Plant -----	San Diego.
Paramount Perlite Co., Inc.	Box 83 Paramount, Calif. 90723	-----do -----	Los Angeles.
Redco, Inc -----	11831 Vose St. North Hollywood, Calif. 91605	-----do -----	Do.
Petroleum and natural gas: <sup>10</sup>			
Pumice:			
Cinder Products Co -----	3450 Lakeshore Ave. Oakland, Calif. 94610	Open pit mine ----	Lake.
Glass Mountain Block, Inc.	Redding Highway Alturas, Calif. 96101	-----do -----	Siskiyou.
Red Lava Products of California.	Star Route Clearlake, Calif. 95423	Plant -----	Lake.
Shastalite Cinder Co -----	Box 341 Weed, Calif. 96094	-----do -----	Siskiyou.
Rare-earth minerals:			
Molycorp, Inc -----	Nipton, Calif. 92366	Open pit mine ----	San Bernardino.
Salt: Leslie Salt Co. <sup>11</sup> -----	505 Beach St. San Francisco, Calif. 94111	Open pit mines and evaporators.	Alameda, Napa, San Bernardino, San Mateo.

See footnotes at end of table.

Table 32.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Sand and gravel:</b>			
Conrock Co -----	Box 2950, Terminal Annex Los Angeles, Calif. 90051	Pits -----	Los Angeles, Orange, San Bernardino.
Kaiser Industries Corp. <sup>5</sup> --	300 Lakeside Dr. Oakland, Calif. 94612	----do -----	Alameda, Contra Costa, Glenn, Santa Clara, Santa Cruz, Sonoma.
Owl Rock Products Co ----	Box 47 Irwindale, Calif. 91707	----do -----	Fresno, Los Angeles, Orange, Riverside.
Pacific Cement & Aggregates. <sup>6</sup>	400 Alabama St. San Francisco, Calif. 94110	----do -----	Alameda, Fresno, Monterey, Sacramento, San Joaquin, San Mateo, Santa Cruz, Tulare, Yolo.
Silver: Claude B. Lovestedt. <sup>12</sup>	Box 1496 Carson City, Nev. 89701	Mine -----	Alpine.
Sodium compounds: Stauffer Chemical Co.	Box 3050 San Francisco, Calif. 94108	Lake brines ----	San Bernardino.
<b>Stone:</b>			
Granite Rock Co -----	Box 151 Watsonville, Calif. 95076	Quarry -----	San Benito.
Basalt Rock Co., Inc ----	Box 2540 Napa, Calif. 94558	----do -----	Marin, Napa, Sonoma.
East Bay Excavating Co --	28814 Mission Blvd. Hayward, Calif. 94544	----do -----	Kern and San Bernardino.
Tungsten: Union Carbide Corp. <sup>13</sup>	270 Park Avenue New York, N.Y. 10017	Underground mine.	Inyo.

<sup>1</sup> Also sodium compounds.<sup>2</sup> Also boron minerals and compounds, lime, lithium minerals, potassium salts, and sodium compounds.<sup>3</sup> Byproduct of natural gasoline processing; also petroleum production.<sup>4</sup> Also clays and stone.<sup>5</sup> Also clays, sand and gravel, and stone.<sup>6</sup> Also stone.<sup>7</sup> Also crude asbestos, gold, silver, molybdenum, and tungsten.<sup>8</sup> Also talc, soapstone, and pyrophyllite.<sup>9</sup> Also petroleum and natural gas.<sup>10</sup> Most of the major oil and gas companies and many smaller companies operate in California; several commercial directories contain lists of them.<sup>11</sup> Also calcium compounds.<sup>12</sup> Also gold, copper, lead, and zinc.<sup>13</sup> See also listing under copper.

# The Mineral Industry of Colorado

By Joseph Blake Smith <sup>1</sup>

In 1975, mineral production in Colorado was valued at \$960.8 million, 28% greater than in 1974. Most of this increase was caused by higher prices paid for portland cement, vanadium, uranium, coal, natural gas, molybdenum, and petroleum; a lesser amount was caused by increases in production mainly of coal, natural gas, natural gas liquids, and vanadium. For most of the mineral commodities produced in Colorado in 1975, the value of production increased over that of 1974. Exceptions were three metals: Copper, iron ore, and tin; and five nonmetals: Clays, gypsum, pyrites, sand and gravel, and stone. Decreased values for the nonmetals reflected a downturn in construction demand which led to decreased production of these commodities and also lowered the production levels of masonry cement and pumice. Other commodities having less production

in 1975 than in 1974 were iron ore, molybdenum, tin, tungsten, uranium, and zinc.

Thirty minerals were produced in Colorado in 1975, one fewer than during 1974. Of these, 12 were classified as nonmetals, 11 as metals, and 7 as fuels. The fuels comprised 60% of the total mineral value; metals, 29%; and nonmetals, 11%. Based on value, the leading commodity in each group was petroleum, molybdenum, and cement.

Colorado ranked first in the Nation in output of molybdenum, was second in production of tungsten and vanadium, and ranked third in production of silver, lead, and uranium. Usually the Nation's leading producer of tin by a substantial margin, Colorado, tied for first place with New Mexico in 1975.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Denver, Colo.



Table 1.—Mineral production in Colorado<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Carbon dioxide -----thousand cubic feet--	123,016	W	229,382	W
Clays -----thousand short tons--	663	\$1,588	480	\$1,101
Coal (bituminous) -----do-----	6,896	64,677	8,219	135,872
Copper (recoverable content of ores, etc.) short tons--	3,012	4,657	3,560	4,571
Gem stones -----	NA	135	NA	145
Gold (recoverable content of ores, etc.) troy ounces--	52,083	8,320	55,483	8,960
Gypsum -----thousand short tons--	191	800	185	782
Lead (recoverable content of ores, etc.) short tons--	24,609	11,074	27,088	11,648
Lime -----thousand short tons--	198	3,815	198	4,577
Natural gas -----million cubic feet--	144,629	28,926	171,629	44,624
Natural gas liquids:				
Natural gasoline and cycle products				
thousand 42-gallon barrels--	1,574	9,319	1,742	9,378
LP gases -----do-----	2,580	14,190	4,821	22,803
Peat -----thousand short tons--	30	201	37	280
Perlite -----do-----	W	W	W	W
Petroleum (crude) thousand 42-gallon barrels--	37,508	283,904	38,089	365,654
Sand and gravel -----thousand short tons--	23,793	39,674	20,019	34,850
Silver (recoverable content of ores, etc.) thousand troy ounces--	2,784	13,113	3,366	14,878
Stone -----thousand short tons--	6,572	15,109	5,315	10,940
Zinc (recoverable content of ores, etc.) short tons--	49,489	35,533	48,460	37,799
Value of items that cannot be disclosed:				
Cement, feldspar, fluorspar (1974), iron ore, molybdenum, pumice, pyrites, salt, tin, tungsten, uranium, vanadium, and values indicated by symbol W -----	XX	215,264	XX	251,938
Total -----	XX	750,299	XX	960,800
Total 1967 constant dollars -----	XX	354,741	XX	P 380,477

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

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Colorado, by county <sup>1</sup>

(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams -----	\$32,553	\$49,319	Petroleum, natural gas liquids, natural gas, sand and gravel, lime, stone.
Alamosa -----	W	45	Sand and gravel, peat.
Arapahoe -----	23,697	22,256	Petroleum, natural gas liquids, sand and gravel, natural gas, stone.
Archuleta -----	W	498	Petroleum, sand and gravel, natural gas.
Baca -----	W	1,459	Natural gas, petroleum, sand and gravel.
Bent -----	251	309	Natural gas, petroleum, sand and gravel, clays.
Boulder -----	18,080	17,707	Cement, sand and gravel, stone, lime, gold, petroleum, clays, peat, silver, copper, lead.
Chaffee -----	W	W	Stone, sand and gravel, peat.
Cheyenne -----	4,674	W	Petroleum, natural gas liquids.
Clear Creek -----	W	621	Molybdenum, sand and gravel, lead, silver, gold, stone, copper, zinc.
Conejos -----	112	W	Sand and gravel.
Costilla -----	W	W	Gold, pumice, silver, sand and gravel.
Crowley -----	W	51	Sand and gravel.
Custer -----	W	W	Perlite, sand and gravel.
Delta -----	W	W	Coal, sand and gravel, lime, stone.
Denver -----	75	80	Sand and gravel, stone.
Dolores -----	3,231	3,015	Petroleum, natural gas, silver, stone, gold, copper, lead, zinc.
Douglas -----	W	W	Sand and gravel, clays, stone.
Eagle -----	W	12,394	Zinc, silver, lead, sand and gravel, copper, gold, pumice.
Elbert -----	604	1,011	Petroleum, natural gas, sand and gravel, clays.
El Paso -----	W	W	Sand and gravel, stone, clays.
Fremont -----	17,955	30,331	Cement, stone, coal, gypsum, petroleum, clays, sand and gravel, feldspar.
Garfield -----	2,203	2,654	Vanadium, natural gas, sand and gravel, uranium, stone, coal.
Gilpin -----	W	157	Gold, silver, peat, lead, zinc, copper.
Grand -----	165	635	Sand and gravel, stone.
Gunnison -----	W	W	Coal, zinc, sand and gravel, stone, lead, silver, copper.
Hinsdale -----	2	8	Sand and gravel.
Huerfano -----	W	W	Sand and gravel, petroleum.
Jackson -----	5,013	9,659	Petroleum, coal, natural gas, sand and gravel, stone.
Jefferson -----	25,850	W	Sand and gravel, uranium, stone, clays, peat.
Kiowa -----	W	W	Petroleum, natural gas, sand and gravel.
Kit Carson -----	W	W	Petroleum, sand and gravel.
Lake -----	152,909	180,467	Molybdenum, tungsten, zinc, lead, silver, gold, copper, sand and gravel, tin, pyrites, stone, peat.
La Plata -----	12,542	14,071	Natural gas, natural gas liquids, sand and gravel, coal, petroleum, stone.
Larimer -----	20,571	16,270	Cement, stone, sand and gravel, petroleum, lime, gypsum.
Las Animas -----	10,906	19,029	Coal, sand and gravel, clays, stone.
Lincoln -----	123	348	Sand and gravel, stone.
Logan -----	10,555	12,077	Petroleum, natural gas liquids, natural gas, lime, sand and gravel.
Mesa -----	3,507	5,435	Sand and gravel, uranium, natural gas liquids, vanadium, coal, natural gas, petroleum, stone.
Mineral -----	7,214	12,093	Silver, zinc, lead, copper, gold, stone.
Moffat -----	14,051	22,311	Coal, petroleum, natural gas, sand and gravel.
Montezuma -----	1,884	2,798	Petroleum, sand and gravel, natural gas, carbon dioxide, stone.
Montrose -----	6,167	9,214	Vanadium, uranium, coal, sand and gravel, salt, stone, gold.
Morgan -----	5,918	7,292	Petroleum, natural gas liquids, lime, natural gas, sand and gravel, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Colorado, by county <sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Otero -----	W	W	Lime, sand and gravel.
Ouray -----	\$7,291	W	Zinc, lead, copper, silver, gold, sand and gravel.
Park -----	W	W	Peat, sand and gravel, gold.
Phillips -----	6	\$42	Sand and gravel.
Pitkin -----	10,309	19,668	Coal, natural gas, iron ore, sand and gravel.
Prowers -----	136	451	Natural gas, sand and gravel, petroleum.
Pueblo -----	W	W	Lime, sand and gravel, clays, stone.
Rio Blanco -----	171,928	216,433	Petroleum, natural gas, natural gas liquids, coal, sand and gravel, stone.
Rio Grande -----	W	W	Sand and gravel.
Routt -----	W	W	Coal, sand and gravel, petroleum, stone, natural gas.
Saguache -----	--	W	Uranium, sand and gravel.
San Juan -----	11,925	W	Gold, zinc, lead, silver, copper, stone.
San Miguel -----	28,067	35,491	Vanadium, zinc, uranium, lead, copper, silver, gold, natural gas, sand and gravel, petroleum, stone.
Sedgwick -----	W	W	Lime, natural gas, sand and gravel.
Summit -----	468	W	Sand and gravel, stone, silver, zinc, lead.
Teller -----	250	W	Peat, gold, silver, lead, sand and gravel, copper.
Washington -----	W	22,404	Petroleum, natural gas, sand and gravel.
Weld -----	37,755	65,942	Petroleum, natural gas, natural gas liquids, coal, sand and gravel, lime, stone.
Yuma -----	W	W	Sand and gravel, natural gas.
Undistributed <sup>2</sup> -----	101,344	146,706	
Total <sup>3</sup> -----	750,299	960,800	

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

<sup>1</sup> Values for petroleum are based on an average price per barrel for the State.

<sup>2</sup> Includes gem stones, some gold (1974), natural carbon dioxide (1974), and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Colorado business activity

	1974	1975 <sup>p</sup>	Change, percent
Employment and labor force, annual average:			
Total labor force -----thousands--	1,139.4	1,143.4	+0.4
Unemployment -----do-----	43.4	72.1	+66.1
Employment (nonagricultural):			
Mining -----do-----	16.3	13.3	+12.3
Manufacturing -----do-----	144.0	134.9	-6.3
Contract construction -----do-----	66.0	56.8	-13.9
Transportation and public utilities -----do-----	61.0	59.8	-2.0
Wholesale and retail trade -----do-----	232.2	227.4	-2.1
Finance, insurance, real estate -----do-----	56.5	56.1	-.7
Services -----do-----	180.0	183.3	+1.8
Government -----do-----	201.9	211.7	+4.9
Total nonagricultural employment -----do-----	957.9	948.3	-1.0
Personal income:			
Total -----millions--	\$13,955	\$15,168	+8.7
Per capita -----do-----	\$5,549	\$5,985	+7.9
Construction activity:			
Number of private and public residential units authorized -----	20,175	16,793	-16.8
Value of nonresidential construction -----millions--	\$82.5	\$275.6	-27.9
Value of State road contract awards -----do-----	\$76.0	\$218.0	+186.8
Shipments of portland and masonry cement to and within the State -----thousand short tons--	1,373	1,186	-13.6
Mineral production value:			
Total crude mineral value -----millions--	\$750.3	\$960.8	+28.1
Value per capita, resident population -----do-----	\$298.29	\$378.12	+26.8
Value per square mile -----do-----	\$7,196.46	\$9,216.57	+28.1

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

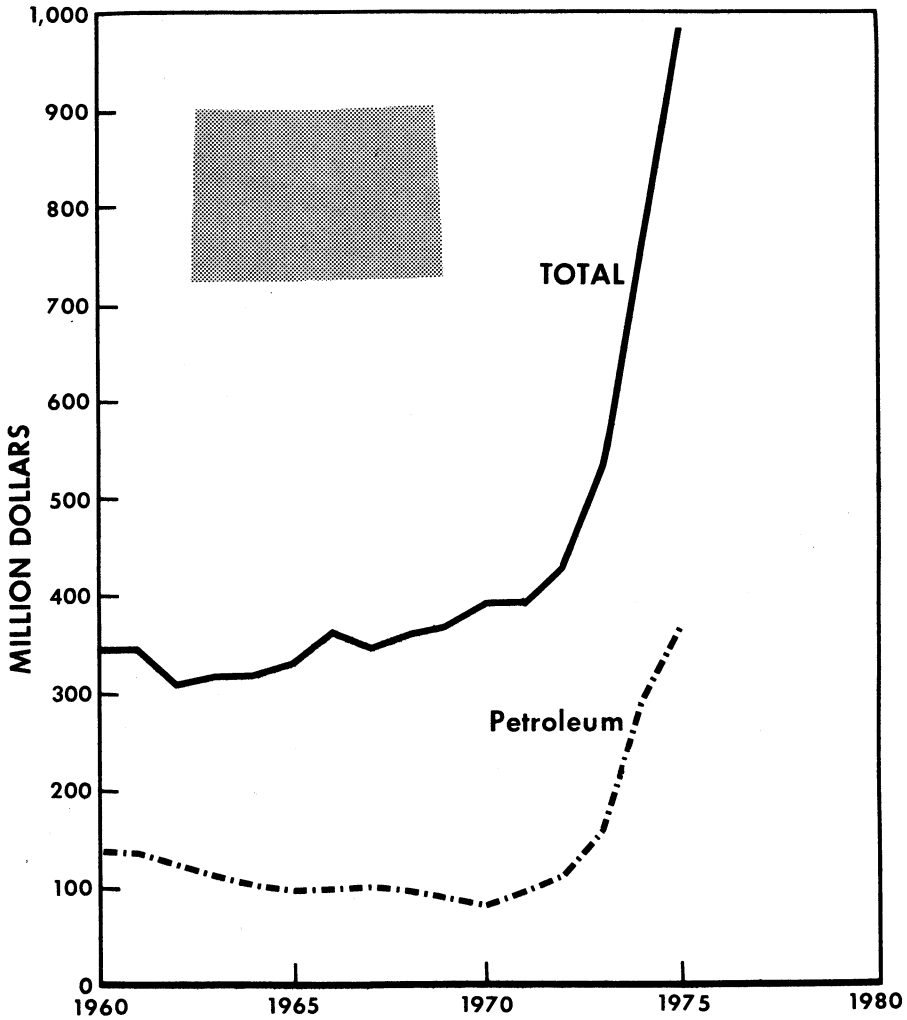


Figure 1.—Value of petroleum and total value of mineral production in Colorado.

**Legislation and Government Programs.**  
 —Proposed new regulations to tighten the State's control over reclamation of land strip mined for coal, sand and gravel, and other nonmetallic minerals were approved by the Colorado Land Reclamation Board. The new regulations eliminate using individual reclamation agreements with each strip mine operator as a way to enforce reclamation and define the State's law by outlining the goals of reclamation and the standards and criteria to be used in meeting those goals.

At the request of Congressman Frank E. Evans of Colorado, the U.S. Department of the Interior drafted legislation that would authorize the Department to "rehabilitate and maintain in a safe condition the existing Leadville mine drainage tunnel" and also would authorize the Secretary to provide facilities to treat the polluted water discharged from the tunnel so as to meet water quality standards under the 1972 Clean Water Act. Originally built during World War II under a Bureau of Mines contract to drain mines in

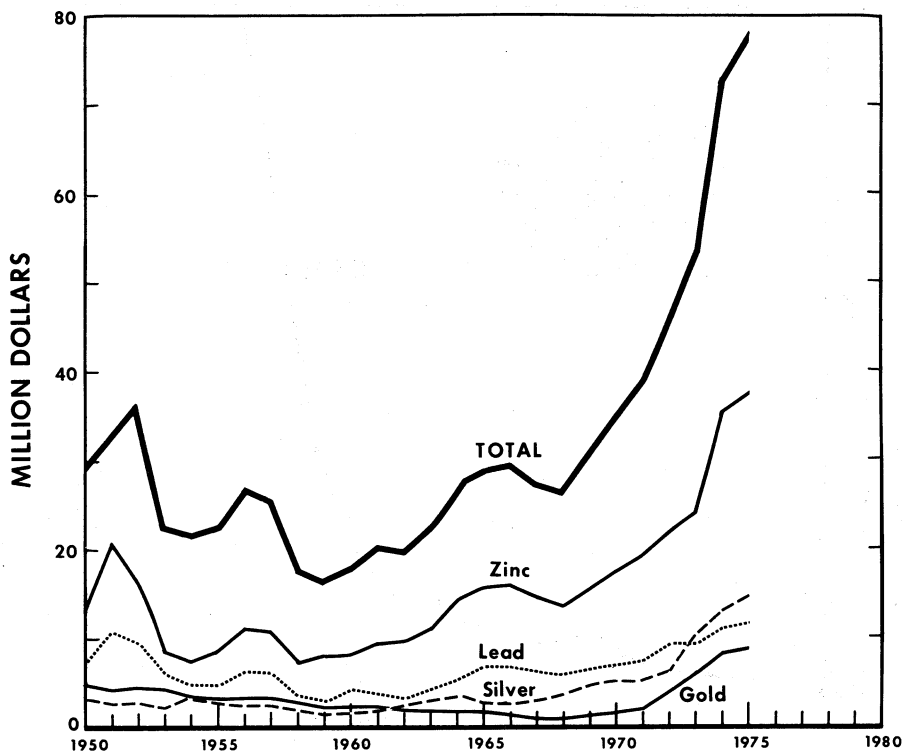


Figure 2.—Value of mine production of gold, lead, silver, and zinc, and total value of these minerals (including copper) in Colorado.

a portion of the Leadville district, Lake County, the tunnel fell into disuse, and in the late 1960's cave-ins developed, sinkholes appeared, and the water table in the area began to rise. These problems, a threat to State Highway 91 and other land users, have been a bane to the Bureau of Reclamation which took over operation of the tunnel from the Bureau of Mines to gain the water rights.

Bendix Field Engineering Group has been selected for negotiation of a contract to supply uranium exploration and development services to the Grand Junction office of Energy Research and Development Administration (ERDA). The contract has been held for several years by Lucius Pitkin, Inc. Bendix will be responsible for estimating uranium resources, identifying favorable areas, developing technology, and administering leases on land under ERDA control.

A much-debated proposed mineral severance tax bill died in a Senate committee of the Colorado General Assembly. The legislation was aimed at taxing all mineral extraction industries and was often promoted as a method for easing impact problems created by the growing energy industry of Colorado. The bill had passed the House but could not get through the Senate Finance Committee. An interim legislative committee studied the severance tax question after the Legislature adjourned, and at yearend Governor Richard Lamm said he would place legislation dealing with a mineral severance tax on his call for the 1976 General Assembly.

To familiarize legislators with mining operations, the president of Club 20, former Governor John Vanderhoof, organized a tour of mineral operations on the Western Slope of Colorado. About 25 members of the State Legislature and State

resource officials toured the Idarado mine and the Climax molybdenum mill and flew over coal, uranium, and oil shale areas.

Energy Fuels Corp.'s coal lease application in Routt County, pending for several years, was approved by the Department of the Interior just before the mine would have had to close because of a lack of coal reserves. The lease complied with the Secretary's short-term criteria and permitted the company to continue operation through 1977. A significant economic impact on the community and workers would have occurred if the mine had shut down.

The U.S. Geological Survey, in cooperation with the Colorado Water Quality Control Commission, issued a report, "Effects of Metal Mine Drainage on Water Quality in Selected Areas of Colorado, 1972-73." The report concluded that significant amounts of acidity and potentially toxic metals are added to streams by draining mines and tailings in at least 18 areas of the State.

Colorado State's Committee on Oil Shale Environmental Problems (COSEP) completed its assignments and issued final reports on a \$750,000 study to evaluate

environmental problems of oil shale development and to recommend approaches toward their solution.

The governors of Colorado, Arizona, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah, and Wyoming formed the Western Governors' Regional Energy Policy Office with headquarters in Denver. Principal goal of the office is to coordinate regional energy and environmental policy and to present a unified voice in response to the U.S. Congress and the Administration concerning matters of national policy.

The U.S. Soil Conservation Service selected a site near Meeker to establish an Upper Colorado River regional plant materials center. The center would develop and grow seed for revegetation of oil-shale- and coal-mined lands in northwest Colorado, southwest Wyoming, and northeast Utah.

The U.S. Geological Survey awarded a grant to the Colorado School of Mines Research Institute for survey and subsurface evaluation of unleased coal in the Yampa and Danforth Hills areas of northwest Colorado.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Carbon Dioxide.**—According to the Colorado Oil and Gas Conservation Commission, sales of carbon dioxide from the McElmo field, Montezuma County, were 229.4 million cubic feet. This was produced from a single well. Production increased 106.4 million cubic feet (86%) above that of 1974.<sup>2</sup>

**Coal (Bituminous).**—Although coal production increased only 19% in 1975 over that of 1974, value increased 110%. Thirty-three producing mines operated in 14 counties, 2 mines more than in 1974. Strip mine production again exceeded that of underground mines. Fifteen strip mines, seven more than in 1974, produced 58% of the State output. Eighteen underground mines, five fewer than in 1974, produced 3,446,000 tons of coal, a 6% increase over underground production in 1974. Routt County, with seven mines, again had the highest production with almost 4 million tons, 49% of the State output. Four other counties had output over 500,000 tons. In

order of rank they were Gunnison, Pitkin, Las Animas, and Moffat.

Average price of coal mined in 1975 was \$16.53 per ton. Coal from underground mines averaged \$27.16 per ton, while that from strip mines averaged \$8.86 per ton; comparable figures for 1974 were \$9.38, \$13.89, and \$5.33, respectively.

Colorado's coal-mining industry provided direct employment to 1,914 workers; of these, 1,209 worked in underground mines, 339 at strip mines, and the remainder at miscellaneous surface jobs.<sup>3</sup> The average number of days worked in 1975 by an employee was 161, compared with 197 in 1974. Underground coal was mined principally by continuous-mining machines.

<sup>2</sup> Colorado Department of Natural Resources, Oil and Gas Conservation Commission. Oil and Gas Statistics 1975. Production review, p. 9. All natural gas and petroleum production figures cited in the text of this chapter are from this publication.

<sup>3</sup> Colorado Department of Natural Resources, Division of Mines. Coal 1975. Colorado Coal Statistics, p. 16; all coal employment and data other than production and price data cited in the text of this chapter are from this publication.

Colorado coal was transported to markets by either rail or truck. More than two-thirds of the coal was consumed in the State; 31% was shipped to out-of-State markets. About 2,000 tons was consumed at the mines. Most of the coal was consumed as mine-run coal. Thirteen percent of the State coal output was processed in washing plants, and 6% was chemically treated or oiled.

Of the 8.2 million tons of coal mined during the year, 1.58 million tons was captive production, and the balance was sold on the open market. Nearly all the captive production was used in making steel in Colorado and Utah. The principal purchaser and/or consumer of merchant coal was the electric utility industry; most of

the steam-operated plants in the State use coal for electric power generation.

Anschutz Coal Co. took over the Thompson Creek No. 1 and No. 3 coal mines in Pitkin County from North American Resources Corp. of Houston, Tex. The mines, west of Carbondale, have produced metallurgical coal from two steeply dipping seams.

Mineral rights on about 18,000 acres of land near Trinidad, Las Animas County, have been purchased by the Freeport Coal Co., a subsidiary of Freeport Minerals Co.

W. R. Grace & Co. and Hanna Mining Co. announced an agreement to produce coal in Moffat County from the Colowyo tract south of Craig.

Table 4.—Colorado: Bituminous coal production, by type of mine and county, 1975  
(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines				Production (thousand short tons)				Value (thousands)
	Underground		Auger		Underground		Auger		
	Strip	Auger	Strip	Auger	Strip	Auger	Strip	Auger	
Delta									
Fremont	1		3			W	W		W
Garfield	1			4		1			W
Gunnison	4			4		1,070			1
Jackson			3				321		1,070
La Plata	1			1		W			\$38,185
Las Animas	1			1		632			4,173
Mesa	1			1		55			W
Moffat	1		1	2		W	W		2 18,961
Montrose			1	1		W	W		55
Pitkin	5		1	6		W	W		W
Rio Blanco	1			1		4			W
Routt	1		6	7		19	3,980		49
Weld	1			1		W			34,067
Undistributed <sup>3</sup>						1,667	472		W
Total <sup>4</sup>	18	15	33	33	3,446	4,773		1,990	89,919
									135,872

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."  
<sup>1</sup> One mine extends into two counties, but is counted only in the county where its greater production occurred.  
<sup>2</sup> Estimated.  
<sup>3</sup> Figures may not add to totals shown because of concealments.  
<sup>4</sup> Data may not add to totals shown because of independent rounding.



**Natural Gas.**—Marketed natural gas increased only 19% in quantity but increased 54% in value. Marketed production during the year was 171.6 billion cubic feet, 27 billion cubic feet more than in 1974.

Of the counties reporting marketed natural gas, the five leading counties were Weld with 42.9 billion cubic feet, La Plata with 25.3 billion, Rio Blanco with 25 billion cubic feet, Adams with 23.6 billion cubic feet, and Moffat with 21.5 billion cubic feet.

Production from more than 400 wells in the Wattenberg field resulted in production from Weld County to be almost triple that of 1974. Weld County produced almost a quarter of Colorado's total output. More gas was sold from the Wattenberg field alone than from any other in the State. Weld County ranked fifth in the Nation in the number of wells completed during 1975.<sup>4</sup>

The State's six gas-storage projects—Asbury Creek, Fort Morgan, Fruita, House Creek, Leyden Mine, and Springdale—had 22.1 billion cubic feet of gas in storage at the beginning of 1975; 12.6 billion cubic feet was injected and 11.1 billion cubic feet withdrawn during the year for a yearend balance, after an adjustment downward of 61 million cubic feet at Leyden Mine, of 23.5 billion cubic feet. As in past years, the Fort Morgan reservoir, Morgan County, was the most active;

8.7 billion cubic feet was injected and 8.1 billion cubic feet withdrawn. The second most active was the Leyden Mine reservoir in Jefferson County, a converted coal mine, with 3.1 billion cubic feet injected and 3 billion cubic feet withdrawn. The House Creek and Fruita reservoirs were not active during the year.

The American Gas Association (AGA) and the American Petroleum Institute (API) gave Colorado natural gas reserves of 1.9 trillion cubic feet as of December 31, 1975. New fields, revisions, and extensions added 172 billion cubic feet; this exceeded production and resulted in a slight increase in reserves.<sup>5</sup>

**Natural Gas Liquids.**—Production of natural gas liquids rose 58% in quantity and 37% in value compared with that of 1974. Prices for natural gasoline and cycle products declined 54 cents per barrel, and prices for LP gases declined 77 cents per barrel. Natural gas throughput at 30 (4 more than last year) processing plants in Colorado, according to the Oil and Gas Conservation Commission, was 166.6 billion cubic feet for the year; output was 7.7 million barrels of product.<sup>6</sup>

<sup>4</sup> Petroleum Information Corp. Resume of 1975 Oil and Gas Operations in the United States. V. 1, 1976, p. 3.

<sup>5</sup> 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 December 31, 1975. V. 30, May 1976, p. 114.

<sup>6</sup> Page 142 of reference cited in footnote 2.

Table 5.—Colorado: Gas input and production at natural gas liquids extraction plants in 1975

Plant	Owner	Gas input (million cubic feet)	Production (thousand barrels)
Adena	Union Oil Co. of Calif	1,510	161
Barrel Springs	Lamar Utilities Board	579	1
Bennett	Halliburton Resource Management	121	5
Brighton	do	1,260	67
Cabin Creek	Ecological Engineering	66	8
Denver Central	Sun Oil Co	3,033	289
Dragon Trail	do	4,503	193
Fort Lupton	Halliburton Resource Management	152	9
Frederick	TOA-American Gas Production	331	37
Fruita	Continental Oil Co	6,415	170
Irondale	Halliburton Resource Management	3,546	250
Latigo	Gas Producing Enterprises	774	39
Lowry	N. C. Ginther	331	23
McClave	Fleetwood Drilling Co	2,180	68
Peoria	Amoco Production Co	3,184	447
Piceance Creek	Chadbourne Corp	9,387	126
Rangely	Chevron Oil Co	1,654	228
Roggen	Charter Exploration & Production Co	424	33
Roundup	Halliburton Resource Management	225	8
San Juan	Northwest Pipeline Corp	70,080	1,233
Space City	Tom G. Vessels	113	7
Spindle	Amoco Production Co	5,644	689
Tampa	Phillips Petroleum Co	3,427	346
Third Creek	Amoco Production Co	2,451	106
Do	Koch Oil Co	5,592	439
Vallery	Vallery Corp	759	51
Watkins Plant	Amoco Production Co	34,274	2,470
Wattenberg	Production Operators, Inc	792	5
West Douglas Creek	Western Slope Gas Co	1,042	13
Wilson Creek	Texaco, Inc	571	34
Yenter	Excelsior Oil Corp	1,317	116
Total <sup>1</sup>		166,601	7,734

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Source: Colorado Department of Natural Resources, Oil and Gas Conservation Commission. Oil and Gas Statistics 1975. Plant Intake and Products, pp. 134-142.

**Oil Shale.**—A State-Federal study team recommended two additional Federal oil shale leasing sites for in situ shale processing. Two prime sites were recommended, one in Colorado and one in Utah. The team also recommended two other Utah sites as alternates. The Colorado in situ tract is between and just south of tracts C-a and C-b, about 20 miles northwest of Rifle. The prime Utah in situ tract is 13 miles west of the two previously leased Utah tracts. One alternate is about 10 miles south of the previously leased Utah tracts. The other is to the northeast of them and just west of Rangely.

Brinkerhoff Drilling Co., Denver, made the low bid for drilling of two stratigraphic tests scheduled by the Federal Bureau of Mines in the Piceance basin of western Colorado. Brinkerhoff's bid was approximately \$802,960. Locations for the proposed stratigraphic tests were staked in sec. 13, T. 1 S., R. 97. W and sec. 6, T. 2. S. R. 97. W, Rio Blanco County, about 27

miles southwest of Meeker. The holes were cored and extensive tests were conducted in the Green River aquifers above and below the Mahogany zone. Award of the contract to Brinkerhoff was made in September.

More than 400,000 tons of oil shale was produced during the year at two experimental test sites.

Taking over the operation of Development Engineering, Inc., Paraho Development Corp. continued to test vertical kiln technology at the Anvil Points oil shale experimental facility near Rifle in Garfield County. Paraho proposes to build at the site a 42-foot-diameter retort capable of processing 11,500 tons of oil shale per day.

Under contract from the Navy, Gary Western Co.'s refinery at Fruita processed 9,956 barrels of shale oil produced from a 56-day run of Paraho's 8½ foot-diameter retort. Refinery yield was 5,756 barrels of seven different military fuels: Three types of jet fuel, two types of diesel fuel, a lead-

free gasoline, and a heavy fuel oil. These fuels, derived from 15,789 tons of oil shale, were tested by several Government agencies.

Early in the year, operation of the modified in situ shale oil recovery process, developed by Garrett Research and Development Co., Inc., was transferred to Occidental Oil Shale, Inc., a subsidiary of Occidental Petroleum Corp. Occidental ignited its third 30- by 30- by 70-foot rubblized chamber at its project site at the southern edge of the Piceance basin and completed development of its fourth retort, which measures 120 feet on each side by 300 feet in height. This retort would produce 70,000 to more than 100,000 barrels of shale oil.

Environmental and exploratory work continued throughout the year on lease tracts C-a and C-b. At the C-b tract, leased by a consortium of four companies—Atlantic Richfield Co. (Arco), The Oil Shale Corp., Shell Oil Co., and Ashland Oil Co.—Shell Oil Co. has replaced Arco as the operator. Standard Oil of Indiana and Gulf Oil Corp., lessees of tract C-a, jointly formed the Rio Blanco Oil Shale Project to manage that operation. Superior Oil Co.'s oil shale project, on the north edge of the Piceance basin, was awaiting approval of a land exchange with the Bureau of Land Management. The exchange would block up the company's oil shale resources at the site.

**Peat.**—Sales of peat was up 23% in quantity and 39% in value compared with that of 1974.

Ten producers mined 39,500 tons of peat in eight counties. Park County had the most production, followed by Teller County. Three producers operated in Teller County, and one each operated in Alamosa, Boulder, Chaffee, Gilpin, Jefferson, Lake, and Park Counties. Most of the output, 98%, was moss type, and 2% was reed sedge. Average value for all peat sold in 1975 was \$7.57, 96 cents more than in 1974.

Most of the output was shipped in bulk; the rest was packaged. Of the total sold, 34,800 tons was processed. Forty-seven percent of the sales, 17,400 tons, was used for general soil improvement, and the remainder for other uses.

**Petroleum.**—Production of petroleum rose 2% in quantity and 29% in value

compared with that of 1974. The price of petroleum reflected a worldwide increase in price and accounted for the difference in the percentage rates. Average price per barrel increased from \$7.57 in 1974 to \$9.60 in 1975. Petroleum continued to be the most valuable mineral produced in Colorado and accounted for 38% of the State total mineral value. Leading county in oil output was Rio Blanco with 21.6 million barrels, the same as in 1974, or 57% of the State total; the county also had the leading oilfield, the Rangely-Weber. Production from Mancos, Morrison, and Weber horizons in the Rangely oilfield was 20.4 million barrels.

Weld and Adams Counties ranked second and third, with 13% and 7%, respectively, of the State total production.

Fifty-five companies produced oil in Colorado during the year. Chevron Oil Co. was the leading producer with 20.5 million barrels, followed by Amoco Petroleum Corp. with 4 million barrels and Texaco, Inc., with 1.4 million. Most of Chevron's production was from the Rangely-Weber field.

During the year, 38 fluid-injection projects were operated in 36 fields; of these, 36 were waterflood projects, 1 was gas injection, and 1 was a combined water and gas injection. Water injected in all projects totaled 164.3 million barrels; of this, 108.4 million barrels, or 66%, was injected into the Rangely-Weber reservoir.

The API estimated crude oil reserves for Colorado as of December 31, 1975, at 276.1 million barrels, a decline of 13.2 million barrels from 1974. An additional 83.7 million barrels were considered economically available by the application of enhanced recovery techniques. New reservoir discoveries in and extensions of old fields and new field discoveries added almost 1 million barrels; revisions added 14.3 million barrels.<sup>7</sup>

The Colorado Petroleum Council and the Colorado-Nebraska Division of the Rocky Mountain Oil and Gas Association (RMOGA), two of the State's oldest oil industry trade associations, have merged. The new organization is called the Colorado Petroleum Association. RMOGA activities had not included petroleum marketing, which was the responsibility of the Colorado Petroleum Council.

<sup>7</sup> Pages 21-22 of reference cited in footnote 5.

*Exploration and Development.*—A record total of 1,191 wells with a combined footage of 6.9 million feet were drilled during the year, 355 more than during 1974 and well ahead of 1972, the previous record year when 1,005 wells were drilled. Of the wells drilled, 778 were development drilling and 413 were wildcat drilling.

Of the development drilling, 291 were completed as oil wells, 281 as gas wells, and 206 were dry holes. Wildcat drilling resulted in 56 successful wells; of these, 37 were oil and 19 were gas. The most extensive wildcatting was done in Washington County, where 88 exploratory holes were drilled; all but 2 were dry holes. A total of 398 holes were drilled in Weld County, the most active county. Of these holes, 352 were development drilling, and all but 46 found oil or gas.

Colorado ranked ninth in the Nation in

the number of oil and gas wells completed during 1975.<sup>8</sup>

Champlin Petroleum Co. set production casing at a 17,974-foot test of the Weber formation (Pennsylvanian) in NE NE 12, R. 11. N, T. 100. W, Moffat County. It is in the Shell Creek area 4 miles southeast of the town of Hiawatha, and the same distance southeast of production in the Hiawatha field. Champlin planned to drill a 19,800-foot wildcat 4½ miles to the northeast of its Weber test and designated No. 2 Shell Creek unit. It is located in SE SE 27, R. 12. N, T. 99. W, and at the projected depth of 19,800 feet would set a new drilling depth record for Colorado. Mobil Oil Corp. holds the current Colorado record, a depth of 19,710 feet. It was set in 1968 at a deeper pool wildcat in Rio Blanco County.

<sup>8</sup> Work cited in footnote 4.

Table 6.—Colorado: Oil and gas well drilling completions in 1975, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Adams	66	31	24	5	1	34	161	1,192,948
Alamosa	—	—	—	—	—	1	1	9,490
Arapahoe	5	—	7	2	—	13	27	190,098
Archuleta	—	—	1	—	—	—	1	1,360
Baca	—	11	9	—	2	8	30	111,866
Bent	—	3	5	—	1	4	13	60,437
Boulder	—	—	—	—	—	1	1	7,000
Cheyenne	7	—	11	—	—	8	26	135,267
Crowley	—	—	—	—	—	1	1	6,650
Dolores	—	—	—	—	—	3	3	20,342
Elbert	1	—	2	—	—	12	15	98,865
El Paso	—	—	—	—	—	2	2	9,671
Fremont	—	—	—	—	—	1	1	40
Garfield	—	9	2	—	—	2	13	72,327
Grand	—	—	—	—	—	1	1	2,820
Huerfano	—	—	—	1	—	2	3	12,997
Jackson	13	—	3	—	—	4	20	73,616
Kiowa	3	1	4	2	2	7	19	93,518
Kit Carson	1	—	—	1	—	1	3	16,634
La Plata	5	13	3	—	—	1	22	131,385
Larimer	1	—	—	1	—	—	2	9,555
Las Animas	—	—	—	—	—	7	7	14,945
Lincoln	—	—	—	—	—	7	7	35,681
Logan	3	1	15	6	—	51	76	399,538
Mesa	1	1	1	—	2	5	10	39,977
Moffat	3	3	5	—	—	12	23	115,551
Montezuma	12	—	5	1	—	3	21	23,861
Montrose	—	—	—	—	1	5	6	40,874
Morgan	2	—	9	1	—	18	30	173,248
Ouray	—	—	—	—	—	1	1	3,759
Pitkin	—	—	—	—	—	1	1	10,950
Prowers	1	5	3	—	—	6	15	74,718
Rio Blanco	22	22	24	1	7	11	87	392,370
Routt	—	—	—	2	—	—	2	14,925
San Miguel	—	1	—	—	—	2	3	24,970
Sedwick	—	1	—	—	—	—	1	3,896
Washington	10	—	25	2	—	86	123	558,006
Weld	135	171	46	12	2	32	398	2,726,174
Yuma	—	8	2	—	1	4	15	34,424
Total	291	281	206	37	19	357	1,191	6,949,753

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 7.—Colorado: Oil production and gas sales in 1975, by county

County	Number of producing wells	Oil production (barrels)	Gas sales <sup>1</sup> (thousand cubic feet)	Cumulative production to Jan. 1, 1976	
				Oil (barrels)	Gas (thousand cubic feet)
Adams	419	2,713,159	23,586,963	25,112,003	92,069,881
Arapahoe	128	1,725,377	5,523,735	14,649,990	33,074,280
Archuleta	35	49,110	21,534	5,931,432	277,764
Baca	84	41,750	3,853,905	1,545,421	54,366,163
Bent	8	9,196	758,748	90,744	2,987,953
Boulder	3	1,676	--	778,677	--
Cheyenne	48	499,434	--	3,372,881	87,224
Dolores	9	237,666	1,870,798	1,100,164	5,641,720
Elbert	10	69,589	858,288	468,428	2,339,553
Fremont	24	20,293	--	14,673,921	--
Garfield	45	--	2,367,490	564	27,134,103
Huerfano	1	805	--	1,134	1,543
Jackson	66	452,029	183,418	11,367,076	648,028,036
Jefferson	--	--	--	15,275	3,820
Kiowa	67	543,057	1,728,878	8,486,328	22,168,079
Kit Carson	3	9,120	--	29,566	--
La Plata	518	25,825	25,201,742	626,560	665,918,483
Larimer	45	166,412	--	13,688,641	22,298,649
Las Animas	--	--	--	--	2,390,121
Logan	252	1,109,763	1,758,884	97,592,536	187,639,473
Mesa	37	10,186	1,913,287	13,470	59,566,478
Moffat	200	791,107	21,463,422	52,311,950	441,333,666
Montezuma	44	232,236	553,195	6,253,554	18,860,725
Montrose	--	--	--	--	58,092
Morgan	117	518,591	1,778,015	82,950,885	174,545,050
Phillips	--	--	--	--	36,696
Pitkin	3	--	633,699	--	12,294,737
Prowers	10	14,406	624,432	46,754	674,125
Rio Blanco	615	21,555,616	24,965,403	611,243,651	1,016,658,565
Routt	11	84,683	1,692	4,239,659	515,737
San Miguel	8	11,012	1,522,726	86,948	17,223,030
Sedgwick	3	--	255,058	--	5,130,498
Washington	350	2,305,376	541,121	119,457,956	57,426,921
Weld	924	4,889,257	40,369,718	42,902,070	114,911,927
Yuma	12	--	186,549	13,109	294,836
Total	4,099	38,086,731	162,522,700	1,119,051,347	3,685,957,928

<sup>1</sup> Thousand cubic feet at 15.025 psi.

Sources: Colorado Department of Natural Resources, Oil and Gas Conservation Commission. Oil and Gas Statistics 1975, Oil and Gas Production Statistics by Counties, p. 10.

## METALS

**Cadmium, Indium, and Thallium.**—ASARCO, Inc., recovered cadmium, indium, and thallium metal and thallos sulfate at its Denver plant from flue dust, dross, and other byproduct materials from out-of-State smelters and processing plants. The value of these products is not included in the State mineral value because of their out-of-State origin.

**Copper.**—Copper production increased 18% in quantity but decreased 2% in value compared with that of 1974. The decrease in value reflected lower prices paid for the metal. Average 1975 price was 64.2 cents, 13.1 cents lower than in

1974. Of the 17 mines reporting copper production, the Idarado mine of Idarado Mining Co. in Ouray and San Miguel Counties accounted for 61% of the State copper output.

Higher costs and declining metal prices affected several Colorado base and precious metal producers. Idarado Mining Co., at Ouray-Telluride, laid off 48 employees, a 10% reduction of the work force. Idarado had a net loss of \$21,500 for the first half of 1975; in 1974 net income was \$2,057,600 for the same period. It's labor costs were up 14%, mill reagents up 25%, and lead and zinc smelting costs were up 10% and 13%, respectively.

Table 8.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing <sup>1</sup>		Material sold or treated <sup>2</sup> (short tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1973, total	16	5	1,297,513	63,422	\$6,203,306	3,598,209	\$9,204,220
1974, total	25	1	1,321,489	52,083	8,319,740	2,783,978	13,112,536
1975:							
Boulder	2	1	3,096	597	96,409	204	902
Eagle	1	--	179,092	580	93,664	191,615	846,938
Gunnison	1	--	5,713	--	--	8,451	37,354
Montrose	--	1	--	15	2,422	--	--
Ouray	1	--	162,580	1,764	284,868	214,145	946,521
San Juan	1	--	186,615	27,689	4,471,496	206,287	911,789
San Miguel	1	--	348,118	9,258	1,495,075	444,457	1,964,500
Teller	3	--	1,654	444	71,701	201	890
Undistributed <sup>3</sup>	12	2	513,387	15,136	2,444,311	2,300,640	10,168,829
Total	22	4	1,400,255	55,483	8,959,946	3,366,000	14,877,723
	Copper		Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	Short tons	Value	
1973, total	3,123	\$3,716,417	28,112	\$9,159,034	58,339	\$24,105,692	\$52,388,669
1974, total	3,012	4,656,796	24,609	11,074,214	49,489	35,533,340	72,696,626
1975:							
Boulder	( <sup>4</sup> )	71	( <sup>4</sup> )	51	--	--	97,433
Eagle	158	202,233	1,696	729,193	13,118	10,232,220	12,104,248
Gunnison	6	8,099	112	48,132	141	109,904	203,489
Montrose	--	--	--	--	--	--	2,422
Ouray	779	999,840	3,516	1,511,754	5,510	4,297,620	8,040,603
San Juan	292	375,272	3,367	1,447,698	4,662	3,636,012	10,842,267
San Miguel	1,855	2,382,356	6,571	2,825,421	9,259	7,222,114	15,889,466
Teller	( <sup>4</sup> )	75	2	683	--	--	73,349
Undistributed <sup>3</sup>	470	603,029	11,825	5,084,743	15,771	12,301,064	30,601,976
Total <sup>5</sup>	3,560	4,570,975	27,088	11,647,675	48,460	37,798,934	77,855,253

<sup>1</sup> Operations from which gold, silver, copper, lead, or zinc were recovered as byproducts from fluorspar, sand and gravel, or cleanup, not counted as mines.

<sup>2</sup> Does not include gravel washed.

<sup>3</sup> Includes Clear Creek, Costilla, Dolores, Gilpin, Lake, Mineral, Park, and Summit Counties, combined to avoid disclosing individual company confidential data.

<sup>4</sup> Less than 1/2 unit.

<sup>5</sup> Data may not add to totals shown because of independent rounding.

Table 9.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc, in 1975, by type of material processed and method of recovery

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	12,324	1,967	--	--	--
Cyanidation	1,398	16,429	--	--	--
Smelting of concentrates	41,113	3,310,673	3,533	27,016	48,366
Direct smelting of ore and cleanup <sup>1</sup>	439	36,931	27	71	94
Total	55,274	3,366,000	3,560	<sup>2</sup> 27,088	48,460
Placer					
	209	--	--	--	--
Grand total	55,483	3,366,000	3,560	27,088	48,460

<sup>1</sup> Combined to avoid disclosing individual company confidential data.

<sup>2</sup> Data do not add to total shown because of independent rounding.

Table 10.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by class of ore or other source material

Source	Number of mines <sup>1</sup>	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	62,950	2,196	774	( <sup>2</sup> )	2	( <sup>2</sup> )
Silver -----	5	179,020	212	1,726,402	92	1,809	730
Total -----	12	241,970	2,408	1,727,176	92	1,821	730
Copper and lead <sup>3</sup> -----	4	4,590	261	W	42	43	1
Copper-lead-zinc -----	2	408,800	11,301	522,444	2,170	7,704	10,825
Lead-zinc -----	5	564,911	40,720	910,155	1,123	15,776	23,692
Zinc -----	1	177,494	367	W	131	1,689	13,118
Total <sup>4</sup> -----	11	1,155,795	52,649	1,633,389	3,466	25,213	47,637
Other lode material: Silver and lead-zinc cleanup <sup>5</sup> -----	--	2,490	217	5,435	1	64	93
Total lode <sup>4</sup> -----	22	1,400,255	55,274	3,366,000	3,560	27,088	48,460
Placer -----	4	--	209	--	--	--	--
Grand total -----	26	1,400,255	55,483	3,366,000	3,560	27,088	48,460

W Withheld to avoid disclosing individual company confidential data; included in total.

<sup>1</sup> Detail will not necessarily add to totals shown because some mines produce more than 1 class of material.

<sup>2</sup> Less than ½ unit.

<sup>3</sup> Combined to avoid disclosing individual company confidential data.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

<sup>5</sup> Cleanup not counted as producing mine.

**Gold.**—Output of gold increased 7% above that of 1974, and value increased 8%. Average price for the year was \$161.49 per troy ounce. Most of the gold was recovered as a coproduct of base metal ores. Twenty-two lode mines and 3 placer operations yielded gold, compared with 25 lode mines and 1 placer operation in 1974. The three placer mines produced 149 troy ounces of gold from 11,200 cubic yards of washed material having an average value of \$2.15 per cubic yard. In addition, a sand and gravel operation in Boulder County produced 60 troy ounces.

Half of the State gold production came from Standard Metals Corp.'s Sunnyside mine north of Silverton.

Late in the fall, Golden Cycle Corp. of Colorado Springs signed a letter of intent with Texasgulf, Inc., covering development of Golden Cycle's mining properties in the Cripple Creek area by Texasgulf. The letter of intent granted Texasgulf an exploration option in return for its pledge to commit substantial sums in the exploration and development of the mining properties. If Texasgulf exercises the option and develops the gold properties, it would hold a 60% interest in the venture and Golden Cycle would be the junior partner with 40%. Golden Cycle owns about 3,000

of the 5,000 acres that make up the Cripple Creek gold district, including Ajax and other mines plus a gold mill.

Earlier in the year, Golden Cycle drilled test holes at its Ajax mine and found the downward extension of the highly productive Newmarket vein below the bottom of the 3,100-foot-deep mine. The sample showed mineralization of nearly 2 ounces of gold per ton in a vein 10½ feet thick. Further drilling in the same test hole cut a second unexpected mineralized vein about 52 feet thick. It assayed at 1.8 ounces of gold per ton. A third mineralized layer about 6 feet thick assayed at 0.347 ounce of gold per ton. Some commercially minable silver also was found in all the veins. The company planned to tunnel under the veins to establish actual reserves.

Earth Sciences, Inc., of Golden produced gold and silver at its Rito Seco leaching plant on the O J property near San Luis in Costilla County. About 60,000 tons of low-grade ore was leached. Additional test drilling was done.

At Colorado Springs, Gold Hill Mesa Corp. continued its project to recover gold from mill tailings which cover 400 acres on a site just 2 miles west of the business district. The tailings were the result of 40 years of milling operations by Golden

Cycle Corp. Gold Hill made public the results of its drilling and sampling program. The tailing pile contains 12 million tons of recoverable material assaying 0.040 ounce of gold and 0.167 ounce of silver per ton.

Standard Metals had difficulties recovering gold from its Sunnyside ore and installed a rodmill to cure the problem. Standard may have to pay a major fine for polluting the Animas River when its No. 1 tailings pond broke out in June. Also at Silverton, Dixilyn Corp. planned to scrap its mill and buildings.

W. W. Ferris completed work on a gold mill in Boulder County and milled ore from the Bueno mine. The mine is near Jamestown and the mill is in sec. 24, T. 2. N., R. 72. W.

**Iron Ore.**—The Cooper mine south of Ashcroft, Pitkin County, was operated by Morrison-Knudsen Co., Inc., for the owners, Pitkin Iron Corp. Ore was trucked to a railhead north of Aspen and rail-shipped to CF&I Steel Corp.'s Pueblo smelter.

**Lead.**—Output of lead increased 10%; however, because of a price decrease, the value of production rose only 5%. Average price for the year was 21.5 cents per pound, 1 cent below the average price in 1974.

The Idarado mine in Ouray and San Miguel Counties dropped to second place in production of lead behind that of the Leadville Unit of ASARCO, Inc. Idarado produced 7,669 tons, 9% less than in 1974.

Shareholders of Leadville Corp. approved a plan to put the company's mining and milling properties in Lake County into the hands of Day Mines, Inc., of Idaho. Day Mines improved the mill and ran it throughout the year on ore from its operation at the Sherman tunnel.

**Molybdenum.**—Production of molybdenum dropped 10% below that of 1974, but because of a price increase, value of production rose 12%. Colorado produced more than half of the Nation's output of molybdenum during 1975 and more than one-third of the world's production.

The ore haulage tunnel under the Continental Divide from the AMAX Co. Henderson mine near Berthoud Pass in Clear Creek County to the mill in Grand County was completed during the year. The 15-foot-high, 16.5-foot-wide tunnel is 9.6 miles long and is the third longest railroad

tunnel in the world. The Henderson mine, under development since 1967, was expected to be in production in 1976. The Henderson No. 3 shaft was completed by Harrison-Western Corp.

At yearend, employment at the Climax molybdenum mine leveled off at 2,480 after a year of hiring. Employment at yearend 1974 was 2,162.

**Silver.**—Output of silver from 22 mines in 14 counties was 582,000 troy ounces (21%) above that of 1974; average price of silver for the year was \$4.42 per troy ounce, a decrease of 29 cents below the 1974 price. Eight mines had production exceeding 20,000 ounces. The two principal mines, Bulldog Mountain and Idarado, were responsible for 59% of the State silver output. The Bulldog Mountain mine of Homestake Mining Co. was the major source of silver during the year. Production from the mine exceeded the output of the next largest producer, Idarado, by an appreciable amount. Other mines having silver production in excess of 20,000 troy ounces were the Eagle (New Jersey Zinc Co.), Leadville Unit (ASARCO), Sherman Tunnel (Day Mines, Inc.), Camp Bird (Federal Resources Corp.), Sunnyside (Standard Metals Corp.), and Emperius (Minerals Engineering Co.). Leading counties in silver output, in order of production, were Mineral, Lake, San Miguel, Ouray, San Juan, and Eagle.

At Ophir, Silver Bell Industries, Inc., closed its mill and the Silver Clad mine at Rico which fed it. At the Camp Bird mine near Ouray, the work force was reduced to 30 from 105 at yearend 1974. The mine was on a 4-day workweek, and a temporary shutdown was possible.

A major silver discovery at Creede was made by Minerals Engineering Co. of Denver. The discovery resulted from a 15-hole joint exploration venture with Freeport Exploration Co. and was adjacent to the Bulldog Mountain mine operated by Homestake Mining Co. Several flat-lying beds of silver ore ranging in thickness from 165 to 260 feet were found. Silver content of the beds ranges from 2.19 to 4.5 ounces per ton. Thinner zones, 40 to 55 feet in thickness, contain 9 to 20 ounces per ton.

Brodie Exploration Co. of Denver obtained an option from Nederland Mines, Inc., to purchase all of Nederland's real estate and personal property. The primary



asset of Nederland Mines is a group of patented mining claims constituting the Caribou silver mine and a mill in Boulder County. The mine has not been operated since the mid-1950's.

**Tin.**—Byproduct tin concentrate was produced at the Climax mill of AMAX in Lake County. Production was 91% under that of 1974, and value decreased by 92%.

**Tungsten.**—Rising tungsten prices did not cause an increase in production at the tungsten camps in Boulder and San Juan Counties. Output of tungsten decreased 8% below that of 1974, but value increased 16% because of higher prices. Most of the output of tungsten concentrate was as a byproduct of milling operations at the Climax molybdenum mine of AMAX. Nationally, Colorado was exceeded only by California in production of tungsten.

**Uranium.**—Although output of uranium oxide ( $U_3O_8$ ) decreased 2%, Colorado ranked third in the Nation in uranium production, behind New Mexico and Wyoming. In 1974, the State ranked fourth, behind Utah. Value of production, reflecting a continuing trend of price increases, increased 14% over that of 1974.

The last remnant of a uranium oxide stockpile, valued at more than \$0.5 billion, was shipped from Grand Junction by ERDA. During the stockpiling program, 103,776 drums weighing 42,160 tons (gross weight) were accumulated. The average drum weighed about 650 pounds and was valued at around \$5,000. The last drum loaded came from Climax Uranium Co. and was checked in during April 1965 by the then Atomic Energy Commission.

The Homestake Mining Co. Uranium Div. acquired an 85% interest in the Pitch uranium mine and adjacent properties near Gunnison. The Pitch mine was operated by Pinnacle Exploration, Inc., from 1958 to 1972. Homestake has delineated ore-grade mineralization and planned to accelerate development and exploration activities on the Pitch properties in order to determine more precisely the extent of the deposits and the economic feasibility of mining.

The General Electric Corp. established a uranium-vanadium ore-buying station and sampling plant in Montrose County west of Naturita.

Sweeney Mining and Milling Co.'s mill in Boulder County produced a uranium

product from a tin-tungsten concentrate obtained from the Climax mill. The uranium-bearing minerals in the Climax concentrates are brannerite and betafite.

**Vanadium.**—Vanadium output increased 24% over that of 1974, and value increased 69%. San Miguel and Montrose Counties supplied 90% of the State total; other counties with vanadium production were Garfield and Mesa.

**Zinc.**—Output of zinc was down by 1,029 tons, but value was up 6% because of higher zinc prices. Average price per pound in 1975 was 39 cents. Eleven counties had 12 operating mines. Eagle County ranked first in production, followed in order of output by Lake, San Miguel, Ouray, and San Juan. These five counties accounted for 94% of the State total. Of the 12 producing mines, 7 had output of more than 500 tons of zinc. The largest producers were the Eagle mine, operated by New Jersey Zinc Co. in Eagle County, and the Leadville Unit (Black Cloud mine), operated by ASARCO in Lake County. Other mines having more than 500 tons of output were the Idarado mine (Idarado Mining Co.), Sunnyside mine (Standard Metals Corp.), Camp Bird mine (Federal Resources Corp.), Bulldog Mountain mine (Homestake Mining Co.), and Emperius mine (Minerals Engineering Co.).

The Leadville unit (Black Cloud mine) at Leadville had to stockpile half its zinc because of depressed markets. In September, 2,850 tons was shipped, via rail to Galveston, to a smelter in West Germany, and another shipment to West Germany of 2,800 tons was made later in the fall. Because Colorado does not have any custom mills or smelters, freight rates and beneficiation and smelting costs reduce the profits on any ore shipped out-of-State for processing.

## NONMETALS

**Cement.**—Portland and masonry cements were produced and shipped by Ideal Cement Co., a division of Ideal Basic Industries, Inc., and by Dewey Rocky Mountain Cement Co., a division of Martin Marietta Corp. Shipments of portland cement were 10% above those of 1974, but masonry cement shipments were 24% below those of 1974. At yearend, portland

cement stocks at mills had increased 21% compared with yearend 1974. Increased stocks reflected a general low level of demand by the construction sector. Ready-mix concrete companies purchased 68% of the portland cement. Other customers, in order of quantity, were concrete product manufacturers, building material dealers, and highway contractors.

Ninety-three percent of the portland cement production shipped from the plants was by truck; the balance moved by rail.

In 1975, cement surpassed sand and gravel as the most valuable nonmetallic mineral produced in the State.

**Clays.**—Production of clays decreased 28% in quantity and 31% in value compared with that of 1974. Decreased output was due to a lessened demand for clay products by the building industry. Common clay (including shale) accounted for 94% of total clay production; the remainder was fire clay with 5.5% of the production total and bentonite with less than 1% of the total. Common clay and shale were used for common and face brick, lightweight aggregate, and sewer pipe. Fire clay was used for fire brick, and bentonite was used as a water sealant.

Output of clay came from 45 mines operated by 21 companies, compared with 53 mines operated by 21 companies in 1974. Since 1973, a peak year for mine count, the number of mines has dropped by 20. Six companies produced fire clay; 3, bentonite; and 13, common clay and shale. The largest producer, the Idealite Co., a division of Ideal Basic Industries, Inc., mined shale from a quarry south of Boulder for

making lightweight aggregate. Because of market conditions, the plant was closed in December. The second largest producer was Robinson Brick & Tile Co., which operated 11 mines for common clay and shale and produced almost 100,000 tons. Clay was produced in nine counties. Jefferson County had the most production, 65% of the total output of the State. The average price for common clay and shale was \$2.14 per ton and that of fire clay was \$4.15 per ton, compared with \$2.19 and \$4.10 per ton, respectively, for 1974.

The Fountain Sand and Gravel Co., a subsidiary of CF&I Steel Corp., constructed a lightweight aggregate plant to recycle coal waste materials from CF&I's coke plant into a new construction product. The new product, "Fountain-Lite," is used in making lightweight concrete and concrete blocks, soundproofing, insulation, and skid-inhibiting asphalt paving. The aggregate can also be used as a fill material in critical soil conditions.

**Feldspar.**—Lockhard & Sons produced feldspar from the Mica lode west of Canon City, and Colonna & Co. produced feldspar from pegmatites in the Rampart Range. Production in 1975 was 53% above that of 1974. The product, all recovered by hand cobbing, was used for decorative aggregate.

**Fluorspar.**—Although no fluorspar has been mined in Colorado since 1973, the Ozark Mahoning Co. has a stockpile of 2,300 tons of mine-run ore. No shipments were made from the stockpile in 1975.

**Gypsum.**—The Flintkote Co., Quad-Honstein Joint Venture, Ernest W. Mun-

Table 11.—Colorado: Clays sold or used by producer, by county

County	1974		1975	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Bent .....	261	\$2,088	W	W
Boulder .....	24,020	69,118	W	W
Douglas .....	79,003	224,200	48,567	\$114,306
Elbert .....	20,100	W	1,847	7,100
El Paso .....	10,052	W	13,122	51,808
Fremont .....	44,507	179,889	22,760	83,634
Jefferson .....	407,848	765,478	313,273	639,805
Las Animas .....	18,867	36,834	11,887	16,271
Pueblo .....	58,922	242,877	63,022	173,779
Undistributed .....	--	67,730	5,637	14,126
Total .....	663,280	1,588,214	480,115	1,100,829

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

roe, and Joe C. Lackey mined 185,000 tons of gypsum in Fremont and Larimer Counties. Output decreased 3% below that of 1974. The Flintkote Co. calcined gypsum at its Coaldale plant at Florence in Fremont County. Output decreased 6% below that of 1974. Calcined gypsum was used in the manufacture of building products, principally wallboard. Uncalcined gypsum was marketed as a cement retarder and soil conditioner; the former was sold to cement manufacturing plants, and the latter to farm supply stores.

**Lime.**—CF&I Steel Corp., The Great Western Sugar Co., American Crystal Sugar Co., and Holly Sugar Corp. produced lime at 11 plants in 10 counties for steel furnaces, sugar refining, and other uses. Leading counties were Pueblo, Morgan, and Larimer. Output was the same as in 1974, 198,000 tons, and was all used in Colorado.

**Perlite.**—The only crude perlite produced in Colorado was mined at the Rosita mine of Persolite Products, Inc., in Custer County. Output was greater than in 1974. Production from the mine was shipped to the company's expanding plant near Florence. A small quantity of crude perlite was sold to local markets.

Perlite was expanded at two mills in Colorado—the Antonito operated by Grefco, Inc., and the Florence plant operated by Persolite Products, Inc. Source of crude perlite for the Grefco, Inc., mill was New Mexico.

Expanded perlite was used principally as filter aid material (77%). Other uses included concrete and plaster aggregate, insulation, and fillers.

**Pumice.**—Output of pumice, in the form of volcanic cinder and scoria, decreased 12%, and value increased 3% from those of 1974. Scoria was produced by Colorado Aggregate Co., Inc., at its Mesita Hill mine in Costilla County, and volcanic cinder was mined by Dotsero Block Co., Inc., from its mine near Gypsum in Eagle County. More than 11,000 tons of pumice was used in landscaping, a considerable growth in that use compared to 1974. Other uses were concrete aggregate, road construction, and roofing granules.

**Salt.**—Salt in the form of brine was recovered from a well in Montrose County by Union Carbide Corp. for use in the company's uranium-vanadium mill at

Uravan. Value of production was 10% above that of 1974; the quantity produced was the same as in 1974.

**Sand and Gravel.**—Output of sand and gravel decreased 16% in quantity and 12% in value compared with the 1974 figure. These decreases reflected the second year of downturn in the level of construction in the State. Sand and gravel, the second most valuable nonmetallic mineral produced in Colorado, comprised 35% of the total value of nonmetallics and 4% of the total value of all minerals. In 1974, sand and gravel ranked fourth in value after petroleum, molybdenum, and coal. Because of the lower production in 1975, sand and gravel value has been surpassed by the values of cement, natural gas, and zinc.

Most sand and gravel mined in Colorado was used in construction by commercial operators or by government agencies and their contractors. That portion not used in construction was classified as industrial sand and was used in oil well hydrofracturing or glass manufacturing.

A major portion (83%) of the sand and gravel used in construction was processed before use; that is, washed, screened, crushed, or a combination of these processes. The balance was used as pit-run material. Average value of the processed sand was \$1.83 per ton; average value for processed gravel was \$1.66 per ton; and average value of pit-run material was \$0.82 per ton. Output of commercial operators was 57% of total construction production. Noncommercial production—that produced by governmental agencies, either by their employees or by contractors—amounted to 43% of total construction output. The number of sand and gravel mines increased from 200 in 1974 to 210 in 1975.

The royalty on Colorado State sand and gravel leases and permits is 15 cents per ton of material mined. Permits can be obtained for \$10 and are nonexclusive; that is, more than one sand and gravel permit can be issued for the same land. Leases, which are exclusive, are \$1 per acre per year and can be as long as 5 years. To issue permits or leases, the State must own both surface and mineral rights.

Plains Aggregate Co. of Boulder mined, crushed, and washed 95,000 tons of gravel in August and September from the Webster pit at Leadville. The rock,  $\frac{3}{4}$  inch to  $1\frac{1}{2}$

Table 12.—Colorado: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	4,591	7,964	4,693	8,567
Gravel -----	16,944	30,009	11,776	19,583
Unprocessed:				
Sand and gravel -----	2,258	1,578	3,413	2,790
Industrial:				
Sand -----	W	W	138	1,580
Gravel -----	--	--	--	--
Total -----	23,793	39,551	<sup>2</sup> 20,019	32,520

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

Table 13.—Colorado: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ---	4,625	9,346	3,866	8,966
Highway and bridge construction -----	287	612	198	473
Other construction (dams, waterworks, airports, etc.) -----	193	371	202	450
Concrete products (cement blocks, brick, pipe, etc.) -----	623	1,159	1,163	2,764
Bituminous paving (asphalt and tar paving) -----	1,406	3,139	1,365	2,132
Roadbase and subbase -----	5,097	9,064	2,221	3,551
Fill -----	476	766	318	419
Other -----	1,267	2,528	362	853
Unprocessed:				
Roadbase and subbase -----	515	415	734	609
Fill -----	680	600	417	414
Other -----	--	--	493	745
Industrial sand and gravel -----	W	W	138	1,580
Total <sup>1</sup> -----	15,172	28,000	11,475	22,955

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 14.—Colorado: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete:				
Nonresidential and residential construction ---	692	931	395	1,037
Highway and bridge construction -----	1,021	1,552	500	1,141
Other construction (dams, waterworks, airports, etc.) -----	127	212	156	316
Concrete products (cement blocks, brick, pipe, etc.) -----	W	W	53	114
Bituminous paving (asphalt and tar paving) ---	2,006	3,079	1,734	2,438
Roadbase and subbase -----	3,344	4,762	3,656	5,276
Fill -----	172	221	152	133
Other -----	195	354	129	248
<b>Unprocessed:</b>				
Roadbase and subbase -----	400	287	1,499	950
Fill -----	664	276	141	56
Other -----	--	--	129	186
<b>Total</b> -----	<b>8,621</b>	<b>11,674</b>	<b>8,544</b>	<b>11,895</b>

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

Table 15.—Colorado: Sand and gravel sold or used by county, in 1975  
(Thousand short tons and thousand dollars)

County	Number of mines	Quantity	Value
Adams	18	2,392	4,527
Alamosa	2	112	44
Arapahoe	5	1,145	2,032
Bent	2	35	25
Boulder	9	1,663	3,251
Clear Creek	1	220	331
Costilla	1	( <sup>1</sup> )	( <sup>1</sup> )
Crowley	1	35	51
Custer	1	W	27
Delta	3	95	176
Denver	1	66	73
Douglas	6	208	173
Elbert	2	194	116
El Paso	10	998	2,723
Grand	4	316	682
Gunnison	2	W	96
Hinsdale	1	4	8
Huerfano	3	93	166
Jackson	2	21	21
Jefferson	20	4,401	7,370
Kiowa	1	17	16
La Plata	4	290	615
Larimer	14	1,156	1,876
Las Animas	1	26	52
Lincoln	3	323	337
Logan	3	94	115
Mesa	11	897	1,452
Montezuma	3	140	333
Montrose	5	248	313
Morgan	1	84	47
Otero	4	115	196
Ouray	1	34	50
Phillips	1	23	42
Pueblo	5	778	1,341
Routt	6	374	1,173
Saguache	1	8	2
San Miguel	3	68	168
Sedgwick	1	26	10
Summit	8	433	813
Teller	1	1	( <sup>1</sup> )
Washington	2	101	70
Weld	8	1,209	1,260
Yuma	2	135	51
Other counties <sup>2</sup>	27	1,447	2,625
Total <sup>3</sup>	210	20,019	34,850

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

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Includes Archuleta, Baca, Chaffee, Conejos, Eagle, Fremont, Garfield, Kit Carson, Lake, Moffat, Park, Pitkin, Prowers, Rio Blanco, and Rio Grande Counties.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

inches in diameter, was trucked to the Climax mine for its winter stockpile.

**Stone.**—Production of stone totaling 5.3 million tons was 19% lower than in 1974. Thirty-three counties had stone production from 92 quarries. The number of quarries was up from 88 in 1974 and 91 in 1973. The principal producing county was Fremont with 1,826,377 tons from eight quarries. Boulder County with eight quarries was the second largest producer (884,279), followed by Jefferson County with eight quarries and 735,281 tons. Three other counties had output exceeding 100,000 tons; these were Larimer, El Paso, and Chaffee. Virtually all stone produced,

99.9%, was crushed and broken stone; 5,338 tons was dimension stone.

Principal uses of crushed and broken stone were for making cement and lime, and for flux stone, sugar refining, riprap, and concrete aggregate. Mine dusting has become another important use.

Diedrich Construction Co. of Leadville produced railroad ballast for the Denver & Rio Grande Western Railroad Co. from a portion of a slag dump just southwest of Leadville. The slag is from ASARCO's now-dismantled Arkansas lead-zinc smelter. The materials site is owned by the railroad.

Table 16.—Colorado: Dimension stone sold or used by producers, by use

Use	1974			1975		
	Cubic feet	Short tons	Value (thousands)	Cubic feet	Short tons	Value (thousands)
<b>Rough:</b>						
Irregular-shaped stone <sup>1</sup> ---	24,386	1,900	\$47	20,781	1,622	\$37
Architectural <sup>2</sup> -----	20,044	1,663	77	9,669	777	52
Flagging <sup>3</sup> -----	29,862	2,329	41	W	W	W
<b>Dressed:</b>						
House stone veneer -----	45,239	3,528	82	36,445	2,842	73
Flagging <sup>4</sup> -----	5,948	464	14	1,258	97	4
Monumental <sup>5</sup> -----	4,575	379	68	--	--	--
<b>Total</b> -----	<b>130,054</b>	<b>10,263</b>	<b>329</b>	<b>68,153</b>	<b>5,338</b>	<b>° 167</b>

W Withheld to avoid disclosing individual company confidential data; included with "Irregular-shaped stone."

<sup>1</sup> 1974 data include stone used for rubble; 1975 include flagging.

<sup>2</sup> Includes rough monumental stone.

<sup>3</sup> Includes unspecified rough stone.

<sup>4</sup> Includes a small amount of cut stone (1975).

<sup>5</sup> Includes a small amount of stone used in construction work.

<sup>6</sup> Data do not add to total shown because of independent rounding.

Table 17.—Colorado: Crushed stone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	71	153	212	323
Concrete aggregate (coarse) -----	1,100	2,314	549	1,421
Dense-graded roadbase stone -----	884	1,211	323	582
Surface treatment aggregate -----	152	276	170	344
Other construction aggregate and roadstone <sup>1</sup> -----	222	880	155	216
Cement and lime manufacture -----	2,668	5,827	2,763	4,542
Riprap and jetty stone -----	605	1,875	352	949
Filter stone -----	4	14	4	14
Terrazzo and exposed aggregate -----	8	92	2	14
Other uses <sup>2</sup> -----	846	2,638	775	2,368
<b>Total</b> <sup>3</sup> -----	<b>6,562</b>	<b>14,780</b>	<b>5,309</b>	<b>10,773</b>

<sup>1</sup> Data include manufactured fine aggregate (1974).

<sup>2</sup> Includes flux and refractory stone, stone used for sugar refining and fillers. 1975 data also include agricultural limestone, macadam aggregate, railroad ballast, stone used for mine dusting, and waste material.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 18.—Colorado: Crushed stone sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind of stone	1974		1975	
	Quantity	Value	Quantity	Value
Limestone and dolomite -----	4,427	10,519	3,920	7,744
Granite -----	1,614	2,972	928	1,929
Marble -----	W	W	--	--
Sandstone, quartz, and quartzite -----	494	1,223	375	971
Other stone -----	W	W	86	128
Undistributed <sup>1</sup> -----	28	65	--	--
<b>Total</b> <sup>2</sup> -----	<b>6,562</b>	<b>14,780</b>	<b>5,309</b>	<b>10,773</b>

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

<sup>1</sup> Includes uses indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 19.—Colorado: Crushed granite sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Adams	1	4	8	3	1	2
Arapahoe	1	1	2	2	1	2
Baca	1	(1)	1	--	--	--
Bent	1	1	1	1	(1)	(1)
Boulder	1	1	1	1	1	2
Clear Creek	1	1	2	1	(1)	(1)
Delta	--	--	--	2	3	7
Denver	1	3	5	--	--	--
Dolores	1	20	38	--	--	--
Eagle	1	18	26	--	--	--
Elbert	1	3	5	--	--	--
El Paso	2	W	677	1	W	W
Fremont	2	(1)	1	--	--	--
Garfield	1	W	126	1	W	W
Gilpin	1	(1)	(1)	--	--	--
Grand	1	15	15	1	1	3
Jackson	1	(1)	(1)	6	(1)	(1)
Jefferson	3	W	W	714	1,464	88
La Plata	3	25	42	5	43	W
Larimer	2	3	4	1	W	W
Las Animas	1	(1)	(1)	2	(1)	(1)
Lincoln	--	--	--	6	11	7
Mesa	1	W	W	2	3	3
Mineral	--	--	--	1	1	3
Moffat	1	19	51	--	--	--
Montezuma	1	1	1	2	14	2
Montrose	1	2	3	1	1	1
Morgan	--	--	--	1	1	1
Otero	1	1	1	--	--	--
Pitkin	1	(1)	1	--	--	9
Pueblo	1	(1)	(1)	1	5	4
Rio Blanco	--	--	--	1	1	13
Routt	--	--	--	1	3	(1)
Summit	--	--	--	1	(1)	(1)
Weld	1	(1)	(1)	1	4	6
Undistributed <sup>2</sup>	--	1,497	1,964	--	135	291
Total <sup>3</sup>	35	1,614	2,972	40	928	1,929

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

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Includes counties indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

**Sulfur.**—Continental Oil Co. recovered elemental sulfur from acid gases at its petroleum refinery in Denver. Elemental sulfur was not included in table 1 because it is considered a secondary product.

**Vermiculite.**—Crude vermiculite from Montana was exfoliated by W. R. Grace & Co. at its plant in Denver. The product was sold for use in concrete aggregate, fireproofing, horticulture, loose-fill insulation, and plaster aggregate.



Table 20.—Principal producers

Commodity and company	Address	Type of activity	County
Carbon dioxide (natural):			
Dye Carbonic, Inc -----	Box 816 Denver, Colo. 80201	Well -----	Montezuma.
Cement:			
Ideal Basic Industries, Inc. <sup>1</sup>	Box 231 Florence, Colo. 81226	Plants -----	Fremont and Larimer.
Martin Marietta Corp. <sup>2</sup> ---	11300 Rockville Pike Rockville, Md. 20852	---do -----	Boulder.
Clays:			
George W. Parfet Estate, Inc.	Box 266 Golden, Colo. 80401	Mine -----	Jefferson.
Robinson Brick & Tile Co.	Box 1619 Denver, Colo. 80223	Mines -----	Douglas, Elbert, El Paso, Jefferson.
Coal, bituminous:			
CF&I Steel Corp. <sup>3</sup> -----	Box 316 Pueblo, Colo. 81002	Mine -----	Las Animas.
Energy Fuels Corp -----	Box G Steamboat Springs, Colo. 80477	Strip mine and plant.	Routt.
Mid-Continental Coal and Coke Co.	Box 158 Carbondale, Colo. 81623	Mine and plant ---	Pitkin.
Peabody Coal Co -----	301 N. Memorial Dr. St. Louis, Mo. 63102	Strip mines and plant.	Montrose and Routt.
Pittsburg & Midway Coal Mining Co.	Tenmain Center Kansas City, Mo. 64105	Strip mine and plant.	Routt.
United States Steel Corp --	Box 807 Dragerton, Utah 84520	Mine and plant ---	Gunnison.
Copper:			
Federal Resources Corp. <sup>4</sup> ---	Ouray, Colo. 81427 -----	Mine -----	Ouray.
Idarado Mining Co. <sup>5</sup> -----	---do -----	---do -----	Ouray and San Miguel.
Standard Metals Corp. <sup>5</sup> ---	Box 247 Silverton, Colo. 81433	---do -----	San Juan.
Gypsum:			
The Flintkote Co -----	400 Westchester Ave. White Plains, N.Y. 10604	Mine and plant ---	Fremont.
Ernest W. Munroe -----	101 E. Vine Drive Fort Collins, Colo. 80521	Mine -----	Larimer.
Quad-Honstein Joint Venture.	1301 Arapahoe Golden, Colo. 80401	---do -----	Do.
U.S. Soil Conditioning Co.	Box 336 Salida, Colo. 81201	---do -----	Fremont.
Iron ore:			
Pitkin Iron Corp -----	105 W. Adams St. Chicago, Ill. 60603	Strip mine and plant.	Pitkin.
Lead:			
ASARCO, Inc. <sup>6</sup> -----	Box 936 Leadville, Colo. 80461	Mine -----	Lake.
Homestake Mining Co. <sup>7</sup> ---	Box 98 Creede, Colo. 81130	---do -----	Mineral.
Lime:			
The Great Western Sugar Co.	Box 5308 Denver, Colo. 80217	Plant -----	Adams, Boulder, Larimer, Logan, Morgan, Sedgwick, Weld.
Molybdenum:			
AMAX Inc. <sup>8</sup> -----	13949 W. Colfax Ave. Golden, Colo. 80401	Mine -----	Clear Creek and Lake.
Peat:			
Colorado Peat Industries --	6003 Indian Rd. Boulder, Colo. 80302	Bog -----	Boulder.
Universal Peat Co -----	1557 S. Ingalls St. Lakewood, Colo. 80422	Bog -----	Park.
Ver-Ja Peat Moss -----	Woodland Park, Colo. 80863	Bog -----	Teller.
Perlite (crude and expanded):			
Grefco, Inc -----	Box 308 Antonito, Colo. 81120	Plant -----	Conejos.
Persolite Products, Inc. <sup>9</sup> --	Box 105 Florence, Colo. 81226	Mine -----	Custer.
Petroleum (crude):			
Amoco Petroleum Corp ---	Box 591 Tulsa, Okla. 74102	Wells -----	Adams, Arapahoe, Cheyenne, Montezuma, Washing- ton, Weld.

See footnotes at end of table.

Table 20.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Petroleum (crude)—Continued</b>			
Beaver Mesa Exploration, Inc.	910 Metro Bank Bldg. Denver, Colo. 80202	Wells -----	Adams and Weld.
Champlin Petroleum Co ---	Box 9365 Fort Worth, Tex. 76107	----do -----	Adams, Arapahoe, Morgan, Washington, Weld.
Charter Exploration & Production Co.	1515 Arapahoe St. Denver, Colo. 80202	----do -----	Weld.
Chevron Oil Co -----	Box 599 1700 Broadway Denver, Colo. 80201	----do -----	Kiowa, Rio Blanco, Weld.
Continental Oil Co -----	Box 2197 Houston, Tex. 77001	----do -----	Jackson and Washington.
Inexco Oil Co -----	1100 Milam Bldg. Houston, Tex. 77002	----do -----	Cheyenne and Kiowa.
Texaco, Inc -----	Box 2100 Denver, Colo. 80201	----do -----	Adams, Arapahoe, Moffat, Rio Blanco.
Thomas G. Vessels -----	600 S. Cherry St. Denver, Colo. 80222	----do -----	Adams, Arapahoe, Weld.
<b>Pumice:</b>			
Colorado Aggregate Co., Inc.	Box 106 Mesita, Colo. 81142	Strip mine and plant.	Costilla.
Dotsero Block Co., Inc ---	Box 933 Glenwood Springs, Colo. 81601	----do -----	Eagle.
<b>Sand and gravel:</b>			
Asphalt Material & Paving Co.	Golden, Colo. 80401 -----	Pits and plants ---	Douglas, Garfield, Jefferson.
Brannan Sand & Gravel Co.	4800 Brighton Blvd. Denver, Colo. 80216	----do -----	Adams, Arapahoe, Jefferson.
Cooley Gravel Co. <sup>2</sup> -----	Box 313 Pueblo, Colo. 81002	----do -----	Adams, Arapahoe, Pueblo.
L. G. Everist, Inc -----	313 S. Phillips Sioux Falls, S. Dak. 57102	Pit -----	Jefferson.
Mobile Pre-Mix Sand and Gravel Co.	7620 Madison St. Denver, Colo. 80204	Pits and plants ---	Adams and Arapahoe.
Plains Aggregate Co ---	P.O. Box 229 Boulder, Colo. 80302	Pit -----	Larimer.
Western Paving Construction Co.	5105 Washington St. Denver, Colo. 80216	Pit and plant ---	Adams.
<b>Stone:</b>			
Castle Concrete Co -----	Box 2379 Colorado Springs, Colo. 80901	Quarry and plant -	El Paso.
<b>Uranium:</b>			
Cotter Corp -----	Box 352 Golden, Colo. 80401	Mine -----	Jefferson.
Union Carbide Corp. <sup>10</sup> ---	270 Park Ave. New York, N.Y. 10017	Mines -----	Garfield, Mesa, Montrose, San Miguel.
<b>Zinc:</b>			
New Jersey Zinc Co. <sup>11</sup> ---	Gilman, Colo. 81634 -----	Mine and mill ---	Eagle.

<sup>1</sup> Also stone and clays.<sup>2</sup> Also stone.<sup>3</sup> Also lime and stone.<sup>4</sup> Also lead and zinc.<sup>5</sup> Also gold, lead, silver, and zinc.<sup>6</sup> Also silver and zinc.<sup>7</sup> Also zinc.<sup>8</sup> Also pyrites, tin, and tungsten.<sup>9</sup> Also a plant in Fremont County.<sup>10</sup> Also vanadium.<sup>11</sup> Also lead and silver.



# The Mineral Industry of Connecticut

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

By William R. Barton <sup>1</sup>

The value of minerals produced in Connecticut decreased 7% in 1975, and the quantity of mineral products registered an even greater decline. The large quantitative drop was a result of recession-associated sluggish demand for construction mineral raw materials such as stone, sand, and gravel. Increases in unit-value due to inflationary pressures in the general economy lessened the erosion in total value of Connecticut mineral products, but demand was not strong enough to completely sustain the value levels of 1974. In order of declining value, Connecticut's principal 1975 mineral products were as follows: Stone, sand and gravel, feldspar, lime, clays, mica, and gem stones. The State also is the site of important copper and brass milling operations, silverware, brick, and glass manufacture, all of which depend directly on products of the minerals industry.

Governor Ella Grasso named Joseph N. Gill as Commissioner of Environmental Protection replacing Douglas M. Costle. The Department of Environmental Protection includes the office of Hugo F. Thomas, State Geologist and Director of the Natural Resources Center.

The Connecticut Resources Recovery

Authority (CRRA) received as its new Chairman Charles Stroh, who replaces Malcolm Baldrige. The CRRA Bridgeport plant, which is under construction, will feature recovery of powdered fuel (to be used in production of commercial electric power) along with metallic and nonmetallic byproducts. Occidental Petroleum Corp., the prime contractor, has been joined in the undertaking by Combustion Equipment Associates, Inc.

The Connecticut Geological and Natural History Survey published Quadrangle Report No. 31, the Surficial Geology of the Essex and Old Lyme Quadrangles, and Quadrangle Report No. 32, the Bedrock Geology of the South Canaan Quadrangle.

The U.S. Geological Survey, in cooperation with the Connecticut Geological and Natural History Survey, published map GQ-1205, Surficial Geology of the Moodus Quadrangle; map GQ-1214, Geologic Map of the Westford Quadrangle; map GQ-1216, Surficial Geology of the Stafford Springs Quadrangle; and map GQ-1257, Geology of the New Hartford Quadrangle.

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<sup>1</sup> State Liaison Officer, Bureau of Mines, Newmarket, N.H.

Table 1.—Mineral production in Connecticut <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays -----thousand short tons--	156	\$363	116	\$307
Gem stones -----	NA	15	NA	W
Lime -----thousand short tons--	33	1,148	23	1,013
Mica (scrap) -----do-----	2	W	W	W
Sand and gravel -----do-----	6,345	11,272	4,900	10,040
Stone -----do-----	8,457	21,134	7,332	20,117
Value of items that cannot be disclosed:				
Feldspar, sheet mica (1974), and values indicated by symbol W -----	XX	<sup>r</sup> 1,433	XX	1,533
Total -----	XX	<sup>r</sup> 35,365	XX	33,010
Total 1967 constant dollars -----	XX	16,721	XX	<sup>p</sup> 13,072

<sup>p</sup> Preliminary. <sup>r</sup> 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.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Connecticut, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Fairfield -----	\$798	\$309	Sand and gravel.
Hartford -----	10,952	W	Stone, sand and gravel, clays.
Litchfield -----	4,486	4,930	Sand and gravel, stone, lime.
Middlesex -----	<sup>r</sup> 2,915	2,952	Feldspar, sand and gravel, stone, mica, clays.
New Haven -----	12,840	W	Stone, sand and gravel, clays.
New London -----	W	W	Sand and gravel, stone.
Tolland -----	W	W	Do.
Windham -----	W	739	Do.
Undistributed <sup>1</sup> -----	3,375	24,082	
Total <sup>2</sup> -----	<sup>r</sup> 35,365	33,010	

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

<sup>1</sup> Includes gem stones, some sand and gravel that cannot be assigned to specific counties (1974), and values indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Connecticut business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands--	1,442.0	1,453.0	+ 0.8
Unemployment ----- do-----	88.0	133.0	+51.1
<b>Employment (nonagricultural):</b>			
Mining ----- do-----	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )
Manufacturing ----- do-----	430.7	389.4	- 9.6
Contract construction ----- do-----	<sup>2</sup> 53.7	<sup>2</sup> 43.8	-23.6
Transportation and public utilities ----- do-----	55.5	52.8	- 4.9
Wholesale and retail trade ----- do-----	250.6	248.7	- 0.8
Finance, insurance, and real estate ----- do-----	85.4	85.9	+ 0.6
Services ----- do-----	217.2	221.2	+ 1.8
Government ----- do-----	171.0	178.7	+ 4.5
Total nonagricultural employment ..do----	1,264.1	1,220.5	- 3.5
<b>Personal income:</b>			
Total ----- millions--	\$20,019	\$21,584	+ 7.8
Per capita ----- do-----	\$6,487	\$6,973	+ 7.5
<b>Construction activity:</b>			
Number of private and public residential units authorized	13,561	12,114	- 10.7
Value of nonresidential construction ..millions--	\$891.3	\$184.3	- 79.3
Value of State road contract awards ----- do-----	\$138.8	\$22.0	- 84.1
Shipments of portland and masonry cement to and within the State ----- thousand short tons--	757	637	- 15.9
<b>Mineral production value:</b>			
Total crude mineral value ----- millions--	\$35.4	\$33.0	- 6.8
Value per capita, resident population ----- do-----	\$11.46	\$10.65	- 7.1
Value per square mile ----- do-----	\$7,059.69	\$6,590.14	- 6.7

<sup>p</sup> Preliminary.<sup>1</sup> Included with "Contract construction."<sup>2</sup> Includes mining.

Source: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Table 4.—Worktime and injury experience in the Connecticut mineral industry in 1975 <sup>1, 2</sup>

	Men	Man-hours	Injuries	Fatal frequency rate	Non-fatal disabling injuries	Non-fatal disabling frequency rate	Nondisabling injuries	Nondisabling frequency rate
<b>Sand and gravel:</b>								
Surface -----	388	507,245	--	--	11	21.69	1	1.97
Office -----	75	102,208	--	--	--	--	--	--
Total -----	463	609,453	--	--	11	18.05	1	1.64
<b>Stone:</b>								
Surface -----	311	623,612	--	--	8	12.83	2	3.21
Mill -----	96	191,823	1	5.21	2	10.43	1	5.21
Office -----	35	71,753	--	--	--	--	--	--
Total -----	442	887,188	1	1.13	10	11.27	3	3.38
<b>Clay:</b>								
Surface -----	23	17,566	--	--	--	--	--	--
Mill -----	11	15,275	--	--	--	--	--	--
Office -----	2	3,120	--	--	--	--	--	--
Total -----	36	35,961	--	--	--	--	--	--
<b>Feldspar:</b>								
Surface -----	12	28,199	--	--	1	35.46	--	--
Mill -----	27	56,870	--	--	2	35.17	--	--
Office -----	5	8,174	--	--	--	--	--	--
Total -----	44	93,243	--	--	3	32.17	--	--
<b>Mica: Mill</b>								
-----	1	2,088	*	--	--	--	--	--
<b>State totals:</b>								
Surface -----	734	1,176,622	--	--	20	17.00	3	2.55
Mill -----	135	266,056	1	3.76	4	15.03	1	3.76
Office -----	117	185,255	--	--	--	--	--	--
Total -----	986	1,627,933	1	.61	24	14.74	4	2.46

<sup>1</sup> All data are preliminary.<sup>2</sup> Data supplied by Mining Enforcement and Safety Administration.

## REVIEW BY MINERAL COMMODITIES

## NONMETALS

**Cement.**—There are no cement manufacturing plants in Connecticut. Data are not available on the origin of cement shipped into the State, but the Hudson River Valley plants would seem to be a logical major source. Preliminary data on cement shipments received in Connecticut indicates a 16% decrease, from 757,000 tons in 1974 to 637,000 tons in 1975.

**Clays.**—Common clay was mined by four companies in Hartford, Middlesex, and New Haven Counties. Most of the clay was consumed in manufacturing building brick; the rest was utilized by the ceramic and specialty clay products industry.

**Feldspar.**—The Feldspar Corp. mined feldspar from pegmatites at the Middletown and Hale mines and ground it at its Middletown plant in Middlesex County. The ground feldspar was shipped to various States and Canada for use in manufacturing glass and ceramic products. Despite installation of extensive pollution control equipment during the previous year, the Federal Environmental Protection Agency warned Feldspar Corp. that both mining and milling operations were in violation of Federal and State air pollution regulations. The Middletown operation is the largest feldspar producer in New England.

**Gem Stones.**—Individuals, mineralogical clubs, and dealers collected specimens and bulk cutting and polishing material from mine dumps, quarries, and pegmatites throughout the State, with the most in-

tense activity in the Middletown-Portland old beryl-mica district.

**Lime.**—At Canaan, Litchfield County, lime was produced by Pfizer Inc. The product was sold for sewage treatment, mason's lime, and other uses. Production dropped 30% in quantity and 12% in value from the levels of the previous year. The lime was consumed in New England and other States. Total consumption of lime in Connecticut was 52,037 tons.

**Mica.**—Scrap and flake mica were by-products of feldspar mining and processing in Middlesex County.

**Sand and Gravel.**—Sand and gravel were exceeded only by stone in both quantity and value among the mineral products excavated in Connecticut. Production of sand and gravel was reported in all eight counties in the State, led by Hartford and New Haven.

Of the 4.9 million tons of sand and gravel produced, 78% was reported sold or used commercially and the rest was used in publicly funded projects. The production, 23% below that of 1974 in quantity, was used primarily as aggregate in either portland cement or bituminous concrete. Other uses were fill, railroad ballast, and foundry sand.

A plan to convert two Shoreline Washed Sand and Stone Co. pits into a recreational lake was defeated at a special Killingsworth town meeting in June. The pits were required to cease operations no later than 1976. In addition, the pits will have to be restored in accordance with specifications to be approved by the Killingsworth Planning and Zoning Commission.

Table 5.—Connecticut: Construction sand and gravel sold or used by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	5,118	9,906	2,146	4,497
Gravel -----			1,663	3,972
Unprocessed: Sand and gravel ---	1,227	1,275	1,091	1,316
Total -----	6,345	11,181	4,900	9,785

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

Table 6.—Connecticut: Construction aggregate (blended sand and gravel) sold or used commercially by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction	1,378	2,977	1,249	3,123
Highway and bridge construction	150	229	150	315
Other construction (dams, waterworks, airports, etc.)	203	403	61	154
Concrete products (cement blocks, brick, pipe, etc.)	1,015	1,853	550	1,288
Bituminous paving (asphalt and tar paving)	719	1,566	517	1,195
Roadbase and subbase	737	1,232	272	527
Fill	182	214	219	304
Other	177	305	99	205
<b>Unprocessed:</b>				
Roadbase and subbase	447	477	208	247
Fill	780	798	477	663
Other	--	--	W	W
Total <sup>1</sup>	5,788	10,054	3,803	8,020

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 7.—Connecticut: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction	85	232	83	238
Highway and bridge construction	109	149	67	176
Other construction (dams, waterworks, airports, etc.)	W	W	27	47
Concrete products (cement blocks, brick, pipe, etc.)	31	68	37	65
Bituminous paving (asphalt and tar paving)	221	568	285	655
Roadbase and subbase	48	109	45	98
Fill	27	41	9	14
Other	36	51	139	293
<b>Unprocessed:</b>				
Roadbase and subbase	--	--	183	204
Fill	W	W	223	232
Total <sup>1</sup>	557	1,218	1,097	2,020

W Withheld to avoid disclosing individual company confidential data; included with "Highway and bridge construction."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Stone.**—Production of stone decreased 13% in volume and 5% in value compared with the levels of 1974.

Crushed basalt (including diabase), used chiefly as construction aggregate and railroad ballast, was the major stone product in Hartford, Litchfield, and New Haven Counties and constituted an important export from Connecticut. The basalt is

barged to New York, New Jersey, and other destinations and carried by rail (for railroad ballast use) as far as Illinois. In tonnage, it constituted the largest rail freight item originating in Connecticut.

Crushed limestone and dolomite were produced in Litchfield County by three operators. It was marketed for metallurgical flux, soil neutralizer, lime manufactur-



ing, stucco, and filler. It also constituted the raw material basis for production of calcium at Canaan.

Crushed sandstone produced in Middlesex County was used in manufacturing fine aggregate and terrazzo. Quartz was produced in New London and Middlesex Counties for use in glass, asphalt and other industrial fillers, and abrasives. The quartz from Middlesex County was a byproduct of milling pegmatite ore for feldspar. The New London County quartz was produced from a large quartz replacement body at Lantern Hill. Dimension sandstone was produced in Windham County and sold for rubble, rough construction, and building stone veneer.

#### METALS

Pfizer, Inc., at Canaan, was the only known commercial producer of calcium metal in the United States. Pfizer also produced barium metal at Canaan.

There were six steel fabrication mills in the State, producing bars, rods, coils, strips, and wire rope from primary shapes.

The Abbott Ball Co., Hartford County, produced steel shot and grit. Approximately 75 foundries produced ferrous and nonferrous castings, and 11 foundries produced ferrous and nonferrous forgings and ingots. Fabrication of copper and brass items remained a major industrial activity during the year, as was silver crafting.

About 25 scrap metal dealers collected and processed ferrous metal for export and for sale to area foundries.

#### MINERAL FUELS

**Petroleum.**—Wyatt Fuel Oil Co., New Haven began accepting waste industrial lubrication oils and motor oils for reprocessing. Wyatt intended to use the reprocessed oil as a substitute for industrial fuel oil.

Both the In-O-Ven Corp. and Pepco International, Inc. refinery proposals remained active. However, neither proposal appeared any nearer to fruition at the end of the year. Both proposals faced sustained opposition from organized groups of environmentally concerned citizens.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Michael Kane Brick Co.	654 Newfield St. Middletown, Conn. 06475	Pit -----	Middlesex.
Keller Potter Corp. of Conn.	Four Rod Rd. Kensington, Conn. 06037	Pit -----	Hartford.
Kelsey-Ferguson Brick Co., (Div. of Susquehanna Corp.)	Route 5 East Windsor Hill, Conn. 06028	Pit -----	Do.
Plasticrete Corp., Stiles Brick Div.	P.O. Box 248 North Haven, Conn. 06473	Pit -----	New Haven.
Feldspar: The Feldspar Corp. <sup>1</sup>	Spruce Pine, N.C. 28777 -----	Pits, plant ---	Middlesex.
Lime: Pfizer, Inc. <sup>2</sup> -----	Daisy Hill Rd. Canaan, Conn. 06018	Pit, plant ---	Litchfield.
Sand and gravel:			
Balf Co. <sup>3</sup> -----	P.O. Box 11190 Newington, Conn. 06111	Pit -----	Hartford.
Dunning Sand & Gravel Co., Inc.	Farmington, Conn. 06032 -----	Pit -----	Do.
Genestra Sand & Gravel ---	260 Picket Rd. New Milford, Conn. 06776	Pit -----	Litchfield.
New London Sand and Gravel.	47 Fog Plain Rd. Waterford, Conn. 06385	Pit, dredge --	New London.
Oneglia and Gervasini Building Materials. <sup>3</sup>	P.O. Box 907 Torrington, Conn. 06790	Pits -----	Hartford.
J. Romanella & Sons -----	Route 49 Dunns Corner, R.I. 02854	Pit -----	New Haven.
Roncari Industries, Inc. <sup>3</sup> ---	1776 South Main St. East Granby, Conn. 06026	Pit -----	Hartford.
Sega Sand and Gravel Co., Inc.	271 Danbury Rd. New Milford, Conn. 06776	Pits -----	Litchfield.
Silliman Co -----	290 North Ave. Bridgeport, Conn. 06601	Pit -----	Do.
Silica, ground and crushed:			
Ottawa Silica Co -----	P.O. Box 577 Ottawa, Illinois 61350	Pit, plant ---	New London.
Stone: Basalt, crushed and broken:			
New Haven Traprock/ Tomasso (Div. of Ashland Oil, Inc.) <sup>4</sup>	P.O. Box 5033 Hamden, Conn. 06518	Quarries -----	Hartford and New Haven.
York Hill Trap Rock Quarry Co.	Westfield Rd. Meriden, Conn. 06450	Quarry -----	New Haven.

<sup>1</sup> Also scrap mica, ground and crushed silica.<sup>2</sup> Also dolomite.<sup>3</sup> Also basalt.<sup>4</sup> Also crushed granite.



# 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 Joseph A. Sutton<sup>1</sup>

Sand and gravel remained Delaware's only significant mineral product in 1975. A major decrease in sand and gravel output was the principle cause of a 50% decrease in the total value of the State's mineral production. Other mineral-related activities carried on in the State included recovering sulfur from petroleum, calcining gypsum, and mining small quantities of clay for use in producing building brick.

**Legislation and Government Programs.**—The Bureau of Mines Tuscaloosa, Ala., Metallurgy Research Center tested a sample of the clays dredged from ship channels in the Delaware River. The dredged clays had been placed on spoil piles encroaching on marshland adjacent to Getty Oil Co.'s refinery. Test results indicated that, when the material is pelletized and quick-fired, it may be a promising source material for making lightweight aggregate.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Clays.**—The Delaware Brick Co., the only producer of clay in Delaware, produced 9,000 tons of common clay in 1975, a decrease of 33% compared with that of 1974. The clay was produced just south of New Castle, and was used to produce building brick.

**Gypsum.**—Georgia-Pacific Corp. calcined gypsum at Wilmington in New Castle County. Output decreased 12% and was 19% below the 1973 record high.

**Magnesium Compounds.**—The Barcroft Co. plant at Lewes continued to produce magnesium hydroxide (milk of magnesia) from seawater.

**Sand and Gravel.**—Output of sand and gravel was down 59% in quantity and 50% in value in 1975. The decrease resulted

mainly from unusually small shipments of processed sand and gravel for use in nonresidential and residential construction, highway and bridge construction, and roadbase and subbase use of unprocessed sand and gravel.

The main use for the sand and gravel produced in the State continued to be for roadbase.

Production of sand and gravel was reported by 10 companies operating 13 pits and 7 dredging operations in 2 of the State's 3 counties. New Castle County contained 11 of the 13 pits operated in the State, and Kent County contained 2 pits and all of the 7 dredging operations. Of the sand and gravel produced, 310,352 tons valued at \$1,013,552 was processed, and 665,270 tons valued at \$886,073 was unprocessed.

<sup>1</sup>State Liaison Officer (Delaware and Maryland), Bureau of Mines, Washington, D.C.

Table 1.—Mineral production in Delaware<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ----- thousand short tons	14	\$8	9	\$6
Gem stones -----	NA	2	NA	W
Sand and gravel ----- thousand short tons	2,396	3,783	976	1,900
Value of items that cannot be disclosed:				
Other nonmetals and values indicated by symbol W -----	XX	W	XX	W
Total <sup>2</sup> -----	XX	3,793	XX	1,906
Total 1967 constant dollars -----	XX	1,793	XX	\$7,548

<sup>P</sup>Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data.  
XX Not applicable.

<sup>1</sup>Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup>Total of listed figures only.

Table 2.—Indicators of Delaware business activity

	1974	1975 <sup>P</sup>	Change, percent
Employment and labor force, annual average:			
Total labor force ----- thousands	249.6	246.3	-1.3
Unemployment ----- do	15.3	21.2	+38.6
Employment (nonagricultural):			
Mining ----- do	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )
Manufacturing ----- do	72.4	66.7	-7.9
Contract construction ----- do	16.1	15.1	-6.2
Transportation and public utilities ----- do	11.7	11.5	-1.7
Wholesale and retail trade ----- do	47.6	46.4	-2.5
Finance, insurance, real estate ----- do	11.3	11.5	+1.8
Services ----- do	299.0	297.2	-2.4
Government ----- do	35.7	38.2	+7.0
Total nonagricultural employment ----- do	233.8	226.6	-3.1
Personal income:			
Total ----- millions	\$3,628	\$3,908	+7.7
Per capita ----- do	\$6,284	\$6,748	+7.4
Construction activity:			
Number of private and public residential units authorized -----	3,195	3,040	-4.9
Value of nonresidential construction ----- millions	\$28.8	\$20.9	-27.4
Value of State-road-contract awards ----- do	\$38.0	\$33.0	-13.2
Shipments of portland and masonry cement to and within the State ----- thousand short tons	188	129	-31.4
Mineral production value:			
Total crude mineral value ----- millions	\$33.8	\$31.9	-50.0
Value per capita, resident population -----	\$6.57	\$3.29	-49.9
Value per square mile -----	\$1,843.95	\$926.59	-49.8

<sup>P</sup>Preliminary.

<sup>1</sup>Included with "Services."

<sup>2</sup>Includes mining.

<sup>3</sup>Partial figure; excludes values of some commodities to avoid disclosing individual company confidential information.

Source: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction magazine, and U.S. Bureau of Mines.

Table 3.—Principal producers

Commodity and company	Address	Type of activity	County
Clays: Delaware Brick Co -----	River Rd. New Castle, Del. 19720	Pit -----	New Castle.
Gypsum, calcined: Georgia-Pacific Corp.	900 SW Fifth Ave. Portland, Oreg. 97204	Plant -----	Do.
Magnesium compounds: Barcroft Co.	P.O. Box 474, Henlopen Dr. Lewes, Del. 19958	-----do-----	Sussex.
Sand and gravel:			
Barber Sand and Gravel -----	R.F.D. 1 Harrington, Del. 19952	Pit -----	Kent.
Clough & Caulk Sand & Gravel -----	Route 1, Box 129 Wyoming, Del. 19934	Pit -----	Do.
Delaware Sand & Gravel -----	R.D. 2, Box 286 New Castle, Del. 19720	Pit -----	New Castle.
George Nashold, Inc -----	Box 286 Frederica, Del. 19946	Pit -----	Kent.
Material Transit, Inc -----	Box 210 924 South Herald St. Wilmington, Del. 19800	Pit -----	New Castle.
Parkway Gravel, Inc -----	4048 New Castle Ave. New Castle, Del. 19720	3 Pits -----	Do.
St. Jones River Gravel Co -----	Box 426 Dover, Del. 19901	Pit -----	Kent.
Whittington's Sand & Gravel Co.	U.S. Route 40 Bear, Del. 19701	Pit -----	New Castle.
Woodlawn Gravel Co -----	Box 2501 Wilmington, Del. 19805	Pit -----	Do.



# The Mineral Industry of Florida

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the Florida Bureau of Geology.

By John W. Sweeney<sup>1</sup> and Charles W. Hendry Jr.<sup>2</sup>

The value of mineral production in Florida increased from \$1.04 billion in 1974 to \$1.78 billion in 1975, principally owing to increases in the value of crude petroleum, natural gas, and phosphate rock.

Of the 48.9 million tons of phosphate rock produced in the United States, Florida and North Carolina produced 40.7 million. Florida was the predominant producer and for the 82d consecutive year supplied more than any other State. The State ranked first in the value of fuller's earth, first in the value of titanium concentrates,

and fourth in the value of peat. Staurolite was produced only in Florida. Florida and North Carolina supplied 83% of the domestic phosphate rock market and 90% of the exports from the United States. Phosphate rock was exported from the ports of Tampa, Boca Grande, and Jacksonville. The principal recipients were Canada, Japan, and Mexico.

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Table 1.—Mineral production in Florida<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry ----- thousand short tons--	235	\$4,787	W	W
Portland ----- do-----	2,562	75,183	1,721	\$62,525
Clays ----- do-----	808	<sup>2</sup> 14,261	712	17,063
Lime ----- do-----	185	5,315	199	7,708
Natural gas ----- million cubic feet--	38,137	20,441	44,383	43,185
Peat ----- thousand short tons--	67	616	82	1,037
Petroleum (crude) ----- thousand 42-gallon barrels--	36,351	351,331	41,877	490,258
Titanium concentrates (rutile) ----- short tons--	6,446	996	W	W
Sand and gravel ----- thousand short tons--	24,372	33,400	13,237	20,199
Stone <sup>3</sup> ----- do-----	54,560	100,378	39,071	73,372
Value of items that cannot be disclosed:				
Clays (kaolin, 1974), magnesium compounds, natural gas liquids, phosphate rock, rare-earth metals, staurolite, stone (shell (1974) and dimension), titanium concentrates (ilmenite), zircon concentrates, and values indicated by symbol W -----	XX	437,287	XX	1,060,153
Total -----	XX	1,043,895	XX	1,775,500
Total 1967 constant dollars -----	XX	493,658	XX	P 703,098

<sup>2</sup> Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes kaolin; included with "Value of items that cannot be disclosed."

<sup>3</sup> Excludes dimension stone and shell; included with "Value of items that cannot be disclosed."



Table 2.—Value of mineral production in Florida, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Alachua	\$3,245	\$2,404	Stone.
Bay	W	474	Sand and gravel.
Bradford	W	W	Natural gas liquids.
Brevard	W	W	Sand and gravel, stone.
Broward	22,553	11,093	Stone, sand and gravel.
Calhoun	W	--	
Citrus	1,823	1,881	Stone, phosphate rock.
Clay	W	30,556	Zircon, ilmenite, rutile, sand and gravel, staurolite, clays, monazite.
Collier	6,008	2,384	Stone.
Dade	87,767	65,148	Cement, stone, sand and gravel.
De Soto	W	--	
Dixie	--	W	Stone.
Escambia	W	759	Sand and gravel, clays.
Franklin	W	--	
Gadsden	12,794	W	Clays, sand and gravel.
Glades	W	W	Sand and gravel.
Gulf	W	W	Magnesium compounds, lime.
Hamilton	W	W	Phosphate rock.
Hendry	W	W	Sand and gravel, stone.
Hernando	23,186	W	Stone, lime, clays.
Highlands	W	358	Peat.
Hillsborough	W	W	Cement, sand and gravel, stone, peat.
Jackson	W	W	Stone, sand and gravel.
Lake	3,869	2,925	Sand and gravel.
Lee	W	W	Stone.
Leon	W	W	Sand and gravel.
Levy	247	290	Stone.
Manatee	W	W	Cement, stone.
Marion	5,133	6,092	Stone, clays, sand and gravel, phosphate rock.
Martin	W	--	
Monroe	1,296	881	Stone.
Nassau	--	W	Titanium, zircon, monazite.
Okaloosa	W	W	Sand and gravel.
Okeechobee	W	W	Stone.
Orange	W	W	Sand and gravel, peat.
Palm Beach	W	W	Stone.
Pasco	611	343	Do.
Pinellas	W	W	Do.
Polk	355,028	W	Phosphate rock, sand and gravel, peat, stone.
Putnam	2,749	2,079	Sand and gravel, clays, peat.
St. Lucie	383	W	Sand and gravel.
Santa Rosa	--	W	Natural gas liquids, sand and gravel.
Sarasota	W	W	Sand and gravel.
Sumter	7,904	W	Stone, lime, peat.
Suwannee	W	2,643	Stone.
Taylor	W	578	Do.
Wakulla	--	1	Sand and gravel.
Walton	W	269	Do.
Washington	W	--	
Undistributed <sup>2</sup>	509,298	1,644,341	
Total <sup>3</sup>	1,043,895	1,775,500	

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

<sup>1</sup>The following counties are not listed because no production was reported: Baker, Charlotte, Columbia, Duval, Flagler, Gilchrist, Hardee, Holmes, Indian River, Jefferson, Lafayette, Liberty, Madison, Osceola, St. Johns, Seminole, Union, and Volusia. County data for petroleum and natural gas are not available; included with "Undistributed."

<sup>2</sup>Includes values of counties indicated by symbol W and petroleum and natural gas values.

<sup>3</sup>Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Florida business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	3,226.0	3,472.0	+7.6
Unemployment -----do-----	208.0	370.0	+77.9
<b>Employment (nonagricultural):</b>			
Mining -----do-----	10.8	11.0	+1.9
Manufacturing -----do-----	369.0	327.7	-11.2
Contract construction -----do-----	267.2	171.1	-36.0
Transportation and public utilities -----do-----	190.7	181.4	-4.9
Wholesale and retail trade -----do-----	747.0	719.4	-3.7
Finance, insurance, and real estate -----do-----	196.6	189.9	-3.4
Services -----do-----	578.3	581.0	+0.5
Government -----do-----	510.1	548.0	+7.4
Total nonagricultural employment -----do-----	2,869.7	2,729.5	-4.9
<b>Personal income:</b>			
Total -----millions--	\$43,742	\$47,055	+7.6
Per capita -----do-----	\$5,406	\$5,638	+4.3
<b>Construction activity:</b>			
Number of private and public residential units authorized--	110,794	47,989	-56.7
Value of nonresidential construction-----millions	\$1,208.0	\$802.3	-33.6
Value of State road contract awards -----do-----	\$369.0	\$180.0	-51.2
Shipments of portland and masonry cement to and within the State -----thousand short tons--	5,327	3,404	-36.1
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$1,043.9	\$1,775.5	+70.1
Value per capita, resident population -----do-----	\$128.89	\$214.51	+66.4
Value per square mile -----do-----	\$17,826.08	\$30,319.33	+70.1

<sup>P</sup> Preliminary.

Source: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

The Uranium Recovery Corp. facilities at Mulberry, to recover uranium from wet-process phosphoric acid, were completed and were being readied for production.

Construction at the Florida Power Corp. Crystal River nuclear powerplant was resumed. The 825-megawatt plant originally was to go into service in 1972, but was delayed due to money shortages, regulatory snarls, and material and labor shortages. The new completion date was the fall of 1976.

A Solar Energy Research Center was established at Cape Canaveral. It is anticipated that the Center will make Florida a leader in the use of solar energy and become a testing center for solar energy devices. The Center was started July 1, 1975.

Tampa Electric Co. (TECO), along with 15 other utilities, made a \$1 billion bid to purchase Peabody Coal Co. TECO's portion of the purchase would amount to \$40 million, or 4%, if the proposal is approved by the Federal Trade Commission.

Ashland Oil Co. acquired 14,500 acres in St. Lucie County where it proposes to build an inland oil refinery with a capacity of 250,000 barrels per day.

Gulf Steel Corp. announced it will construct its new plant at Quincy about 20 miles west of Tallahassee. It will manufacture structural steel, steel girders, trusses, structural reinforcing steel, and other products.

In 1975 following the Mississippi, Alabama, Florida Outer Continental Shelf (MAFLA OCS) lease sale of December 1973, 15 wells were drilled off the west coast of Florida, all of which were dry. Eight of these were located in the Destin Dome, located 30 to 70 miles south of Choctowhatchee Bay in the Florida panhandle. The failure of this structure to produce hydrocarbons was a severe setback to the "bright-spot" seismic technique, which here proved fallible. Exxon Corp., Mobil Oil Corp., and Chaplin Oil and Refining Co. had ventured \$530 million on lease bonuses for five tracts on the structure on which they subsequently drilled seven dry holes. Exploration is continuing at a reduced level.

Exxon Corp. produced oil at a daily rate of 15,000 barrels at Blackjack Creek and 89,000 barrels at Jay field, both in Santa Rosa County. Pressure maintenance, via water injection, was scheduled to commence in the Blackjack Creek field during

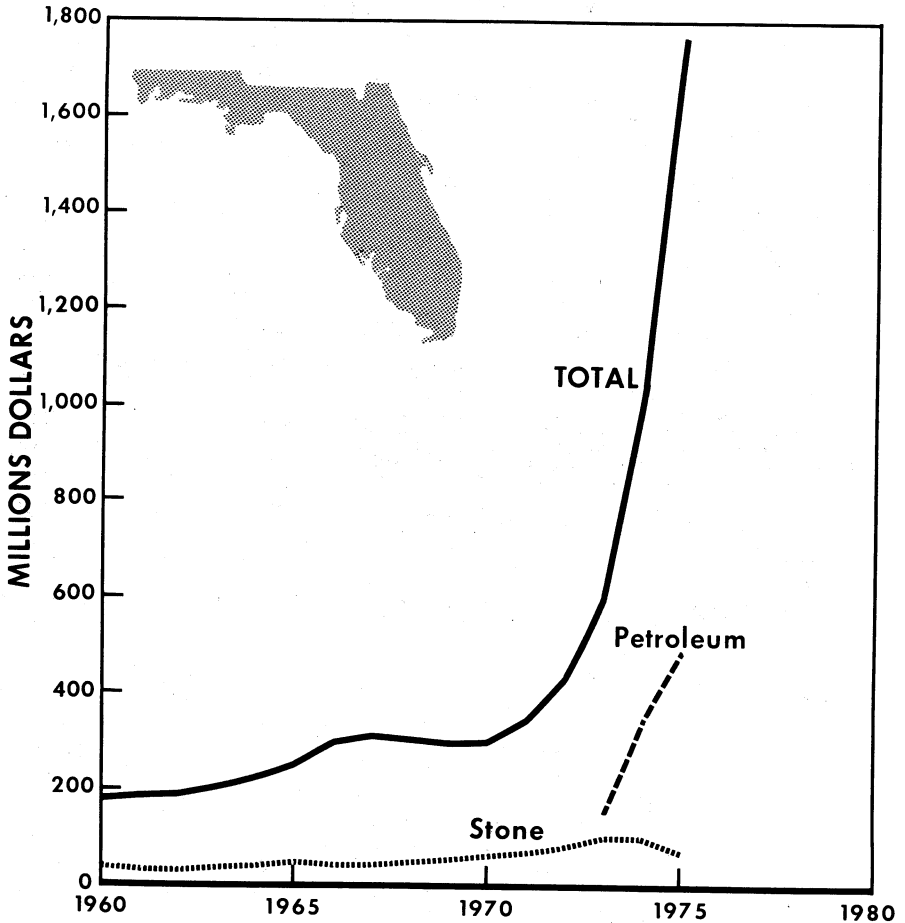


Figure 1.—Value of stone, petroleum, and total value of mineral production in Florida.

the summer of 1975. A similar program begun at Jay in 1973 responded successfully, as measured by production and reservoir pressures to date.

A moratorium on oil exploration in the Ocala National Forest was lifted by the Interior Department, and Amoco Production Co. drilled two exploratory wells with no traces of oil or gas.

#### Legislation and Government Programs.

—A. T. Kearney, Inc., prepared a report for the U.S. Army Corps of Engineers assessing the benefits of the Cross Florida Barge Canal. The Kearney study showed average annual transportation benefits of \$8.6 million, compared to \$7.23 million

calculated by the Corps of Engineers in 1962; traffic would total 5.1 million tons during the canal's first year of operation and would increase to 10.9 million tons in 50 years, which may not be enough to justify completion. The Kearney study was restricted to transportation; other segments on flood control and recreation are under study and may change the cost-benefit relationship in favor of completion.

Secretary of the Interior Thomas S. Kleppe directed that a 2-year study be conducted to determine what potential effect phosphate mining in the Osceola National Forest would have upon the area's water and wildlife.

The Corps of Engineers announced the first phase of a \$120 million, 40-mile-long harbor-deepening project. The project will deepen the Tampa Channel from its current 34 feet to 43 feet.

The U.S. Environmental Protection Agency (EPA) released Technical Note ORP/CSD-75-4 Preliminary Findings Radon Daughter Levels in Structures Constructed on Reclaimed Florida Phosphate Land, which suggests that prolonged exposure to radon daughters could double the incidence of lung cancer. The EPA emphasized that the findings presented in its report were preliminary and require substantial (at least 1 year) additional study before the overall radiological impact can be ascertained. It is the belief of EPA and the Division of Health, Florida Department of Health and Rehabilitative Service officials that there is no imminent danger to the public health and that studies, rather than precipitous action, are indicated.

The 1975 Florida Legislature passed a mandatory surface mine reclamation act (Ch. 75-40, Laws of 1975). This act was effective July 1, 1975, and modified the Florida Severance Tax Act of 1971 (Ch. 211, Part II, Florida Statutes). The 1975 act imposes mandatory reclamation of lands subject to the severance tax. Such tax shall be 5% of the value at the point of severance. The bill allows for a tax credit for ad valorem payments. The remainder of the tax is paid into the State treasury, 50% to the credit of the general revenue fund of the State and 50% to the credit of a land reclamation trust fund. Each taxpayer shall institute and complete a reclamation and restoration program upon each site of severance in accordance with criteria adopted by the Department of Natural Resources.

Upon completion of reclamation or in lieu thereof by deeding title of mined lands to the State, a severance taxpayer would be entitled to a refund of up to 50% of the severance tax paid.

The Florida Bureau of Geology promulgated rules and regulations to achieve the maximum reclamation of land disturbed by surface mining to carry out the purpose of the 1975 surface mine reclamation act.

In 1975, the legislature, at the request of the Governor, consolidated the functions of the Office of Petroleum Allocation and

Energy Conservation and the Florida Energy Data Center into the State Energy Office under the Department of Administration (Ch. 75-256, Laws of 1975). Several reports on energy were published.<sup>3</sup>

The 1975 Florida Legislature passed the Local Government Comprehensive Planning Act of 1975. Under the act, every county and municipality in the State will have to prepare and adopt a comprehensive plan before July 1, 1979. If a city does not adopt a plan by that date, it shall be governed by the plan for the county in which it is situated. If the county does not adopt a plan by the 1979 date, the State land planning agency will prepare the plan for the county, and the Administration Commission shall have the authority to adopt it. The plan will require the following: (1) a future land use element, (2) a traffic circulation element, (3) a general sanitary sewer, solid waste, drainage, and potable water element, (4) a conservation element, (5) a recreation and open space element, (6) a housing element, (7) a coastal zone protection element, (8) an intergovernmental coordination element, and (9) a utility element.

A cooperative research project to develop methods of dewatering phosphatic clay slimes, funded jointly by the Federal Bureau of Mines and the Florida Phosphate

<sup>3</sup> Booz, Allen & Hamilton Inc. Solar Energy Utilization in Florida (prepared for Florida Energy Committee). June 1975, 69 pp.

Florida Energy Committee. Energy Law in Florida. May 1975, 30 pp.

Florida Energy Data Center (Department of Administration). Monthly Florida Crude Oil and Natural Gas Production: September, 1943 through March, 1975. June 1975, 44 pp.

Statistics of the Florida Electrical Utility Industry 1960 through 1974. April 1975, 114 pp.

Florida Energy Office (Department of Administration). Florida Energy Consumption Statistics 1968-1974. December 1975, 8 pp.

Florida State University, Department of Urban and Regional Planning, and Department of Geography, University of South Florida. Florida Coastal Policy Study Input of Offshore Oil Development (prepared for the Florida Energy Office). December 1975, 273 pp.

Florida State University, Florida Resources and Environmental Analysis Center. Patterns of Energy Consumption in Florida: 1960-1972. June 1975, 461 pp.

University of Florida, Center for Governmental Responsibility, Holland Law Center. Energy: The Power of the States (prepared for Florida Energy Committee). January 1975, 238 pp.

University of West Florida. The Role of Energy in Solid Waste Utilization and Disposal (prepared for Florida Energy Committee). May 1975, 242 pp.

Council, representing 10 phosphate rock mining companies, continued through 1975. The Bureau of Mines programs under the project were conducted by the Tuscaloosa (Ala.) Metallurgy Research Laboratory. During the year, gel formation of phosphate slimes, electrochemistry of fine particles, effects of reagents on dewatering slimes, and scanning electron microscope studies were carried out. Research grants at Auburn University to promote channeling in a continuous gravity sedimentation process and at Florida State University to investigate the distribution of minerals in settled slimes using scanning electron microscope techniques were funded through the project. Several field tests, evaluating sand-spraying techniques, flocculation, and sand drains, were evaluated during the year. A bibliography and characterization studies on the slimes project were published.<sup>4</sup>

The Bureau's Albany (Oreg.) Metallurgy Research Center continued its program on direct acidulation of Florida phosphate matrix. Preliminary data indicated that 92% to 96% of the  $P_2O_5$  content of the matrix is recoverable, and the  $P_2O_5$  concentration in the product acid ranged from 21% to 30%. The waste filter cake appeared suitable for use in land reclamation. Detailed results were published.<sup>5</sup>

Characterization and beneficiation studies on the phosphate-bearing Hawthorn Formation were conducted at the Bureau's Tuscaloosa Metallurgy Research Laboratory. The project is a cooperative program with the Florida Bureau of Geology. The objective is to determine if the phosphorite in the Hawthorn Formation is amenable to beneficiation. Additional studies on utilization of wet-process phosphoric acid waste gypsum were carried out at the Tuscaloosa Metallurgy Research Laboratory.

The report *International Trade in Phosphate Rock Present and Projected to 1985* was published.<sup>6</sup>

The Bureau's College Park (Md.) Metallurgy Research Center assisted Hillsborough and Pinellas Counties in developing their resource recovery system by evaluating their urban refuse to determine recoverable components and heat value of the combustibles.

The Florida Bureau of Geology, Department of Natural Resources, continued studies of mineral resources and hydrology throughout the State and published five reports.<sup>7</sup>

Alachua County passed a mine reclamation ordinance which requires total mined land reclamation. Sarasota County proposed a new mining ordinance intended to strengthen its current ordinance.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

Nonmetals accounted for 66% of the State's total mineral production value in 1975. The principal nonmetals produced, listed in order of value, were phosphate rock, stone, cement, sand and gravel, and clays.

**Cement.**—Shipments of both portland and masonry cement decreased from 1974 levels, reflecting the continued slowdown in Florida's construction activity. Portland cement shipments and value were 1.7 million short tons and \$62.5 million, respectively. The value of portland cement declined 17% from the reported 1974 value.

Types I and II (general-use and moderate-heat), Type III (high-early-strength), white cement, and waterproofed portland cements were produced. Most of the shipments were made within the State. Masonry shipments were principally within the State.

<sup>4</sup> Lamont, W. E., J. T. McLendon, L. W. Clements Jr., and I. L. Feld. *Characterization Studies of Florida Phosphate Slimes*. BuMines RI 8089, 1975, 24 pp.

U.S. Bureau of Mines. *The Florida Phosphate Slimes Problem—A Review and a Bibliography*. BuMines IC 8668, 1975, 41 pp.

<sup>5</sup> White, J. C., A. J. Fergus, and T. N. Goff. *Phosphoric Acid by Direct Sulfuric Acid Digestion of Florida Land-Pebble Matrix*. BuMines RI 8086, 1975, 12 pp.

<sup>6</sup> Buie, B. F., G. L. Daugherty, and A. T. Cole. *International Trade in Phosphate Rock Present and Projected to 1985*. Prepared for the Bureau of Mines under Contract 50 133092 with Florida State University, 1975, 119 pp.

<sup>7</sup> Anderson, W., and G. H. Hughes. *Hydrology of Three Sinkhole Basins in Southwestern Seminole County, Florida*. Fla. Bu. Geol., Dept. of Nat. Res., RI 81, 1975, 35 pp.

Crain, L. J., G. H. Hughes, and L. J. Snell. *Water Resources of Indian River County, Florida*. Fla. Bur. Geol., Dept. Nat. Res., RI 80, 1975, 75 pp.

Motz, L. H. *Hydrologic Effects of the Tampa Bypass Canal System*. Fla. Bur. Geol., Dept. Nat. Res., RI 82, 1975, 42 pp.

Putnam, A. L. *Summary of Hydrologic Conditions and Effects of Walt Disney World Development in the Reedy Creek Improvement District, 1966-73*. Fla. Bur. Geol., Dept. Nat. Res., RI 79, 1975, 115 pp.

Sutcliffe, H., Jr. *Appraisal of the Water Resources of Charlotte County, Florida*. Fla. Bur. Geol., Dept. Nat. Res., RI 78, 1975, 53 pp.

Portland cement shipments, mainly in bulk form, were made 94% by truck and 6% by rail. The consumption pattern of portland cement in the State was 58% to ready-mix concrete companies, 16% to building materials dealers, 13% to concrete product manufacturers, 9% to highway contractors, and 4% for miscellaneous applications.

Raw materials used in the manufacture of cement were mined principally within the State and included limestone, clay, sand, and staurolite. Oolitic aragonite imported from the Bahamas was used exclusively by one company, and another firm used minor amounts. Small amounts of blast furnace slag, iron ore, clay, ash, and gypsum were used, but most were obtained from out-of-State sources. Eleven rotary kilns were operated at five plants. Of the five plants, four used the wet process and one used the dry process. Over 257 million kilowatt-hours of energy was consumed in the manufacture of cement; 100% of the power was purchased.

The National Portland Cement Co. plant at Port Manatee processed imported clinker and made shipments to local markets.

Maule Industries, Inc., Miami, continued its expansion program at its Pennsuco, Fla., plant, which will increase capacity from 430,000 tons per year to about 2 million tons per year.<sup>8</sup>

Rinker Materials Cement Division announced that it would build a new 40,000-ton cement terminal at Cape Canaveral.<sup>9</sup>

**Clays.**—Total clay output decreased 12%, while the value increased 13%. Florida ranked first in the Nation in output value of fuller's earth.

Fuller's earth output decreased 7%, but its value increased 15%, reflecting high unit values for the products. Three producers were active, two in Gadsden County and one in Marion County. Fuller's earth was used for fillers, oil and gas absorbents, pet absorbents, pesticides, drilling mud, paper coating, and other uses.

Kaolin output and value each decreased from that of 1974. Kaolin was produced by one company in Putnam County; principal uses were in whiteware, pottery, and wall tile.

Miscellaneous clay output decreased 17%, and the value decreased 16% from that of 1974, reflecting the continued decline in building construction. The clays were used in the manufacture of cement, lightweight aggregate, and building brick. Mines were operated in Clay, Escambia, Gadsden, and Hernando Counties in 1975.

**Fluorine.**—Fluorine in the form of fluosilicic acid was recovered from six plants as a byproduct of wet-process phosphoric acid manufacture. Fluosilicic acid was used to produce cryolite, aluminum fluoride, and sodium silico-fluoride and for water fluoridation. The value of fluorine byproducts is not included in the State's mineral production value.

**Gypsum.**—Crude gypsum was imported from mines in Nova Scotia, Canada, and processed into gypsum building products at two plants in Duval County and one plant in Hillsborough County. United States Gypsum Co., National Gypsum Co., and Kaiser Cement & Gypsum Corp. calcined crude gypsum in kettles, a rotary kiln, and a Holoelite unit. A total of 344,000 short tons of calcined gypsum was produced, a decline of 37% from 1974 production. The Kaiser plant operated intermittently during the year, and at yearend the Jacksonville plant was closed and offered for sale to the Celotex Co. The large decline in output is attributable to the Kaiser plant closing and the depressed homebuilding market.

**Lime.**—Quicklime and hydrated lime were produced by Basic Magnesia, Inc., Gulf County; Chemical Lime, Inc., Hernando County; and Dixie Lime & Stone Co., Sumter County. The total sold or used was 199,362 short tons and was valued at \$8 million. Compared with those of 1974, quantity and value increased 8% and 45%, respectively. The lime was used in the pulp and paper industries, in the recovery of magnesia from seawater, in construction, in waste neutralization, in water treatment, and in other chemical processes. Lime consumption exceeded production in the State.

**Magnesia.**—Basic Magnesia, Inc., Port St. Joe, Gulf County, produced caustic-calcined magnesia and refractory-grade

<sup>8</sup> Pit and Quarry. V. 67, No. 7, January 1975, p. 63.

<sup>9</sup> Work cited in footnote 8.

magnesia from seawater. Shipments decreased 28%, and the value decreased 21% from that of 1974.

**Perlite.**—Four companies produced expanded perlite from ore mined in Colorado and New Mexico. Production decreased to 21,286 short tons from 24,006 short tons in 1974. The quantity sold or used was 21,344 short tons, a decrease of 11% from that of 1974. The value of the quantity sold or used was \$1.4 million, an increase of 2% over that of 1974. Production from plants in Broward, Escambia, and Indian River Counties was used for horticultural uses, plaster and concrete aggregate, filter acid, and fillers.

**Phosphate Rock.**—Florida's 1975 production data are combined with those 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 1975 was 40.7 million short tons, valued at \$1 billion, increases of 10% in output and 145% in value, reflecting the continued worldwide high demand for phosphates. The combined output represented 83% of the national output.

Combined marketable production sold or used totaled 37.9 million tons valued at \$927.3 million, a 5% decrease in sales but a 112% increase in value from that of 1974.

Most of the 11.3 million short tons of marketable phosphate rock exported from Florida and North Carolina was from Florida. Florida's exports declined 16% in 1975 owing to increased domestic consumption.

Of that sold or used, agricultural uses accounted for 70%, industrial 1%, and exports 29%. Agricultural uses were for wet-process phosphoric acid, normal superphosphate, triple superphosphate, direct application to the soil, and defluorinated rock for stock and poultry feed. Industrial uses were for the manufacture of elemental phosphorus and ferrophosphorus.

Mine production of crude dry ore in Florida and North Carolina was 190 million tons with a  $P_2O_5$  content of 25 million tons.

Soft-rock phosphate was produced by four companies operating six mines in two counties. Total mine production was 28,152 tons with a  $P_2O_5$  content of 5,744 tons, valued at \$502,907. The soft-rock phos-

phate was used for direct application to the soil.

Land-pebble phosphate was produced at 18 mines by 10 companies in 2 counties. One company processed tailings from previous mining operations. Marketable phosphate rock was produced from land-pebble phosphate mines by Agrico Chemical Co., Borden, Inc., Brewster Phosphates, Gardinier, Inc., W. R. Grace & Co., International Minerals & Chemical Corp., Mobil Oil Corp., Poseidon Mines, Inc., Occidental Petroleum Corp., USS Agri-Chemicals, Inc., and Swift Chemical Co.

Agrico Chemical Co.'s Fort Green mine came onstream during the year. The complex has a capacity to produce 3.5 million tons of marketable phosphate rock annually. The company also opened its wet-phosphate rock shipping terminal at Big Bend, Hillsborough County. The facility can handle several million tons of phosphate rock annually and can load ships at the rate of 3,000 tons of rock per hour.

What is reported to be the largest phosphate fertilizer granulation plant in the world, with a rated capacity of 80 tons per hour of granulated triple superphosphate and a greater capacity of diammonium phosphate, has gone onstream at Agrico's South Pierce complex in Polk County.<sup>10</sup>

A new process of wet-grinding phosphate rock for phosphoric acid production has been demonstrated in a 60-ton-per-hour pilot plant at the Agrico operation.<sup>11</sup>

Beker Industries Corp. had received all necessary local, State, and regional permits preparatory to mining in Manatee County, and the Manatee County operating permit was all that was needed before mining could commence. During the year Beker Industries expanded its holding by purchasing an additional 1,800 acres in eastern Manatee County.<sup>12</sup>

Beker Phosphate Corp. awarded a \$30 million contract to build a phosphate ore beneficiation plant. The wet ore will be shipped to Beker's fertilizer-processing facilities in Louisiana.<sup>13</sup>

Borden Chemical division of Borden, Inc., announced plans to develop a new phosphate rock mine in the southern part of

<sup>10</sup> Tampa Tribune. Mar. 13, 1975.

<sup>11</sup> Engineering and Mining Journal. V. 176, No. 1, January 1975, pp. 94-96.

<sup>12</sup> Bradenton Herald. Aug. 12, 1975.

<sup>13</sup> Sarasota Herald-Tribune. July 16, 1975.

Hillsborough County and has filed a Development of Regional Impact Statement with Hillsborough County to develop its 5,700-acre property. The proposed new mine will replace its Teneroc mine near Lakeland, which is scheduled to close in early 1978.<sup>14</sup>

Brewster Phosphates started construction at its new \$70 million Lonesome mine and beneficiation complex in southeastern Hillsborough County. Traditional transportation of the phosphate ore from the mine to the washer is being changed. Brewster Phosphates has announced that it will transport the ore from the Lonesome mine to the washer (6 miles) by a 54-inch-wide belt conveyor. The system will move 3,900 tons per hour of phosphate ore to the washer and return 1,800 tons per hour of refuse to the mine.<sup>15</sup>

CF Industries announced plans for a new phosphate mining and processing complex on 19,555 acres in Hardee County. The plans are for a \$130 million mining and beneficiation complex to go onstream in 1978 and a \$200 million chemical plant to go onstream in 1980.<sup>16</sup>

Initial capacity of CF's new Hardee County plant was designed for processing 2 million tons per year of rock which can be expanded to 4 million tons.<sup>17</sup>

Duval Corp. secured an option on the Ben Hill Griffin ranch consisting of 15,100 acres. The option gives the company the right to prospect and purchase the ranch.<sup>18</sup>

Gardiner, Inc., purchased over 15,000 acres of phosphate reserve and resource lands, mainly in Hardee County.

W. R. Grace & Co. announced plans to establish a new phosphate mine and beneficiation plant on company-owned property in southeastern Hillsborough and north-eastern Manatee Counties. The new mine is designated as the Four Corners mine. The 18,685-acre minesite includes 8,880 acres in Hillsborough County and 9,805 acres in Manatee County. The proposed development of the phosphate mining and beneficiation operation is designed to produce annually a maximum of 5 million tons of phosphate for a projected 15- to 20-year period. Construction is scheduled to begin late in 1978 after approval of necessary mining and environmental permits. The scope of the operation will include (1) the open pit extraction of the phosphate matrix by dragline, and (2) the

physical separation of phosphate product from the matrix.

W. R. Grace also announced it will spend approximately \$200 million over the next 3 years in expanding its central Florida phosphate operations. Phosphoric acid production capacity in the Florida division will be increased from 330,000 tons annually to 520,000 tons by 1978, and phosphate rock production capacity will be doubled to 5 million tons per year.

International Minerals & Chemical Corp. (IMC) announced plans to build a \$7 million defluorinated phosphate plant at its Noralyn phosphate complex near Bartow. The plant will produce about 75,000 tons of defluorinated phosphate rock annually and is scheduled to go onstream in late 1976.<sup>19</sup>

IMC's \$90 million New Wales chemical complex went onstream. The complex has the capacity to produce 750,000 tons of concentrated phosphate products which include phosphoric acid, triple superphosphate, diammonium phosphate, and monammonium phosphate.<sup>20</sup> IMC purchased 3,323 acres of phosphate reserves near Ona in Hardee County.<sup>21</sup>

Kerr McGee Corp. announced plans for two 1.5-million-ton-per-year mining operations, one in Bradford County and the other in Union County; the phosphate rock would be processed through a central plant with a 3-million-ton annual capacity. The company has assembled a block of fee-owned property of about 5,000 acres, which is supplemented with fee leases of about 3,000 acres. The total investment will be about \$75 million, and the operation will employ about 300 workers. No date has been set for startup.<sup>22</sup>

Mississippi Chemical Corp. announced that it had contracted to buy 14,000 acres of phosphate land in Hardee County and is planning a mining and processing facility. Mining is anticipated to begin in 1980.<sup>23</sup>

Noranda Phosphate, Inc., a subsidiary of Noranda Mines, Limited, of Toronto, Can-

<sup>14</sup> Lakeland Ledger. June 18, 1975.

<sup>15</sup> Pit and Quarry. V. 68, No. 3, September 1975, p. 28.

<sup>16</sup> Tampa Tribune. Dec. 2, 1975.

<sup>17</sup> Tampa Tribune. July 6, 1975.

<sup>18</sup> Herald-Advocate. July 13, 1975.

<sup>19</sup> Tampa Tribune. Feb. 13, 1975.

<sup>20</sup> Lakeland Ledger. Apr. 27, 1975.

<sup>21</sup> Wauchula Herald-Advocate. Apr. 24, 1975.

<sup>22</sup> Gainesville Sun. Jan. 7, 1975.

<sup>23</sup> Wauchula Herald-Advocate. Aug. 28, 1975.



ada, acquired a 51% undivided interest in 3,000 acres in De Soto County from the New Jersey Zinc Co. Engineering feasibility and environmental impact studies were scheduled for 1975 with production anticipated in 1980.<sup>24</sup>

The Occidental Chemical Co. Swift Creek mine came onstream during the the year. The mine will employ three draglines and have a capacity to produce 2.5 million tons of phosphate rock per year. Much of the expansion at Occidental's Suwanee River complex, started in 1974 to meet U.S.S.R. contracts, was completed. Phosphoric acid production was increased from 220,000 tons to 550,000 tons per year, diammonium phosphate capacity was increased from 250,000 tons to 600,000 tons per year, and sulfuric acid was scheduled for higher output.<sup>25</sup>

Phillips Petroleum Co. completed its Development of Regional Impact Statement on its proposed phosphate mine in De Soto County. The company continued the process of obtaining permits in anticipation of mining its Manatee-De Soto properties in 1978.

Swift Chemical Co. considered plans to obtain mining permits to mine 1,500 acres of company-owned land in Hillsborough County. The mining plan calls for mining 150 acres per year and trucking the matrix to its washer at Agricola.<sup>26</sup>

T & A Minerals Corp., a subsidiary of Tranammonia Inc. of New York, let a contract to Davy Powergas Inc. for a washer and beneficiation plant having a design capacity of 500,000 tons per year of marketable phosphate rock. The company has obtained properties in Polk, Citrus, and Marion Counties.<sup>27</sup>

USS Agri-Chemicals, a division of United States Steel Corp., announced plans to build a 300,000-ton-per-year diammonium phosphate plant at its Bartow complex. Construction was scheduled for early 1976 with the plant scheduled for operation in 1977.

**Sand and Gravel.**—Sand and gravel production totaled 13.2 million tons valued at \$20.2 million. Production decreased 46%, and the value decreased 40% from that of 1974. As with the other construction materials, this dramatic decrease in output and value reflects the slowdown in building and road construction and the overall depressed economic conditions. The sand was mainly used for construction purposes with a small amount going into industrial uses.

<sup>24</sup> Industrial Minerals. No. 95, August 1975, p. 43.

<sup>25</sup> Florida Times Union. Nov. 22, 1975.

<sup>26</sup> Tampa Times. July 2, 1975.

<sup>27</sup> Engineering and Mining Journal. V. 176, No. 9, September 1975.

**Table 4.—Florida: Sand and gravel sold or used by producers, by county**  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Bay -----	3	W	W	5	315	474
Broward -----	6	3,461	4,990	4	1,591	2,578
Dade -----	5	3,414	5,809	3	403	633
Escambia -----	5	525	1,025	4	346	753
Hendry -----	2	W	W	3	1,034	1,212
Hillsborough -----	1	283	W	1	W	W
Lake -----	8	3,588	3,869	9	2,682	2,925
Polk -----	14	4,180	6,659	12	2,051	4,254
Putnam -----	3	W	W	4	612	1,152
St. Lucie -----	1	574	383	1	W	W
Wakulla -----	--	--	--	1	1	1
Walton -----	1	W	W	1	W	269
Other <sup>1</sup> -----	18	8,349	10,667	14	4,202	5,947
Total <sup>2</sup> -----	67	24,372	33,400	62	13,237	20,199

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

<sup>1</sup> Includes Brevard, Calhoun (1974), Clay, De Sota (1974), Gadsden, Glades, Jackson, Leon, Marion, Martin (1974), Okaloosa, Orange, Pinellas (1974), Santa Rosa (1975), Sarasota, and Washington (1974) Counties.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 5.—Florida: Construction and industrial sand and gravel sold or used by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	14,265	18,055	7,959	9,986
Gravel -----	4,051	7,264	1,272	2,625
Unprocessed: Sand and gravel -----	5,329	3,995	3,295	2,473
Industrial:				
Sand -----	727	3,940	710	4,181
Total <sup>2</sup> -----	24,372	33,254	13,237	19,213

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than unit value of unblended processed sand or gravel.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 6.—Florida: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction--	W	W	140	176
Highway and bridge construction -----	1,849	2,111	823	1,152
Other construction (dams, waterworks, airports, etc.) -----	68	116	173	195
Bituminous paving (asphalt and tar paving) ----	W	W	W	W
Road base and subbase -----	1,289	2,180	W	W
Fill -----	W	W	W	W
Unprocessed:				
Road base and subbase -----	W	W	W	W
Fill -----	--	--	W	W
Other -----	--	--	W	W
Total -----	4,257	5,885	1,863	2,565

W Withheld to avoid disclosing individual company confidential data; included in total.

**Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction...	6,746	9,382	3,784	5,592
Highway and bridge construction .....	1,075	1,816	220	362
Other construction (dams, waterworks, airports, etc.) .....	195	301	80	97
Concrete products (cement block, brick, pipe, etc.) .....	3,749	5,141	2,882	3,512
Bituminous paving (asphalt and tar paving) .....	529	672	635	861
Road base and subbase .....	755	1,227	282	453
Fill .....	1,236	1,101	442	519
Other .....	--	--	W	W
<b>Unprocessed:</b>				
Roadbase and subbase .....	943	975	214	251
Fill .....	4,161	2,961	2,394	1,694
Other .....	--	--	222	152
Industrial sand and gravel .....	727	3,940	710	4,131
<b>Total</b> <sup>1</sup> .....	<b>20,115</b>	<b>27,516</b>	<b>11,374</b>	<b>17,634</b>

W Withheld to avoid disclosing individual company confidential data; included in total.

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Staurolite.**—Staurolite was recovered as a byproduct of ilmenite production at the Highland and Trail Ridge plants of E. I. du Pont de Nemours & Co. in Clay County. Both output and value decreased from 1974 levels. It was principally used in sandblasting, and minor amounts were used for cement. Florida was the only State with a recorded production of staurolite.

**Stone.**—Total stone output, including crushed limestone, dolomite, and oyster-shell, was 39 million tons valued at \$73 million. Florida ranked eighth in the Nation in terms of stone output in 1975.

Crushed limestone output decreased 29% and its value decreased 28%, reflecting the continued downward trend in homebuilding and highway projects. The stone was produced from 119 quarries in 22 counties in 1975, compared with production from 96 quarries in 20 counties in 1974. Dade, Hernando, and Broward Counties, in that order, were the principal producing counties, supplying 69% of the total production and 68% of the total value. Eleven companies operated 24 quarries accounting for 70% of the crushed stone output and 63% of the value. One company processed oys-

tershell for road base material. Of the total crushed limestone sold or used by producers, 28% was used for concrete aggregate, 34% for dense-graded road base, 10% for bituminous aggregate, 4% for cement manufacture, 2% for agricultural use, and the remainder for miscellaneous uses. Eighty-seven percent of the stone was hauled by truck, 11% was moved by rail, and the remainder was shipped by waterway.

**Sulfur.**—Recovered sulfur from petroleum production at Exxon's desulfurization plant in Santa Rosa County increased from 249,000 long tons in 1974 to 285,000 in 1975. The value of byproduct sulfur is not included in the State's mineral production value.

**Vermiculite.**—Exfoliated vermiculite was produced by two operators at four plants in Broward, Duval, and Hillsborough Counties from crude ore shipped into the State. The exfoliated vermiculite was used for lightweight aggregate, plaster aggregate, insulation, and other purposes. The value of vermiculite is not included in the State's mineral production value.

**Table 8.—Florida: Crushed limestone sold or used by producers, by county**  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Alachua -----	4	3,449	3,245	4	2,516	2,404
Brevard -----	1	173	220	1	112	149
Broward -----	18	9,185	17,563	18	4,982	8,275
Citrus -----	5	953	1,336	6	790	1,542
Collier -----	10	2,628	6,008	9	1,071	2,384
Dade -----	18	18,361	28,488	18	14,318	23,068
Hernando -----	8	8,670	20,838	6	7,386	17,775
Levy -----	3	236	247	3	245	290
Marion -----	7	1,255	3,119	7	1,039	3,384
Monroe -----	1	550	1,296	1	358	881
Okechobee -----	1	66	W	1	W	W
Pasco -----	2	352	611	2	214	343
Polk -----	1	112	141	1	73	96
Sumter -----	4	4,163	5,865	5	2,635	3,824
Suwannee -----	4	W	W	3	865	2,643
Taylor -----	1	W	W	1	193	578
Undistributed <sup>1</sup> -----	8	4,409	11,401	33	1,758	4,397
Total <sup>2</sup> -----	96	54,560	100,378	119	38,556	72,034

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

<sup>1</sup> Includes Dixie (1975), Hendry (1975), Jackson, Lee, Manatee, and Palm Beach Counties, and counties indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

**Table 9.—Florida: Crushed limestone sold or used by producers, by use**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	4,930	10,341	4,030	8,800
Concrete aggregate -----	14,918	32,309	10,668	22,518
Dense-graded roadbase stone -----	19,114	24,590	12,950	16,683
Macadam aggregate -----	260	458	161	274
Surface treatment aggregate -----	5,407	13,699	2,000	6,201
Other construction aggregate and roadstone -----	2,089	3,479	2,392	4,085
Agricultural limestone <sup>1</sup> -----	1,478	5,154	942	3,112
Cement manufacture -----	1,840	2,412	1,446	2,023
Fill -----	1,802	2,756	1,610	1,946
Manufactured fine aggregate (stone sand) -----	1,779	3,130	1,201	2,374
Riprap and jetty stone -----	218	547	158	451
Other uses <sup>2</sup> -----	725	1,504	997	3,565
Total <sup>3</sup> -----	54,560	100,378	38,556	72,034

<sup>1</sup> 1974 data include soil conditioners, poultry grit and mineral food.

<sup>2</sup> Data include stone used in fillers, lime manufacture, railroad ballast, soil conditioners, poultry grit and mineral food (1975).

<sup>3</sup> Data may not add to totals shown because of independent rounding.

## METALS

Metals accounted for less than 2% of the State's total mineral production value.

**Rare Earth Minerals.**—Humphreys Mining Co., Nassau County, and Titanium Enterprises, Clay County, produced monazite concentrate. Production in Florida increased dramatically owing to the Hum-

phreys mining operations in the Boulogne, Fla., area.

**Titanium Concentrates.**—Titanium Enterprises produced rutile from its Green Cove Springs plant. Output increased over that of 1974. E. I. du Pont de Nemours & Co. and Titanium Enterprises produced ilmenite concentrate from their plants in Clay County, and Humphreys

Mining Co. produced ilmenite concentrate from its mine in Nassau County. Overall production increased slightly from that of 1974.

**Zircon Concentrate.**—Production of zircon concentrate from the E. I. du Pont de Nemours & Co. Trail Ridge plant and the Titanium Enterprises Green Cove Springs plant, both in Clay County, decreased 22% from that of 1974. The value was 106% higher than that reported in 1974, reflecting the continued high demand for zircon.

#### MINERAL FUELS

Mineral fuels produced were natural gas, natural gas liquids, crude petroleum, and peat. These commodities accounted for 32% of the total State mineral production value in 1975.

**Natural Gas.**—Total net sales of natural gas in Florida in 1975 were about 39 billion cubic feet. The difference between the total net sales volume and the 44.4 billion cubic feet measured at the wellhead was a 12.3% H<sub>2</sub>S, CO<sub>2</sub>, and N<sub>2</sub> content, plus plant losses and inplant consumption for combustion purposes. All of the gas sold was from the Blackjack Creek and Jay fields, except a small quantity that was produced from the nearby Mount Carmel field. The Florida Gas Transmission Pipeline Co. sold the natural gas to industrial customers in the Pensacola area. Prior to

distribution to the Florida Gas Transmission Pipeline Co., the gas was stripped of natural gas liquids at a plant in Jay field, northern Santa Rosa County.

**Peat.**—Peat production increased from 67,000 tons valued at \$616,000 in 1974 to 100,895 tons valued at \$1,037,000 in 1975. The 50% increase in production was accompanied by a 68% increase in value.

**Petroleum.**—Total oil production in Florida was 41.9 million barrels in 1975. The 15% increase was primarily attributed to development of the Blackjack Creek field. The Jay field yielded 76% of the total crude oil production in the State. The wellhead value of northwest Florida high-grade crude averaged \$12.58 per barrel in January 1975.<sup>28</sup>

Crude petroleum production from south Florida was derived entirely from the Lower Cretaceous age Sunniland Limestone Formation. The average depth of development wells in the Sunniland trend is about 11,500 feet. There were 74 producing wells in 8 fields in this trend.

Approximately 4.8 million barrels of crude oil ranging from 25° to 32° API gravity and representing 11% of Florida's total production came from south Florida fields. Wellhead prices ranged from \$5.66 per barrel in January to \$9.50 per barrel in December 1975 for old and new oil combined.

<sup>28</sup> Based on 5% gross production tax reported to Florida Department of Revenue.

Table 10.—Florida: Oil and gas well drilling completions, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Calhoun	--	--	--	--	--	1	1	12,140
Collier	2	--	--	--	--	7	9	116,258
Gulf	--	--	--	--	--	1	1	14,570
Hendry	3	--	1	--	--	3	7	78,283
Lake	--	--	--	--	--	2	2	5,228
Lee	2	--	2	--	--	2	6	73,478
Liberty	--	--	--	--	--	1	1	12,654
Manatee	--	--	--	--	--	1	1	11,500
Marion	--	--	--	--	--	1	1	4,102
Monroe	--	--	--	--	--	1	1	13,000
Palm Beach	--	--	--	--	--	1	1	16,348
St. Lucie	--	--	--	--	--	1	1	12,652
Santa Rosa	8	--	1	--	--	3	12	194,450
Taylor	--	--	--	--	--	2	2	14,981
<b>Total</b>	<b>15</b>	<b>--</b>	<b>4</b>	<b>--</b>	<b>--</b>	<b>27</b>	<b>46</b>	<b>580,144</b>

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Cement:</b>			
General Portland Inc -----	4400 Republic National Bank Tower, Box 324 Dallas, Tex. 75221	Plants -----	Dade and Hillsborough.
Lehigh Portland Cement Co. <sup>1</sup> --	718 Hamilton St. Allentown, Pa. 18105	Plant -----	Dade.
Pennsuo Cement & Aggregates.	Box 2035 PVS Hialeah, Fla. 33012	--- do -----	Do.
<b>Clays:</b>			
Engelhard Minerals & Chemicals Corp. -----	Menlo Park Edison, N.J. 08817	Open pit mines.	Gadsden.
Mid-Florida Mining -----	Box 68-F Lowell, Fla. 32663	--- do -----	Marion.
Pennsylvania Glass Sand Corp.	Berkeley Springs, W.Va. 25411	--- do -----	Gadsden.
<b>Gypsum (calcined):</b>			
Kaiser Cement & Gypsum Corp.	300 Lakeside Dr. Oakland, Calif. 94612	Plant -----	Duval.
National Gypsum Co -----	325 Delaware Ave. Buffalo, N.Y. 14202	--- do -----	Hillsborough.
United States Gypsum Co ----	101 South Wacker Dr. Chicago, Ill. 60606	--- do -----	Duval.
<b>Lime:</b>			
Chemical Lime, Inc -----	Box 250 Ocala, Fla. 32670	--- do -----	Hernando.
Dixie Lime & Stone Co. <sup>1</sup> ----	Drawer 217 Ocala, Fla. 32670	--- do -----	Sumter.
<b>Magnesium compounds:</b>			
Basic Magnesia, Inc. <sup>2</sup> -----	Box 160 Port St. Joe, Fla. 32456	--- do -----	Gulf.
<b>Peat:</b>			
Raymond Johnson -----	Box 555 Zellwood, Fla. 32798	Bog -----	Orange.
Oxford Peat Co -----	Box 154 Oxford, Fla. 32684	Bog -----	Sumter.
Peace River Peat, Inc -----	Box 1192 Bartow, Fla. 33830	Bog -----	Polk.
F. E. Stearns Peat -----	Rt. 1 Box 347-I Valrico, Fla. 33594	Bog -----	Hillsborough.
Traxler Peat Co -----	Box 10 Florahome, Fla. 32635	Bog -----	Putnam.
<b>Perlite (expanded):</b>			
Airlite Processing Corp. of Florida.	Rt. 2, Box 740 Vero Beach, Fla. 32960	Plant -----	Indian River.
Armstrong Cork Co -----	Box 1991 Pensacola, Fla. 32589	--- do -----	Escambia.
Chemrock Corp -----	End of Osage St. Nashville, Tenn. 37208	--- do -----	Duval.
W. R. Grace & Co. <sup>3</sup> -----	62 Whittemore Ave. Cambridge, Mass. 02140	--- do -----	Broward.
<b>Petroleum (crude):</b>			
Exxon Co., U.S.A -----	Box 2024 Houston, Tex. 77001	Wells -----	Santa Rosa.
Sun Oil Co -----	Box 2880 Dallas, Tex. 75221	--- do -----	Collier and Hendry.
<b>Petroleum (refined):</b>			
Seminole Asphalt Refining, Inc	Box 128 St. Marks, Fla. 32355	Refinery -----	Wakulla.
<b>Phosphate rock:</b>			
Agrico Chemical Co -----	Box 3166 Tulsa, Okla. 74101	Open pit mines and plants.	Polk.
Borden, Inc -----	Box 790 Plant City, Fla. 33566	Open pit mine and plant.	Do.
Brewster Phosphates -----	Bradlev. Fla. 33835	--- do -----	Do.
Gardinier, Inc -----	Box 3269 Tampa, Fla. 33601	--- do -----	Do.
International Minerals & Chemical Corp.	Box 867 Bartow, Fla. 33830	Open pit mines.	Do.
Mobil Oil Corp. <sup>4</sup> -----	Box 311 Nichols, Fla. 33863	--- do -----	Do.
Occidental Petroleum Corp ----	White Springs, Fla. 32096.	Open pit mine.	Hamilton.
Swift Chemical Co -----	Box 208 Bartow, Fla. 33830	Open pit mines.	Polk.
USS Agri-Chemicals, Inc.-----	Box 867 Ft. Meade, Fla. 33841	Open pit mine.	Do.

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Sand and gravel:</b>			
General Development Corp ----	1111 South Bayshore Dr. Miami, Fla. 33131	Pits -----	Brevard and St. Lucie.
Ortona Sand Co -----	First & East Tillman Lake Wales, Fla. 33853	Dredge -----	Hendry.
Seminole Rock Products, Inc --	8100 N.W. 74th St. Miami, Fla. 33166	--- do -----	Dade.
Standard Sand & Silica Co ---	Box 35 Davenport, Fla. 33837	Pit -----	Polk.
Warren Bros. Co -----	Fairfield, Maine 04937 ---	Pit -----	Sarasota.
<b>Staurolite:</b>			
E. I. du Pont de Nemours & Co. <sup>5</sup>	DuPont Bldg. D-10084 Wilmington, Del. 19898	Plant -----	Clay.
<b>Stone:</b>			
Florida Crushed Stone Co ----	Box 668 Ocala, Fla. 32670	Quarries -----	Hernando and Sumter.
Florida Mining and Materials Corp.	Box 59351 Miami, Fla. 33159	Quarry -----	Hernando.
Florida Rock Industries, Inc. <sup>6</sup> -	Box 4667 Jacksonville, Fla. 32201	Quarries -----	Collier, Lee, Sumter, Suwannee.
Houdaille-Duvall-Wright Co ---	Box 1588 Jacksonville, Fla. 32201	Dredge -----	Alachua and Broward.
Maule Industries, Inc -----	Box 2601 Hialeah, Fla. 33012	Quarries -----	Dade.
Sterling Crushed Stone Co ---	Miami, Fla. 33163 -----	--- do -----	Do.
<b>Titanium concentrates:</b>			
Titanium Enterprises <sup>7</sup> -----	Box 1036 Green Cove Springs, Fla. 32043	Mine and plant.	Clay.

<sup>1</sup> Also stone.<sup>2</sup> Also lime.<sup>3</sup> Also phosphate rock and exfoliated vermiculite.<sup>4</sup> Also elemental phosphorus.<sup>5</sup> Also titanium and zircon concentrates.<sup>6</sup> Also sand and gravel.<sup>7</sup> Also zircon concentrate, and rare-earth oxides and thorium oxide in monazite concentrate.

# The Mineral Industry of Georgia

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Georgia Department of Natural Resources, Geologic and Water Resources Division, under a cooperative agreement for collecting information on all minerals except fuels.

By James D. Cooper<sup>1</sup> and Sam M. Pickering, Jr.<sup>2</sup>

After more than two decades of uninterrupted annual increases in value of mineral production, the 1975 mineral value of Georgia registered a decline of 8%. Among the hardest hit were the construction materials—crushed stone, cement, and common clay—which declined appreciably in volume of production and in value. Of all the Georgia minerals for which production was reported in 1975, only sand and gravel and dimension stone reported gains in volume of output. However, some minerals showed increases in total value in 1975 due to higher unit prices.

Energy was in plentiful supply during 1975 but prices remained high, and this was a factor in the record high unit prices which prevailed for most of Georgia's mineral commodities. Coal mining resumed in northwest Georgia in 1975, with small quantities shipped from Chattooga and Dade Counties.

Plant expansions were fewer in 1975 than in the previous year, but a number of firms made improvements to increase plant

efficiency and to meet environmental requirements. Mine and plant acquisitions were numerous in 1975, with a number of operations changing hands during the year. Most of the acquisitions occurred in the crushed stone industry.

A new law, Act No. 108, which was passed by the Georgia Legislature in 1975, provided for registration of geologists involved in the practice of geology related to the public welfare or safeguarding of life, health, property, and the environment. A State Board of Geologist Examiners was appointed to administer the act. Exemptions from the provisions of the act were provided for State and Federal employees, teachers, and subordinates working under the direction of registered geologists. Certification in several specialties is provided, including mining geology, engineering geology, and ground water geology.

<sup>1</sup> State Liaison Officer (now retired), Bureau of Mines, Atlanta, Ga.

<sup>2</sup> State Geologist and Director, Geologic and Water Resources Division, Georgia Department of Natural Resources.



Table 1.—Mineral production in Georgia <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>Cement:</b>				
Masonry ----- thousand short tons--	40	\$1,304	W	W
Portland ----- do-----	1,150	31,535	828	\$25,822
Clays ----- do-----	<sup>2</sup> 7,692	<sup>2</sup> 203,936	6,156	195,300
Peat ----- do-----	1	6	( <sup>3</sup> )	5
Sand and gravel ----- do-----	4,989	9,639	5,105	8,818
Stone ----- do-----	40,321	105,582	30,084	91,157
Talc ----- short tons--	33,850	102	27,400	82
Value of items that cannot be disclosed:				
Barite, bauxite, fire clay (1974), coal (1975), feldspar, iron ore, kyanite, mica (scrap), rare-earth metal concentrates (1974), titanium concentrates (1974), zircon (1974), and values indicated by symbol W -----	XX	10,996	XX	12,203
Total -----	XX	363,100	XX	333,387
Total 1967 constant dollars -----	XX	171,674	XX	<sup>p</sup> 132,021

<sup>p</sup> Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes fire clay; included with "Value of items that cannot be disclosed."

<sup>3</sup> Less than ½ unit.

Table 2.—Value of mineral production in Georgia, by county <sup>1</sup>

(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Bacon -----	\$48	W	Sand and gravel.
Baldwin -----	W	\$84	Do.
Banks -----	W	73	Stone.
Barrow -----	225	189	Do.
Bartow -----	5,199	4,375	Barite, stone, clays.
Bibb -----	W	W	Clays, sand and gravel.
Burke -----	--	W	Sand and gravel.
Carroll -----	W	W	Stone.
Chariton -----	W	--	
Chattham -----	W	294	Sand and gravel.
Chattooga -----	--	W	Coal.
Cherokee -----	W	W	Mica.
Clarke -----	W	1,364	Stone.
Clayton -----	2,042	W	Do.
Cobb -----	W	W	Stone, sand and gravel.
Coffee -----	--	W	Sand and gravel.
Columbia -----	W	W	Stone, clays.
Columbus (city) -----	3,983	W	Stone, sand and gravel, clays.
Cook -----	W	W	Sand and gravel.
Coweta -----	W	W	Stone.
Crawford -----	W	W	Sand and gravel.
Dade -----	--	W	Coal.
Dawson -----	186	49	Stone.
Decatur -----	W	W	Clays, sand and gravel.
De Kalb -----	6,223	5,112	Stone.
Dougherty -----	337	279	Sand and gravel.
Douglas -----	4,723	W	Stone, clays, sand and gravel.
Early -----	W	W	Stone.
Effingham -----	W	639	Sand and gravel.
Elbert -----	4,186	W	Stone, sand and gravel.
Evans -----	194	159	Sand and gravel.
Fannin -----	W	12	Stone.
Fayette -----	1,083	844	Do.
Floyd -----	3,486	W	Stone, clays.
Forsyth -----	2,807	W	Stone, sand and gravel.
Fulton -----	21,136	W	Cement, stone, clays, sand and gravel.
Gilmer -----	5,950	W	Stone.
Glynn -----	--	W	Sand and gravel.
Gordon -----	205	568	Stone.
Greene -----	W	W	Sand and gravel, stone.
Gwinnett -----	W	W	Stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Georgia, by county<sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Habersham	\$374	W	Stone.
Hall	W	W	Do.
Hancock	W	W	Do.
Hart	W	W	Mica.
Houston	W	W	Cement, stone, clays.
Jasper	W	W	Feldspar, stone.
Jefferson	W	W	Clays.
Jones	W	W	Stone.
Laurens	--	W	Sand and gravel.
Lee	191	W	Do.
Lincoln	W	W	Kyanite.
Lowndes	--	W	Sand and gravel.
Lumpkin	W	W	Stone.
McDuffie	W	--	
Madison	W	W	Stone.
Marion	--	W	Sand and gravel.
Miller	4	\$2	Peat.
Mitchell	W	357	Stone.
Monroe	W	W	Do.
Montgomery	W	--	
Murray	102	W	Talc.
Oglethorpe	1,669	2,001	Stone.
Paulding	W	W	Do.
Pickens	W	9,657	Do.
Pierce	--	W	Sand and gravel.
Pike	W	168	Do.
Polk	W	W	Cement, stone, clays.
Quitman	790	W	Iron ore.
Rabun	W	W	Stone.
Richmond	9,241	W	Clays, stone, sand and gravel.
Screven	2	3	Peat.
Seminole	--	W	Sand and gravel.
Spalding	W	W	Stone.
Stephens	W	W	Do.
Stewart	292	W	Iron ore.
Sumter	W	W	Clays, bauxite.
Talbot	733	549	Sand and gravel.
Taylor	W	679	Do.
Telfair	--	W	Do.
Thomas	5,918	W	Clays, sand and gravel.
Tift	--	W	Sand and gravel.
Troup	W	W	Stone.
Twiggs	58,616	51,368	Clays.
Union	W	W	Stone.
Upson	W	W	Sand and gravel.
Walker	W	W	Stone, clays.
Walton	W	W	Stone.
Ware	W	W	Sand and gravel.
Warren	16,344	W	Clays, stone.
Washington	66,556	57,308	Clays.
Wheeler	--	W	Sand and gravel.
Whitfield	W	W	Stone.
Wilkinson	25,292	29,950	Clays.
Undistributed <sup>2</sup>	114,954	167,302	
Total <sup>3</sup>	363,100	333,387	

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

<sup>1</sup> The following counties are not listed because no production was reported: Appling, Atkinson, Baker, Ben Hill, Berrien, Bleckley, Brantley, Brooks, Bryan, Bullock, Butts, Calhoun, Camden, Candler, Catoosa, Chatahoochee, Clay, Clinch, Colquitt, Crisp, Dodge, Dooly, Echols, Emanuel, Franklin, Glascock, Grady, Haralson, Harris, Heard, Henry, Irwin, Jackson, Jeff Davis, Jenkins, Johnson, Lamar, Lanier, Liberty, Long, McIntosh, Macon, Meriwether, Morgan, Muscogee, Newton, Oconee, Peach, Pulaski, Putnam, Randolph, Rockdale, Schley, Taliaferro, Tattnall, Terrell, Toombs, Towns, Treutlen, Turner, Wayne, Webster, White, Wilcox, Wilkes, and Worth.

<sup>2</sup> Includes values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Georgia business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	2,120.0	2,143.0	+1.1
Unemployment -----do-----	109.0	185.0	+69.7
<b>Employment (nonagricultural):</b>			
Mining -----do-----	7.7	6.8	-11.7
Manufacturing -----do-----	483.3	433.2	-10.4
Contract construction -----do-----	104.6	80.1	-23.4
Transportation and public utilities -----do-----	120.1	113.1	-5.8
Wholesale and retail trade -----do-----	410.8	388.3	-5.5
Finance, insurance, and real estate -----do-----	100.8	97.4	-3.4
Services -----do-----	259.5	252.8	-2.6
Government -----do-----	340.5	353.1	+3.7
Total nonagricultural employment -----do-----	1,827.3	1,724.8	-5.6
<b>Personal income:</b>			
Total -----millions--	\$23,396	\$25,052	+7.1
Per capita -----do-----	\$4,798	\$5,086	+6.0
<b>Construction activity:</b>			
Number of private and public residential units authorized----	26,314	21,009	-20.2
Value of nonresidential construction -----millions--	\$508.2	\$349.5	-31.2
Value of State road contract awards -----do-----	\$193.0	\$247.0	+28.0
Shipments of portland and masonry cement to and within Georgia -----thousand short tons--	2,405	1,685	-29.9
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$363.1	\$333.4	-8.2
Value per capita, resident population -----do-----	\$74.45	\$67.61	-9.2
Value per square mile -----do-----	\$6,167.20	\$5,662.53	-8.2

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

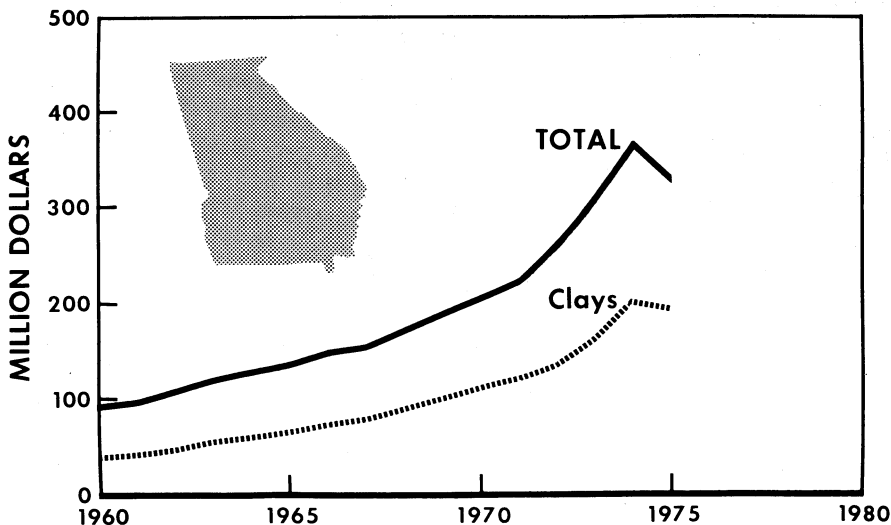


Figure 1.—Value of clays, and total value of mineral production in Georgia.

## REVIEW BY MINERAL COMMODITIES

## NONMETALS

**Barite.**—The Cartersville district in Bartow County accounted for all of the barite production in the State in 1975. New Riverside Ochre Co. produced barite from an open pit located within the city of Cartersville. Ore from the Cartersville mine was trucked to processing facilities south of Cartersville near the Oconee River where it was concentrated by gravity and flotation methods. Paga Mining Co., Div. of Thompson-Weinman & Co., recovered barite by flotation of mill tailings from past operations in the district. During the year Thompson-Weinman & Co. was acquired by Cyprus Industrial Minerals Co.

Production of barite declined 15% in 1975; however, the value of barite sold or used increased slightly over that reported for 1974. End uses for the processed barite included barium chemicals, fillers and extenders for rubber and paint, glass fluxing agent, drilling muds, and admix for heavy concrete.

Barite concentrates were processed into barium chemicals by Chemical Products Corp., a Cartersville firm. Much of the New Riverside Ochre Co. production was purchased by Chemical Products Corp.

**Cement.**—Cement production in Georgia was hard hit by the decline in construction activity in 1975. The quantity of cement output declined by 29%, and despite a substantial increase in selling price, the total value in 1975 was 19% below that reported for 1974. Portland cement dropped 28% in quantity and 18% in value, while masonry cement declined both in quantity and value.

Marquette Cement Manufacturing Co. in Polk County and Martin-Marietta Corp. in Fulton County operated dry-process plants, while Medusa Cement Co., a division of Medusa Corp., operated a wet-process plant in Houston County. Medusa added a \$3.6 million finish mill to its recently rebuilt cement manufacturing complex in 1975.

**Clays.**—Clay production in Georgia in 1975 was of four types; kaolin, fuller's earth, fire clay, and common clay. All four types showed declines in both quantity and value of production compared with 1974 data. The combined output of all types of

clay was 20% less in quantity and 4% less in value compared with the 1974 production. Despite the decreased output in 1975, Georgia maintained its position of leadership in clay production in the United States.

Kaolin clay, which is by far the most important mineral commodity produced in Georgia, accounted for more than half of the reported value of mineral production in the State in 1975. Production in 1975 dropped 16% in quantity, but owing to significant increases in selling prices, the total value was only 3% below the 1974 figure. The reported average unit values in 1975 ranged from \$12.04 per ton for unprocessed kaolin, to more than \$110.00 per ton for some grades of calcined kaolin.

Kaolin production was reported from eight counties in 1975. All of the output came from the Fall Line kaolin belt in the northern Coastal Plain. The Fall Line crosses the State in an irregular line from Columbus on the western side to Augusta on the east. The five largest producers accounted for 59% of the quantity and 68% of the value of Georgia kaolin output in 1975. Fourteen smaller firms accounted for the balance of production in the State.

Georgia kaolin was used as the raw material for cooperative alumina extraction research underway at the Bureau of Mines Boulder City (Nevada) Metallurgy Research Laboratory. During 1975, a nitric acid extraction miniplant, which was completed in 1974, was operated on several occasions to obtain data on operating conditions. A second miniplant based on a hydrochloric acid process was nearing completion at the end of 1975, and most of the units of the plant had been successfully operated. Plans called for construction of two additional miniplants, one to demonstrate a sulfurous acid process for extracting alumina from clays and shales, and the other to work with nonclay aluminous materials. A 50-ton carload of Georgia kaolin was shipped to the Boulder City facility during 1975.

Fuller's earth production in Georgia in 1975 declined 9% in volume and 8% in value from the record highs of the preceding year. The average unit value for fuller's earth rose about 1% in 1975, following a major price increase of 34% in

1974. Escalation of the cost of fuels used in mining and processing was largely responsible for the 1975 increase.

Most of the uses of fuller's earth are based on its absorbent properties. Absorbent uses included animal litter, oil absorbents, insecticide and fertilizer carriers, and oil clarifiers. Attapulgitite, an important constituent of some fuller's earth clays, can form a jell in saltwater, and this property makes attapulgitite-type fuller's earth useful as a drilling fluid where salty environments are encountered.

Fuller's earth was produced in Decatur County by Engelhard Minerals & Chemicals Corp. and Milwhite Co., Inc.; in Houston County by Medusa Corp.; in Jefferson County by Georgia-Tennessee Mining & Chemical Co.; and in Thomas County by Oil-Dri Corp. of Georgia, Thor Mining Co., Div. of Pennsylvania Glass Sand Co., and Waverly Mineral Products Co., Div. of Johnson-March Corp.

Essentially all of the common clay and shale produced in Georgia in 1975 was

used to make structural clay products and portland cement for the construction industries. Both quantity and value of output took a sharp drop of 31% in 1975, following the downward trend of construction during the year. Common clay and shale was produced by 12 firms in 10 Georgia counties in 1975. Most of the output came from mines located near the major metropolitan areas of the State, which are the market centers for structural clay products. Six brick manufacturers accounted for 79% of the 1975 common clay and shale output.

Fire clay output in Georgia declined substantially in both quantity and value in 1975. Two firms accounted for all of the reported production. Griffin Pipe Products Co., Div. of AMSTED Industries mined fire clay in Floyd County for use in manufacturing firebrick. Georgia Vitrified Brick and Clay Co. operated fire clay mines in Columbia and Richmond Counties to obtain clay for production of firebrick and flue liners.

**Table 4.—Georgia: Kaolin sold or used by producers, by county**  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Twiggs -----	7	1,404	58,616	5	1,058	51,368
Warren -----	5	243	11,682	5	264	12,297
Washington -----	33	1,729	66,556	31	1,303	57,308
Wilkinson -----	6	646	25,292	11	626	29,950
Other <sup>1</sup> -----	8	740	21,465	10	766	26,689
Total -----	59	4,762	183,611	62	4,017	177,612

<sup>1</sup> Includes Floyd, Houston, Richmond, and Sumter Counties.

**Table 5.—Georgia: Kaolin sold or used by producers, by kind**

Kind	1974		1975	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Airfloat -----	920,463	\$15,680,712	677,505	\$12,560,862
Calcined -----	159,260	16,956,465	478,103	36,305,591
Delaminated -----	221,407	13,328,375	277,209	17,547,878
Unprocessed -----	602,905	18,943,946	<sup>1</sup> 330,667	<sup>1</sup> 3,982,292
Waterwashed -----	2,857,965	118,701,442	2,253,443	107,215,238
Total -----	4,762,000	183,610,940	4,016,927	177,611,861

<sup>1</sup> Excludes calcined grades.

Table 6.—Georgia: Kaolin sold or used by producers, by kind and use  
(Short tons)

Use	1974				1975			
	Airfoot	Unproc- essed	Water- washed <sup>1</sup>	Total	Airfoot	Unproc- essed	Water- washed <sup>1</sup>	Total
Domestic:								
Adhesives	35,127	W	11,538	46,665	51,700	W	11,182	62,882
Alum (aluminum sulfate) and other chemicals	W	W	W	184,730	W	W	W	229,981
Animal feed	2,644	W	W	2,644	W	W	W	4,925
Catalysts (oil refining)	W	W	W	46,319	W	W	W	54,408
Ceramic floor and wall tile	2,500	W	3,957	6,457	11,475	W	3,819	14,794
Crockery and other earthenware	37,325	W	4	37,329	31,530	W	1,871	33,401
Electrical porcelain	3,011	W	W	3,011	6,113	W	1,171	7,284
Face brick	W	W	133	133	W	W	93	93
Fiberglass	W	W	W	91,513	81,215	W	70	81,285
Firebrick, block and shapes	W	W	1,153	94,087	25,281	W	411	38,212
Flue linings and high alumina brick	65,100	W	W	73,719	W	W	W	60,035
Foundry sand	154	W	81	235	859	W	W	859
Refractory grogs and crudes	W	W	W	277,362	W	W	293,558	293,558
Ink	W	W	W	43,883	W	W	W	11,322
Medical, pharmaceutical, and cosmetic	1,377	W	W	1,986	222	W	535	757
Paint	57,663	W	609	58,272	3,800	W	38,208	92,008
Paper coating	2,000	W	170,697	223,360	13,614	W	88,208	92,008
Paper filling	197,613	W	1,308,180	1,310,180	1,498,621	W	1,498,621	1,498,621
Plastics	6,833	W	795,846	993,459	169,211	W	484,701	603,912
Portland cement	1,169	W	46,725	53,558	5,326	W	38,259	43,585
Pottery	19,894	W	18,400	38,294	W	W	W	W
Roofing granules	W	W	W	W	32,446	W	W	32,446
Rubber	115,842	W	15,045	130,887	79,917	W	8,590	88,507
Sanitary ware	W	W	15,441	62,362	47,287	W	W	88,973
Miscellaneous airfoot:								
China/dinnerware; fertilizer; glazes, glass, and enamels; hobby ceramics; kiln furniture; mineral wool and insulation; pesticides and related products; roofing granules (1975); roofing tile (1975); starch (1975); unknown uses	53,745	W	W	53,745	21,357	W	W	21,357
Miscellaneous unprocessed:								
Sewer pipe and data indicated by W (1975)	W	W	W	267	W	W	W	267
Miscellaneous waterwashed:								
China/dinnerware; gypsum products; mineral oil filtering, clarifying and decolorizing; refractory mortar and cement; waterproofing and sealing; textiles; wire and cable; agriculture; unknown uses	256,978	W	18,487	275,465	76,747	W	33,016	308,481
Undistributed	858,975	W	2,506,247	3,846,120	658,100	W	93,435	751,535
Total	3,846,120	480,898	2,506,247	6,853,265	658,100	327,667	2,370,040	9,850,972

See footnotes at end of table.

Table 6.—Georgia: Kaolin sold or used by producers, by kind and use—Continued  
(Short tons)

Use	1974			1975			
	Airfloat	Unproc- essed	Water- washed <sup>1</sup>	Airfloat	Unproc- essed	Water- washed <sup>1</sup>	Total
Export:							
Paint	30	--	17,660	--	--	18,052	18,052
Paper coating			532,593	3,400	--	349,518	352,918
Paper filling	40,537	--	124,303	5,590	--	114,144	119,734
Plastics			25,364			18,788	18,788
Refractories	17,000	122,007	--	8,400	--	134,427	142,827
Rubber	3,921	--	1,318	2,015	--	393	2,408
Miscellaneous			30,747		3,000	18,393	16,393
Total	61,488	122,007	732,385	19,405	3,000	633,715	661,120
Grand total	920,463	602,305	3,233,632	677,505	330,667	3,008,755	4,016,927

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

<sup>1</sup> Includes calcined and delaminated.

<sup>2</sup> Incomplete total; remainder included in totals for specific end uses.

**Feldspar.**—High-potash feldspar was produced in Jasper County by The Feldspar Corp., Div. of Pacific Tin Consolidated Corp. The feldspar was obtained from weathered pegmatite dikes by grinding the weathered material and treating it in a series of froth flotation steps to separate the feldspar from the other mineral constituents. The flotation concentrate was sold to manufacturers of ceramic products in about 20 States as well as Canada and Mexico.

Volume of feldspar output declined from that reported for 1974. However, the total value of the 1975 production registered a substantial increase over the 1974 value owing to a large upward change in the selling price.

**Gypsum.**—Gypsum was not mined in Georgia, but three firms—National Gypsum Co., The Flintkote Co., and Georgia-Pacific Corp.—operated calcining and gypsum products plants in Savannah and Brunswick. The principal gypsum products produced in 1975 were wallboard, cement retarder, mineral filler, and agricultural soil additive. The quantity of gypsum used by the three firms in 1975 was 512,000 tons, representing a decline of about 20% from that of 1974.

American Cyanamid Co., utilizing imported aragonite for treatment of acid wastes from a titanium pigments plant in Savannah, produced substantial quantities of a gypsum material in 1975. Although the artificial gypsum might be suitable for commercial use no firm has yet been located which was interested in using the product.

**Kyanite-Mullite.**—Kyanite production in Georgia declined moderately in 1975. Aluminum Silicates Div., C-E Minerals, Inc., Division of Combustion Engineering, Inc., was the only producer. The C-E Minerals operations consisted of an open pit mine and a flotation plant at the Graves Mountain deposit in Lincoln County, and a calcining-shipment plant at Washington, where much of the kyanite was heated to form refractory mullite grog.

Synthetic mullite and other aluminum silicate refractory grogs were produced by the Mulcoa Div. of C-E Minerals in two plants near Andersonville in Sumter County. Bauxite, kaolin, or mixtures of the two materials were calcined in rotary kilns to produce three refractory products, Mul-

coa-70, Mulcoa-60, and Mulcoa-45, the numbers representing the approximate percentage of alumina content. Mulcoa-70 is essentially mullite,  $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ . Much of the grog was exported to Europe and other foreign markets.

**Lime.**—Georgia had no production of quicklime or hydrated lime in 1975. Consumption was 156,822 tons, representing an 8% drop from the quantity reported for 1974. Five firms in Alabama supplied 90% of the shipments in 1975, with the balance supplied by 14 firms in 6 eastern States.

**Mica.**—Output of flake mica in Georgia in 1975 showed a decrease from the reported production for 1974. Two firms were active. Jones Mining Co., Inc., operated the Brady mine in Cherokee County, with all of the output going to Thompson-Weinman & Co., Cartersville, which was acquired by Cyprus Industrial Minerals Co. in 1975. Thompson-Weinman & Co. ground the crude mica for use as a filler by the paint industry. Franklin Mineral Products Co., Inc., produced crude mica from the Hartwell quarry in Hart County, and ground the material for use as filler and extender in numerous products including paint, rubber, and wallpaper.

**Peat.**—Humus peat was produced in two counties and sold as general soil conditioner and for potting soils. Output was 378 tons valued at \$4,980 in 1975, compared with the 1974 output of 550 tons worth \$5,900. Producers were Shep Peat Co. in Miller County and Colonial Peat Co. in Screven County.

**Perlite.**—Armstrong Cork Co. operated an expanded perlite plant in Bibb County, utilizing raw perlite shipped into Georgia from mines in the Western United States. Principal uses for the expanded perlite included acoustical tile, pipe insulation, and other lightweight insulating materials. The quantity of expanded perlite produced in Georgia in 1975 declined from the 1974 figure; however, the total reported value was greater because of increased production costs.

**Sand and Gravel.**—Production of sand and gravel was reported from 70 mines by 67 firms in 36 Georgia counties in 1975. Output in 1975 was 5,105,000 tons with a reported value of \$8,818,000, representing an increase of more than 2% in quantity



but a 9% decrease in value compared with data reported for the previous year. Georgia Marble Co. completed a modern sand processing facility in Marion County south of Junction City. Major end uses for the sand were glassmaking and sandblasting, but the plant was equipped to produce a wide range of industrial sands by a series of operations which included desliming, attrition scrubbing, flotation, screening, and drying. The first shipments from the new plant were made to the glass industry in January 1975.

Marine scientists from the Marine Resources Center on Skidaway Island, Ga., using tools and techniques developed under the Sea Grant program of the National Oceanic and Atmospheric Administration, continued exploration at several marine sites for construction aggregates which are in short supply in Coastal Georgia. Encouraged by preliminary results, the research team started construction of larger sampling equipment and planned a more comprehensive bulk sampling program for the more promising areas which had been discovered by yearend 1975. A technical report on exploration techniques was released by the Skidaway-based center.<sup>3</sup>

**Stone.**—Stone output in Georgia declined appreciably in both quantity and value in 1975. Crushed stone was down 26% in tonnage and 16% in value compared with 1974 figures, with all types of crushed stone showing lower volume of production. Only crushed marble regis-

tered an increase in total value, with six other categories of crushed stone showing value declines. Dimension stone output was up 4% in total quantity and total value over the 1974 data, with production of dimension granite and quartzite increasing sufficiently to offset decreased production of dimension marble and sandstone. Anomalously, the number of crushed stone operations reporting increased from 69 to 74 in 1975, while dimension stone operations decreased from 41 in 1974 to 38 in 1975.

Production of crushed stone totaled 29.8 million tons valued at \$78.8 million in 1975, significantly below the 40.1 million tons worth \$93.7 million reported for 1974. Crushed granite accounted for nearly 81% of the crushed stone output and 71% of the value in 1975, followed by crushed limestone and dolomite with 17% of production and 15% of reported value. Five other categories of crushed stone accounted for the balance.

Dimension stone—granite, marble, sandstone, and quartzite—was produced at 38 quarries in 1975, compared with 41 quarries in 1974. The quantity of dimension stone production in 1975 was 249,700 tons with a reported value of \$12.3 million compared with 239,600 tons worth \$11.8 million reported for 1974.

<sup>3</sup>Harding, J. L., and J. R. Woolsey. Exploration Techniques for Aggregate Resources in Coastal Georgia. Georgia Marine Science Center Tech. Rept. Series, No. 75-1, January 1975, 55 pp.

Table 7.—Georgia: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	3,865	5,257	3,250	4,408
Gravel -----	514	1,744	423	1,238
Unprocessed:				
Sand and gravel -----	251	162	1,090	725
Industrial:				
Sand -----	358	2,430	343	1,875
Gravel -----	--	--	W	W
Total <sup>2</sup> -----	4,989	9,593	5,105	8,247

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

<sup>1</sup>Value f.o.b. plant of processed sand and of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup>Data may not add to totals shown because of independent rounding.

**Table 8.—Georgia: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction----	23	57	74	106
Highway and bridge construction-----	2	W	116	197
Other construction (dams, waterworks, airports, etc.)-----	--	--	W	W
Concrete products (cement blocks, bricks, pipe, etc.)-----	17	W	W	W
Bituminous paving (asphalt and tar paving)---	--	--	W	W
Road base and subbase-----	--	--	--	--
Fill-----	--	--	7	W
Other-----	--	--	--	--
<b>Unprocessed:</b>				
Road base and subbase-----	--	--	213	95
Fill-----	--	--	20	10
Other-----	--	--	--	--
Total <sup>1</sup> -----	42	57	431	409

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction aggregate."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Crushed granite production of 24.1 million tons worth \$56.1 million was reported from 45 quarries in 29 counties in 1975. Corresponding data for 1974 were 42 quarries operating in 32 counties with 32.2 million tons valued at \$65.3 million. The five largest producers accounted for 84% of the 1975 output. They were Dixie Lime & Stone Co.; Georgia Marble Co. (Jim Walter Corp.); Ivy Corp. (Davidson Mineral Properties, Inc., North Georgia Crushed Stone Co., and Gainesville Stone Co.); Martin-Marietta Aggregates, Southeast Div.; and Vulcan Materials Co., Southeastern Div.

Ivy Corp. closed its Davidson Mineral Properties crushed granite quarry in Walton County late in 1974, but continued to sell from stockpiled material during 1975. Ivy Corp. also permanently closed the Banks County crushed granite quarry of North Georgia Crushed Stone in February 1975. The Siloam quarry in Greene County, acquired from Hall Aggregates Co. by Vulcan Materials Co. in 1974, was reopened by Vulcan in 1975 to supply crushed granite for construction of Wallace Dam in central Georgia on the Oconee River. Crushed granite from the Siloam quarry was also furnished to local area contractors.

Florida Rock Industries, Inc., acquired two crushed granite quarries from LBI

Quarries, Inc., early in 1975. The Griffin quarry in Spalding County carried a lease through 1996 with an option for 25 additional years. The lease for the Columbus quarry had an expiration date of 1983 with an option for a 10-year extension. Florida Rock Industries also was actively exploring other granite deposits throughout the year.

Production of dimension granite in Georgia in 1975 was 222,331 tons valued at \$8.7 million. This represented an increase of 4% in quantity and 8% in value over the 1974 output of 213,628 tons worth \$8 million. The relatively good showing of the dimension granite industry was due to the fact that the major end use, monuments, was not affected by the decline in construction activity which prevailed in 1975. Dimension granite output came mostly from the Elberton area in Elbert, Madison, and Oglethorpe Counties. The five largest producers accounted for 61% of dimension granite output in 1975. They were Bennie & Harvey Quarries, Inc.; Coggins Granite Industries, Inc.; Georgia Marble Co.; Middle Georgia Quarries Co.; and Peppers Granite Co.

Davidson Mineral Properties, Inc., ceased operation of the Pine Mountain dimension granite quarry and mill near Lithonia, and sold most of the mill equipment to North Carolina Granite Co. R. O. Rennie, op-

erating as Rennie Granite & Stone Co., obtained the Pine Mountain lease from Davidson and continued operation of the quarry, producing rough curbing and rubble.

Three firms produced crushed sandstone and quartzite in 1975. The Feldspar Corp. produced construction sand as a byproduct in the processing of feldspar ores in Jasper County, Marquette Cement Manufacturing Co. used crushed sandstone from Polk County as a component in making cement, and Buchanan Flagstone Co. produced crushed quartzite aggregates in Pickens County. Total output of crushed sandstone and quartzite in 1975 was substantially less than the production reported for 1974.

Buchanan Flagstone Co. produced quartzite flagging and irregular shapes, and sandstone flagging and rubble, from quarries in Pickens County. North Georgia Stone Co., also in Pickens County, produced quartzite flagging and irregular shapes. Production in 1975 was 14% greater in quantity and value compared with reported output for the preceding year.

Crushed limestone and dolomite was produced from 19 quarries by 15 firms in 11 counties in 1975. Principal uses were construction aggregates, cement manufacture, agricultural limestone, and decorative terrazzo and exposed aggregate facing. Production in 1975 was 5 million tons with a reported value of \$12.2 million, a decline of 27% in quantity and 30% in value from the 1974 totals of 6.9 million tons

valued at \$17.3 million. The five largest producers accounted for three-fourths of the total output.

Florida Rock Industries, Inc., acquired the Rome limestone quarry in northwest Georgia from LBI Quarries, Inc., in November 1975. Earlier in the year the Arlington limestone quarry in southwest Georgia was closed by Florida Rock Industries due to depletion of readily obtainable reserves of stone.

Output of dimension marble and crushed marble declined slightly in 1975; however, the total combined value for dimension and crushed marble was greater than that reported for 1974 because of higher 1975 unit prices. Georgia Marble Co., the only producer, operated two surface dimension marble quarries in Pickens County, and two underground operations—one each in Pickens and Gilmer Counties—which produced crushed and ground marble products. Some scrap from the dimension marble quarries was also crushed to make specialty products. End uses for the marble products ranged from dimension stone for structural and monumental applications to finely ground high-purity fillers for chewing gum and toothpaste.

Georgia Lightweight Aggregate Co. mined slate at Rockmart in Polk County for manufacture of expanded aggregates by the rotary kiln method. Because of the depressed construction activity during much of 1975, output of lightweight aggregate was considerably less than that reported for 1974.

Table 9.—Georgia: Crushed granite sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974			1975		
	Quantity	Value		Quantity	Value	
		Total	Average per ton		Total	Average per ton
Bituminous aggregate -----	7,120	14,392	\$2.02	5,459	13,003	\$2.38
Concrete aggregate -----	8,307	16,930	2.04	5,137	12,222	2.38
Dense-graded road base stone -----	6,097	12,462	2.04	5,422	12,475	2.30
Macadam aggregate -----	1,264	2,641	2.09	602	1,336	2.22
Surface treatment aggregate -----	1,448	3,094	2.14	1,282	3,073	2.40
Unspecified construction aggregate and roadstone -----	4,691	9,605	2.05	3,082	6,915	2.24
Railroad ballast -----	2,525	4,774	1.89	2,363	5,516	2.33
Riprap and jetty stone -----	428	891	2.08	221	488	2.21
Manufactured fine aggregate -----	W	W	W	212	465	2.19
Other uses <sup>1</sup> -----	295	489	1.66	293	583	1.99
Total <sup>2</sup> -----	32,174	65,277	2.03	24,072	56,077	2.33

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

<sup>1</sup> Includes poultry grit, filter stone, and uses indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 10.—Georgia: Dimension granite sold or used by producers, by county

County	1974				1975			
	Number of quarries	Cubic feet	Short tons	Value (thousands)	Number of quarries	Cubic feet	Short tons	Value (thousands)
De Kalb -----	3	185,206	18,520	\$425	3	229,545	20,803	\$416
Elbert -----	12	535,654	52,361	3,543	13	519,578	50,736	3,662
Oglethorpe -----	18	659,466	67,099	1,669	15	703,097	69,991	2,001
Undistributed <sup>1</sup> -----	3	756,300	75,648	2,396	3	753,033	80,801	2,574
Total <sup>2</sup> -----	36	2,136,626	213,628	8,034	34	2,205,253	222,330	8,653

<sup>1</sup> Includes Hancock and Madison Counties.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 11.—Georgia: Dimension granite sold or used by producers, by use  
(Thousand cubic feet and thousand dollars)

Use	1974			1975		
	Quantity	Value		Quantity	Value	
		Total	Average per cubic foot		Total	Average per cubic foot
<b>Rough:</b>						
Architectural -----	231	656	\$2.84	298	937	\$3.14
Monumental -----	1,642	6,238	3.80	1,590	6,486	4.08
Other rough stone <sup>1</sup> -----	W	W	W	114	113	.99
<b>Dressed:</b>						
Curbing -----	139	980	7.05	W	W	W
Other dressed stone <sup>2</sup> -----	125	160	1.28	203	1,116	5.50
Total -----	2,137	8,034	3.76	2,205	<sup>3</sup> 8,653	3.92

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

<sup>1</sup> Includes rubble.

<sup>2</sup> Includes dressed monumental stone.

<sup>3</sup> Data do not add to total shown because of independent rounding.

Table 12.—Georgia: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	672	1,350	500	1,032
Concrete aggregate -----	785	1,733	635	1,494
Dense-graded road base stone -----	916	3,165	808	2,261
Surface treatment aggregate -----	901	2,356	733	2,040
Other construction aggregate and roadstone -----	633	1,422	503	1,069
Riprap and jetty stone -----	W	W	14	27
Cement manufacture -----	1,675	3,036	1,323	2,130
Other uses <sup>1</sup> -----	1,279	4,223	474	2,099
Total -----	6,861	17,285	<sup>2</sup> 4,996	12,152

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

<sup>1</sup> Includes agricultural limestone, railroad ballast, macadam aggregates, manufactured fine aggregate, terrazzo and exposed aggregate, asphalt, whiting, other fillers or extenders, waste material (1975), and uses indicated by symbol W.

<sup>2</sup> Data do not add to total shown because of independent rounding.

**Strontium.**—Chemical Products Corp. of Cartersville imported celestite from Mexico and used the material to produce a number of strontium chemicals for use in television tubes, electronic ceramics, ferrites, and numerous other specialty products.

**Talc.**—Output of talc in Georgia declined substantially in 1975. The State's only producer, Southern Talc Co., operated underground mines in Murray County, and a grinding mill in Chatsworth, Ga. The ground material was sold for use in rubber, asphalt, composition roofing, and various other products.

### METALS

**Bauxite.**—Bauxite was produced from surface mines in Sumter County by two firms in 1975. Output dropped by more than 50% from the reported production in 1974. Mulcoa Div. of C-E Minerals produced bauxite for use in refractory grogs which were calcined in two Mulcoa plants near Andersonville, Ga. American Cyanamid Co. mined bauxite for use in production of aluminum-based chemicals.

**Iron Ore.**—Limonite iron ore was produced in Quitman County by Lumpkin Mining Co., and in Stewart County by Luverne Mining Co. Output reported for 1975 declined substantially from that of 1974. The crude material, mined from open pits, was concentrated by log washers and picking belts to recover lump ore. No attempt was made to recover fine iron oxides which wound up in tailings ponds along with clays and other impurities. Lump ore recovered from the log washers was shipped to steel producers in Alabama. Lumpkin Mining Co. completed construction of a new log washer in 1975 to replace the older plant which was worn out.

Ochre and umber of pigment-grade were mined in Bartow County by New Riverside Ochre Co., and processed for sale as coloring agents for mortar, brick and tile, paints, and other products. Both quantity and value of ochre and umber marketed in 1975 registered declines compared with the 1974 data.

**Rare Earth Minerals.**—Humphreys Mining Co. operated a concentrate separation plant at Folkston, Ga., where monazite and other valuable components were separated from heavy mineral sand concentrates obtained from a deposit operated by Hum-

phreys in Florida, 13 miles south of Folkston. Output from the Folkston plant increased in 1975, following a year when the plant was down for several months while the mining dredge and wet concentration facilities were moved from the depleted Folkston deposit to the new mine in Florida. The sand deposit being mined contained about 4% heavy minerals, which were concentrated by wet gravity methods in Florida and transported by truck to the final separation plant at Folkston.

**Titanium.**—Ilmenite was separated from a heavy minerals concentrate by Humphreys Mining Co. at Folkston. The concentrate was produced from a new mine in Florida operated by Humphreys. Output from the Folkston plant increased in 1975, following a year in which the Folkston deposit was mined out and the wet mill and dredge were moved to the Florida deposit.

**Zirconium.**—Zircon was not mined in Georgia in 1975, but Humphreys Mining Co. produced zircon at Folkston, from a heavy minerals concentrate obtained at its new mine in north Florida. Output of zircon concentrates by Humphreys increased in 1975. Major end uses for zircon included refractories, molding sands, mold facings, and ceramic products.

### MINERAL FUELS

**Coal.**—Coal mining was resumed in northwestern Georgia in 1975, with three firms producing small quantities of coal from strip mines in Chattooga and Dade Counties. Gregisco, Inc., acquired the Coal Man, Inc., property near Cloudland in western Chattooga County, and shipped high-grade metallurgical coal to Brazil for use in steelmaking. Charbon, Inc., and Turner & Ussery Coal Co. operated mines northwest of Trenton in Dade County, marketing the coal in the Chattooga area.

**Petroleum and Natural Gas.**—W. K. Davis and Hunt Petroleum Corp. drilled two holes to a depth of 4,500 feet in Wayne County in southeastern Georgia in 1975. Both holes were reported as dry, although one showed slight traces of petroleum. Resource Energy Corp. drilled one dry hole to a depth of 1,545 feet in Twiggs County in central Georgia.

The Oil and Gas Act of 1975, passed by the State Legislature and signed into law in March 1975, established requirements for drilling exploratory holes in environ-

mentally sensitive areas particularly where freshwater tables and aquifers exist, and for regulating the production of oil and gas. The State Board of Natural Resources was given authority to administer the act.

Construction continued during the year on the Southern Natural Gas Co. liquefied natural gas (LNG) complex in southeastern Georgia, including receiving and re-

gasification facilities on Elba Island near Savannah and a pipeline to Wrens, Ga., where the gas will enter the firm's main distribution system. The LNG for the Georgia facility will be imported from Algeria at the rate of 350 million standard cubic feet per day by a consortium of American and Algerian firms.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Barite, primary:</b>			
New Riverside Ochre Co -----	Box 387 Cartersville, Ga. 30120	Open pit mine --	Bartow.
Paga Mining Co., Div. Thompson-Weinman & Co.	Box 130 Cartersville, Ga. 30120	Reclaimed tailings and grinding mill.	Do.
<b>Bauxite:</b>			
American Cyanamid Co -----	Berdan Ave. Wayne, N.J. 07470	Open pit mine and drying plant.	Sumter.
C-E Minerals, Inc., Div. Combustion Engineering, Inc.	901 E. Eighth Ave. King of Prussia, Pa. 19406	Open pit mines and calcining plants.	Do.
<b>Cement:</b>			
Marquette Cement Manufac- turing Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Plant -----	Polk.
Martin-Marietta Cement (Southern Div.) Sub. of Martin-Marietta Corp.	18th Floor, Daniel Bldg. Birmingham, Ala. 35233	-----do -----	Fulton.
Medusa Cement Co., Div. Medusa Corp.	Box 5668 Cleveland, Ohio 44101	-----do -----	Houston.
<b>Clays:</b>			
<b>Fuller's earth:</b>			
Engelhard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	Open pit mine and calcining plant.	Decatur.
Georgia-Tennessee Mining & Chemical Co.	3379 Peachtree Rd. Atlanta, Ga. 30326	-----do -----	Jefferson.
Milwhite Co., Inc -----	Box 15038 Houston, Tex. 77020	-----do -----	Decatur.
Oil-Dri Corp. of Georgia --	Box 200-A Ochlocknee, Ga. 31773	-----do -----	Thomas.
Thor Mining Co., Div. Pennsylvania Glass Sand Co.	Berkeley Springs, W. Va. 25411	-----do -----	Do.
Waverly Mineral Products Co., Div. Johnson- March Corp.	Box 106 Meigs, Ga. 31765	-----do -----	Do.
<b>Kaolin:</b>			
American Industrial Clay Co.	433 N. Broad St. Elizabeth, N.J. 07207	Open pit mines and processing plant.	Warren and Washington.
Engelhard Minerals & Chemicals Corp.	Menlo Park Edison, N.J. 08817	Open pit mine and plant.	Washington and Wilkinson.
Freeport Kaolin Co -----	733 Third Ave. New York, N.Y. 10017	-----do -----	Twiggs.
Georgia Kaolin Co -----	433 N. Broad St. Elizabeth, N.J. 07207	-----do -----	Do.
J. M. Huber Corp -----	Thornall St. Edison, N.J. 08817	Open pit mines and processing plant.	Twiggs and Warren.
Thiele Kaolin Co -----	Box 1056 Sandersville, Ga. 31082	-----do -----	Warren and Washington.
<b>Common clay and shale:</b>			
Bickerstaff Clay Products Co.	P.O. Box 1178 Columbus, Ga. 31902	Open pit mine --	Floyd.
Burns Brick Co -----	Box 4787 Macon, Ga. 31208	-----do -----	Bibb.
Chattahoochee Brick Co --	3195 Brick Plant Rd. N.W. Atlanta, Ga. 30318	Open pit mines -	Floyd, Fulton. Polk.
Cherokee Brick & Tile Co -	Box 4567 Macon, Ga. 3120b	Open pit mine --	Bibb.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clays—Continued			
Common clay and shale—Continued			
Georgia-Carolina Brick & Tile Co.	RFD 1, Box 10 Augusta, Ga. 30906	Open pit mine --	Richmond.
Griffin Pipe Products Co., Div. AMSTED Industries.	Drawer 548 Milledgeville, Ga. 31061	Open pit mines -	Floyd.
Martin-Marietta Corp ----	18th Floor, Daniel Bldg. Birmingham, Ala. 35233	Open pit mine --	Fulton.
Feldspar:			
The Feldspar Corp -----	Box 99 Spruce Pine, N.C. 28777	Open pit mine and flotation plant.	Jasper.
Gypsum:			
The Flintkote Co -----	400 Westchester Ave. White Plains, N.Y. 10604	Calcination plant	Chatham.
Georgia-Pacific Corp., Gypsum Div.	Box 311 Portland, Oreg. 97207	----do -----	Glynn.
National Gypsum Co -----	327 Delaware Ave. Buffalo, N.Y. 14202	----do -----	Chatham.
Iron Ore:			
Lumpkin Mining Co -----	Box 234 Greenville, Ala. 36037	Open pit mine and plant.	Quitman.
Luverne Mining Co -----	Box 409 Luverne, Ala. 36104	----do -----	Stewart.
Iron oxide pigment materials:			
New Riverside Ochre Co ----	Box 387 Cartersville, Ga. 30120	----do -----	Bartow.
Kyanite:			
Aluminum Silicates Div., C-E Minerals, Inc., Div. Com- bustion Engineering, Inc.	433 S. Gulph Rd. King of Prussia, Pa. 19406	Open pit mine and flotation plant.	Lincoln.
Mica:			
Franklin Mineral Products Co., Inc.	P.O. Box O, 635 Main St. Wilmington, Mass. 01887	Open pit mine and grinding mill.	Hart.
Thompson-Weinman & Co ----	Box 130 Cartersville, Ga. 30120	----do -----	Cherokee.
Peat:			
Shep Peat Co -----	Box 307 Colquitt, Ga. 31737	Bog -----	Miller.
Perlite, expanded:			
Armstrong Cork Co -----	1010 Concord St. Lancaster, Pa. 17604	Plant -----	Bibb.
W. R. Grace & Co -----	62 Whittemore Ave. Cambridge, Mass. 02140	----do -----	Gwinnett.
Rare-earth minerals:			
Humphreys Mining Co -----	Box 8 Folkston, Ga. 31537	Processing plant.	Charlton.
Sand and gravel:			
Atlanta Sand & Supply Co ---	695 Forsyth Bldg. Atlanta, Ga. 30303	Open pit mine --	Crawford.
Brown Brothers Sand Co -----	Howard, Ga. 31039 ----	Open pit mines -	Talbot and Taylor.
Claussen-Lawrence Construc- tion Co.	Box 4510 Augusta, Ga. 30907	Open pit mine --	Richmond.
Colwell Construction Co -----	Box 6 Blairsville, Ga. 30512	----do -----	Upson.
Cornell-Young Co -----	Box 96, 4496 Mead Rd. Macon, Ga. 31206	----do -----	Bibb.
Crawford County Mining Co., Inc.	3166 Maple Dr., N.E. Atlanta, Ga. 30305	----do -----	Crawford.
Dawes Silica Mining Co -----	Box 470 Thomasville, Ga. 31792	Open pit mines -	Dougherty.
Howard Sand Co -----	Box 118 Butler, Ga. 31006	----do -----	Talbot and Taylor.
The Scruggs Concrete Co., Inc.	Box 2065 Valdosta, Ga. 31601	Open pit mine --	Cook.
Stone:			
Granite, crushed:			
Dalton Rock Products Co -	Box 1608 Dalton, Ga. 30720	Quarry -----	Whitfield.
Dixie Lime & Stone Co --	Rt. 1, P.O. Box 998 Bridgeboro, Ga. 31744	----do -----	Clayton and Fayette.
Georgia Marble Co., Div. Jim Walter Corp.	3460 Cumberland Pkwy. N.W. Atlanta, Ga. 30303	Quarries and crushing plants.	De Kalb and Douglas.
Ivy Corp. (Davidson Min- eral Properties, Inc.; Gainesville Stone Co.; and North Georgia Crushed Stone Co.).	100 Peachtree St., N.W. Atlanta, Ga. 30303	----do -----	Banks, Clarke, Fulton, Habersham, Hall, Stephens, Walker.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Granite, crushed—Continued			
Martin-Marietta Aggregates (Southeast Div.) Sub. of Martin-Marietta Corp.	18th Floor, Daniel Bldg. Birmingham, Ala. 35233	Quarries and mills.	Jones and Richmond.
Vulcan Materials Co., Southeastern Div.	Box 7324-A, 1 Office Park Birmingham, Ala. 35223	----do -----	Cobb, Douglas, Fulton, Gwinnett.
Granite, dimension:			
Coggins Granite Indus- tries, Inc.	Box 250, Railroad St. Elberton, Ga. 30635	Quarries and plants.	Elbert and Madison.
Georgia Marble Co., Div. Jim Walter Corp.	3460 Cumberland Pkwy., N.W. Atlanta, Ga. 30303	----do -----	Madison.
Middle Georgia Quarries Co.	Box 958 Elbertson, Ga. 30635	----do -----	Oglethorpe.
Limestone, crushed:			
Dalton Rock Products Co.	Box 1608 Dalton, Ga. 30720	Quarry and mill	Whitfield.
Dixie Lime & Stone Co.	Route 1, P.O. Box 998 Bridgeboro, Ga. 31744	Quarries	Clayton, Fayette, Mitchell, Monroe.
LBI Quarries, Inc.	Box 1067, 401 East 1st Ave. Rome, Ga. 31061	Quarry and mill	Floyd.
Martin-Marietta Cement (Southern Div.) Sub. of Martin-Marietta Corp.	18th Floor, Daniel Bldg. Birmingham, Ala. 35233	Quarry	Bartow.
Vulcan Materials Co., Southeastern Div.	Box 7324-A, 1 Office Park Birmingham, Ala. 35223	----do -----	Carroll.
Marble, crushed:			
Georgia Marble Co., Div. Jim Walter Corp.	3460 Cumberland Pkwy., N.W. Atlanta, Ga. 30303	Quarries and mill	Gilmer and Pickens.
Marble, dimension:			
Georgia Marble Co., Div. Jim Walter Corp.	----do -----	Quarry and finishing plant.	Do.
Sandstone, crushed:			
The Feldspar Corp.	P.O. Box 99 Spruce Pine, N.C. 28777	Open pit mine	Jasper.
Marquette Cement Manu- facturing Co.	20 N. Wacker Dr. Chicago, Ill. 60606	Quarry and mill	Polk.
Sandstone, dimension:			
North Georgia Stone Co.	Whitestone, Ga. 30186	Quarry	Pickens.
Slate, crushed:			
GAF Corp., Industrial Products Div.	140 West 51st St. New York, N.Y. 10020	Quarry and mill	Bartow.
Georgia Lightweight Aggregate Co.	Box 188 Rockmart, Ga. 30125	Mine and mill	Polk.
Talc (soapstone):			
Southern Talc Co.	Box F Chatsworth, Ga. 30705	Underground mines and grinding mill.	Murray.
Titanium concentrate:			
Humphreys Mining Co., Div. Humphreys Engineering Co.	Box 8 Folkston, Ga. 31537	Plant	Charlton.
Zircon concentrate:			
Humphreys Mining Co., Div. Humphreys Engineering Co.	----do -----	----do -----	Do.





# 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 William H. Kerns <sup>1</sup>

Value of mineral production in Hawaii in 1975 reached a new high of nearly \$50 million, an 18% increase over that of 1974. This record was primarily due to increased prices for mineral products since output of the principal commodities—construction materials—actually declined as a result of decreased building activities in the State during 1975.

Quantitative output of portland and masonry cement from the State's two cement plants declined 6% and 10%, respectively. Lime output declined 9%; pumice declined 17%; sand and gravel declined 32%; stone declined 1%; and clays output remained about the same. One plant in Honolulu exfoliated vermiculite from Montana.

Two petroleum refineries, located at Barbers Point in Honolulu County, produced petroleum products for local use from imported crude petroleum. Because imported petroleum is virtually the State's sole energy source, major studies sponsored by Federal, State, and local agencies, and public utilities were made concerning Hawaii's energy resources management, planning and conservation, and development of alternate energy sources. One of the alternate energy sources studied was geothermal.

Phase 1 of the Hawaii Geothermal Project (HGP), covering geophysical, engineering, and environmental-economic

<sup>1</sup> State Liaison Officer, Bureau of Mines, Sacramento, Calif.

Table 1.—Mineral production in Hawaii <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>Cement:</b>				
Masonry ----- short tons	14,257	\$706	12,809	\$762
Portland ----- do	487,422	16,405	455,834	19,942
Lime ----- do	6,070	221	5,538	250
Pumice ----- thousand short tons	385	792	318	912
Sand and gravel ----- do	990	2,379	671	2,460
Stone ----- do	<sup>2</sup> 7,638	<sup>2</sup> 21,370	7,569	25,319
Value of items that cannot be disclosed:				
Other nonmetals -----	XX	169	XX	65
Total -----	XX	42,042	XX	49,710
Total 1967 constant dollars -----	XX	19,877	XX	<sup>p</sup> 19,685

<sup>p</sup> Preliminary. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes dimension stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Hawaii, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Hawaii -----	\$3,687	\$4,617	Stone, pumice, sand and gravel.
Honolulu -----	32,229	39,031	Cement, stone, lime, clays.
Kauai -----	1,303	1,556	Stone, sand and gravel, pumice.
Maui -----	4,825	4,507	Sand and gravel, stone, pumice, lime, gem stones.
Total <sup>1</sup> -----	42,042	49,710	

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Hawaii business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----	359.1	356.4	-0.8
Unemployment -----	27.2	25.7	-5.5
<b>Employment (nonagricultural):</b>			
Mining -----	( <sup>1</sup> )	( <sup>1</sup> )	XX
Manufacturing -----	22.8	23.9	+4.8
Contract construction -----	28.0	28.2	+7
Transportation and public utilities -----	25.4	25.4	--
Wholesale and retail trade -----	82.8	84.4	+1.9
Finance, insurance and real estate -----	23.1	23.3	+9
Services <sup>2</sup> -----	72.1	72.0	-1
Government -----	78.8	82.0	+4.1
Total nonagricultural employment -----	333.0	339.2	+1.9
<b>Personal income:</b>			
Total -----	\$5,069	\$5,674	+11.9
Per capita -----	\$6,010	\$6,658	+10.8
<b>Construction activity:</b>			
Number of private and public residential units authorized	19,705	12,240	-37.9
Value of nonresidential construction -----	\$152.4	\$162.2	+6.4
Value of State road contract awards -----	\$40.0	\$101.0	+152.5
Shipments of portland and masonry cement to and within the State -----	519	476	-8.3
<b>Mineral production value:</b>			
Total crude mineral value -----	\$42.0	\$49.7	+18.3
Value per capita, resident population -----	\$49.23	\$67.27	+16.3
Value per square mile -----	\$6,518.14	\$7,706.98	+18.2

<sup>p</sup> Preliminary. XX Not applicable.

<sup>1</sup> Included with "Services."

<sup>2</sup> Includes mining.

Source: U.S. Department of Commerce; U.S. Department of Labor; Highway and Heavy Construction magazine; and U.S. Bureau of Mines.

study programs, was completed late in 1975. Phase 2 was then begun with the starting of HGP Well No. 1 in the Puna area of Hawaii County. The well is to be drilled to a depth of 6,000 feet to test the geothermal resource potential for generating energy.

The Hawaii Coastal Zone Management Program, First-Year Summary Report: 1974-1975 was published.<sup>2</sup> It summarized the first-year planning work and projected second-year planning of the technical, legal, and organizational aspects of managing Hawaii's coastal zone under the

Section 305 program development grant of the National Coastal Zone Management Act of 1972. A coastal zone management plan, when adopted by the State, could have an effect on the State's mineral industry development. The legislature adopted the Hawaii Shoreline Protection Act of 1975 as special interim controls on shoreline development until a general coastline management program can be developed.

<sup>2</sup> Hawaii Department of Planning and Economic Development. Hawaii Coastal Zone Management Program, First-Year Summary Report: 1974-1975. 1976, 88 pp.

## REVIEW BY MINERAL COMMODITIES

## NONMETALS

**Cement.**—Kaiser Cement & Gypsum Corp. operated a cement plant near Nanakuli, and Cyprus Hawaiian Cement Corp. operated a cement plant near Ewa. Both plants are on Oahu Island in Honolulu County. Shipments of portland cement totaled 456,000 tons, a 6% decline compared with that of 1974, but the total value was a record \$20 million, a 22% increase. Masonry cement shipments totaled 13,000 tons, 10% below that of 1974, but the value increased 8% to a record \$762,000.

Of the total portland cement, 79% was used for ready-mix concrete; 10% by concrete products manufacturers; 5% by building materials dealers; 6% by highway and other contractors; and government agencies and miscellaneous customers, less than 0.5%.

Raw materials consumed in manufacturing portland cement included 560,800 tons of limestone and 89,700 tons of basalt (for iron and silica), quarried on Oahu; 44,600 tons of imported silica sand; 22,500 tons of imported gypsum; and 34,500 tons of imported clinker. The two cement plants consumed 364,000 barrels of fuel oil and purchased 60.5 million kilowatt-hours of electrical energy.

Ninety-three percent of Cyprus Hawaiian Cement Corp. is owned by Cyprus Mines Corp.; the remaining 7% is owned by Alexander & Baldwin, a prominent Hawaii-based company. In addition to manufacturing and selling portland and masonry cement in Hawaii, the firm also produces and sells calcium silicate, a soil enricher, to the Hawaiian sugar industry, mines and sells limestone aggregate, and markets white portland cement imported from producers outside Hawaii. The company's capacity was increased by nearly one-third, to 280,000 tons per year, with the completion of a major expansion of its plant.

Kaiser Cement & Gypsum Corp. completed a 1,600-ton cement storage silo at Lihue, Kauai County, to expand the capacity of its cement distribution facility by more than fourfold. The project included a 1,000-foot pipeline extending

from the docks at Nawiliwili to the silo to speed the unloading of cement barges.

**Clays.**—Pacific Clay Corp. mined common clay near Waimanalo, Honolulu County, and used it for making brick at a plant in Campbell Industrial Park near Ewa.

**Gem Stones.**—Black and pink coral harvested in the waters surrounding the Hawaiian Islands provide most of the raw material for a local jewelry industry, which may gross \$11 million in retail sales in fiscal 1974-75 and employ over 500 persons, as projected by the Hawaii Department of Planning and Economic Development.<sup>3</sup>

Hawaii has had a precious-coral industry since 1958, but the growth in the last few years has been substantial and rapid. In 1969, retail sales of the industry were only about \$2.6 million. All of the black coral used in Hawaiian jewelry is harvested locally by independent scuba divers in waters off Maui and Kauai Islands at depths between 150 and 250 feet. Pink coral grows at greater depths, usually around 1,200 feet, and was collected by dredging the ocean floor with weighted nets. In 1975, research using Star II, a manned underwater vehicle equipped with a coral cutter and a basket to collect the coral, tentatively established the economic feasibility of harvesting pink coral. This method permits selective harvesting, which is desirable in order not to overexploit the renewable resources. Recovery of pink coral locally has been supplemented by imported material. Gold coral was discovered off Makapuu, Oahu Island, in 1971 and proved to have great commercial potential. A new bed of gold coral was discovered at a depth of 1,200 feet off Keahole Point, Hawaii Island, in 1975, using Star II.

**Lime.**—Two companies produced lime for use in sugar refining and for finishing lime. GasprO, Ltd., produced quicklime and hydrate from coral at Waianae, Honolulu County, and Hawaiian Commercial & Sugar Co. Ltd., produced hydrate at Paia, Maui County. Total output declined 9% compared with that of 1974, but value in-

<sup>3</sup> Thompson, N. Marine Science Aids Rare-Coral Industry. *Hawaii Econ. Rev.*, Spring/Summer 1975, pp. 9-10.

creased 13% owing to increased unit prices.

**Pumice and Volcanic Cinder.**—Thirteen operators mined pumice and volcanic cinder at 14 pits for use in concrete, road-building and surfacing, landscaping, and for fill. Output declined 17%, but value increased 15% compared with that of 1974. Production came from Hawaii, Maui, and Kauai Counties, in descending order of output.

**Sand and Gravel.**—Eleven operators mined 671,000 tons of sand and gravel at 11 pits in the State for concrete aggregate, roadbase and subbase, and fill. Two pits were in Hawaii County, four in Kauai County, and five in Maui County. Material is recorded as sand and gravel if it is mined without drilling and blasting. Otherwise, it is recorded as stone production.

Of the total output of sand and gravel, 40% was sold or used as processed, and the remainder was sold or used as unprocessed sand and gravel. Output in 1975 was 32% below that of 1974 because of the drop in the level of private building and the completion of a number of larger public projects.

Supplying natural water-worn coral or basalt sand to replenish or improve beaches is a continuing problem. The sources of this sand are dunes or back-beach deposits of coralline limestone, crushed lithified sand or basalt, or offshore deposits. Working under National Science Foundation Sea Grant Programs, the Hawaii Institute of Geophysics, University of Hawaii, inventoried sand deposits off

leeward Oahu, Molokai, and Maui Islands<sup>4</sup> and made studies of a recovery system.<sup>5</sup> Also under the Sea Grant Program, the Hawaii Institute of Geophysics made a study of the erosion and accretion at selected Hawaiian beaches.<sup>6</sup>

**Stone.**—Production was 1% below that of 1974, but the total value of output increased 18% because of higher prices. Limestone was produced as crushed and broken stone at 9 quarries, traprock (basalt) as crushed and broken stone at 18 quarries, and other miscellaneous types of stone as dimension and crushed and broken stone at 10 quarries. Of the 37 quarries in the State, 12 were located in Honolulu County, 16 in Hawaii County, 3 in Maui County, and 6 in Kauai County. Three-quarters of the State's total stone output came from Honolulu County, 14% from Hawaii County, 7% from Maui County, and 4% from Kauai County. Leading producers were Lone Star Industries, Pacific Concrete & Rock Co., Ltd., and HC&D, Ltd. Together the three companies operated seven quarries and accounted for 61% of the State's total stone output of 7.6 million tons. Other major producers included Hawaiian Bitumuls &

<sup>4</sup> Moberly, R., J. F. Campbell, and W. T. Coulbourn. *Offshore and Other Sand Resources for Oahu, Hawaii.* University of Hawaii Sea Grant Program, UNIHI-SEAGRANT-TR-75-03, May 1975, 36 pp.

<sup>5</sup> Casciano, F. M. *Development of a Submarine Sand Recovery System for Hawaii.* University of Hawaii Sea Grant Program, UNIHI-SEAGRANT-AR-73-04, July 1973, 14 pp.

<sup>6</sup> Campbell, J. F. *Erosion and Accretion of Selected Hawaiian Beaches.* University of Hawaii Sea Grant Program, UNIHI-SEAGRANT-TR-72-02, January 1975, 30 pp.

Table 4.—Hawaii: Construction sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	331	713	270	946
Gravel -----	265	658	W	W
Unprocessed: Sand and gravel -----	394	1,008	402	1,445
Total -----	990	2,379	<sup>2</sup> 671	2,391

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

Table 5.—Hawaii: Construction aggregate (blended sand and gravel) sold or used commercially by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concentrate aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	430	1,022	225	841
Highway and bridge construction -----	14	17	28	139
Other construction (dams, waterworks, airports, etc.) -----	14	17	8	13
Concrete products (cement blocks, bricks, pipe, etc.) -----	17	25	9	17
Bituminous paving (asphalt and tar paving) -----	W	W	W	W
Roadbase and subbase -----	121	290	W	W
Fill -----	W	W	W	W
Other -----	W	W	W	W
Unprocessed:				
Roadbase and subbase -----	394	1,008	302	1,316
Fill -----	W	W	100	133
Other -----	W	W	W	W
Total <sup>1</sup> -----	990	2,379	671	2,460

W Withheld to avoid disclosing individual company confidential data. "Bituminous paving," "Processed roadbase and subbase," and "Processed other" included with "Nonresidential and residential construction"; "Unprocessed fill" and "Unprocessed other" included with "Unprocessed roadbase and subbase."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Paving Co., Ltd.; James W. Glover, Ltd.; Cyprus Hawaiian Cement Corp.; Herbert Tanaka Co.; Grove Farm Co., Inc.; and Kaiser Cement & Gypsum Corp. Output from four quarries each exceeded 500,000 tons. Together the four quarries accounted for 58% of the State total. Seven other quarries, each with a production of between 200,000 and 500,000 tons, supplied an additional 28% of the total. An additional 26 quarries supplied the remaining 14%.

**Vermiculite.**—Vermiculite of Hawaii, Inc., exfoliated vermiculite from Montana at a plant in Honolulu. Output was 287 short tons valued at \$122,000. Fifty-five percent of the total output was used as plaster aggregate, 29% as soil conditioner, and 16% as packing insulation and for miscellaneous uses.

#### MINERAL FUELS

Hawaii depends almost entirely on imported crude petroleum and petroleum products for its energy requirements. It has no oil, natural gas, or coal resources and has no nuclear, hydroelectric, or geothermal energy developments. It has two refineries that process imported crude oil to produce petroleum products for local use. They are Standard Oil Co. of California and Hawaiian Independent Refinery Inc. Both are located in Campbell Indus-

trial Park at Barbers Point on Oahu Island, Honolulu County. Continental Oil Co. and Dillingham Corp. wanted to build a 50,000-barrel-per-day oil refinery on Oahu, but no final decision had been made by the close of the year.

Hawaiian Independent Refinery Inc., a subsidiary of Pacific Resources, Inc., completed a 2-year \$20 million expansion and modification program that doubled its original refinery capacity for clean fuels and added new equipment for the production of reformate, the basic high-octane component of unleaded gasoline. The new capacity is 59,500 barrels per day plus up to 11,000 barrels per day of reformate.

Gasco, Inc., another subsidiary of Pacific Resources, Inc., opened a plant in Campbell Industrial Park in 1975. The plant supplies synthetic natural gas (SNG) to about 30,000 Oahu Island customers from Pearl City to Hawaii Kai. The SNG is pumped through a \$5.3 million, 22-mile pipeline installed to connect the \$7.6 million plant with the city's utility system. The new facility has a daily production capacity of 16.7 million cubic feet of SNG. The SNG is cleaner to produce than the gas manufactured at Gasco's old Iwilei plant, which had been in operation since 1905 and is now on standby.

Fuel hardship and emergency allocation requests to the State Department of Planning and Economic Development Energy Management Unit during the first 8 months of 1975 resulted in the distribution of 3.8 million gallons of gasoline by the State agency. The fuel was taken from the State set-aside, which represented 3% of the total amount used in the Islands. In addition, nearly 1 million gallons of propane, middle distillate fuels, diesel oils, and fuel oils were allocated during that period.

Because of the 1973-74 Arabian oil embargo and resultant energy crisis and because imported petroleum is virtually Hawaii's sole energy source, a State of Hawaii Energy Policies Plan was prepared and published in early 1975.<sup>7</sup> The plan examined Hawaii's response to the energy crisis; provided background information on which planning and policy for future energy shortages, contingencies, and related events can be based; and examined what Hawaii can do in the future in regard to energy use, allocation, development, and conservation.

The second annual report of the State Energy Resources Coordinator was published.<sup>8</sup> It reviewed the substantial progress made during 1975 in energy resource management, planning, and conservation, and development of alternate energy sources.

Hawaii legislative actions on energy during the 1975 session included the following:

Inclusion in the budget for the 1975-77 biennial (Act 195, SLH 1975, Part V) of an appropriation for alternate energy sources research and development of \$863,000 for fiscal 1976 and \$924,000 for fiscal 1977. The sum of \$141,000 was released to the Hawaii Natural Energy Institute (HNEI), and in the third quarter, an additional \$76,000 was committed to HNEI and \$59,000 to the Natural Energy Laboratory of Hawaii.

The appropriation of \$125,000 for the FY 1976 in general fund monies for solid waste management demonstration projects.

The appropriation of \$125,000 for the Department of Land and Natural Resources to undertake a water study at Mt. Waialeale, Kauai County. The study will investigate the feasibility of power generation in the Wailua River Basin and the

environmental, recreational, and conservation aspects of the project.

Act 38, SLH 1975, which provided the Governor with emergency powers in the event of a shortage of petroleum products such as occurred in the 1975 gasoline crisis.

Act 19, SLH 1975, which increased the State tax on liquid fuel and diesel oil by 3.5¢ per gallon for a 14-month period beginning in May 1975.

The findings of the Committee on Alternate Energy Sources for Hawaii of the State Advisory Task Force on Energy Policy were published.<sup>9</sup> Alternate sources of energy and conversion methods investigated included solid wastes; hydroelectric power; wind; geothermal steam; solar; ocean waves, tides, and currents; coal; nuclear; bioconversion; ocean thermal conversion; and osmosis.

The study of geothermal resources as an alternate energy source resulted in the establishment of the HGP. The HGP was to focus the efforts of the State of Hawaii and the University of Hawaii on coordinated research to lead to the development of geothermal power on the island of Hawaii. From the beginning, the HGP received both encouragement and financial support from Federal, State, and county governments, as well as from the business community, utilities, and public interest groups. Phase 1 of HGP was initiated in 1973 with a \$252,000 grant from the National Science Foundation—Research Applied to National Needs (NSF-RANN), supplemented by \$100,000 each from the State and the county of Hawaii. Phase 1 research was to cover four areas—geophysical, engineering, environmental-socioeconomic, and drilling. Two additional grants totaling \$336,000 were received from NSF-RANN that provided operational support to HGP through April 1975. These funds were used to continue the exploratory surveys and support programs of phase 1, to begin to establish environmental baselines, and to initiate

<sup>7</sup> Hawaii Department of Planning and Economic Development, State of Hawaii Energy Policies Plan, General Plan Revision Program, 1974, 1975, 153 pp.

<sup>8</sup> Hawaii Department of Planning and Economic Development, Energy Resources Coordinator 1975 Annual Report, March 1976, 37 pp.

<sup>9</sup> Hawaii Natural Energy Institute, University of Hawaii and Hawaii Department of Planning and Economic Development, Alternate Energy Sources for Hawaii, Report of the Committee on Alternate Energy Sources for Hawaii of the State Advisory Task Force on Energy Policy, February 1975, 271 pp.

planning for phase 2—the research drilling program. An additional \$39,000 was received from a variety of public and private sources.

In April 1975 notice was received from the Energy Research and Development Administration (ERDA) that an HGP proposal for \$1,064,000 was approved, of which \$580,000 was earmarked for a research geothermal well. In addition, the State legislature allocated \$500,000 for exploratory geothermal drilling, and the Hawaiian Electric Co. contributed \$20,000 to assist with the drilling program. HGP Well No. 1 in the Puna area on the island of Hawaii was dedicated in the Hawaiian tradition on November 22, 1975, with the objective of obtaining intermittent cores and scientific data to a depth of 6,000 feet.

A summary report<sup>10</sup> for phase 1 of the HGP was published. May 1, 1975, was established rather arbitrarily as the beginning of phase 2, the research drilling program.

Solid waste was a second alternate energy source studied. Agricultural and municipal solid wastes represent a viable means of conserving fossil fuels and resolving a critical disposal problem. The State of Hawaii currently generates about 650,000 tons of solid waste per day, of which 85% is generated in the city and county of Honolulu. It is estimated that this amount of solid waste could produce about 10% of the State's total energy requirements. Currently, about 462,000 megawatt-hours of power using bagasse, (sugarcane waste) is being generated annually by the sugar industry.

## METALS

**Manganese.**—For several years the University of Hawaii has been the leading center for Pacific Ocean nodular-manganese research. The University's Manganese Research Project, under the National Science Foundation office of the International Decade of Ocean Exploration, has been co-

ordinating all international exchanges and research in this field. International symposium/workshops were held in Honolulu in 1972 and 1973 and proceedings published. In 1975 the University of Hawaii was awarded two scientific research grants by the National Science Foundation to study Pacific Ocean ferromanganese nodules. One of the grants, amounting to \$37,100, was awarded to the oceanography department for a 9-month study of the microstructure and chemistry of the nodules. The second, for \$22,200, went to the chemistry department for a 9-month study of free and organically complex trace metals in the nodules. A report on a study in 1974 was published.<sup>11</sup>

Manganese deposits in the Pacific are of two types: deep-ocean nodules with high copper and nickel concentrations; and Archipelago crust deposits, with relatively high cobalt and noble metal concentrations. The nodules, which constitute the major deposits, are located in water depths greater than 6,500 feet, and the richest deposits are about 600 to 1,000 miles southeast of Hawaii. The crust-type deposits were recently discovered in Hawaiian waters in the channels of the main Hawaiian Islands. For both types of deposits, Hawaii is the closest land mass and commercial center for treatment or partial treatment of the nodules and/or transloading them from barges to ships. In 1975, the Hawaii Legislature approved a \$100,000 appropriation to study the feasibility of establishing a manganese nodule processing industry in Hawaii. Industry requirements, State policy, legal questions of ownership of the nodules, site availability, and environmental problems are to be included in the study being conducted by the Hawaii Department of Planning and Economic Development.

<sup>10</sup> University of Hawaii. The Hawaii Geothermal Project, Summary Report for Phase 1. May 1975, 160 pp.

<sup>11</sup> Margolis, S. V., C. J. Bower, J. Murray, J. L. Mero, W. Hardy, W. C. Dudley, B. K. Dugolinsky, K. Binder, R. Hall, and C. Boatman. Ferromanganese Deposits of the Ocean Floor. Hawaii Inst. Geophys., Univ. Hawaii, Cruise Rept. Mn-74-02, September 1975, 121 pp.



Table 6.—Principal producers

Commodity and company	Address	Type of activity	Island
<b>Cement:</b>			
Cyprus Hawaiian Cement Corp --	1600 Kapiolani Blvd. Honolulu, Hawaii 96814	Cement plant ----	Oahu.
Kaiser Cement & Gypsum Corp -	Permanente Rd. Permanente, Calif. 95014	----do -----	Do.
Clays: Pacific Clay Corp -----	547 Halekauwila St. Honolulu, Hawaii 96813	Open pit mine ---	Do.
<b>Lime:</b>			
GasprO, Ltd -----	Box 2454 Honolulu, Hawaii 96804	Rotary kiln and continuous hydrator.	Do.
Hawaiian Commercial & Sugar Co. Ltd.	Puunene, Hawaii 96784	----do -----	Maui.
<b>Pumice and volcanic cinder:</b>			
Fong Construction Co., Ltd ----	237 Dairy Rd. Kahului, Hawaii 96732	Open pit mine ----	Do.
HC&D, Ltd -----	Box 190 Honolulu, Hawaii 96810	----do -----	Molokai.
Hilo Coast Processing Co ----	Pepeekeo, Hawaii 96783	----do -----	Hawaii.
Laupahoehoe Sugar Co -----	Papaaloa, Hawaii 96780	----do -----	Do.
Volcanite, Ltd -----	3232 Fort St. Honolulu, Hawaii 96813	----do -----	Do.
<b>Sand and gravel:</b>			
Concrete Industries, Inc -----	Box 86 Puunene, Hawaii 96784	----do -----	Maui.
HC&D, Ltd -----	Box 190 Honolulu, Hawaii 96810	----do -----	Molokai.
Maui Concrete & Aggregates, Inc	8 Central Ave. Wailuku, Hawaii 96793	----do -----	Maui.
Louis K. Rego Trucking Co ----	Lihue, Hawaii 96766 --	----do -----	Kauai.
<b>Stone:</b>			
Cyprus Hawaiian Cement Corp --	1600 Kapiolani Blvd. Honolulu, Hawaii 96814	Quarry -----	Oahu.
James W. Glover, Ltd -----	Box 275 Hilo, Hawaii 96720	----do -----	Hawaii.
Grove Farm Co., Inc -----	Puhi Rural Station Puhi, Hawaii 96766	----do -----	Kauai.
Hawaiian Bitumuls & Paving Co., Ltd.	Box 2240 Honolulu, Hawaii 96804	----do -----	Oahu.
HC&D, Ltd -----	Box 190 Honolulu, Hawaii 96810	----do -----	Maui and Oahu.
Kaiser Cement & Gypsum Corp -	Permanente Rd. Permanente, Calif. 95014	----do -----	Oahu.
Lone Star Industries -----	400 Alabama St. San Francisco, Calif. 94110	----do -----	Do.
Pacific Concrete & Rock Co., Ltd	2344 Pahounui Dr. Honolulu, Hawaii 96819	----do -----	Maui, Molokai, Oahu.
<b>Vermiculite (exfoliated):</b>			
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 D. W. Lockard,<sup>1</sup> E. H. Bennett,<sup>2</sup> and J. G. Bond<sup>3</sup>

The 1975 value of Idaho's mineral production increased 12% to nearly \$234 million from approximately \$209 million in 1974. This represents an increase in mineral value of over 100% since 1972. Twenty-one mineral commodities were produced; 9 were metallic and 12 were nonmetallic or industrial minerals. Phosphate rock rose more than 32% in value over that of 1974 to surpass silver as the leading mineral commodity. Metallics ac-

counted for \$129 million of the Idaho output, or 55% of the total mineral revenue. Silver provided 26% of the total mineral value; zinc, 14%; and lead, 9%. Practically all of the metallic production came from the Coeur d'Alene mining district.

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<sup>2</sup> Supervisory Geologist, Idaho Bureau of Mines and Geology, Moscow, Idaho.

<sup>3</sup> Formerly Acting Director, Idaho Bureau of Mines and Geology, Moscow, Idaho.

Table 1.—Mineral production in Idaho<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate				
short tons, antimony content...	445	W	W	W
Clays	29	\$10	30	\$284
thousand short tons...				
Copper (recoverable content of ores, etc.)				
short tons...	2,841	4,393	3,192	4,099
do.	NA	120	NA	120
Gem stones				
do.				
Gold (recoverable content of ores, etc.)				
troy ounces...	2,898	463	2,529	408
Lead (recoverable content of ores, etc.)				
short tons...	51,717	23,273	50,395	21,670
do.	108	182	111	187
Pumice				
thousand short tons...	7,665	10,484	6,881	12,768
Sand and gravel				
do.				
Silver (recoverable content of ores, etc.)				
thousand troy ounces...	12,436	58,572	13,868	61,297
do.	3,528	9,868	3,316	8,952
Stone				
thousand short tons...	39,469	28,339	40,926	31,922
Zinc (recoverable content of ores, etc.)				
short tons...				
Value of items that cannot be disclosed:				
Barite, cement, fire clay (1974), garnet, gypsum, iron ore, lime, perlite, phosphate rock, tungsten, vanadium, and values indicated by symbol W	XX	72,854	XX	92,081
Total	XX	208,558	XX	233,788
Total 1967 constant dollars	XX	986,062	XX	\$ 925,800

<sup>p</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes fire clay; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Idaho, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Ada	\$960	\$2,101	Sand and gravel.
Adams	777	916	Copper, silver.
Bannock	W	W	Cement, stone, sand and gravel.
Bear Lake	107	W	Sand and gravel.
Benewah	W	W	Garnet, stone, sand and gravel, clays.
Bingham	W	W	Phosphate rock, sand and gravel.
Blaine	279	600	Lead, sand and gravel, barite, silver, zinc, copper, gold.
Boise	11	W	Stone, gold, silver, lead.
Bonner	712	142	Sand and gravel.
Bonneville	3,396	W	Sand and gravel, stone, lime, pumice.
Boundary	37	6	Stone, sand and gravel.
Butte	W	W	Silver, zinc, lead, gold.
Camas	33	W	Sand and gravel, lime.
Canyon	W	W	Phosphate rock, vanadium, stone, sand and gravel, pumice.
Caribou	53,213	W	Sand and gravel, stone, iron ore.
Cassia	405	W	Stone, sand and gravel.
Clark	W	W	Zinc, silver, lead, copper, stone, gold.
Clearwater	W	701	Sand and gravel, clays.
Custer	1,701	2,897	Sand and gravel, stone.
Elmore	W	W	Sand and gravel, stone, iron ore.
Franklin	W	61	Stone, sand and gravel.
Fremont	W	341	Sand and gravel.
Gem	W	499	Sand and gravel.
Gooding	499	939	Do.
Idaho	W	W	Stone, sand and gravel, gold, silver, copper, zinc, lead.
Jerome	1,350	1,264	Sand and gravel.
Kootenai	--	W	Sand and gravel, stone.
Latah	912	1,112	Stone, clays.
Latah	W	W	Stone, lead, copper, gold, silver, gypsum, sand and gravel, zinc.
Lemhi	W	W	Stone.
Lewis	W	W	Sand and gravel.
Lincoln	W	W	Do.
Madison	366	W	Lime, sand and gravel.
Minidoka	619	W	Stone, sand and gravel.
Nez Perce	W	W	Sand and gravel, perlite, pumice, stone.
Oneida	W	W	Silver, gold, lead, zinc.
Owyhee	19	W	Sand and gravel.
Payette	W	248	Do.
Power	42	38	Silver, zinc, lead, copper, antimony, gold, stone, sand and gravel.
Shoshone	W	W	Sand and gravel, lime.
Teton	W	260	Sand and gravel, stone, tungsten.
Twin Falls	W	W	Sand and gravel, stone, iron ore.
Valley	810	W	
Valley	W	W	
Washington	W	W	
Washington	513	W	
Undistributed <sup>2</sup>	141,795	222,162	
Total	<sup>3</sup> 208,558	233,788	

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

<sup>1</sup> Jefferson County is not listed because no production was reported.

<sup>2</sup> Includes value of mineral production which cannot be assigned to specific counties and values indicated by symbol W.

<sup>3</sup> Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Idaho business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	356.0	357.7	+ 0.5
Unemployment -----do-----	21.5	24.9	+15.8
<b>Employment (nonagricultural):</b>			
Mining -----do-----	3.7	3.7	--
Manufacturing -----do-----	48.1	46.5	- 3.3
Contract construction -----do-----	15.8	16.0	+ 1.3
Transportation and public utilities -----do-----	16.7	16.4	- 1.8
Wholesale and retail trade -----do-----	65.4	67.1	+ 2.6
Finance, insurance and real estate -----do-----	10.8	11.2	+ 3.7
Services -----do-----	43.0	45.6	+ 6.0
Government -----do-----	59.4	61.0	+ 2.7
Total nonagricultural employment -----do-----	262.9	267.5	+ 1.7
<b>Personal income:</b>			
Total -----millions--	\$4,096	\$4,234	+ 3.4
Per capita -----do-----	\$5,140	\$5,159	+ 0.4
<b>Construction activity:</b>			
Number of private and public residential units authorized --	7,165	8,172	+14.1
Value of nonresidential construction -----millions--	\$53.6	\$56.7	+ 5.8
Value of State road contract awards -----do-----	\$38.0	\$58.0	+52.6
Shipments of portland and masonry cement to and within the State -----thousand short tons--	419	396	- 5.5
Total crude mineral value -----millions--	\$208.6	\$233.8	+12.1
<b>Mineral production value:</b>			
Value per capita, resident population -----do-----	\$262.01	\$287.56	+ 9.8
Value per square mile -----do-----	\$2,496.00	\$2,797.95	+12.1

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine and U.S. Bureau of Mines.

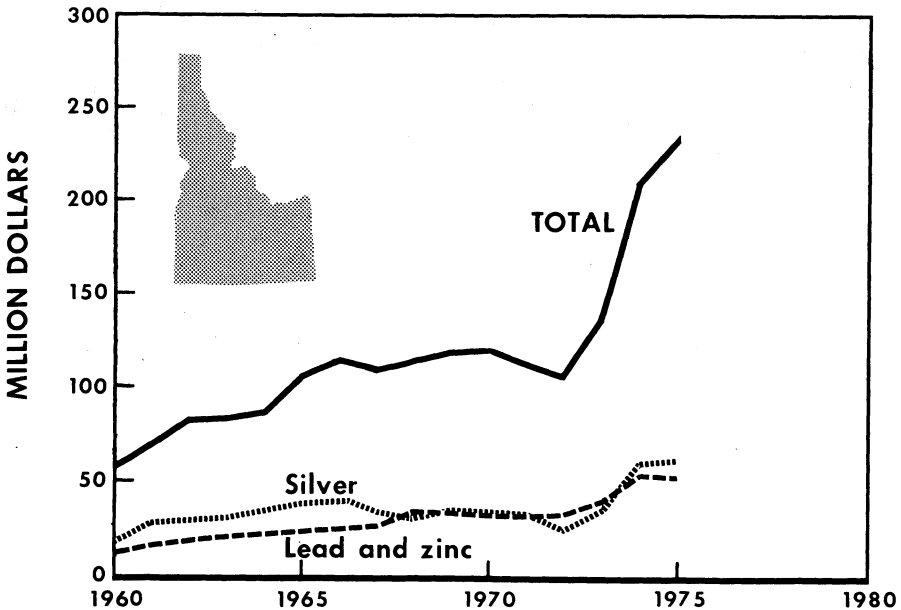


Figure 1.—Value of silver, lead, and zinc, and total value of mineral production in Idaho.

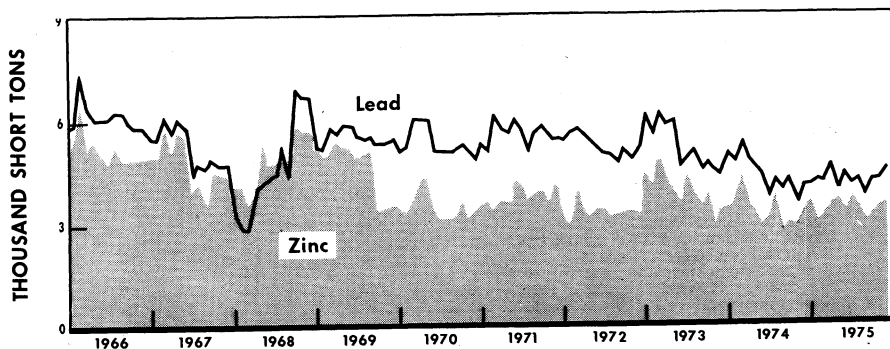


Figure 2.—Mine production of lead and zinc in Idaho, by months, in terms of recoverable metals.

The commodities for which values cannot be disclosed, led by phosphate rock and vanadium, accounted for about 40% of the total mineral revenue for 1975. Idaho ranked 31st in production value out of the 50 States but was first in the production of antimony, silver, and abrasive garnet; second in lead and phosphate rock; third in vanadium; and fifth in zinc.

The increased value for phosphate rock was principally due to rising prices as the quantity produced decreased by 7%. Prices for metallic commodities were unsettled throughout the year; prices for copper, silver, and lead dropped and those for zinc rose.

Statewide, two mining areas continued to dominate mining activity in Idaho; these were the Coeur d'Alene district in the north, and the phosphate region in the southeast.

In the Coeur d'Alene district, ASARCO Inc.'s Coeur Project, located between the country's two largest silver mines (the Sunshine and Galena), is projected to be the district's fourth largest silver mine when in full operation. The new mine is expected to produce 2.2 million ounces of silver per year and to employ 125 employees when operational in 1976. ASARCO also plans to build a \$7 million refinery at El Paso, Tex., that will handle concentrates from the Coeur d'Alene district.

Normal mining activities continued during 1975 at the Sunshine Mine. Gaining the most attention during the year was the ownership problem in the Sunshine Unit

area where Sunshine, as the operator, has been taken to court by Silver Syndicate Mining Co. for allegedly mining some of its holdings within the Rambo area. Hecla Mining Co. and Silver Dollar Mining Co., the other participants in the Sunshine Unit area, have joined with Sunshine and filed a complaint to clear up the ownership problem. The issue of extra-lateral rights in underground mining has often been raised but has never been fully resolved in the Coeur d'Alene mining district; the methods established in this case for determining those rights are expected to form the guidelines for settling future extra-lateral disputes.

Hecla maintained active exploration programs both within the district and elsewhere. In the Coeur d'Alene district, exploration continued in the D.I.A., Abot North, and West Independence Projects near the Star-Morning and Lucky Friday mines and in the South Morning Project east of Wallace. The Alice Consolidated Project, south of the latter, was completed early in 1975 without encountering significant mineralization.

The Consolidated Silver Project, planned to test Silver Belt structures at deep levels in the area east of the Sunshine mine, remained on standby as it did in 1974.

There was no new exploration by Bunker Hill Co. this year in the Coeur d'Alene district. Bunker Hill reported that its outside exploration responsibilities were assumed by a newly organized exploration subsidiary of the parent company, Gulf Resources and Chemical Corp. In-mine

programs at the Bunker Hill, Crescent, and Star mines continued as part of the normal development sequence. Considerable research emphasis has been given by the mine geology group to ore controls. Reports indicated that the Crescent mine is getting low on reserves and could be closed down in the near future if no new reserves are found.

Production increased from the Bunker Hill mine workings located above the Kellogg tunnel level where mining by blast hole and pillar system methods using trackless equipment were employed. Pioneering in the changeover from pneumatic to electrohydraulic power on underground diamond drills of intermediate and long depth range has had positive results. Introduction of diesel haulage units in the Kellogg tunnel was accomplished during the year.

Noranda Exploration focused activity on an exploration program at the Atlas Mine property near Mullan.

As metals markets improved, old or inactive properties were being sought by established companies for re-evaluation of their mineral potential. A joint venture is underway between U.S. Antimony Corp. and Intermountain Mineral Engineers, Inc., to explore and develop a group of properties in the Pine Creek area. Of primary interest were the Sidney, Little Pittsburgh, and Nabob mines. Drilling and renovation programs were initiated during 1975 and lead-zinc-silver ore shipments began in the fall.

Interest has been shown in several other areas of the district. Examples are Magna Mining Co. and its evaluation work through drilling and geochemical studies of the Princeton property; Earth Resources Co. and what may turn out to be a \$20 million venture on the Niagara properties; the Painted Desert Uranium and Oil Co. looking into 26 claims of the Beauty Bay properties through a drilling program; and the New Wellington-Gold Leaf Mining Corp. joint venture to put the Canyon Silver Mine back into operation. Even the city of Mullan is getting into the act with its joint venture with Allied Silver-Lead Co. and United States Borax and Chemical Corp. to explore under the townsite.

Phosphate production in southeastern Idaho continued to expand in 1975 with growth limits being placed by plant facilities and Federal regulations.

International Minerals and Chemical Corp. conducted a drilling program in leased areas extending from the Stewart Canyon area, in which 32,000 feet of drill holes were put down in 1974, to the general vicinity of the Diamond Creek-Georgetown Canyon drainage area. A total of approximately 17,000 feet of drilling was completed in 52 drill holes. The company's development plans for a new mine and a beneficiation-calcination facility have been temporarily deferred pending completion and approval of the Environmental Impact Statement (EIS) for the southeast Idaho phosphate area. The final EIS is expected to be given to the Secretary of Interior for his decision in late June or early July 1976.

A 1974 proposal by National Steel Corp., Southwire Co., and Earth Sciences Inc. to construct a complex of plants for production of phosphate, aluminum, and other commodities in the Soda Springs area is still being held in abeyance because of an inability to acquire leases and to start developmental work until the EIS for the region is complete. Arrangements by Alumet, the operational name taken by the three companies, have been made for the selling of fertilizer and other products on a sustained basis.

The J. R. Simplot Co. continued phosphate production from the Gay and Conda operations at near capacity during 1975. The Conda plant was expanded so that it could handle 1,500,000 tons annually.

FMC Corp. continued development drilling on phosphate reserves in the Soda Springs area. It also continued an extensive hydrologic study on the possible impact of groundwater on the development of future open pit mining.

There was significant activity in 1975 in other areas of the State outside of the Coeur d'Alene and southeastern phosphate areas. Earth Resources Co. continued silver-gold exploration in the DeLamar-Silver City region. This is a joint venture with Canadian Superior Oil (U.S.) Ltd. and Superior Oil Co. Ground has been broken for a mill by Mountain States Mineral Enterprises, Inc. Mill capacity design is being raised from 1,400 to 1,700 tons of ore per day; a combined total for this property investment is predicted to be nearly \$20 million. If silver production meets anticipated levels, this operation could become the fourth largest silver

producer in Idaho and exceed the predicted output of the Coeur Project.

Silver King Mines, Inc., cutback from a 7-day to a 5-day schedule in February as a result of increased costs and lower copper prices at the Copper Cliff mining and milling operation in the Seven Devils-Cuprum area. The cutback has delayed an expansion program but this should still be completed by the beginning of 1976. During 1975, concentrates were shipped to the Anaconda smelter. As of late 1975, 1 million pounds of copper and 30,000 ounces of silver have been processed by Anaconda since the first shipment was made in March.

The feasibility of mining kyanite at Woodrat Mountain in central Idaho is still being pursued by Ethyl Corp. At this time environmental impact studies are being carried on by the company and Federal and State agencies. Diamond drill crews were utilized this summer to help delineate the kyanite deposit, now in its fourth year of study. An open pit development is anticipated; a startup time is dependent upon the completion and results of the impact statement. If the mine is developed, it could employ 150 people.

The Clayton Silver mine continued operations in 1975. A general emphasis on increasing ore reserves commenced in late 1974 when an offset shaft was started to open up new areas and excavation for hoist equipment and ore pockets was completed.

Cyprus Mines Corp. (Tuscarora Mining Co.) drilled four surface holes for a total of just over 5,100 feet on the Thompson Creek Molybdenum Project.

Hanna Mining Co. (Coastal Mining Co.) continued its program of general exploration in Lemhi County with particular attention given to cobalt and copper near the Blackbird mine.

El Paso Mining and Milling Co. entered a joint venture with Louisiana Land and Exploration Co. in the vicinity of Stibnite, Idaho. The work consisted of geological, geophysical and geochemical investigations plus some diamond drilling.

A reconnaissance metals exploration program, by U.S. Borax, is underway in the northwest and includes portions of Idaho. A drilling program is also being carried out on a Coeur d'Alene silver vein deposit. U.S. Borax still holds its lease on the Gold Hill vermiculite property.

Other companies active in Idaho in the search for metals through drilling and field programs included Amax Exploration Inc., Bear Creek Mining Co., Union Carbide Corp., Cominco American, and Amoco. Other companies which have been evaluating submittals included Phelps Dodge Corp., Occidental Minerals Corp., Atlantic Richfield Exploration, and Superior Mining Co.

Isolated localities in Idaho which received marked attention were the Plume Creek silver mines property north of Clark Fork, the Montgomery mines near Copeland, the Hercules silver properties in Washington County and the Weiser quartz pegmatite deposit. Exploration for large-tonnage, low-grade deposits also was carried out in the Challis Volcanics of the Yankee Fork area.

Companies which reported little or suspended activities in Idaho this year included Callahan Mining Corp., Ranchers Exploration and Development Corp., Porter and Co., Newmount Mining Corp., Exxon and Ozark-Mahoning Co.

Geothermal leasing activity subsided this year from the rush which occurred in June of 1974 when the State Board of Land Commissioners placed into effect the rules and regulations governing the issuance of geothermal leases on State lands. Following a period during which applications in conflict were resolved, in March 1975, 536 geothermal leases representing 213,350 acres were granted to 11 different lessees; a comparable number were processed for Federal lands. To date few drilling permits have been requested by private companies for exploratory drilling.

Two test wells were drilled by Energy Research and Development Administration (ERDA) through Aero Jet Nuclear in the Raft River Basin. Well No. 1 went to about 5,000 feet and encountered 265° to 280° F water, with a flow rate of 600 gallons/minute. Well No. 2 was drilled to about 6,000 feet and had similar water temperatures. Flow rate was 800 gallons/minute. ERDA announced that a third well will be drilled in the area in an effort to establish a boundary for the geothermal field.

Shallow drilling was started in the geothermal field along the Boise front to determine the feasibility of heating State buildings with thermal water; no private funds are involved.

Idaho produced no fossil fuels in 1975. Deep drilling for petroleum has been unsuccessful in the State although interest by oil companies has renewed. Two drilling permits were issued this year to Standard American Co. for drilling in Payette County. One well is reported to have reached 4,835 feet. Two more applications were pending; one well was proposed for Bonneville County and one near Caldwell.

There was a deep test being made in Montana's Centennial Basin by Farmer's Union Central Exchange, which will affect the several hundred thousand acres under oil and gas lease in Clark County. Recent discoveries in the Nugget and Twin Creek formations in Summit County, Utah, have spurred the search for oil into the overthrust belt of southeastern Idaho.

Bunker Hill smelter curtailed operations in December due to temperature inversions which resulted in a SO<sub>2</sub> buildup. Environmental Protection Agency (EPA) published final regulations that the smelter will have to control sulfur oxide emissions at an 82% level through permanent devices. Both the State and EPA have agreed that by 1977 Bunker Hill must achieve an average of 96% control. In order to meet the required ambient air standards by mid-1977, two 700-foot stacks are to be constructed at the smelter. A cost of \$7 million is anticipated for the stacks, fans, and connecting equipment; an additional \$3 million may be needed to take full advantage of the revised system.

A detailed metallurgical report concluded that the silver refinery proposed for the Sunshine mine was not feasible.

Public hearings were held on the proposal for Idaho Power Co. to construct a coal-fired powerplant near Boise. The powerplant may be served by a coal slurry pipeline.

A bill was passed creating a 100-mile Hells Canyon Recreation Area along the Snake River in Washington, Oregon, and Idaho. The recreation area contains 671,206 acres.

The first regular session of the 43d Idaho Legislature did not pass legislation that would have a significant impact on the State's mineral resources or development. However, a land use bill that passed which provided for locally controlled land use planning may have some effect. Also, a pollution control act was passed that

would authorize counties to acquire, construct, and install facilities for environmental pollution control. Changes were requested, but not adopted, dealing with geothermal leases and royalties.

The Bureau of Mines had a number of research projects in progress within the State in 1975. The Spokane Mining Research Center was active, through cooperative studies with mining companies, in the Coeur d'Alene region, Shoshone County. The studies involved rock mechanics, fall-of-back, and backfilling techniques. Tailing pond designs were also reviewed for the Blackbird mine (Lemhi County) and Copper Cliff mine (Adams County). The Bureau of Mines Metallurgical Research Centers at Reno and Salt Lake conducted beneficiation tests on Idaho ores from the Lucky Friday mine (Shoshone County), Hoodoo mine (Custer County), Blackbird mine (Lemhi County); studied phosphate recovery from low-grade rock from Beker Industries' Mabie Canyon mine (Caribou County); and garnet recoveries from Benewah County. The citrate process pilot plant (Salt Lake City Metallurgical Center) was operated at the Bunker Hill smelter. The plant has operated almost 4,000 hours since its construction in 1974 and the SO<sub>2</sub> absorption efficiency has averaged better than 95%.

The Bureau of Mines Western Field Operation Center concentrated its efforts on mineral investigations of wilderness or proposed wilderness areas and wild and scenic rivers. Work was conducted in the Boulder-Pioneer (Custer and Blaine Counties), Hells Canyon (Adams County), and Scotchman Peaks (Bonner and Shoshone Counties) areas. Minerals Availability System (MAS) information was gathered on Idaho deposits of lead, zinc, thorium, fluorite, and phosphate through outside contracts.

During 1975, the Idaho Bureau of Mines and Geology gained a new Director—Dr. Maynard M. Miller. Dr. Miller replaced Dr. John Bond, who served as acting director during the first part of the year. Besides many internal projects, the Idaho Bureau expanded its cooperative programs with various Federal agencies. Input continued into both the Computer Resource Information Bank (CRIB) and the MAS. Research on the use of low-impact exploration techniques was conducted in



Owyhee County, and hydrologic investigations of water resource problems continued in the Coeur d'Alene and Blackbird mining districts and in the phosphate area of southeastern Idaho. In addition, mineral inventories were initiated in the Loon Creek and Yellowjacket areas on the South Fork of the Salmon River. Fifteen publications dealing with geology and water resources of the State were released during the year.

Employment in the mineral industries continued to increase in 1975; average men

working and man-hours worked expanded by 23% and 35%, respectively. Fatal accidents increased by 1 and nonfatal disabling injuries increased by 39. Five of the fatalities were experienced in underground metal mines, one at a surface quarry and another in a phosphate plant. Due to the increased man-hours worked, however, frequency rates for fatal and nonfatal injuries decreased by 13% and 9%, respectively. Nondisabling injuries were 117 and the corresponding frequency rate was 16.09.

Table 4.—Idaho: Employment and injury experience <sup>1</sup>

Year and industry	Average men working daily	Man-hours worked (thousands)	Number of disabling injuries reported		Frequency <sup>2</sup> (injury rates per million man-hours)	
			Fatal	Nonfatal	Fatal	Nonfatal
<b>1974:</b>						
Metal -----	2,029	3,630	5	204	NA	NA
Nonmetal -----	643	1,193	--	10	NA	NA
Sand and gravel -----	387	225	--	5	NA	NA
Stone -----	147	127	1	2	NA	NA
<b>Total -----</b>	<b>3,206</b>	<b>5,175</b>	<b>6</b>	<b>221</b>	<b>1.16</b>	<b>39.99</b>
<b>1975:</b>						
Metal -----	2,433	4,695	5	241	1.06	50.26
Nonmetal -----	959	1,900	1	15	0.53	7.90
Sand and gravel -----	320	232	--	4	--	8.62
Stone -----	240	135	1	--	7.43	--
<b>Total -----</b>	<b>3,952</b>	<b>6,962</b>	<b>7</b>	<b>260</b>	<b>1.01</b>	<b>36.34</b>

NA Not available.

<sup>1</sup> All data are preliminary.

<sup>2</sup> Only injuries with matching man-hours are included in injury-frequency rate computations.

Source: Mining Enforcement and Safety Administration, U.S. Department of the Interior.

## REVIEW BY MINERAL COMMODITIES

### METALS

**Antimony.**—All antimony produced in 1975 was recovered as a byproduct of the treatment of silver ores by Sunshine Mining Co. at its own electrolytic plant. Although production increased, the value decreased by almost 6%.

**Cadmium.**—Production dropped 28% and value decreased 71% as compared with 1974 figures. The entire output came from the Bunker Hill complex as a byproduct of zinc smelting.

**Cobalt.**—Although there was no cobalt produced within the State, exploration continued by Coastal Mining Co. (Hanna) in Lemhi County. Specific targets were the cobalt-nickel and cobalt-copper areas at the Blackbird mine.

**Copper.**—A total of 24 mines produced 3,192 tons of copper valued at \$4.1 million. While production increased 12%, the value declined 7% due to lower prices. The lead-zinc-silver mines in the Coeur d'Alene region contributed roughly 79% of the total with the remainder primarily from the Copper Cliff mine in Adams County; which produced 589 tons of copper valued at \$756,000.

**Gold.**—Gold was produced at 27 lode mines during the year. No placers operated during 1975. Production and value both declined about 13%. The Lucky Friday mine in Shoshone County continued to be the leading gold producer at 996 ounces, down from 1,026 ounces in 1974.

Table 5.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing <sup>1</sup>		Material sold or treated <sup>2</sup> (short tons)	Gold		Silver																																																																																														
	Lode	Placer		Troy ounces	Value	Troy ounces	Value																																																																																													
1973, total	29	--	1,658,213	2,696	\$263,693	13,619,824	\$94,839,515																																																																																													
1974, total	38	1	1,766,252	2,898	462,925	12,435,701	58,572,152																																																																																													
1975:																																																																																																				
Adams	1	--	116,232	--	--	36,250	160,225																																																																																													
Custer	6	--	113,658	86	13,887	211,597	935,259																																																																																													
Idaho	2	--	137	23	3,714	85	375																																																																																													
Lemhi	5	--	7,925	264	42,633	9,708	42,909																																																																																													
Shoshone	10	--	1,687,182	2,083	336,383	13,596,486	60,096,467																																																																																													
Undis-tributed <sup>3</sup>	5	--	10,229	73	11,788	14,007	61,912																																																																																													
Total	29	--	1,935,363	2,529	408,405	13,868,133	61,297,147																																																																																													
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Copper</th> <th colspan="2">Lead</th> <th colspan="2">Zinc</th> <th rowspan="2">Total value</th> </tr> <tr> <th>Short tons</th> <th>Value</th> <th>Short tons</th> <th>Value</th> <th>Short tons</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>1973, total</td> <td>3,625</td> <td>\$4,313,682</td> <td>61,744</td> <td>\$20,116,130</td> <td>46,107</td> <td>\$19,051,546</td> <td>\$78,584,566</td> </tr> <tr> <td>1974, total</td> <td>2,841</td> <td>4,392,677</td> <td>51,717</td> <td>23,272,733</td> <td>39,469</td> <td>28,338,551</td> <td>115,039,038</td> </tr> <tr> <td colspan="8">1975:</td> </tr> <tr> <td>Adams</td> <td>589</td> <td>755,922</td> <td>--</td> <td>--</td> <td>--</td> <td>--</td> <td>916,147</td> </tr> <tr> <td>Custer</td> <td>47</td> <td>60,778</td> <td>834</td> <td>358,448</td> <td>1,913</td> <td>1,492,044</td> <td>2,860,416</td> </tr> <tr> <td>Idaho</td> <td>(<sup>4</sup>)</td> <td>107</td> <td>1</td> <td>513</td> <td>(<sup>4</sup>)</td> <td>202</td> <td>4,911</td> </tr> <tr> <td>Lemhi</td> <td>36</td> <td>46,245</td> <td>121</td> <td>51,978</td> <td>4</td> <td>3,118</td> <td>186,883</td> </tr> <tr> <td>Shoshone</td> <td>2,510</td> <td>3,223,452</td> <td>48,899</td> <td>21,026,573</td> <td>38,946</td> <td>30,377,923</td> <td>115,060,798</td> </tr> <tr> <td>Undis-tributed<sup>3</sup></td> <td>10</td> <td>12,625</td> <td>540</td> <td>232,391</td> <td>63</td> <td>49,067</td> <td>367,783</td> </tr> <tr> <td>Total</td> <td>3,192</td> <td>4,099,129</td> <td>50,395</td> <td>21,669,903</td> <td>40,926</td> <td>31,922,354</td> <td>119,396,938</td> </tr> </tbody> </table>								Copper		Lead		Zinc		Total value	Short tons	Value	Short tons	Value	Short tons	Value	1973, total	3,625	\$4,313,682	61,744	\$20,116,130	46,107	\$19,051,546	\$78,584,566	1974, total	2,841	4,392,677	51,717	23,272,733	39,469	28,338,551	115,039,038	1975:								Adams	589	755,922	--	--	--	--	916,147	Custer	47	60,778	834	358,448	1,913	1,492,044	2,860,416	Idaho	( <sup>4</sup> )	107	1	513	( <sup>4</sup> )	202	4,911	Lemhi	36	46,245	121	51,978	4	3,118	186,883	Shoshone	2,510	3,223,452	48,899	21,026,573	38,946	30,377,923	115,060,798	Undis-tributed <sup>3</sup>	10	12,625	540	232,391	63	49,067	367,783	Total	3,192	4,099,129	50,395	21,669,903	40,926	31,922,354	119,396,938
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<sup>1</sup> Operations at old mill or miscellaneous cleanups not counted as producing mines.

<sup>2</sup> Does not include gravel washed.

<sup>3</sup> Includes Blaine, Boise, Butte, and Owyhee Counties combined to avoid disclosing individual company confidential data.

<sup>4</sup> Less than 1/2 unit.

Table 6.—Idaho: Mine production of gold, silver, copper, lead, and zinc in 1975, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines	Material sold or treated (thousand short tons)	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Gold, gold-silver <sup>1</sup>	6	2,662	285	3	3	1	1
Silver	7	520,230	659	9,325	1,986	1,090	535
Copper	3	122,732	36	37	647	--	--
Lead	6	188,319	1,072	2,545	247	18,371	1,846
Lead-zinc, zinc <sup>1</sup>	7	1,101,420	477	1,958	310	30,933	38,544
Total lode material	29	1,935,363	2,529	13,868	<sup>2</sup> 3,192	50,395	40,926

<sup>1</sup> Combined to avoid disclosing individual company confidential data.

<sup>2</sup> Data do not add to total shown because of independent rounding.

Table 7.—Idaho: Mine production of gold, silver, copper, lead, and zinc in 1975, by type of material processed and method of recovery, in terms of recoverable metal

Type of material processed and method of recovery	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
<b>Lode:</b>					
Smelting of concentrates -----	2,268	13,857	3,189	50,355	40,921
Direct smelting of ore -----	261	11	3	40	5
<b>Total -----</b>	<b>2,529</b>	<b>13,868</b>	<b>3,192</b>	<b>50,395</b>	<b>40,926</b>

**Iron Ore.**—Minor quantities of iron ore were produced in 1975. Production fell 33% and value decreased 24%. Virtually all of the production was used in cement manufacturing.

**Lead.**—Shoshone County continued to produce nearly all of the lead in the State, 97% of the reported 50,395 tons. Production and value both decreased, 3% and 7%, respectively. A total of 26 mines produced lead, led by the Bunker Hill, Star Unit (Bunker Hill and Hecla), and the Lucky Friday. Clayton Silver mines, Custer County, was the only large producer outside of Shoshone County; production exceeded 700 tons.

**Silver.**—Idaho remained the leading silver producing state with a production of 13,868,133 ounces, up 12%, valued at \$61,297,147, an increase of nearly 5%. The 10 mines in Shoshone County accounted for 98% of the production; 4 mines produced over 1.0 million ounces. Led by the Sunshine mine at 5.1 million ounces, these 4 mines accounted for 12.2 million ounces or 88% of the State's production. Only 2 mines outside the County had any significant production; Clayton, Custer County, produced 190,000 ounces and the Copper Cliff mine, Adams County, produced 36,000 ounces.

Construction continued on ASARCO's Coeur Project. A capital investment of \$20 million is anticipated with a production schedule of 2.0 million ounces of silver annually. Beginning in 1977, the Delamar Silver Mine, Owyhee County, should be in production; it is also rated at 2.0 ounces annually.

**Tungsten.**—Production fell dramatically at the Golden Gate mine, Valley County, Idaho's only producer in 1975. The amount of concentrate shipped and reported value were only 3% and 2% respectively, of amount and value reported in 1974.

**Vanadium.**—Vanadium production continued as a byproduct of ferrophosphorus slag derived from the phosphate operations in Caribou County. The slag was processed at the Kerr-McGee Corp. plant at Soda Springs, Idaho, and the Union Carbide Corp. plant at Hot Springs, Ark. Total slag processed decreased by 7% but the value increased by 8%.

**Zinc.**—Zinc production increased 4% while the value increased 13% from that reported in 1974. Twenty-six mines produced, of which the 10 mines in Shoshone County accounted for 95% of the production. The Bunker Hill and Star mines were the large producers.

#### NONMETALS

**Barite.**—Rocky Mountain Refractories' Deer Park mine in Blaine County was the State's only producer of barite. Production increased although the value decreased by 39%. The material was processed for use in well-drilling muds.

**Cement.**—Portland and masonry cement was produced only in Bannock County by Idaho Portland Cement Co., a division of Oregon Portland Cement Co. Production and value of masonry cement remained constant; portland cement decreased in quantity 10%, but one price increase raised the total value by 13%. Stocks on hand at the end of year also increased.

**Clays.**—Total clay production from four mines in three counties increased by 67% and the value by fivefold. Latah County's two operations—J. R. Simplot Co. and A. P. Green Refractories—contributed the major percentage of the total production. Kaolin clay was the type of clay with the most production; fire clay was produced at only one operation.

**Garnet.**—Garnet production from Emerald Creek Garnet Milling Co. and Idaho Garnet Abrasive Co., both in Benewah

County, decreased by 12% in 1975 as compared with that of 1974. Value also decreased but only by 3%. The principle use of the sand was for abrasives and water filtration systems.

**Gem Stones.**—The value of gem stones collected in the State during 1975 was estimated to have remained constant with that in 1974—\$120,000. Star garnets and opals were the principal stones collected.

**Gypsum.**—Output and value decreased 65% and 67% respectively. E. J. Wilson and Sons produced from its pit in Lemhi County while Consumers Co-Op Association, Washington County, sold from stocks on hand. Except for a small quantity that was used for agricultural purposes, the entire production was used in cement manufacturing.

**Lime.**—Lime was produced in Bonneville, Canyon, Minidoka, and Twin Falls Counties. Output and value both increased, the latter by 22%. Amalgamated Sugar Co. and the Utah-Idaho Sugar Co. were the major producers; lime was utilized primarily for beet-sugar processing.

**Perlite.**—The Oneida Perlite Corp. in Oneida County was Idaho's only producer in 1975. Production and value more than doubled. Over 50% of the production was used to make expanded perlite for use in masonry and insulation.

**Phosphate Rock.**—Phosphate rock value surpassed that of silver as the State's leading mineral commodity in 1975. Production declined 7% but value rose almost 33% to an alltime high. Five mines contributed to the output; four—J. R. Simplot's Conda, Monsanto's Henry, Stauffer Chemical Co.'s Wooley Valley, and Beker Industries' Marblie Canyon—are located in Caribou County and one operation—J. R. Simplot's Gay Mine—is in Bingham County. Production was generally limited due to legal restraints by the Federal Government on exploration work. Operations planned by International Minerals and Chemical Corp. and Alumet are being

held in abeyance pending the completion of an EIS on phosphate leasing.

**Pumice.**—Production and value rose slightly in 1975. Amcor, Inc., and Producers Pumice in Bonneville County accounted for over 50% of the total State production; the pumice was consumed as concrete aggregate. Hess Pumice Products in Oneida County processed pumice for use as an abrasive and horticultural additive. All of Caribou County's production was used in road construction.

**Sand and Gravel.**—The value of the sand and gravel production increased by 22% although the output decreased by 784,000 tons from 99 mines or quarries. Commercial uses for sand and gravel accounted for 54% of the production; the remainder was used in publicly funded projects. The largest single commercial use was in nonresidential and residential construction at 17%; the largest use for publicly funded projects was for roadbase and subbase at 19%. Virtually every county had some sand and gravel, although in seven counties it was insignificant. Ada and Bonneville each produced over 1 million tons followed by Canyon and Kootenai Counties, each with a production exceeding 500,000 tons. A high-grade silica sand operation in Gem County placed that county fourth in production value. The silica sand was shipped for use in making glass.

**Stone.**—Stone was produced at 73 quarries throughout the State; production decreased in both quantity and value by 6% and 9% respectively. Bonneville County had the largest production, followed by Bannock, Idaho, Clearwater, Caribou and Boise Counties; all produced over 250,000 tons. Principle uses of crushed and broken stone were for flux, riprap, aggregate, surface trim and dense roadbase. The value of dimension stone produced in the State was about 1%. Over 50% of the production was traprock with lesser amounts of crushed and broken quartzite and limestone.

Table 8.—Idaho: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	7,665	10,449	893	2,175
Gravel -----			4,036	7,119
Unprocessed:				
Sand and gravel -----			1,823	1,652
Industrial:				
Sand -----	W	W	128	1,205
Gravel -----	W	W	--	--
Total <sup>2</sup> -----	7,665	10,449	6,881	12,150

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data may not add to totals shown due to independent rounding.

Table 9.—Idaho: Construction aggregate and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Construction aggregate:				
Nonresidential and residential construction -----	4,086	6,348	1,177	3,195
Highway and bridge construction -----			131	359
Other uses such as dams, waterworks, airports, etc -----			108	271
Concrete products (cement blocks, bricks, pipe, etc. -----			269	752
Bituminous paving (asphalt and tar paving) -----			379	758
Roadbase and subbase -----			622	1,176
Unprocessed aggregate -----			662	668
Fill -----	396	291	185	280
Other uses -----	420	731	35	73
Industrial sand and gravel -----	323	764	123	1,205
Total <sup>1</sup> -----	5,225	8,134	3,695	8,735

<sup>1</sup> Data may not add to totals shown due to independent rounding.

Table 10.—Idaho: Construction aggregate sold or used for publicly funded projects by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Construction aggregate:				
Nonresidential and residential construction -----	2,333	2,154	8	20
Highway and bridge construction -----			237	442
Other uses such as dams, waterworks, airports, etc -----			155	341
Concrete products (cement blocks, bricks, pipe, etc) -----			9	24
Bituminous paving (asphalt and tar paving) -----			192	399
Roadbase and subbase -----			1,338	1,600
Unprocessed aggregate -----			1,161	1,043
Fill -----	105	190	67	120
Other -----	2	5	18	44
Total -----	2,440	2,349	<sup>1</sup> 3,186	4,033

<sup>1</sup> Data do not add to total shown due to independent rounding.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
METALS			
Antimony:			
Sunshine Mining Co -----	Kellogg, Idaho 83837 -----	Mine and plant ---	Shoshone.
Copper:			
American Smelting and Refining Co.	Wallace, Idaho 83873 -----	Mine and mill ----	Do.
Silver King Mines, Inc ---	Salt Lake City, Utah 84110. -----do -----	-----do -----	Adams.
Sunshine Mining Co -----	Kellogg, Idaho 83837 -----	-----do -----	Shoshone.
Gold:			
American Smelting and Refining Co.	Wallace, Idaho 83873 -----	-----do -----	Do.
Hecla Mining Co -----	-----do -----	-----do -----	Do.
Iron ore:			
C & W Sand & Gravel ---	Weiser, Idaho 83672 -----	Mine -----	Washington.
Lead:			
Bunker Hill Co -----	Kellogg, Idaho 83837 -----	Mine, mill, smelter.-----	Shoshone.
Hecla Mining Co -----	-----do -----	Mine and mill ----	Do.
Silver:			
American Smelting and Refining Co.	Wallace, Idaho 83873 -----	-----do -----	Do.
Bunker Hill Co -----	Kellogg, Idaho 83837 -----	-----do -----	Do.
Hecla Mining Co -----	Wallace, Idaho 83873 -----	-----do -----	Do.
Sunshine Mining Co -----	Kellogg, Idaho 83837 -----	-----do -----	Do.
Tungsten:			
Electronic Metals, Inc ---	Yellow Pine, Idaho 83677 --	Mine -----	Valley.
Vanadium:			
Kerr-McGee Corp. <sup>1</sup> -----	Soda Springs, Idaho 83276 -	Plant -----	Caribou.
Zinc:			
Bunker Hill Co -----	Kellogg, Idaho 83837 -----	Mine, mill, smelter.-----	Shoshone.
Day Mines, Inc -----	Wallace, Idaho 83873 -----	Mine and mill ----	Do.
Hecla Mining Co -----	-----do -----	-----do -----	Do.
NONMETALS			
Barite:			
Rocky Mountain Refractories.	Hailey, Idaho 83333 -----	Pit -----	Blaine.
Cement:			
Idaho Portland Cement Co.	Inkom, Idaho 83245 -----	Plant -----	Bannock.
Clays:			
A. P. Green Refractories Co	Troy, Idaho 83871 -----	Pit and plant ----	Latah.
Interpace Corp -----	Ione, Calif. 95640 -----	-----do -----	Do.
Pullman Brick Co., Inc ---	Boise, Idaho 83706 -----	-----do -----	Ada and Elmore.
J. R. Simplot Co -----	Bovill, Idaho 83806 -----	-----do -----	Latah.
Garnet:			
Emerald Creek Garnet Milling Co.	Fernwood, Idaho 83830 ---	Mine and plant --	Benewah.
Idaho Garnet Abrasive Co -	Kellogg, Idaho 83837 -----	-----do -----	Do.
Gypsum:			
E. J. Wilson and Sons ----	Dubois, Idaho 83423 -----	Pit -----	Clark.
Perlite (crude and expanded):			
Oneida Perlite Corp -----	Malad City, Idaho 83252 --	Pit and plant ----	Oneida.
Phosphate rock:			
Beker Industries -----	Conda, Idaho 83230 -----	Mine and plant --	Caribou.
Monsanto Co -----	Soda Springs, Idaho 83276.-----do -----	-----do -----	Do.
J. R. Simplot Co -----	Pocatello, Idaho 83201 ----	Mine -----	Bingham.
Stauffer Chemical Co ----	San Francisco, Calif. 94119	-----do -----	Caribou.
Pumice:			
Amcor, Inc -----	Idaho Falls, Idaho 83401 --	Pit and plant ----	Bonneville.
Hess Pumice Products ---	Malad City, Idaho 83252 --	Mine and plant ----	Oneida.
Producers Pumice -----	Ammon, Idaho 83401 -----	Mine -----	Bonneville.
Sand and gravel:			
Idaho Concrete Pipe Co --	Nampa, Idaho 83651 -----	-----do -----	Canyon.
Monroe, Inc -----	Twin Falls, Idaho 83301 ---	-----do -----	Twin Falls.
Stone:			
FMC Corp -----	Pocatello, Idaho 83201 ----	Quarry and plant -	Bannock.
Idaho Portland Cement Co.	Nampa, Idaho 83651 -----	-----do -----	Canyon.
Monsanto Co -----	Soda Springs, Idaho 83276.-----do -----	-----do -----	Caribou.

<sup>1</sup> Recovered from byproduct ferrophosphorus.



# The Mineral Industry of Illinois

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Illinois State Geological Survey, under a memorandum of understanding for collecting information on all minerals.

By Thomas O. Glover<sup>1</sup> and Ramesh Malhotra<sup>2</sup>

The value of mineral production in Illinois in 1975, \$1,490.6 million, increased 30% above the record high of \$1,147.7 million set in 1974. Mineral fuels continued to account for the major part of the total mineral value; nonmetals comprised 20%; and metals accounted for the remainder. Illinois led in the production of fluorspar, stone, and expanded perlite; ranked second in output of iron oxide pigments; ranked third in the production of peat; and fourth in output of sand and gravel and coal. Coal remained the leading commodity in mineral value, accounting for \$871.4 million or 58% of the State total.

Output of bituminous coal from Illinois in 1975 was 59.5 million tons, an increase of 2% in quantity from that of 1974; total value of coal production increased over that of the previous year. Production of crude petroleum was 26.1 million barrels, 1.5 million barrels less than in 1974 and in value accounted for \$273.2 million, 18% of the total mineral output of the

State. Marketed production of natural gas increased less than 1% in quantity and 76% in value. Production of liquefied petroleum gases decreased 7% in quantity and 9% in value; natural gasoline production increased 5% in quantity while value decreased 13%. Production of peat, as measured by sales, decreased in quantity, but increased in value.

Among the nonmetallic mineral commodities, stone ranked first in value, followed by sand and gravel and cement. Combined output of sand and gravel and stone accounted for 14% of the State's total mineral value in 1975. Illinois supplied 71% of the total domestic output of fluorspar. Other nonmetallic minerals and mineral products produced in Illinois were barite, clays, gem stones, lime and tripoli.

In 1975, Illinois ranked 11th in value of mineral production among the States.

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Table 1.—Mineral production in Illinois<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Portland ----- thousand short tons--	1,460	\$41,023	1,374	\$42,756
Masonry ----- do-----	69	3,228	W	W
Clays <sup>2</sup> ----- do-----	1,587	3,744	1,366	3,249
Coal (bituminous) ----- do-----	58,215	582,010	59,537	871,377
Fluorspar ----- short tons--	<sup>r</sup> 151,898	12,247	99,898	8,957
Gem stones -----	NA	2	NA	2
Lead (recoverable content of ores, etc.)				
----- short tons--	493	222	W	W
Natural gas ----- million cubic feet--	1,436	574	1,440	1,008
Peat ----- thousand short tons--	96	1,412	96	1,511
Petroleum (crude)----- thousand 42-gallon barrels--	27,553	244,395	26,067	273,182
Sand and gravel ----- thousand short tons--	42,705	68,566	39,000	83,515
Stone ----- do-----	63,231	121,763	60,640	130,104
Zinc (recoverable content of ores, etc.)				
----- short tons--	4,104	2,947	W	W
Value of items that cannot be disclosed:				
Barite, clays (fuller's earth), copper, lime, natural gas liquids, silver, tripoli, and values indicated by symbol W -----	XX	<sup>r</sup> 65,517	XX	74,937
Total -----	XX	<sup>r</sup> 1,147,650	XX	1,490,598
Total 1967 constant dollars -----	XX	542,609	XX	<sup>p</sup> 590,277

<sup>p</sup> Preliminary. <sup>r</sup> 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.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes fuller's earth; included with "Value of items that cannot be disclosed."

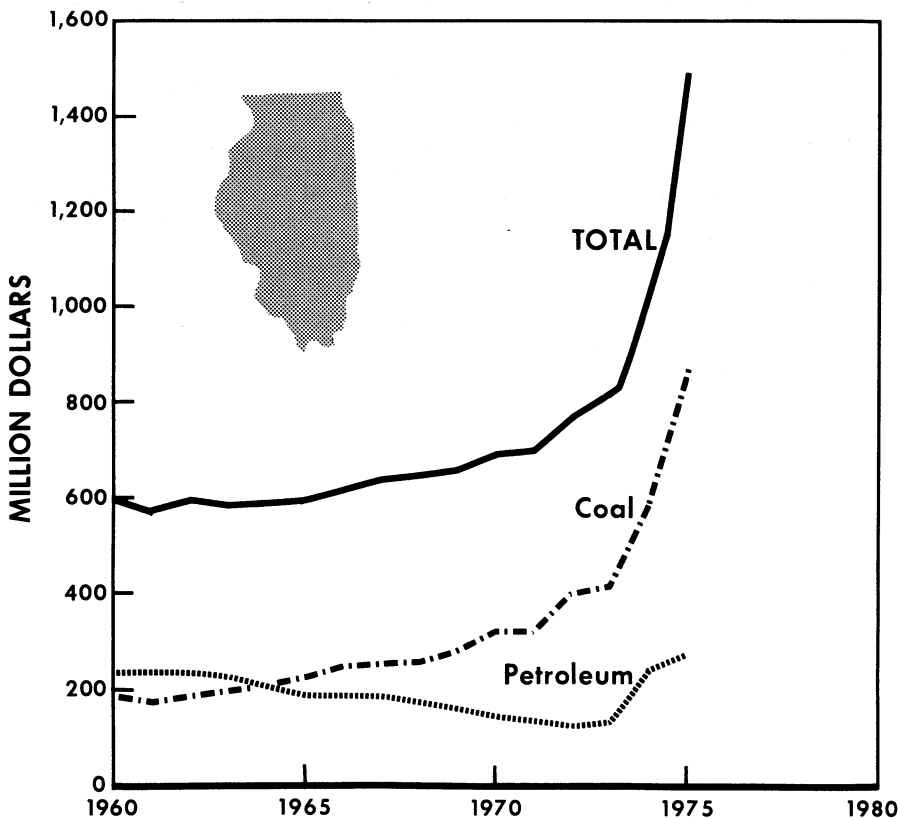


Figure 1.—Value of coal, petroleum, and total value of mineral production in Illinois.

Table 2.—Value of mineral production in Illinois, by county <sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams	\$3,516	W	Stone, sand and gravel, petroleum.
Alexander	W	W	Tripoli, sand and gravel.
Bond	735	\$640	Petroleum, clays, natural gas, sand and gravel.
Boone	W	W	Stone, sand and gravel.
Brown	W	W	Stone, petroleum, clays.
Bureau	904	946	Sand and gravel.
Calhoun	W	52	Stone.
Carroll	422	657	Do.
Cass	—	11	Sand and gravel.
Champaign	993	1,582	Do.
Christian	W	W	Coal, petroleum, stone.
Clark <sup>3</sup>	W	W	Stone, sand and gravel.
Clay	W	W	Petroleum, stone, sand and gravel.
Clinton	W	W	Petroleum, sand and gravel, stone.
Coles	W	4,531	Stone, petroleum, natural gas, sand and gravel.
Cook	53,689	57,228	Stone, lime, sand and gravel, clays, peat.
Crawford	9,969	W	Petroleum, sand and gravel.
Cumberland <sup>3</sup>	123	W	Sand and gravel, stone.
De Kalb	W	W	Stone, sand and gravel.
De Witt	W	W	Petroleum.
Douglas	63,347	74,680	Coal, natural gas liquids, stone, petroleum.
Du Page	W	W	Sand and gravel, stone.
Edgar	896	W	Petroleum.
Edwards	3,521	W	Do.
Effingham	2,031	W	Petroleum, sand and gravel, stone.
Fayette	25,819	W	Petroleum, stone, clays, sand and gravel.
Ford	632	W	Sand and gravel, stone.
Franklin	W	W	Coal, petroleum.
Fulton	26,693	42,580	Coal, sand and gravel.
Gallatin	W	36,178	Coal, petroleum, sand and gravel, natural gas.
Greene	W	805	Stone.
Grundy	W	W	Sand and gravel, clays, stone.
Hamilton	7,202	W	Petroleum.
Hancock	1,003	1,151	Stone.
Hardin	19,201	17,715	Fluorspar, stone, zinc, lead, barite, sliver.
Henderson	W	1,196	Stone.
Henry	W	W	Do.
Iroquois	W	W	Do.
Jackson	W	W	Stone, coal, sand and gravel, petroleum.
Jasper	5,669	W	Petroleum.
Jefferson	W	W	Coal, petroleum.
Jersey	218	257	Stone.
Jo Daviess	1,249	W	Sand and gravel, stone.
Johnson	W	W	Stone, coal.
Kane	11,755	9,260	Sand and gravel, stone, peat.
Kankakee	6,202	W	Stone, clays, sand and gravel.
Kendall	W	W	Sand and gravel, stone.
Knox	W	W	Coal, stone.
Lake	W	W	Sand and gravel, peat.
La Salle	28,836	W	Cement, sand and gravel, stone, clays.
Lawrence	31,848	W	Petroleum, sand and gravel.
Lee	W	W	Cement, stone, sand and gravel.
Livingston	5,352	5,614	Stone, clays.
Logan	W	W	Sand and gravel, stone.
McDonough	W	W	Stone, petroleum, clays.
McHenry	8,832	8,691	Sand and gravel.
McLean	205	2,518	Sand and gravel, stone.
Macon	1,118	W	Sand and gravel, petroleum.
Macoupin	W	W	Coal, stone, petroleum.
Madison	4,110	W	Stone, petroleum, sand and gravel.
Marion	W	W	Petroleum, stone.
Marshall	65	—	—
Mason	35	35	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Illinois, by county<sup>1 2</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Massac -----	W	W	Cement, sand and gravel.
Menard -----	W	\$2,739	Stone.
Mercer -----	W	W	Do.
Monroe -----	W	W	Do.
Montgomery -----	\$15,890	W	Coal, stone, petroleum.
Moultrie -----	W	W	Sand and gravel, petroleum, stone.
Ogle -----	1,441	W	Stone, sand and gravel.
Peoria -----	12,798	W	Coal, sand and gravel, stone.
Perry -----	87,347	W	Coal, petroleum, stone.
Piatt -----	--	W	Sand and gravel, stone.
Pike -----	W	W	Stone, sand and gravel.
Pope -----	--	2	Stone.
Pulaski -----	W	W	Clays, stone.
Randolph -----	66,418	W	Coal, stone, petroleum, sand and gravel.
Richland -----	9,429	W	Petroleum.
Rock Island -----	W	W	Stone, sand and gravel.
St. Clair -----	35,900	W	Coal, stone, petroleum.
Saline -----	31,195	W	Coal, petroleum, natural gas, stone.
Sangamon -----	3,521	W	Sand and gravel, petroleum, stone.
Schuyler -----	W	W	Sand and gravel.
Scott -----	W	W	Stone, clays.
Shelby -----	W	W	Sand and gravel, petroleum, stone.
Stark -----	W	W	Coal, sand and gravel.
Stephenson -----	678	681	Stone, sand and gravel.
Tazewell -----	W	W	Sand and gravel, clays.
Union -----	W	W	Stone, sand and gravel.
Vermilion -----	3,160	W	Stone, sand and gravel, coal.
Wabash -----	W	W	Coal, petroleum, sand and gravel.
Warren -----	W	W	Stone.
Washington -----	W	W	Petroleum, stone.
Wayne -----	25,731	W	Petroleum.
White -----	28,401	W	Petroleum, sand and gravel.
Whiteside -----	W	W	Peat, stone, sand and gravel.
Will -----	13,606	13,764	Stone, sand and gravel.
Williamson -----	40,934	69,016	Coal, petroleum, natural gas.
Winnebago -----	2,989	3,325	Sand and gravel, stone.
Woodford -----	1,905	2,391	Sand and gravel.
Undistributed <sup>4</sup> -----	r 440,123	1,132,349	
Total <sup>5</sup> -----	r 1,147,650	1,490,598	

<sup>1</sup> Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

<sup>2</sup> Morgan and Putnam Counties are not listed because no production was reported.

<sup>3</sup> Value of petroleum is based on an average price per barrel for the State.

<sup>4</sup> Value of petroleum production in Cumberland County is included with Clark County because actual source of production cannot be identified.

<sup>5</sup> Includes some sand and gravel, stone, and petroleum that cannot be assigned to specific counties, gem stones and values indicated by symbol W.

<sup>6</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Illinois business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	4,955.0	4,997.0	+0.8
Unemployment -----do-----	224.0	355.0	+58.5
<b>Employment (nonagricultural):</b>			
Mining -----do-----	23.7	25.0	+5.5
Manufacturing -----do-----	1,347.2	1,220.1	-9.4
Contract construction -----do-----	183.2	179.4	-2.1
Transportation and public utilities -----do-----	290.1	282.9	-2.5
Wholesale and retail trade -----do-----	1,004.8	1,000.2	-.5
Finance, insurance, and real estate -----do-----	252.8	254.3	+6
Services -----do-----	762.6	779.8	+2.3
Government -----do-----	671.3	683.3	+1.8
Total nonagricultural employment -----do-----	4,535.7	4,425.0	-2.4
<b>Personal income:</b>			
Total -----millions--	\$69,950	\$75,666	+8.2
Per capita -----do-----	\$6,268	\$6,789	+8.3
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----			
Value of nonresidential construction -----millions--	\$6,886	\$9,325	+6.6
Value of State road contract awards -----do-----	\$1,025.3	\$933.9	-8.9
Shipments of portland and masonry cement to and within the State -----thousand short tons--	\$402.0	\$573.0	+42.5
	3,710	3,382	-8.8
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$3,710	\$3,382	-8.8
Value per capita, resident population -----do-----	\$1,147.7	\$1,490.6	+29.9
Value per square mile -----do-----	\$102.84	\$133.12	+29.4
	\$20,348.40	\$26,429.04	+29.9

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Coal (Bituminous).**—Illinois continued to rank fourth in the Nation in the production of bituminous coal with an output of 59.5 million tons valued at \$871.4 million, which represented an increase in tonnage of 2% and an increase in value of 50%, compared with the 1974 levels. Value of bituminous coal production accounted for 58% of the State's total mineral value in 1975. The average value per ton (f.o.b. mine) for Illinois coal continued to rise, and in 1975 the average value per ton was \$14.64, compared with \$10.00 in 1974.

The utility market continued to be the largest consuming sector for Illinois coal, and coal's share of the market has been growing steadily since 1957. Until coal gasification and liquefaction plants are developed, a strong Illinois coal industry will remain heavily dependent on its ability to retain its competitive position in the utility fuel market.

Production in Illinois in 1975, excluding mines producing less than 1,000 short tons annually, was reported from 58 mines, 3

more than were operating in 1974. Major producing counties, in order of decreasing tonnage, were Perry, Randolph, Jefferson, Franklin, Christian, St. Clair, Williamson, Macoupin, Fulton, Douglas, and Saline. Underground mine production accounted for 53.5% of the coal produced in the State in 1975, compared with 53.7% in 1974.

Work began on several new mines in Illinois in 1975. Sohio announced its investment of up to \$90 million in Old Ben Coal Co.'s twin mine complex east of West Frankfort. Inland Steel Co. began sinking three 925-foot shafts at its new Inland No. 2 mine near McLeansboro. This mine, the deepest underground working mine in the State, will begin production in the last half of 1977 and reach an expected capacity of 2.5 million tons per year by the end of 1982. Williamson Coal Co. planned the opening of a strip mine west of Energy. Output from the mine, which will have an expected capacity of 300,000 tons per year for 6 years, will be purchased by the Southern Illinois Power Cooperative at Lake of Egypt. Finally,

**Table 4.—Illinois: Bituminous coal production by type of mine and county, 1975**  
(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines			Production (thousand short tons)			Value (thousands)
	Under-ground	Strip	Total	Under-ground	Strip	Total	
Christian -----	1	--	1	W	--	W	W
Douglas -----	2	--	2	2,540	--	2,540	W
Franklin -----	3	--	3	W	--	W	W
Fulton -----	--	4	4	--	2,638	2,638	\$42,249
Gallatin -----	1	1	2	W	W	W	W
Jackson -----	--	2	2	--	55	55	694
Jefferson -----	3	1	4	W	W	6,011	W
Johnson -----	--	1	1	--	1	1	14
Knox -----	--	1	1	--	1,334	1,334	16,963
Macoupin -----	1	--	1	W	--	W	W
Montgomery -----	1	--	1	W	--	W	W
Peoria -----	--	2	2	--	W	W	10,728
Perry -----	--	5	5	--	11,675	11,675	133,326
Randolph -----	2	4	6	W	W	8,209	92,265
St. Clair -----	1	1	2	W	W	W	W
Saline -----	2	4	6	W	W	W	W
Stark -----	--	1	1	--	270	270	3,434
Vermilion -----	--	1	1	--	15	15	196
Wabash -----	1	--	1	W	--	W	W
Williamson -----	3	9	12	1,587	1,777	3,364	67,398
Undistributed -----	--	--	--	27,748	9,896	23,424	504,109
<b>Total</b> <sup>1</sup> -----	<b>21</b>	<b>37</b>	<b>58</b>	<b>31,875</b>	<b>27,661</b>	<b>59,537</b>	<b>871,877</b>

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Zeigler Coal Co. announced that it would build a new underground mine, Zeigler No. 11 mine, in Randolph County. Production is expected to begin in the summer of 1977, and the annual production capacity of 1.5 million tons will be reached by the spring of 1978.

Coal gasification and pollution control research made some important advances in Illinois in 1975. The Hygas Pilot Plant in Chicago operated as a self-sustaining unit for the first time in April. It used no heat or hydrogen from other sources in the conversion of coal to gas. In November, New Athens was chosen as the site for another, \$237 million, demonstration coal gasification pilot plant. Legislation pending for most of the year, designed to encourage the use of high-sulfur Illinois coal, was finally signed into law in September. Specifically, the new law authorizes the use of intermittent or supplemental air pollution control systems as an alternative to immediate compliance with Federal sulfur dioxide emission standards. Caterpillar Tractor Co. and Southern Illinois University (SIU) also took steps to increase the use of Illinois high-sulfur coal. Caterpillar announced its intentions to use more high-sulfur coal by scrubbing sulfur

dioxide from coal-fired boilers at six of its Illinois plants. SIU demonstrated that a new type of scrubber system can burn Illinois coal in an environmentally acceptable manner.

**Coke.**—Production of coke in 1975 was 1,924,000 tons, an increase of about 1% from the 1,912,000 tons produced in 1974. This tonnage represents almost 3% of the U.S. production. Illinois coke plants carbonized 3,087,000 tons of coal. Of this total, 34% came from Illinois, 38% from Kentucky, 18% from West Virginia, 7% from Arkansas, and the balance from Oklahoma, Pennsylvania, and Virginia.

About 251,000 tons of coke breeze was recovered at the producing plants, an increase of 20% over the 210,000 tons recovered in 1974. Other byproducts of coke-oven operations in the State included coke-oven gas, ammonia, tar, and crude light oil.

**Natural Gas.**—Marketed production of natural gas in 1975 was 1,440 million cubic feet valued at \$1,008,000, an increase of less than 1% over the 1,436 million cubic feet valued at \$574,000 of the previous year. About 82% of the gas was from the Mattoon field in Coles County, and the remainder from fields in

Gallatin, Saline, and Williamson Counties.

According to estimates of the American Gas Association (AGA), proved natural gas reserves in Illinois on December 31, 1975, were 380,804 million cubic feet, compared with 399,414 million cubic feet on December 31, 1974.

**Peat.**—Illinois produced 96,295 tons of peat in 1975, an increase of less than 1% more than the 95,807 tons produced in 1974. Production was reported by six companies from Du Page, Lake, McHenry, and Whiteside Counties.

Sales totaling 95,719 tons decreased less than 1% from the 1974 sales. Humus, moss, and reed-sedge peat were sold in bulk and packaged forms. Of all sales, 89% were in packaged forms. The majority of the peat was used for general soil improvement; a small amount was used for potting soils.

Illinois ranked third to Michigan and Florida in output of peat in the United States, accounting for 12% of the Nation's total.

**Petroleum.**—Petroleum production in Illinois continued its downward trend for the 13th consecutive year. Output decreased from 27.6 million barrels in 1974 to 26.1 million barrels in 1975, a decline of 5%. The value of crude petroleum provided 18% of the total State mineral output value.

According to the American Petroleum Institute (API), proved reserves of crude oil in Illinois were 160,986,000 barrels on December 31, 1975, compared with 159,789,000 barrels on December 31, 1974, an increase of less than 1%.

**Petroleum and Natural Gas Exploration and Development.**—Total number of well completions in Illinois increased from 795 wells in 1974 to 956 wells in 1975. Of the 956 wells drilled, 460 were completed as oil wells, 5 as gas wells, and 491 as dry holes. Overall success ratio was 49%; of the exploratory wells, 13% were completed as oil and gas producers.

Activity in the Illinois oil producing industry centered around wildcatting in Johnson County which began in January with a well drilled near Grantsburg. Texas Pacific Oil Co., Inc., of Dallas, Tex., spent over \$1 million on wildcat drilling for gas and oil in that area. In July, the House Appropriations Committee announced a

proposal to promote competitive bidding, should oil rights for the Shawnee National Forest in southern Illinois be leased.

**Petroleum Refineries.**—In 1975, crude oil capacity at petroleum refineries totaled 1,191,800 barrels per calendar day. There were 12 refineries as of January 1, 1976, in the State. Eleven were operating and one was shut down. The M. T. Richards, Inc., refinery at Crossville, with a capacity of 700 barrels per day, was shut down during 1975.

#### NONMETALS

**Barite.**—Allied Chemical Corp. was recovering a primary barite product at its principal mill near Cave in Rock associated with the fluorspar at its No. 1 mine.

Pfizer, Inc., continued to produce ground barite at its East St. Louis plant in St. Clair County.

**Cement.**—Portland and masonry cements were produced by four companies in 1975. These firms were Marquette Cement Manufacturing Co. at its Oglesby plant, La Salle County; Medusa Cement Co., a division of Medusa Corp., at its Dixon plant, Lee County; Missouri Portland Cement Co. at its Joppa plant, Massac County; and Centex Corp. at its La Salle plant, La Salle County. Portland cement shipments decreased 6% in quantity and increased 4% in value; masonry cement shipments increased both in quantity and value.

In 1975, Medusa Cement Co. installed gravel bed filters on four clinker coolers at its Dixon plant. Missouri Portland Cement Co., late in 1975, completed an expansion program at its Joppa plant. This expansion has doubled the plant's existing capacity.

Types of portland cement shipped included type I and type II (general use and moderate heat), type III (high-early strength), white, waterproof, slag-pozzolan, block, and expansive. Portland cement shipments from plants in the State totaled 1,374,000 tons. Raw materials used in making portland cement included limestone, sandstone, clay and shale, sand, gypsum, and iron-bearing materials. Disposition of portland cement by type of customer was as follows: Ready-mix concrete companies (67%); concrete product manufacturers (8%); building material

Table 5.—Illinois: Oil and gas well drilling completions, by county, in 1975

County	Proved field wells <sup>1</sup>			Exploratory wells		Total	
	Oil	Gas	Dry	Oil	Dry	Wells	Footage
Adams	1	--	--	--	1	2	1,349
Bond	1	--	4	--	1	6	5,890
Brown	--	--	1	--	1	2	1,304
Christian	8	--	6	1	9	24	50,343
Clark	7	--	1	--	1	9	6,156
Clay	47	--	33	3	4	87	261,431
Clinton	14	--	9	--	11	34	56,235
Coles	2	2	--	--	4	8	18,811
Crawford	78	--	15	--	2	95	101,793
Cumberland	2	--	4	--	8	14	42,123
Douglas	--	--	1	--	--	1	1,693
Edgar	2	--	1	--	1	4	3,577
Edwards	24	--	11	2	5	42	131,770
Effingham	4	--	2	1	8	15	45,979
Fayette	2	--	1	--	11	14	44,521
Franklin	5	--	3	--	3	11	34,082
Gallatin	1	--	5	--	4	10	27,369
Hamilton	10	--	6	--	3	19	40,915
Hancock	--	--	--	--	2	2	1,194
Iroquois	--	--	--	--	2	2	1,230
Jackson	3	--	--	1	1	5	16,287
Jasper	11	--	5	2	4	22	63,354
Jefferson	4	--	3	1	9	17	53,264
Johnson	--	--	--	--	2	2	17,449
Lawrence	26	1	15	--	5	47	83,495
McDonough	--	--	--	--	1	1	800
Macon	4	--	1	--	1	6	12,732
Maceupin	1	--	3	--	2	6	2,792
Madison	2	--	7	--	3	12	12,070
Marion	4	--	14	3	9	30	96,612
Massac	--	--	--	--	1	1	2,042
Monroe	--	--	--	--	1	1	912
Montgomery	--	--	--	--	6	6	13,511
Morgan	1	--	--	--	--	1	624
Moultrie	--	--	--	--	1	1	1,885
Perry	--	--	3	--	7	10	30,525
Pope	3	--	--	--	1	1	350
Randolph	3	--	--	2	6	11	21,840
Richland	6	--	7	--	1	14	36,857
St. Clair	--	--	--	--	5	5	11,228
Saline	12	2	7	--	4	25	73,796
Sangamon	8	--	15	--	4	27	48,262
Schuyler	--	--	--	--	1	1	710
Shelby	3	--	--	1	8	12	33,873
Vermilion	--	--	--	--	1	1	1,502
Wabash	36	--	23	4	2	65	154,646
Washington	3	--	1	--	20	24	53,545
Wayne	57	--	31	2	13	103	349,699
White	37	--	21	4	12	74	189,397
Williamson	2	--	7	2	13	24	61,991
Total	431	5	266	29	225	956	2,323,197

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

dealers (9%); and contractors and other users (16%).

Clays.—Output and value of fire clay and miscellaneous clay and shale decreased 14% and 13% respectively, from 1974 figures. Production of fuller's earth increased 7% in quantity and 154% in value.

Production of clay and shale was reported from 12 counties. Fire clay was produced by companies in Grundy, McDonough, and Scott Counties.

Absorbent Clay Products, Inc., of Anna started production at a new plant at Mounds in September 1975. The company planned to produce animal litter and sweeping compounds from the Porter's Creek Clay.

Fluorspar.—Shipments of finished fluorspar totaled 99,898 tons valued at \$9.0 million, a decrease of 34% in quantity and a decrease of 27% in value, compared with those of 1974. The State continued to be the Nation's leading producer of fluorspar supplying 71% of the output.

Allied Chemical Corp. and Ozark-Mahoning Co., with operations in Hardin and Pope Counties, continued to be the dominant producers.

In 1975, water pollution regulations relating to the fluorspar industry were amended to standards that are considered reasonable by the industry. In March the Illinois Pollution Control Board adopted fluoride effluent standards of 5 parts per million (ppm) for mine water and 15 ppm for plant water. The waters may not be used as a public drinking supply. In a further relaxing of State regulations, the Illinois Conservation Department decided to permit Ozark-Mahoning Co. to prospect for fluorspar in the Shawnee National Forest. Should the test borings find fluorspar and actual mining be permitted, the company will be required to use underground mining methods.

During the year, the two major producers, Ozark-Mahoning and Allied Chemical, together operated about seven exploration and development drilling rigs in Illinois. The discovery and development of new reserves in this district continued to equal the annual production.

**Gem Stones.**—Small quantities of gem materials and mineral specimens continued to be collected in 1975. Estimated total value of the materials in 1975 remained about the same as the 1974 estimate.

**Gypsum.**—National Gypsum Co. calcined gypsum at the Waukegan plant in Lake County. Output decreased 4% in 1975, and 30% below the 1973 record.

**Lime.**—Illinois ranked eighth in the Nation in lime production. Marblehead Lime Co. and Vulcan Materials Co. produced lime at three plants in Cook County for steel furnaces, refractories, water purification, sewage treatment, and other uses. Output decreased 15% below that of 1974. The lime was used in Indiana, Illinois, and at other destinations. Consumption of lime in Illinois was 877,114 tons.

**Perlite.**—Crude perlite mined outside the State was expanded by five companies with plants in Cook, De Kalb, Lake, and Will Counties. Sales of the expanded product decreased 11% in quantity and increased 16% in value. Principal use was for insulation board which accounted for 69% of the total. Other uses included concrete aggregate, filter aid, low-temperature insulation, plaster aggregate, and horticultural aggregate.

**Sand and Gravel.**—Production of sand and gravel in 1975 was 39.0 million tons valued at \$83.5 million. Counties from which over a million tons was produced were Du Page, Grundy, Kane, Lane, La Salle, McHenry, McLean, Sangamon, Tazewell, Will, Winnebago, and Woodford.

Of the total sand and gravel produced, 81% was used as processed aggregate, 8% as unprocessed aggregate, and the remainder as industrial sands, fill, and other uses. The average value of the total sand and gravel produced was \$2.14 per ton, compared with \$1.61 per ton in 1974. The State ranked fourth in the Nation in quantity and value of sand and gravel produced.

In 1975 the Walnut Sand and Gravel Co. of Walnut, modernized its operations. The company operated two plants on the same property for washed and base material.

**Stone.**—Illinois, with production of 60.6 million tons, ranked first in the Nation in the production of stone. The average value of the total stone produced was \$2.15 per ton in 1975. Major producing counties, each with production of over 1 million tons, were Cook, Hardin, Kane, Kankakee, La Salle, Lee, Livingston, Madison, Montgomery, Rock Island, St. Clair, and Will.

Dimension stone, which represented only a small part of the total stone production in the State, was produced in Kane County.

Trucks transported 92% of the crushed and broken stone, the remainder was shipped by railroad and waterway transportation.

During the period, Western Stoneware Co. of Monmouth opened a new pit east of Colchester. Since the material mined contained much more quartz than the material the company had previously used, the mine had to be abandoned.

**Sulfur (Recovered Elemental).**—Sulfur was recovered by Shell Oil Co. at its Hartford refinery in Madison County; by Union Oil Co. of California, Union 76 Div., in Cook County; by Marathon Oil Co. at its Robinson refinery in Crawford County; by Mobil Oil Corp. at its new refinery near Joliet in Will County; by Texaco, Inc., at its Lockport plant in Will County and Lawrenceville plant, Lawrence County; by Natural Gas Pipeline Co. of America, St. Elmo Pipeline, Fayette County; and by Natural Gas Pipe-



Table 6.—Illinois: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	5,951	12,061	6,318	13,299
Concrete aggregate -----	10,830	20,758	10,309	21,705
Dense-graded roadbase stone -----	18,488	35,414	18,690	39,742
Macadam aggregate -----	3,727	7,485	2,985	6,237
Surface treatment aggregate -----	5,345	10,519	5,240	11,021
Other construction aggregate and roadstone -----	7,276	13,052	5,486	11,464
Agricultural limestone <sup>1</sup> -----	5,203	10,039	5,712	12,010
Cement manufacture -----	<sup>2</sup> 3,505	<sup>2</sup> 5,222	2,394	4,069
Lime manufacture -----	W	W	832	1,779
Flux stone -----	305	577	309	623
Manufactured fine aggregate (stone sand) -----	84	239	45	91
Mineral fillers, extenders and whitening <sup>3</sup> -----	473	2,066	604	3,856
Railroad ballast -----	488	814	400	765
Riprap and jetty stone -----	688	1,361	775	1,647
Other uses <sup>4</sup> -----	866	2,086	539	1,716
Total <sup>5</sup> -----	63,229	121,693	60,638	130,020

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

<sup>1</sup> 1974 data include other soil conditioners, poultry grit, and mineral food.

<sup>2</sup> Includes stone used in lime manufacture.

<sup>3</sup> Includes asphalt filler, whitening or whitening substitute, and other fillers or extenders.

<sup>4</sup> Includes chemicals, fill, mine dusting, roofing aggregates, chips and granules (1974), waste material, glass manufacture (1974), poultry grit and mineral food (1975), and uses indicated by symbol W.

<sup>5</sup> Data may not add to totals shown because of independent rounding.

line Co. of America, Herscher Pipeline Storage Div., Kankakee County. The quantity and value of sulfur recovered from these sources are not included in the mineral production statistics in table 1 because the recovered sulfur is considered a secondary product. Nationally, Illinois ranked sixth in quantity and seventh in value of recovered sulfur.

**Tripoli (Amorphous Silica).**—Crude material was recovered from underground mines in Alexander County by Illinois Minerals Co. near Elco and by Tammsco, Inc., near Tamms. The production of crude material increased 11% in quantity and 24% in value. Output of prepared material decreased 11% in quantity and less than 1% in value. Prepared material was used for abrasives, filler, and other purposes. Of the few States that produce tripoli in the United States, Illinois continued to rank first in production and first in value.

**Vermiculite.**—Crude vermiculite mined outside the State was processed at W. R. Grace & Co. plant in West Chicago, Du Page County; Mica Pellets, Inc., at its plant in De Kalb County; and International Vermiculite Co. at its plant in Macoupin County. Uses were for insulation, aggregate in plaster and concrete, horti-

culture, fertilizer carrier, and other purposes.

## METALS

**Iron Oxide Pigments.**—Four plants, operating in Adam, Kane, Sangamon, and St. Clair Counties, produced finished (natural and manufactured) iron oxide pigments in 1975. Illinois ranked second in the production of finished iron oxide pigments in 1975. Total output for the State (as indicated by sales) in 1975 decreased in quantity and in value over those of the previous year.

**Lead and Zinc.**—Production of lead and zinc, in terms of recoverable metal, increased compared with the 1974 figures. Total value also increased.

**Pig Iron and Steel.**—About 5.2 million tons of pig iron valued at \$905.5 million was shipped from Illinois blast furnaces or was consumed by producing companies, compared with 7.2 million tons valued at \$1,003.6 million in 1974. Pig iron was produced by five companies, one operating a blast furnace in Granite City and four operating blast furnaces in South Chicago.

According to the American Iron and Steel Institute, Illinois produced 9.6 million tons of steel in 1975, compared with

Table 7.—Illinois: Crushed stone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974		1975	
	Quantity	Value	Quantity	Value
Adams	1,052	W	980	4,905
Calhoun	25	W	21	52
Carroll	285	422	352	657
Christian	W	W	710	1,626
Coles	603	1,368	493	1,646
Cook	W	W	14,973	29,006
Cumberland	(1)	(1)	2	5
Effingham	--	--	3	7
Fayette	--	--	258	696
Ford	4	8	3	7
Franklin	(1)	2	--	--
Greene	385	W	365	805
Grundy	22	47	(1)	1
Hancock	520	1,003	498	1,151
Hardin	2,269	3,659	2,273	4,108
Henderson	W	W	544	1,196
Jersey	109	218	119	257
Jo Daviess	303	312	392	529
Kane	1,849	2,577	1,041	2,240
Kankakee	W	W	2,229	4,400
La Salle	2,249	3,474	2,083	4,194
Lee	1,605	2,655	1,409	2,488
Livingston	2,323	4,776	2,302	5,263
McLean	--	--	6	13
Madison	W	W	1,245	3,098
Menard	W	W	W	2,739
Montgomery	1,072	2,291	1,240	3,003
Moultrie	--	--	5	10
Ogle	648	1,176	613	1,208
Perry	--	--	10	20
Piatt	--	--	4	12
Pike	484	884	538	1,144
Pope	--	--	(1)	2
Randolph	1,194	2,468	542	1,089
Rock Island	W	W	1,325	3,160
St. Clair	2,448	4,681	3,229	6,637
Saline	--	--	1	2
Sangamon	4	15	2	6
Scott	523	994	W	W
Stephenson	325	491	274	478
Washington	W	W	418	1,358
Will	5,906	10,518	5,516	10,372
Winnebago	953	1,842	884	1,588
Undistributed <sup>2</sup>	36,563	75,811	13,732	28,847
Total <sup>3</sup>	63,229	121,693	60,637	130,020

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

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Includes stone produced in the following counties: Boone, Brown, Clark, Clay, Clinton, De Kalb, Douglas, Du Page, Henry, Iroquois, Jackson, Johnson, Kendall, Knox, Logan, McDonough, Macoupin, Marion, Mercer, Monroe, Peoria, Pulaski, Shelby, Union, Vermilion, Warren, and Whiteside; production for which no county breakdown is available; and counties indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

12.9 million tons in 1974. Illinois ranked fourth in the production of raw steel in 1975.

Late in 1974, United States Steel Corp.'s \$50 million rod mill at its Chicago south works began break-in operations. By July 1975 the plant was operating at approximately one-third its annual capacity of

700,000 tons. In the area of pollution control, Keystone Steel and Wire Co. of Peoria announced a \$6 million expansion of its air pollution control system at two electric steel-making furnaces.

**Other Metals.**—Smelter production of cadmium in Illinois in 1975 decreased 65% in quantity and 83% in value.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Barite: Pfizer, Inc. <sup>1</sup> -----	2001 Lynch Ave. East St. Louis, Ill. 62201	Plant -----	St. Clair.
Cement:			
Marquette Cement Manufacturing Co. <sup>2 3</sup>	First American Center Nashville, Tenn. 37238	----do -----	La Salle.
Medusa Corp. <sup>3</sup> -----	Box 5668 Cleveland, Ohio 44101	----do -----	Lee.
Missouri Portland Cement Co. <sup>3</sup>	7751 Carondelet Ave. St. Louis, Mo. 63105	----do -----	Massac.
Clays:			
General Dynamics Corp. <sup>3 4</sup>	300 West Washington St. Chicago, Ill. 60606	----do -----	La Salle.
Lowes, Inc -----	North Edward St. Cassopolis, Mich. 49031	----do -----	Pulaski.
Streator Brick Systems, Inc.	West End of Ninth St. Streator, Ill. 61364	Pits -----	La Salle and Livingston.
United States Gypsum Co -	101 South Wacker Dr. Chicago, Ill. 60606	Pit and plant ----	Grundy.
Coal (bituminous):			
American Metal Climax, Inc.	105 South Meridian St. Indianapolis, Ind. 46225	Strip and under- ground mine, plant.	Fulton, Perry, Wabash, Williamson.
Consolidation Coal Co ----	Box 218 Pinckneyville, Ill. 62274	----do -----	Montgomery, Fulton, Perry, Randolph.
Eads Coal Co -----	Box 1473 St. Louis, Mo. 63178	Strip mine -----	Jefferson.
Freeman United Coal Corp.-	300 West Washington Ave. Chicago, Ill. 60606	Strip and under- ground mines, plants.	Jefferson and Williamson.
Inland Steel Co -----	30 West Monroe St. Chicago, Ill. 60603	Underground mine and plant.	Jefferson.
Midland Coal Co -----	Box 8 Trivoli, Ill. 61569	Strip mines and plants.	Knox, Peoria, Stark.
Monterey Coal Co -----	205 Oakland Ave. Carlinville, Ill. 62626	Underground mine and plant.	Macoupin.
Old Ben Coal Co -----	10 South Riverside Plaza Chicago, Ill. 60606	Underground mines and plant.	Franklin.
Peabody Coal Co -----	301 North Memorial Dr. St. Louis, Mo. 63102	Strip and under- ground mines, plant.	Christian, Gallatin, Randolph, St. Clair, Williamson.
Sahara Coal Co., Inc -----	59 East Van Buren St. Chicago, Ill. 60605	----do -----	Saline.
Southwestern Illinois Coal Corp.	Box 14743 St. Louis, Mo. 63178	Strip mines and plants.	Perry and Randolph.
Zeigler Coal Co -----	2700 River Rd. Des Plaines, Ill. 60017	Underground mines and plants.	Douglas, Randolph, Williamson.
Coke:			
Interlake, Inc -----	310 South Michigan Ave. Chicago, Ill. 60604	Coke ovens -----	Cook.
International Harvester Co.	401 North Michigan Ave. Chicago, Ill. 60611	----do -----	Do.
National Steel Corp -----	Box 367 Granite City, Ill. 62041	----do -----	Madison.
Republic Steel Corp -----	Box 6778 Cleveland, Ohio 44101	----do -----	Cook.
Fluorspar:			
Allied Chemical Corp. <sup>5</sup> ---	Cave in Rock, Ill. 62919 ---	Underground mines and mill.	Hardin.
Ozark-Mahoning Co. <sup>5</sup> ----	Rosiclare, Ill. 62982 ----	----do -----	Do.
Iron oxide pigments, finished:			
Prince Manufacturing Co -	Bowmanstown, Pa. 18030 --	Plant -----	Adams.
George B. Smith Chemical Works.	Maple Park, Ill. 60151 ---	----do -----	Kane.
Lime: Marblehead Lime Co --	300 West Washington St. Chicago, Ill. 60606	Kilns -----	Cook.
Natural gas liquids:			
National Distillers & Chemical Corp.	99 Park Ave. New York, N.Y. 10016	Plant -----	Douglas.
Peat:			
Fort Wayne Industries ---	Rt. 3 Morrison, Ill. 61270	Bog and plant ----	Whiteside.
Markman Peat Co -----	----do -----	----do -----	Do.

See footnotes at end of table.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Perlite, expanded:			
Filter Products Corp -----	124 North Buesching Rd. Lake Zurich, Ill. 60047	Plant -----	Lake.
Johns-Manville Perlite Corp.	Box 5108 Denver, Colo. 80217	----do -----	Will.
National Gypsum Co -----	325 Delaware Ave. Buffalo, N.Y. 14202	----do -----	Lake.
Silbrico Corp -----	6300 River Rd. La Grange, Ill. 60525	----do -----	Cook.
Petroleum refineries:			
Amoco Oil Co -----	200 East Randolph Chicago, Ill. 60601	Refinery -----	Madison.
Clark Oil & Refining Corp.	8530 West National Ave. Milwaukee, Wis. 53227	----do -----	Cook and Madison.
Marathon Oil Co. <sup>6</sup> -----	539 South Main Findlay, Ohio 45840	----do -----	Crawford.
Mobil Oil Corp. <sup>6</sup> -----	Box 874 Joliet, Ill. 60434	----do -----	Will.
Shell Oil Co. <sup>6</sup> -----	One Shell Plaza Houston, Tex. 77002	----do -----	Madison.
Texaco, Inc -----	135 East 42d St. New York, N.Y. 10017	----do -----	Lawrence and Will.
Union Oil Co. of California. <sup>6</sup>	Box 239 Lemont, Ill. 60439	----do -----	Cook.
Sand and gravel:			
Del Monte Properties Co --	400 West Higgins Rd. Park Ridge, Ill. 60068	Pit and plant ---	La Salle.
Martin Marietta Aggregates.	Box 789 Cedar Rapids, Iowa 52406	Pits and plants ---	Ogle, Peoria, Tazewell, Woodford.
Meyer Aggregate -----	Box 56, Route 2 Algonquin, Ill. 60102	----do -----	Kendall and McHenry.
Vulcan Materials Co. <sup>7 3</sup> ---	Box 391 La Grange, Ill. 60525	----do -----	Kane, Lake, McHenry.
Stone:			
Allied Chemical Corp -----	Box 70 Morristown, N.J. 07960	Quarries and plants.	Randolph.
Columbia Quarry Co -----	Box 1000 Dupu, Ill. 62239	Quarries, plant, underground mine.	Johnson, Monroe, Pulaski, St. Clair.
Elmhurst-Chicago Stone Co. <sup>4</sup>	400 West First St. Elmhurst, Ill. 61026	Quarry and plant -	Du Page.
Mississippi Lime Co -----	7 Alby St., Box 247 Alton, Ill. 62002	Underground mine and plant.	Madison.
Moline Consumers Co. <sup>4</sup> ---	313 16th St. Moline, Ill. 61255	Quarries and plants.	Adams, Brown, Hancock, Henry, La Salle, Pike, Rock Island, Warren.
Tripoli, amorphous silica:			
Illinois Minerals Co -----	218 Tenth St. Cairo, Ill. 62914	Underground mine.	Alexander.
Tammsco, Inc -----	Box J Tamms, Ill. 62988	----do -----	Do.
Vermiculite, exfoliated:			
International Vermiculite Co.	First and Mound Sts. Girard, Ill. 62640	Plant -----	Macoupin.
Mica Pellets, Inc. <sup>8</sup> -----	1120 Oak St. De Kalb, Ill. 60115	----do -----	De Kalb.
W. R. Grace & Co -----	62 Whittencove Ave. Cambridge, Mass. 02140	----do -----	Du Page.

<sup>1</sup> Also iron oxide pigments.<sup>2</sup> Also clays.<sup>3</sup> Also stone.<sup>4</sup> Also sand and gravel.<sup>5</sup> Also lead and zinc.<sup>6</sup> Also sulfur (recovered).<sup>7</sup> Also lime.<sup>8</sup> Also expanded perlite.



# 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 William S. Miska <sup>1</sup>

In 1975, the value of mineral production in Indiana increased 23% over that of 1974, reaching \$541.6 million, another all-time record high for the sixth consecutive year. An increase in coal production coupled with an increase in the unit value of coal was primarily responsible for the new record. Most of the other mineral fuels and nonmetallic minerals produced in Indiana also increased in value even though output of several of these commodities declined.

Mineral production value in the State was divided as follows: Coal, 52%; portland and masonry cements, 14%; stone, 13%; crude oil, 9%; sand and gravel, 6%; and all remaining commodities combined, 6%.

Although no metallic ores were mined in the State, large quantities of iron, steel, and aluminum were produced from imported ores.

<sup>1</sup> State Liaison Officer (Indiana and Ohio), Bureau of Mines, Bloomington, Ind.

Table 1.—Mineral production in Indiana <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry -----thousand short tons--	W	W	343	\$12,263
Portland -----do-----	W	W	2,185	63,077
Clays -----do-----	1,092	\$1,947	1,094	1,961
Coal (bituminous) -----do-----	23,726	198,410	25,124	280,130
Natural gas -----million cubic feet--	176	25	346	135
Peat -----thousand short tons--	71	946	76	1,918
Petroleum (crude) -----thousand 42-gallon barrels--	4,919	42,402	4,632	48,821
Sand and gravel -----thousand short tons--	26,077	35,656	21,641	35,234
Stone -----do-----	<sup>2</sup> 31,031	<sup>2</sup> 64,106	28,947	68,850
Value of items that cannot be disclosed:				
Abrasive (whetstone), gypsum, lime, stone (sandstone, 1974), and values indicated by symbol W -----	XX	97,198	XX	29,211
Total -----	XX	440,690	XX	541,600
Total 1967 constant dollars -----	XX	208,358	XX	<sup>p</sup> 214,474

<sup>p</sup> Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes sandstone; included with "Value of items that cannot be disclosed."

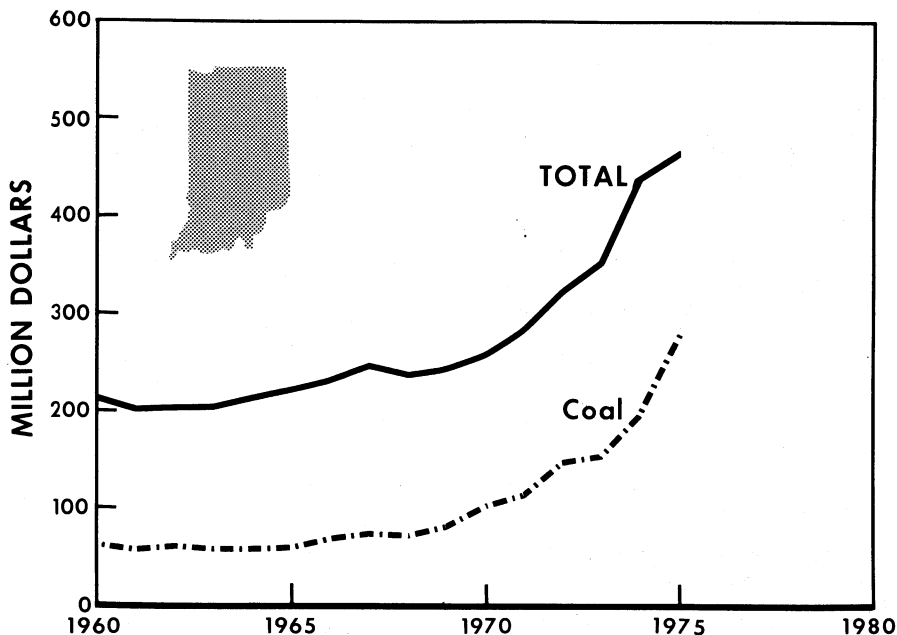


Figure 1.—Value of coal and total value of mineral production in Indiana.

Table 2.—Value of mineral production in Indiana, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams	\$994	W	Stone, sand and gravel.
Allen	5,488	W	Stone, sand and gravel, peat.
Bartholomew	W	W	Stone, sand and gravel.
Blackford	W	W	Stone, clays.
Boone	W	\$308	Sand and gravel.
Carroll	W	W	Stone, sand and gravel.
Cass	12,377	W	Cement, stone, sand and gravel, clays.
Clark	28,351	W	Cement, stone, clays, sand and gravel.
Clay	8,219	W	Coal, clays.
Clinton	W	—	—
Crawford	W	5,633	Stone.
Daviess	W	W	Coal, sand and gravel.
Dearborn	W	W	Sand and gravel.
Decatur	W	W	Stone.
De Kalb	525	456	Sand and gravel.
Delaware	W	W	Stone, peat, sand and gravel.
Dubois	W	W	Coal, clays.
Elkhart	W	814	Sand and gravel, stone.
Fayette	W	410	Sand and gravel.
Floyd	—	W	Do.
Fountain	W	W	Sand and gravel, coal, clays.
Franklin	W	W	Sand and gravel, stone.
Fulton	W	W	Sand and gravel, peat.
Gibson	37	—	—
Grant	1,792	W	Stone, sand and gravel, peat.
Greene	6,904	W	Coal, sand and gravel, clays.
Hamilton	6,075	5,906	Sand and gravel, stone.
Hancock	227	374	Sand and gravel.
Harrison	2,336	W	Stone, sand and gravel.
Hendricks	W	—	—
Henry	456	302	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Indiana, by county<sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Howard	W	W	Stone, sand and gravel.
Huntington	\$2,164	W	Stone, sand and gravel, clays.
Jackson	W	W	Sand and gravel, clays.
Jasper	W	W	Stone, sand and gravel.
Jay	W	W	Do.
Jennings	W	W	Stone.
Johnson	347	\$291	Sand and gravel, stone.
Knox	W	W	Coal, sand and gravel.
Kosciusko	440	457	Sand and gravel.
Lagrange	W	W	Sand and gravel, stone.
Lake	34,558	37,234	Lime, cement, stone, sand and gravel, clays.
La Porte	W	W	Sand and gravel, stone.
Lawrence	W	W	Cement, stone.
Madison	W	W	Stone, sand and gravel.
Marion	W	W	Sand and gravel, stone.
Marshall	W	W	Sand and gravel, stone, peat.
Martin	W	W	Gypsum.
Miami	W	W	Sand and gravel, stone.
Monroe	7,900	8,517	Stone.
Montgomery	68	27	Sand and gravel, clays.
Morgan	1,234	W	Sand and gravel, clays, stone.
Newton	W	W	Stone.
Noble	300	W	Sand and gravel, stone.
Orange	W	W	Stone, abrasives.
Owen	W	W	Stone, sand and gravel, coal.
Parke	W	W	Sand and gravel, coal, clays.
Perry	W	W	Stone, coal.
Pike	50,355	76,943	Coal, sand and gravel.
Porter	10	W	Sand and gravel, clays.
Posey	W	W	Sand and gravel, stone.
Pulaski	850	W	Stone, clays.
Putnam	W	W	Cement, stone, sand and gravel.
Randolph	W	W	Stone, sand and gravel.
Ripley	W	W	Stone.
Rush	495	W	Stone, sand and gravel.
St. Joseph	1,465	1,783	Sand and gravel, stone.
Scott	W	W	Stone.
Shelby	1,595	W	Stone, sand and gravel.
Spencer	7,127	5,481	Coal.
Starke	15	--	
Steuben	651	W	Sand and gravel, stone.
Sullivan	27,963	W	Coal, sand and gravel, stone.
Switzerland	1,924	W	Sand and gravel, stone.
Tiptecanoe	1,438	1,973	Sand and gravel.
Tipton	W	W	Do.
Union	9	--	
Vanderburgh	4	--	
Vermillion	W	W	Coal, sand and gravel, clays.
Vigo	W	W	Coal, stone, sand and gravel.
Wabash	W	W	Stone, sand and gravel.
Warren	W	W	Sand and gravel, peat.
Warrick	74,205	W	Coal.
Washington	W	W	Stone.
Wayne	W	1,628	Sand and gravel, stone.
Wells	W	W	Stone, peat.
White	560	W	Stone.
Whitley	W	W	Sand and gravel.
Undistributed <sup>2</sup>	151,232	393,063	
Total	440,690	541,600	

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

<sup>1</sup>The following counties are not listed because no production was reported: Benton, Brown, Jefferson, and Ohio.

<sup>2</sup>Includes petroleum and natural gas production that cannot be assigned to specific counties and values indicated by symbol W.



Table 3.—Indicators of Indiana business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	2,378.0	2,394.0	+0.7
Unemployment -----do-----	123.0	206.0	+67.5
<b>Employment (nonagricultural):</b>			
Mining -----do-----	7.1	7.6	+7.0
Manufacturing -----do-----	737.2	644.1	-12.6
Contract construction -----do-----	88.6	79.4	-10.4
Transportation and public utilities -----do-----	105.5	100.2	-5.0
Wholesale and retail trade -----do-----	424.9	416.1	-2.1
Finance, insurance and real estate -----do-----	89.6	88.6	-1.1
Services -----do-----	271.8	271.2	-.2
Government -----do-----	308.0	323.1	+4.9
Total nonagricultural employment -----do-----	2,082.6	1,980.4	-5.0
<b>Personal income:</b>			
Total -----millions-----	\$28,138	\$30,023	+6.7
Per capita -----do-----	\$5,295	\$5,653	+6.8
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----	23,937	23,096	-3.5
Value of nonresidential construction -----millions-----	\$345.3	\$309.3	-10.4
Value of State road contract awards -----do-----	\$157.0	\$221.0	+40.8
Shipments of portland and masonry cement to and within the State -----thousand short tons-----	1,841	1,641	-10.9
<b>Mineral production value:</b>			
Total crude mineral value -----millions-----	\$440.7	\$541.6	+22.9
Value per capita, resident population -----do-----	\$82.95	\$109.83	+32.4
Value per square mile -----do-----	\$12,143.23	\$16,079.41	+32.4

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

### Legislation and Government Programs.

—During the 1975 session of the Indiana General Assembly, the following laws were enacted that amend the 1971 Indiana Code (IC 1971) and directly or indirectly affect the mineral industry.

1. House Bill 1822, Public Law 257, amends IC 22-10-3 and 22-10-6, to provide standards for State regulation of blasting operations, with notice, at underground and surface mines; gives Department of Mines and Mining power to promulgate rules and regulations.

2. Senate Bill 228, Public Law 79, amends IC 8-3 by adding a new chapter (ch. 1.5), concerning railroad preservation, which authorizes the Public Service Commission to qualify for Federal rail service continuation subsidies by administering a State plan that contemplates distribution of Federal subsidies, State grants, and the acquisition and refurbishing of rail properties, as well as sale or transfer of such properties; creates special fund to finance purchase and operation of such properties, as well as retirement of bonds; appropriates \$1.1 million.

3. House Bill 1443, Public Law 235, eliminates sex classifications dealing with employment, occupations, and labor. It

also eliminates a provision that banned females 18 or older from working in mines, but continues prohibition on any person 18 or younger doing such work.

Environmental Management Board regulation EMB-2 was promulgated on August 7. The regulation requires State agencies to define their actions that have significant environmental impact. A revision of Stream Pollution Control Board regulation SPC-11 was promulgated on December 1. The regulation concerns monitoring and reporting requirements for waste-water treatment facilities.

With the approval of the Natural Resources Commission, the Division of Reclamation issued 110 surface mining permits for coal, clay, and shale extraction to 68 companies. The acreage under permit totaled 6,264, of which 99.3% was for coal strip mining. The permits require reclamation of the land for the following uses: 341 acres or 5%, forest land with a maximum grade of 33 $\frac{1}{3}$ %; 2,067 acres or 33%, range land with the same maximum grade; 1,979 acres or 32%, pasture land with a maximum grade of 25%; 1,846 acres or 29%, row cropland with a maximum grade of 8%; and 31 acres or 1%, other land uses including recreation areas.

The Indiana Geological Survey published Bulletin 42-L, "Clay and Shale Resources of Indiana," and Bulletin 42-M, "Dimension Sandstone Resources of Indiana." Among other publications released by the Indiana Geological Survey were two directories: "Directory of Crushed Stone, Ground Limestone, Cement, and Lime Producers in Indiana" and "Directory of Sand and Gravel Producers in Indiana."

**Employment and Injuries.**—Employment in Indiana's mineral industries, excluding petroleum and natural gas, totaled 7,446 persons during 1975, compared with 7,601 in 1974. Although coal industry employment increased 14%, total employment decreased in response to substantial declines in employment at clay and limestone operations. Coal industry employment ranked first with 42% of the total, followed by limestone and dolomite with 25%; sand and gravel, 17%; cement, 8%; gypsum, 5%; clays, 2%; and all remaining industries combined, 1%.

During 1975, Federal mine inspectors from the Mining Enforcement and Safety Administration (MESA) conducted 661 inspections and investigations at Indiana coal mines as follows: 101 regular health and safety inspections, 311 spot inspections, 182 electrical inspections, and 67 other inspections and investigations including such matters as accidents, technical inspections and investigations, and complaints. Federal metal and nonmetallic mine inspectors performed a total of 451 regular inspections and 488 spot inspections at clay, cement, gypsum, peat, sand and gravel, and stone operations.

State mine inspectors from the Indiana Bureau of Mines and Mining conducted 49 health and safety inspections and 33 spot inspections at coal mines. The State bureau also inspected the two underground gypsum mines in Martin County.

Injuries in coal mining operations included 3 fatalities, 73 nonfatal disabling injuries, and 72 nondisabling injuries. Nonmetallic mineral producers reported 1 fatality, 79 nonfatal disabling injuries, and 70 nondisabling injuries.

Louisville Cement Co.'s Logansport plant received a safety trophy reaward from the Portland Cement Association. It was the 10th year (not consecutive) without a lost-time accident.

American Aggregates Corp. gravel plant at Richmond was the winner of the National Sand and Gravel Association's 1975 safety contest class D competition for plants producing 170,000 to 224,999 tons. Certificates of achievement in safety were awarded to contestants who operated in 1975 without lost-time accidents as follows: Class C (225,000 to 549,000 tons) American Aggregates Corp., Carmel plant; U.S. Aggregates, Inc., Plainfield plant; and three Western Materials Co. plants—Hanna, Lafayette, and Leesburg; class D, Central Aggregates, Inc., Indianapolis plant; and South Bend Sand and Gravel Corp., South Bend plant; class E (60,000 to 169,999 tons) Western Materials Co., Anderson plant; and class F (less than 60,000 tons) Rieth-Riley Construction Co., Inc.'s portable plants. A special certificate was awarded to Western Materials Co. for a 6-year accident-free record at its Lafayette gravel plant.

Four Indiana operations received safety awards for an injury-free year during 1975 in the National Crushed Stone Association 50th Annual Safety Contest as follows: Group IV (30,001 to 50,000 man-hours worked) Cave Stone, Inc., Norristown quarry; group V (less than 30,000 man-hours worked) two Western Materials Co. quarries—Francesville and Monon; and Kickapoo Stone and Gravel Division of McMahan-O'Connor Construction Co., Peru quarry.

Table 4.—Indiana: Mineral industry employment and injuries in 1975<sup>1</sup>

Mineral	Number employed	Man-hours	Fatal injuries	Fatal frequency rate (per million man-hours)	Nonfatal disabling injuries	Nonfatal disabling frequency rate (per million man-hours)
<b>Coal:</b>						
Underground -----	245	535,552	--	--	14	26.14
Surface -----	2,676	6,305,683	3	0.48	53	8.41
Mills -----	234	539,143	--	--	6	11.13
Total -----	3,155	7,380,378	3	.41	73	9.88
<b>Cement:</b>						
Surface -----	62	126,155	--	--	1	7.93
Mills -----	406	831,734	--	--	1	1.20
Office -----	93	193,383	--	--	--	--
Total -----	561	1,151,272	--	--	2	1.74
<b>Clays:</b>						
Surface -----	91	151,766	--	--	--	--
Mills -----	50	71,527	--	--	1	13.98
Office -----	21	29,522	--	--	--	--
Total -----	162	252,815	--	--	1	3.96
<b>Gypsum:</b>						
Underground -----	55	119,278	--	--	--	--
Mills -----	259	572,221	--	--	--	--
Office -----	50	103,395	--	--	--	--
Total -----	364	794,894	--	--	--	--
<b>Lime:</b>						
Mills -----	63	98,909	--	--	3	30.33
Office -----	5	7,726	--	--	--	--
Total -----	68	106,635	--	--	3	28.13
<b>Limestone and dolomite:</b>						
Underground -----	58	89,890	--	--	--	--
Surface -----	1,068	1,908,693	1	.52	35	17.81
Mills -----	513	833,511	--	--	16	18.00
Office -----	225	404,753	--	--	--	--
Total -----	1,864	3,236,852	1	.31	51	15.14
Sandstone: Surface -----	25	43,330	--	--	--	--
<b>Miscellaneous stone:</b>						
Surface -----	8	5,126	--	--	--	--
Peat: Surface -----	3	2,265	--	--	--	--
<b>Sand and gravel:</b>						
Surface -----	1,040	1,765,247	--	--	22	12.46
Office -----	196	354,766	--	--	--	--
Total -----	1,236	2,120,013	--	--	22	10.38
<b>Total of nonmetals:<sup>2</sup></b>						
Underground -----	113	209,168	--	--	--	--
Surface -----	2,297	4,002,587	1	.25	58	14.24
Mills -----	1,291	2,407,902	--	--	21	8.31
Office -----	590	1,093,545	--	--	--	--
Grand total <sup>2</sup> -----	4,291	7,713,202	1	.13	79	9.98

<sup>1</sup> All data are preliminary.<sup>2</sup> Excludes coal.

Source: Mining Enforcement and Safety Administration.

## REVIEW BY MINERAL COMMODITIES

## MINERAL FUELS

**Coal (Bituminous).**—Indiana's coal production in 1975 was 25,124,000 tons valued at \$280,130,000. In terms of value, coal continued to be the State's principal mineral commodity. Output increased 6% in quantity and 41% in value above that of the previous year. The average value of a ton of coal rose \$2.79 to \$11.15. More than 99% of the coal was produced at 60 strip mines in 15 counties; the remainder was mined at 2 underground mines. Peabody Coal Co. and Amax Coal Co. were the State's largest producers, followed by Old Ben Coal Co. and Squaw Creek Coal Co., which is owned by Peabody Coal Co. and the Aluminum Company of America (Alcoa). These companies operated 14 strip mines which accounted for about 90% of the State's output. The leading coal-producing counties were Warrick, Pike, Sullivan, and Vermillion which together accounted for 86% of the State's coal output in 1975.

Eleven mechanical coal cleaning plants produced 19,402,000 tons of salable coal and 5,585,000 tons of refuse. None of the plants operated thermal drying units to dry coal.

Coal consumption in Indiana was 46,928,000 tons, about 43% of which came from mines within the State; 21%, from West Virginia, Virginia, and eastern Kentucky; 13%, from Illinois; 9%, from western Kentucky; 6%, from Wyoming; 4%, from Pennsylvania; and most of the remainder from Montana, Utah, and Tennessee. Electric utilities used 61% of the coal consumed in the State including most of the low-sulfur western coal; coke and gas plants used 30%; and most of the remainder was used by industrial plants. Despite consuming about twice the tonnage of coal it produced, 19% of Indiana's coal production was shipped to customers in the following states: Kentucky (7%), Wisconsin (3%), Tennessee, Georgia, Missouri, and Illinois (2% each), and the remainder to Michigan, Minnesota, Ohio, and Alabama.

About 20 million tons of Indiana's coal output was transported by rail or water, including 9.6 million tons by unit train, 5 million tons by truck, and the rest was consumed locally.

Strip mine excavation equipment in operation during the year included 88 power shovels, 82 draglines, 16 scrapers, 265 bulldozers, 94 front-end loaders, 1 power broom, 28 motor graders, 76 overburden drills, and 12 coal drills. The bucket capacities of the power shovels and dragline excavators were as follows: 13 exceeding 50 cubic yards; 17 between 16 and 50 cubic yards; 41 between 6 and 15 cubic yards; and 99 less than 6 cubic yards. Shovels and draglines were powered as follows: 72 electric; 88 diesel; and 10 diesel electric.

Peabody Coal Co. and Alcoa entered into a joint venture to open a 600,000-ton-per-year underground coal mine near Booneville in Warrick County. Construction began in the latter part of the year. A small segment of the mine will be used to train underground coal miners for other Peabody mining operations. About 105 employees, including 15 trainees, were expected to be employed when the mine reached full production during 1976. The new mine also is the first underground coal mine opened in Indiana since 1963.

The Brazil Coal & Clay Corp. completed construction of a 23-cubic-yard dragline to mine coal from the Upper Block coal seam near Center Point in Clay County. Indiana's block coal, so-called because it breaks into large blocks when mined, is well-known for its low ash and low sulfur content.

The Indiana Vocational Technical College near Terre Haute began accepting applications for enrollment in a 2½-year associate degree program in surface mining operation. The program was requested by coal companies who also donated equipment and pledged to provide instructional support and cooperative work stations for the students. The program is designed to supply the surface coal-mining industry with qualified miners and managerial personnel. The courses covered include mining law, blasting and explosives, mine machinery operations, reclamation mine planning, and economics of mining. Two 24-week training sessions in an operational mine are included in the curriculum.

**Coke.**—Indiana ranked second in coke production in the Nation after Pennsylvania. Output of coke produced at six plants increased 2%.

During the year, 13,822,000 tons of coal was carbonized to produce 9,246,000 tons

**Table 5.—Indiana: Bituminous coal production by type of mine and county, 1975**  
(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines				Production (thousand short tons)				Value (thousands)
	Under-ground	Strip	Auger	Total	Under-ground	Strip	Auger	Total	
Clay	--	6	--	6	--	1,102	--	1,102	W
Daviess	--	2	--	2	--	97	--	97	\$1,078
Dubois	--	1	--	1	--	W	--	W	W
Fountain	--	1	--	1	--	40	--	40	W
Greene	--	2	--	2	--	W	--	W	W
Knox	--	2	--	2	--	W	--	W	W
Owen	--	1	--	1	--	11	--	11	123
Parke	--	2	--	2	--	4	--	4	48
Perry	--	1	--	1	--	10	--	10	112
Pike	1	13	--	14	W	W	--	5,560	76,928
Spencer	--	10	--	10	--	547	--	547	5,481
Sullivan	--	3	--	3	--	W	--	W	W
Vermillion	--	3	--	3	--	W	--	W	W
Vigo	--	1	--	1	--	34	--	34	375
Warrick	1	12	--	13	W	W	--	W	W
Undistributed	--	--	--	--	188	23,090	--	17,718	195,988
<b>Total<sup>1</sup></b>	<b>2</b>	<b>60</b>	<b>--</b>	<b>62</b>	<b>188</b>	<b>24,935</b>	<b>--</b>	<b>25,124</b>	<b>280,130</b>

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

of coke, a yield of 66.89%. The value of the coal carbonized was \$653.1 million or \$47.25 per ton. No coking coal was produced in Indiana. About 66% of the coking coal came from West Virginia, Virginia, and Kentucky; 15%, from Pennsylvania; and most of the remainder from Illinois.

The steel industry consumed 92% of the coke production for making pig iron and steel. The value of the 8,469,000 tons of coke used in blast furnaces and steel-producing furnaces was \$744.5 million. Coke was produced by Inland Steel Co., United States Steel Corp., and The Youngstown Sheet and Tube Co. in Lake County; Citizens Gas & Coke Utility in Marion County; Bethlehem Steel Corp. in Porter County; and Indiana Gas & Chemical Corp. in Vigo County. These companies also produced 1,012,000 tons of coke breeze for utilization at agglomeration plants and for other industrial uses.

United States Steel Corp. started up one of two new coke oven batteries, No. 2, during 1975. The other battery, No. 3, was scheduled to be fully operational in late 1976. Each battery is designed to produce 900,000 tons of coke per year. In order to comply with State and Federal air quality standards, the company was forced to shut down three older batteries, 10, 12, and 14, in late December 1975.

Inland Steel Co. retired its 73-oven "A" coke battery after 32 years of operation.

Air pollution control authorities granted the company's request for a 1-year extension in "B" battery operations. One of the conditions for continued operation of "B" battery was that coke production must be limited to filling the deficit from the new "C" battery, which was started up during 1974. Substantial problems in both design and operation of the new "C" battery, which is equipped with a unique coal pre-heating and pipeline charging system, prevented it from reaching its rated capacity.

**Peat.**—Peat sales totaled 76,210 tons valued at \$1,918,000, an increase of 7% in quantity and 103% in value. The average value of peat increased \$11.88 per ton to \$25.17, compared with \$13.29 per ton in 1974. Nine companies reported peat production in seven counties. The types of peat produced included moss and reed-sedge, most of which was shredded. The peat was used principally for soil conditioning and horticultural use. None was sold for use as fuel.

**Petroleum and Natural Gas.**—Production of crude petroleum continued to decline during 1975. The total amount produced from 4,380 wells<sup>2</sup> was 4,632,282 barrels, or 5.8% less than produced in 1974. Total value of crude production was \$48,821,000, an increase of 15% from that of the previous year. The average

<sup>2</sup> World Oil. V. 182, No. 3, 1976, p. 92.

value was \$10.54 per barrel, a \$1.92 per barrel increase from the 1974 level.

Secondary recovery methods accounted for 52.5% of the crude petroleum produced during 1975. Secondary recovery of oil by waterflooding has contributed substantially to Indiana's total crude petroleum production during the last 25 years. Waterflooding operations increased rapidly during the early 1950's, and between 1955 and 1961 more than one-third of the oil produced was credited to secondary recovery efforts. In 1962, secondary oil production increased to almost 49% of the total; since that year, secondary oil has accounted for 50% to 66% of the total annual production. In the foreseeable future, secondary recovery operations are expected to continue to produce the bulk of Indiana's crude petroleum.

The number of wells drilled for oil and gas during 1975 increased by less than 1%, but total footage drilled increased 14%. Of the 399 wells drilled, 157 were exploratory and 242 were for primary development. The success ratio of exploratory drilling was 13.4% with 16 oil well discoveries and 5 gas well discoveries. The discovery wells resulted in 3 new field discoveries (1 oil and 2 gas), 13 new pool discoveries (11 oil and 2 gas), and 5 extensions to existing pools (4 oil and 1 gas). Of these discoveries, 16 were in Mississippian rock formations, 1 in Devonian, and 4 in Pennsylvanian.

The Salem Limestone of Mississippian age attracted considerable attention in Daviess and Gibson Counties. A new pool discovery well in the Odon South field in Daviess County was completed in the Salem at a depth of 923 to 927 feet with an initial production of 101 barrels per day. A second well produced 50 barrels per day. In the Owensville North Consolidated field in Gibson County, 12 Salem wells were completed in a continuing effort to expand the area of known productivity.

Proved oil reserves at the end of 1975 amounted to 22,029,000 barrels, and because no natural gas liquid reserves were credited to Indiana in 1975, the total liquid hydrocarbon reserves were also 22,029,000 barrels.<sup>3</sup>

Natural gas production increased 97% in quantity and the value of output increased nearly 450%, from \$25,000 in 1974 to \$135,000 in 1975. The 346.3 mil-

lion cubic feet produced from 478 wells<sup>4</sup> accounted for only 0.07% of the 477,341 million cubic feet of gas used by Indiana consumers during 1975. Natural gas consumption in the State was divided as follows: Industrial, 47%; residential, 34%; commercial, 14%; electric utilities, 2%; and natural gas pipeline companies and other consumers, 3%. Natural gas consumption in 1975 was 10% less than that in 1974.

Proved natural gas reserves at the end of 1975 were 59,839 million cubic feet<sup>5</sup> including native gas and gas injected into underground storage reservoirs.

Seven petroleum refineries were in operation at the beginning of the year with a combined crude oil distillation capacity of 554,300 barrels per calendar day. During the year, Gladieux Refining, Inc. increased its Fort Wayne refinery capacity by 3,700 barrels per day, Indiana Farm Bureau Coop. Association, Inc. increased its Mt. Vernon refinery capacity by 2,500 barrels per day, and Rock Island Refining Corp. increased its Indianapolis refinery capacity by 3,100 barrels per day. Crystal-Princeton Refining Co. shut down its 4,300-barrel-per-day refinery at Princeton in Gibson County. At yearend, the six operating refineries had a combined crude oil distillation capacity of 559,300 barrels per calendar day. These six operating refineries and their capacities at yearend are as follows, in barrels per calendar day: American Oil Co., 360,000 and Atlantic Richfield Co., 126,000 both in Lake County; Rock Island Refining Corp., 32,600 in Marion County; Indiana Farm Bureau Coop. Association, Inc., 20,000 in Posey County; Laketon Asphalt Refining Co., 8,500 in Wabash County; and Gladieux Refining, Inc., 12,200 in Allen County.

Crude oil input to Indiana's refineries during 1975 totaled 163,277,000 barrels, 81% of which was domestically produced crude oil and 19% was foreign. About 32% of Indiana's 4.6-million-barrel crude oil production was sent to Indiana's refineries; the remainder went to refineries in States south and east of Indiana.

<sup>3</sup> American Gas Association, American Petroleum Institute and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada and United States Productive Capacity (as of Dec. 31, 1975). V. 30, May 1976.

<sup>4</sup> Page 94 of work cited in footnote 2.

<sup>5</sup> Work cited in footnote 3.

Table 6.—Indiana: Crude petroleum production in 1975, by major field

Field	Year discovered	Area (acres)	County	Number of wells		Production (barrels)
				Producing	Completed	
Black River Consolidated -----	1950	700	Posey -----	NA	--	112,986
Coe South -----	1961	450	Pike -----	NA	--	131,460
Griffin Consolidated -----	1938	7,540	Gibson, Posey -----	NA	3	563,859
Heusler Consolidated -----	1938	2,270	Posey, Vanderburg.	NA	1	173,950
Mt. Carmel Consolidated -----	1941	2,390	Gibson, Knox -----	NA	6	132,195
Mt. Vernon Consolidated -----	1941	2,490	Posey -----	NA	4	195,437
Owensville Consolidated -----	1940	2,160	Gibson -----	NA	15	126,905
Plummer -----	1969	1,200	Greene -----	NA	3	316,595
Springfield Consolidated -----	1943	2,770	Posey -----	NA	10	274,080
Union-Bowman Consolidated (new) -----	1941	15,940	Gibson, Knox, Pike.	NA	7	189,733
Welborn Consolidated -----	1941	1,860	Posey -----	NA	3	187,438
Wheatonville Consolidated (new) -----	1949	2,120	Gibson -----	NA	2	105,195
Undistributed -----	XX	XX	-----	NA	99	2,122,449
Total -----	XX	XX	-----	NA	153	4,632,282

NA Not available. XX Not applicable.

<sup>1</sup> Includes workovers without newly drilled footage.

Source: Petroleum Section, Indiana Geological Survey.

Table 7.—Indiana: Oil and gas wells drilled in 1975<sup>1</sup>

County	Proved field wells			Exploratory wells			Total	Footage
	Oil	Gas	Dry	Oil	Gas	Dry		
Clay -----	1	--	2	--	--	3	6	6,823
Daviess -----	12	--	7	2	--	19	40	43,789
Decatur -----	--	8	--	--	--	--	8	9,792
Dubois -----	--	--	--	--	2	5	7	10,124
Gibson -----	39	--	30	6	--	21	96	187,539
Greene -----	3	1	1	--	1	11	17	15,485
Hancock -----	--	1	--	--	--	--	1	1,030
Henry -----	--	1	--	--	--	--	1	936
Huntington -----	1	--	--	--	--	--	1	982
Knox -----	8	--	1	1	--	11	21	32,100
Martin -----	--	--	--	--	--	1	1	1,526
Perry -----	--	--	1	--	--	2	3	3,264
Pike -----	7	--	6	--	--	4	17	20,498
Posey -----	48	--	21	5	1	33	108	233,111
Rush -----	--	1	--	--	--	--	1	888
Spencer -----	11	--	10	--	--	8	29	22,149
Sullivan -----	1	--	1	--	1	2	5	6,616
Vanderburgh -----	13	--	4	1	--	12	30	55,258
Vigo -----	--	--	1	1	--	1	3	2,998
Wabash -----	--	--	1	--	--	2	3	3,035
Warrick -----	--	--	--	--	--	1	1	1,926
Total -----	<sup>2</sup> 144	<sup>3</sup> 12	<sup>4</sup> 86	16	5	<sup>3</sup> 136	399	659,869

<sup>1</sup> Does not include service wells (water input, saltwater disposal, water supply, or gas input wells). Also does not include wells drilled in connection with gas storage operations.

<sup>2</sup> Includes oil wells completed in secondary recovery projects.

<sup>3</sup> Includes workovers without newly drilled footage.

<sup>4</sup> Includes dry holes completed in secondary recovery projects.

Source: Petroleum Section, Indiana Geological Survey.

## NONMETALS

**Abrasives.**—Hindustan Whetstone Co. fabricated whetstones from sandstone quarried near Orleans in Orange County. Output decreased 75% in quantity and 76% in value. Abrasives also were manufactured from steel and aluminum by The Wheelabrator-Frye, Inc. at Mishawaka in St. Joseph County.

**Cement.**—Portland cement shipments, comprising 86% of the State's cement output, decreased in quantity but the value rose over 1974 figures. Portland cement was produced at five plants, three of which also produced masonry cement. The average mill value of portland cement for all types was \$28.87 per ton in Indiana, an increase of \$4.71 per ton over the average mill value in 1974.

Type I (general construction use) and Type II (moderately low heat and moderate degree of resistance to sulfate attack) comprised 93% of the portland cement shipped; 5% was Type III (high-early-strength); and all others combined comprised 2%.

Disposition of portland cement shipped by Indiana manufacturers was as follows: 60% to ready-mix concrete producers; 18% to concrete product manufacturers for concrete blocks, concrete pipes, precast prestressed concrete, and other concrete products; 11% to building material dealers; and the remainder to other contractors and for miscellaneous uses. Apparent consumption of portland cement in Indiana during 1975 was 1,543,000 tons, a decrease of 11%.

Masonry cement shipments decreased in quantity, but the value of shipments was nearly the same as in the previous year. The average mill value of masonry cement increased 14% to \$35.75. Apparent con-

sumption of masonry cement in Indiana was 98,000 tons, a decrease of 12%.

Louisville Cement Co. broke ground on a \$23 to \$25 million modernization project at its Speed plant. The project calls for construction of a 670,000-ton-per-year suspension preheater kiln, a 250-ton-per-hour roller mill, and a new raw-materials-handling system with completion scheduled for late 1977. At the Logansport plant of Louisville Cement Co., a dust-emission control system on the two clinker coolers was completed and put into service. Universal Atlas Cement Division of United States Steel Corp. increased its cement production capacity and put new dust control equipment into operation at its Bufington plant.

**Clays.**—Combined clay and shale production totaled 1,094,000 tons valued at \$1,961,000, an increase of less than 1% in quantity and value. Common clay and shale accounted for more than 99% of the total output; less than 1% was fire clay. Production was reported from 26 mines operated by 22 companies in 16 counties. Six companies with 10 mines produced 82% of the State's clay and shale: Hydraulic-Press Brick Co. in Morgan County; Louisville Cement Co. in Cass and Clark Counties; Log Cabin Coal Co. in Clay County; C & F Shale Co. in Clay County; General Shale Products Corp. in Morgan County; and American Brick Co. in Lake County. Fire clay was produced by C. Lorenz & Son and McCool Loam Co./Zehner Excavating Co. in Porter County, and H. H. Bartelt in Dubois County. About 58% of all production was used in making concrete blocks, portland cement, and lightweight aggregate; 33% was used to manufacture building bricks; and the remainder was used for sewer pipe, drain

Table 8.—Indiana: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Fire clay		Common clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1971	11	15	1,324	2,303	1,325	2,308
1972	W	W	1,419	2,462	<sup>2</sup> 1,419	<sup>2</sup> 2,465
1973	143	174	1,393	2,394	1,436	2,568
1974	26	118	1,066	1,828	1,092	<sup>3</sup> 1,947
1975	2	16	1,092	1,945	1,094	1,961

W Withheld to avoid disclosing individual company confidential data; excluded from total.

<sup>1</sup> Includes a small amount of kaolin.

<sup>2</sup> Includes a small amount of ball clay.

<sup>3</sup> Data do not add to total shown because of independent rounding.



tile, ceramic tile, and other ceramic uses. Fire clay was used in making refractory materials.

**Gypsum.**—Crude gypsum production decreased 2%, and was 7% below the 1972 record. National Gypsum Co. and United States Gypsum Co. each operated underground mines near Shoals in Martin County and calcined gypsum at plants adjacent to the mines. United States Gypsum Co. also operated a calcining plant near East Chicago, Lake County, on crude gypsum mined in Michigan and transported by lake carrier. Among the States, Indiana ranked sixth in the production of crude gypsum and fifth in the production of calcined gypsum. Calcined gypsum production decreased 2% and was 12% below the record high in 1973. The major use of calcined gypsum was for building purposes, mainly the manufacture of wallboard and sheathing.

Universal Gypsum Co. of Indiana, Inc., in Elkhart, Elkhart County, processed and marketed byproduct gypsum produced chemically by Miles Laboratories, Inc. in the manufacture of citric acid. The byproduct gypsum was used mainly in food processing and products requiring gypsum of high purity.

**Lime.**—Production of lime decreased 4% in quantity but increased 24% in value. Marblehead Lime Co. produced quicklime in one of the world's largest lime plants at Buffington, Lake County; Inland Steel Co. produced quicklime at its Indiana Harbor Works, also in Lake County. Both plants produced lime from limestone quarried in Michigan and transported to Indiana by lake freighters.

Although Indiana is an important lime producer, ranking sixth in the Nation, the State consumes considerably more lime than it produces. Lime consumption during 1975 was 1,804,000 tons, ranking Indiana fourth among the States in use of lime. Most of the lime was used by the steel industry in steelmaking furnaces.

**Perlite.**—Crude perlite mined in New Mexico was expanded at five plants in Indiana: United States Gypsum Co. at gypsum plants in Lake and Martin Counties; National Gypsum Co. at its gypsum plant in Martin County; Grefco, Inc., near Crawfordsville, Montgomery County; and Chemrock Corp. near Lafayette, Tippecanoe County. Production of expanded

perlite was 15,499 tons, a 4% decrease from that of the previous year. The quantity sold or used totaled 15,144 tons valued at \$1,122,000, a decrease of 4% in quantity and an increase of 5% in value over 1974. Average value per ton increased \$6.16 to \$74.08. The principal uses for perlite expanded in Indiana were for filter aid and plaster aggregate.

**Sand and Gravel.**—Sand and gravel production in Indiana totaled 21,641,000 tons valued at \$35,234,000. Although the quantity produced was 17% lower than in the previous year, the value of output declined only 1%. The average unit value increased 19% to \$1.63 per ton compared with \$1.37 per ton in 1974. Construction sand and gravel accounted for 98.5% of the total tonnage and 97% of total value. The remaining output was industrial sand produced for chemical and foundry industry use. Sand and gravel was mined in 62 counties at 186 locations. Production ranged from 5,000 tons in one county to 1.8 million tons in another. Output exceeded 1 million tons in Hamilton, Marion, St. Joseph, Switzerland, and Tippecanoe Counties.

Only 2 operations produced 1 million tons or more each; 3, between 500,000 and 1 million tons each; 24, between 200,000 and 500,000 tons each; 46, between 100,000 and 200,000 tons each; 52, between 25,000 and 100,000 tons each; and 59, less than 25,000 tons each. American Aggregates Corp., Western Indiana Aggregates Corp., Hilltop Concrete Corp., and Irving Materials, Inc. were the largest producers.

Of the 21,310,000 tons of construction sand and gravel produced in 1975, 9,466,000 tons or 44% was processed sand, 9,589,000 tons or 45% was processed gravel, and 2,255,000 tons or 11% was unprocessed sand and gravel. Processing consisted of washing, screening, sizing, and crushing.

Commercial sale or use of construction aggregate (blended sand and gravel) and industrial sand and gravel accounted for 75% of the total tonnage and 78% of the total value. Construction aggregate sold or used for publicly funded projects accounted for 25% of the tonnage and 22% of the value. The principal uses of the material were highway construction and paving, building construction, and fills.

**Table 9.—Indiana: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mix concrete):				
Nonresidential and residential construction -----	5,590	8,223	5,787	10,449
Highway and bridge construction -----	622	978	1,187	2,149
Other construction (dams, waterworks, airports, etc.) -----	296	418	257	456
Concrete products (cement blocks, brick, pipe, etc.) -----	1,547	2,089	1,581	2,686
Bituminous paving (asphalt and tar paving) -----	6,876	10,495	2,716	4,875
Roadbase and subbase -----	1,210	1,656	1,386	2,291
Fill -----	989	1,056	1,219	1,503
Other -----	580	550	214	386
Unprocessed:				
Roadbase and subbase -----	182	160	236	238
Fill -----	2,532	1,676	1,305	1,323
Other -----	--	--	8	6
Industrial sand and gravel -----	266	804	331	953
Total <sup>1</sup> -----	20,690	28,105	16,228	27,317

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 10.—Indiana: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mix concrete):				
Nonresidential and residential construction -----	156	235	83	144
Highway and bridge construction -----	1,860	2,711	1,485	2,436
Other construction (dams, waterworks, airports, etc.) -----	93	134	70	114
Concrete products (cement blocks, brick, pipe, etc.) -----	24	34	136	204
Bituminous paving (asphalt and tar paving) -----	1,792	2,568	1,385	2,306
Roadbase and subbase -----	1,136	1,528	1,097	1,797
Fill -----	165	192	280	316
Other -----	64	99	170	224
Unprocessed:				
Roadbase and subbase -----	W	W	531	281
Fill -----	96	49	169	91
Other -----	--	--	7	3
Total <sup>1</sup> -----	5,386	7,550	5,414	7,917

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 11.—Indiana: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Allen	8	786	938	8	755	1,107
Bartholomew	2	309	353	2	253	378
Boone	2	W	W	3	188	308
Cass	1	104	111	2	W	434
Clark	2	W	W	1	115	207
De Kalb	6	422	525	6	321	456
Delaware	3	456	536	3	315	425
Elkhart	11	772	908	8	491	804
Fayette	2	W	W	1	231	410
Fulton	3	W	W	4	338	562
Gibson	1	27	37			
Hamilton	4	1,907	3,135	4	1,584	3,255
Hancock	3	140	222	4	208	374
Henry	3	293	456	3	160	302
Jay	1	50	75	1	W	122
Johnson	1	264	346	3	193	288
Kosciusko	4	393	393	6	482	457
Lagrange	6	181	153	8	140	143
La Porte	4	705	1,223	4	818	1,501
Madison	7	620	882	7	528	699
Marion	6	3,886	4,925	5	1,811	2,569
Marshall	4	913	1,300	2	W	W
Miami	2	W	W	4	315	581
Montgomery	4	56	57	3	48	17
Morgan	5	356	538	6	458	824
Noble	6	243	293	6	219	323
Parke	2	166	277	1	45	86
Pike				1	5	98
Putnam	2	W	W	3	74	14
Rush	2	24	30	2	12	14
St. Joseph	6	1,232	1,463	8	1,066	1,781
Shelby	4	440	640	3	342	608
Starke	1	17	15			
Steuben	5	442	639	4	243	325
Sullivan	4	373	493	3	329	458
Switzerland	1	1,181	1,739	1	1,279	W
Tippecanoe	4	992	1,438	5	1,238	1,973
Union	1	11	9			
Vermillion	3	466	680	2	W	W
Vigo	6	430	729	3	W	W
Warren	4	618	907	4	677	1,235
Washington	1	14	7			
Wayne	2	W	W	4	607	1,079
Other counties <sup>1</sup>	37	6,787	9,186	38	5,750	10,929
Total <sup>2</sup>	186	26,077	35,656	186	21,641	35,234

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

<sup>1</sup> Includes Adams, Carroll (1975), Clinton (1974), Daviess, Dearborn, Floyd (1975), Fountain, Franklin, Grant, Greene, Harrison, Hendricks (1974), Howard, Huntington, Jackson, Jasper, Knox, Lake, Owen, Porter (1975), Posey, Randolph, Tipton, Wabash, and Whitley Counties, and counties indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

About 88% of Indiana's sand and gravel output was transported by truck, 6% by barge, and 2% by rail and other means. The remaining 4% was used at the mine-sites.

**Slag.**—About 7 million tons of blast furnace slag and steel furnace slag was produced in Lake and Porter Counties as a waste product from pig iron and steel production. Most of the slag was disposed of or used by the ironmaking and steel-making firms. Some slag was processed and

marketed for mineral wool, roofing granules, and various other aggregate uses.

**Stone.**—Production of stone in Indiana totaled 28,947,000 tons with a value of \$68,850,000, a decrease of 6.7% in quantity, but an increase of 7.4% in value from that of the previous year. Stone output in 1975 was as follows: Crushed and broken limestone and dolomite, 28,665,000 tons with a value of \$57,806,000; dimension limestone, dolomite, and sandstone, 254,000 tons with a value of \$11,004,000; and

marl, 28,000 tons with a value of \$41,000. The average value of crushed and broken stone increased 23 cents per ton to \$2.02; limestone averaged \$1.95 per ton, dolomite averaged \$2.19 per ton, and marl \$1.44 per ton. The average value of dimension stone increased \$4.69 per ton to \$43.32; dimension limestone averaged \$45.93 per ton, dimension dolomite averaged \$14.83 per ton, and dimension sandstone \$35.00 per ton.

Stone was produced by 79 companies at 145 quarries in 54 counties. Three quarries had outputs exceeding 900,000 tons each; 11, between 500,000 and 900,000 tons each; 66, between 100,000 and 500,000 tons each; and 65, less than 100,000 tons each, of which 34 produced less than 25,000 tons each.

Mulzer Crushed Stone Co., France Stone Co., Ralph Rogers & Co., Inc., and Irving Bros. Gravel Co., Inc. were the largest producers of crushed limestone and dolomite. Nine companies mined marl from 12 quarries in Elkhart, Lagrange, La Porte, Marshall, Noble, St. Joseph, and Steuben Counties.

Although dimension stone represented less than 1% of the stone tonnage produced, it had 16% of the value in 1975. Dimension limestone was produced by 14 companies at 22 quarries in Franklin, Lawrence, Monroe, Putnam, and Rush Counties. Victor Oolitic Stone Co. and Indiana Limestone Co., Inc. were the largest producers with operations in Monroe and Lawrence Counties. Two companies produced dimension sandstone in Lawrence and Morgan Counties, and two companies produced dimension dolomite in Franklin and Rush Counties.

Principal uses for Indiana's stone output were as follows: Roadbase and paving materials (66%), concrete aggregate (11%), manufacture of portland cement (10%), agricultural uses (9%), and the remainder for railroad ballast, riprap and jetty stone, rough and dressed architectural dimension stone, and miscellaneous chemical and industrial uses. About 92% of the stone was transported by truck, 5% by water, and the remainder by rail and other means.

Crawford County Stone Co., a subsidiary of Ralph Rogers & Co., opened a new

crushed stone quarry near Tower in Crawford County. A crushed stone quarry was also opened by Berry Materials Corp. near Madison in Jefferson County. Midwest Quarries Co., Inc., a dimension limestone producer, went out of business early in 1976.

Stone quarrying and core drilling operations led to several interesting discoveries in Carroll County. At the Delphi Limestone, Inc. quarry at Delphi, large masses of sphalerite, the principal ore of zinc, were found in a newly opened section of the quarry, and the Indiana Geological Survey's core drilling operations sited at the quarry led to the discovery of the thickest and one of the purest known sections of high-magnesium dolomite in Indiana. The average analysis for 338 feet of core plus 60 feet of exposed rock in the quarry was 54.8%  $\text{CaCO}_3$ , 44.3%  $\text{MgCO}_3$ , and less than 1% impurities; no sphalerite was found in the core. At another coring location in Carroll County, the Indiana Geological Survey discovered a thick section of high-calcium limestone with an average composition of 97.7%  $\text{CaCO}_3$ , 1.1%  $\text{MgCO}_3$ , and 1.2% impurities. Both high-magnesium dolomite and high-calcium limestone are widely used in chemical applications, the manufacture of glass, cement, and lime, and in ironmaking and steelmaking processes.

In celebration of the U.S. Bicentennial, citizens of the Bedford area commissioned stone carvers in the Indiana Dimension Limestone Belt to create a life-size reproduction of Emanuel Leutze's famous painting "Washington Crossing the Delaware." Stone for the project was quarried in Monroe County and carved at Indiana Limestone Co.'s McMillan mill in Lawrence County. The three-dimensional limestone statuary, 20 feet long, 8 feet wide, 8 feet tall, and weighing 40 tons, was permanently located at a point overlooking the Delaware River at the site of the famous crossing in Washington Crossing Park, Pa. Dedication ceremonies were held on July 5, 1976.

**Sulfur.**—American Oil Co. and Atlantic Richfield Co. recovered sulfur from crude petroleum at their refineries in Lake County. Sales increased 22% in volume and 12% in value.

Table 12.—Indiana: Dimension stone sold or used by producers, by use

Use	1975		
	Short tons	Cubic feet	Value (thousands)
Rough architectural .....	127,943	1,701,085	\$3,350
Irregular-shaped stone .....	8,736	121,328	232
Rubble .....	13,760	189,033	130
Flagging .....	W	W	W
Cut stone .....	18,393	250,922	3,074
Sawed stone <sup>1</sup> .....	54,915	757,098	3,191
House stone veneer .....	30,288	425,025	1,027
Total .....	254,035	3,444,491	11,004

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

<sup>1</sup> Includes a small amount of stone used for dressed flagging and construction work.

Table 13.—Indiana: Crushed limestone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate .....	2,516	4,819	3,096	6,715
Concrete aggregate .....	3,644	6,602	3,220	6,597
Dense-graded roadbase stone .....	7,544	13,307	7,116	14,552
Macadam aggregate .....	3,117	5,605	2,348	4,841
Surface treatment aggregate .....	1,316	2,448	849	1,850
Other construction aggregate and roadstone .....	6,583	12,066	5,595	10,954
Agricultural limestone <sup>1</sup> .....	1,810	3,716	2,498	5,202
Cement manufacture .....	3,155	4,036	2,801	3,868
Railroad ballast .....	394	653	271	513
Riprap and jetty stone .....	174	380	250	598
Other uses <sup>2</sup> .....	489	1,069	621	2,114
Total <sup>3</sup> .....	30,741	54,702	28,665	57,806

<sup>1</sup> The 1974 data include other soil conditioners, and poultry grit and mineral food.

<sup>2</sup> Includes stone used for filter stone (1975), manufactured fine aggregates, glass manufacture, flux stone, mine dusting, asphalt filler, fill (1974), agricultural marl, and poultry grit and mineral food (1975).

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 14.—Indiana: Crushed limestone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974		1975	
	Quantity	Value	Quantity	Value
Allen	2,224	4,510	2,160	4,602
Blackford	90	165	W	W
Cass	1,098	1,892	1,049	1,761
Clark	2,731	4,358	2,391	4,197
Crawford	W	W	3,091	5,632
Delaware	790	1,447	W	W
Fayette	2	3	--	--
Hamilton	1,564	2,940	1,217	2,651
Hancock	3	5	--	--
Harrison	642	1,196	680	1,302
Jasper	W	580	W	W
Johnson	1	1	1	3
Kosciusko	22	47	--	--
La Porte	--	--	1	2
Lawrence	1 2,405	1 6,091	1,736	3,399
Miami	230	W	W	W
Monroe	W	1 7,900	751	1,308
Orange	598	1,097	561	1,174
Posey	31	93	2	8
Pulaski	551	831	W	W
Putnam	1 3,258	1 5,303	2,755	5,386
Sullivan	13	49	20	84
Switzerland	67	185	72	166
Vanderburgh	1	4	--	--
Wayne	5	9	240	549
White	350	560	W	W
Undistributed <sup>2</sup>	14,306	24,778	11,937	25,580
Total <sup>3</sup>	30,982	64,044	28,665	57,806

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

<sup>1</sup> Includes some dimension stone.

<sup>2</sup> Includes Adams, Bartholomew, Carroll, Decatur, Grant, Howard, Huntington, Jay, Jennings, Lake, Madison, Marion, Morgan, Newton, Owen, Perry, Randolph, Ripley, Rush, Scott, Shelby, Vigo, Wabash, Washington, and Well Counties, and counties indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 15.—Indiana: Calcareous marl production

Year	Number of producers	Short tons	Value
1971	12	29,074	\$26,095
1972	9	26,137	24,171
1973	10	41,241	48,981
1974	10	48,602	62,215
1975	9	28,373	40,845

## METALS

**Aluminum.**—Alcoa produced aluminum ingots and thin-gage aluminum sheet at its smelter and fabricating operations in Warrick County near Evansville. Alumina was barged to the smelter from Mobile, Ala., and Point Comfort, Tex. Ingot production decreased 7% in quantity and increased 30% in value. In response to natural gas curtailments, the company spent \$5 million at its Warrick operations to install dual fuel systems on furnaces to burn natural gas or fuel oil.

**Pig Iron and Steel.**—Pig iron production from Indiana's 27 blast furnaces was 15,657,000 tons in 1975, a decrease of 1,344,000 tons or 8%. Pig iron shipments totaled 15,648,000 tons valued at \$2,707,967,000; shipments in 1974 totaled 17,022,000 tons valued at \$1,991,438,000. The average value of pig iron increased 48%, from \$116.99 per ton in 1974 to \$173.06 per ton in 1975. Inland Steel Co., United States Steel Corp., and The Youngstown Sheet and Tube Co. each produced pig iron and steel in Lake County, and Bethle-

hem Steel Corp. produced pig iron and steel in Porter County.

Steel output reported by the American Iron and Steel Institute was 19,807,000 tons, 14% less than Indiana's 1974 production. Steel was produced in basic oxygen furnace (BOF) shops by each of the four primary producers and in open-hearth furnaces by Inland Steel Co. and The Youngstown Sheet and Tube Co. Steel was also produced from scrap in electric furnaces.

Groundbreaking ceremonies in June officially began Inland Steel Co.'s previously announced \$1 billion expansion program to increase annual steelmaking capacity at Indiana Harbor Works by 1.8 million tons by 1980.

Bethlehem Steel Corp.'s first continuous slab casters began operating at the Burns Harbor plant in April. The caster is designed to produce 1.5 million tons of steel slabs annually. A sinter plant was placed in operation at the end of September. The

plant is expected to produce annually 2 million tons of fluxed sinter feed for blast furnace use from iron ore fines, flue dust, mill scale, iron-bearing pollution control sludges and dust, BOF slag, and limestone fines.

National Steel Corp. announced plans for an expansion program to turn its Midwest Steel Division plant at Portage, Porter County, into a complex integrated steel-making works. The expansion plans call for a new self-unloading ore-coal vessel dock, raw material storage and preparation facilities, a coke plant, a sintering plant, a 5,500-ton-per-day blast furnace, a two-vessel BOF shop, and a continuous slab caster. When completed in the 1980's, the facility will have a rated capacity of about 2.3 million tons of steel per year.

**Other Metals.**—Antimonial lead was recovered by USS Lead Refinery, Inc., a division of UV Industries, Inc., at its secondary lead refinery in Lake County.

Table 16.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Abrasive stone:</b>			
Hindustan Whetstone Co -----	Box 501 Bedford, Ind. 47421	Quarry and plant.	Lawrence and Orange.
<b>Cement:</b>			
Lehigh Portland Cement Co. <sup>1,2</sup> --	718 Hamilton St. Allentown, Pa. 18105	Plant -----	Lawrence.
Lone Star Industries Inc. <sup>2</sup> -----	One Greenwich Plaza Greenwich, Conn. 06830	----do -----	Putnam.
Louisville Cement Co. <sup>1,2</sup> -----	501 South 2d St. Louisville, Ky. 40202	----do -----	Cass and Clark.
United States Steel Corp. <sup>3</sup> -----	600 Grant St. Pittsburgh, Pa. 15230	----do -----	Lake.
<b>Clays:</b>			
American Brick Co -----	6558 West Fullerton Ave. Chicago, Ill. 60635	Pit and plant..	Do.
General Shale Products Corp --	P.O. Box 96 Mooresville, Ind. 46158	----do -----	Morgan.
Hydraulic-Press Brick Co -----	705 Olive St. St. Louis, Mo. 63101	----do -----	Do.
Log Cabin Coal Co -----	304 South Depot St. Brazil, Ind. 47834	Pits -----	Clay.
S. L. Turner Coal and Clay Co., Inc. -----	Box 337 Carbon, Ind. 47837	----do -----	Parke.
<b>Coal (bituminous):</b>			
Amax Coal Co -----	430 Big Four Bldg. Indianapolis, Ind. 46225	Strip and un- derground mines, plant.	Clay, Pike, Sullivan, Warrick.
Old Ben Coal Co -----	10 South Riverside Plaza Chicago, Ill. 60606	Strip mine ----	Pike.
Peabody Coal Co -----	301 North Memorial Dr. St. Louis, Mo. 63102	Strip mine and plant.	Greene, Sullivan, Vermillion, Warrick.
<b>Coke:</b>			
Citizens Gas & Coke Utility ----	2020 North Meridian Indianapolis, Ind. 46209	Plant -----	Marion.
Indiana Gas & Chemical Corp --	1341 Hulman St. Terre Haute, Ind. 47802	----do -----	Vigo.
Inland Steel Co. <sup>4</sup> -----	3210 Watling St. East Chicago, Ind. 46312	----do -----	Lake.
The Youngstown Sheet and Tube Co. -----	Box 900 Youngstown, Ohio 44501	----do -----	Do.
See footnotes at end of table.			

Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
National Gypsum Co. <sup>5</sup> -----	325 Delaware Ave. Buffalo, N.Y. 14202	Underground mine and plant.	Martin.
United States Gypsum Co. <sup>5</sup> -----	101 South Wacker Dr. Chicago, Ill. 60606	-----do -----	Do.
Lime: Marblehead Lime Co -----	300 West Washington St. Chicago, Ill. 60606	Plant -----	Lake.
Peat:			
Herb Felger Peat Moss and Black Dirt.	9912 Valentine Rd. Fort Wayne, Ind. 46808	Bog and plant.	Allen.
Milburn Peat Co. Inc -----	Box 236 Laporte, Ind. 46350	-----do -----	Warren.
Organic Products Co -----	2695 Cicero Rd. Noblesville, Ind. 46060	-----do -----	Delaware.
Ralph Shewman -----	Route 1, Akron, Ind. 46910	-----do -----	Fulton.
Perlite (expanded):			
Chemrock Corp -----	End of Osage St. Nashville, Tenn. 37208	Plant -----	Tiptecanoe.
Grefco, Inc -----	2111 Enco Dr. Oakbrook, Ill. 60521	-----do -----	Montgomery.
Petroleum refineries:			
American Oil Co. <sup>8</sup> -----	2400 New York Ave. Box 710 Whiting, Ind. 46394	Refinery -----	Lake.
Atlantic Richfield Co. <sup>6</sup> -----	3500 Indianapolis Blvd. East Chicago, Ind. 46312	-----do -----	Do.
Rock Island Refining Corp -----	P.O. Box 68007 Indianapolis, Ind. 46268	-----do -----	Marion.
Roofing granules:			
H. B. Reed & Co., Inc -----	8149 Kennedy Ave. Highland, Ind. 46322	Plants -----	Lake.
Sand and gravel:			
American Aggregate Corp. <sup>2</sup> -----	Garst Ave. at Ave. B Greenville, Ohio 45331	Pits and plants.	Hamilton, Marion, Wayne.
Hilltop Concrete Corp -----	Box 11056 Cincinnati, Ohio 45211	-----do -----	Switzerland.
Smelters and refineries (nonferrous):			
Aluminum Company of America.	Newburgh, Ind. 47630	Smelter -----	Warrick.
American Smelting & Refin- ing Co.	2230 Indianapolis Blvd. Whiting, Ind. 46394	Plant -----	Lake.
NL Industries, Inc -----	Beech Grove, Ind. 46107	-----do -----	Marion.
USS Lead Refinery, Inc -----	5300 Kennedy Ave. East Chicago, Ind. 46312	-----do -----	Lake.
Stone:			
France Stone Co -----	Box 1928 Toledo, Ohio 43603	Quarries -----	Allen and Putnam.
Medusa Corp. <sup>7</sup> -----	Box 5668 Cleveland, Ohio 44101	Quarries and plants.	Pulaski and White.
Mulzer Crushed Stone Co -----	Box 248 Tell City, Ind. 47586	Quarries, mine, plants.	Crawford and Perry.
Ralph Rogers & Co., Inc -----	Box 899 Bloomington, Ind. 47401	-----do -----	Lawrence and Newton.

<sup>1</sup> Also clays.<sup>2</sup> Also stone.<sup>3</sup> Also coke.<sup>4</sup> Also lime.<sup>5</sup> Also perlite.<sup>6</sup> Also recovered sulfur.<sup>7</sup> Also sand and gravel.





# 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 Iowa Geological Survey for collecting information on all minerals except fuels.

By Waldemar M. Dressel <sup>1</sup> and Fred H. Dorheim <sup>2</sup>

Iowa ranked 33d in the Nation in value of mineral production during 1975. Ton-nages of most commodities were down slightly compared with those of 1974, but the total value was up over that of 1974 to achieve an alltime high for the eighth consecutive year. Coal tonnage increased about 5%, but higher prices for coal raised the value of coal produced over 50%.

Nonmetallic minerals dominated the State with production accounting for slightly over 96% of the total mineral out-put value. Mineral fuels, chiefly coal, com-prised the remainder. Iowa mineral pro-

duction value was distributed as follows: Portland and masonry cement, 39%; stone, 38%; sand and gravel, 14%; gypsum, 3%; clays, 1%; and lime, peat, and others, the remainder. Petroleum has not been produced since 1963. During 1975, drilling permits were issued for 25 gas-injection withdrawal wells at Natural Gas Pipeline Co. of America's gas storage facility in Louisa County.

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<sup>2</sup> Geologist, Iowa Geological Survey, Iowa City, Iowa.

Table 1.—Mineral production in Iowa <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry ----- thousand short tons--	65	\$2,660	62	\$2,933
Portland ----- do-----	2,424	64,156	2,258	73,786
Clays ----- do-----	960	1,869	959	1,916
Coal (bituminous) ----- do-----	590	4,591	622	6,891
Gem stones ----- do-----	NA	W	NA	W
Gypsum ----- thousand short tons--	1,397	7,142	1,208	6,546
Sand and gravel ----- do-----	17,091	26,104	15,410	26,844
Stone ----- do-----	32,342	66,119	30,336	78,732
Value of items that cannot be disclosed:				
Other nonmetals and values indicated by symbol W -----	XX	4,079	XX	3,092
Total -----	XX	176,720	XX	195,740
Total 1967 constant dollars -----	XX	83,553	XX	P 77,513

<sup>p</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company con-fidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including con-sumption by producers).

Table 2.—Value of mineral production in Iowa, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adair	W	W	Stone.
Adams	W	W	Do.
Allamakee	\$904	W	Stone, sand and gravel.
Appanoose	1,480	W	Stone, clays.
Audubon	W	W	Sand and gravel.
Benton	W	W	Sand and gravel, stone.
Black Hawk	W	W	Stone, sand and gravel.
Boone	619	\$1,460	Sand and gravel.
Bremer	W	W	Stone, sand and gravel.
Buchanan	656	W	Do.
Buena Vista	W	48	Sand and gravel.
Butler	W	W	Stone, sand and gravel.
Calhoun	80	--	
Carroll	111	524	Sand and gravel.
Cass	W	W	Stone.
Cedar	510	W	Stone, sand and gravel.
Cerro Gordo	37,056	W	Cement, stone, clays, sand and gravel.
Cherokee	407	402	Sand and gravel.
Chickasaw	W	W	Stone, sand and gravel.
Clarke	W	W	Stone.
Clay	200	176	Sand and gravel.
Clayton	1,573	1,760	Sand and gravel, stone.
Clinton	W	W	Stone, sand and gravel.
Crawford	W	W	Sand and gravel.
Dallas	W	W	Sand and gravel, clays.
Davis	W	W	Stone, sand and gravel.
Decatur	W	W	Stone.
Delaware	675	W	Stone, sand and gravel.
Des Moines	3,992	W	Stone, gypsum, sand and gravel.
Dickinson	266	219	Sand and gravel.
Dubuque	1,230	1,453	Stone.
Emmet	731	301	Sand and gravel.
Fayette	1,029	1,218	Stone, sand and gravel.
Floyd	653	610	Stone, sand and gravel, clays.
Franklin	959	W	Do.
Fremont	W	W	Stone, sand and gravel.
Greene	434	305	Sand and gravel.
Grundy	W	W	Sand and gravel, stone.
Guthrie	99	W	Sand and gravel.
Hamilton	W	W	Stone, sand and gravel.
Hancock	W	W	Do.
Hardin	W	W	Do.
Harrison	972	W	Do.
Henry	421	W	Do.
Howard	410	W	Do.
Humboldt	W	W	Do.
Ida	31	34	Sand and gravel.
Iowa	W	W	Do.
Jackson	526	W	Stone, sand and gravel.
Jasper	W	W	Sand and gravel, stone.
Jefferson	W	258	Stone.
Johnson	2,013	2,131	Stone, sand and gravel.
Jones	2,923	3,031	Do.
Keokuk	W	W	Stone.
Kossuth	121	W	Sand and gravel.
Lee	W	W	Stone, sand and gravel.
Linn	3,774	4,243	Do.
Louisa	W	W	Stone.
Lucas	W	W	Coal.
Lyon	703	645	Sand and gravel.
Madison	5,228	W	Stone, clays.
Mahaska	W	W	Coal, stone, sand and gravel.
Marion	1,772	W	Stone, coal, sand and gravel, gypsum.
Marshall	W	W	Stone, sand and gravel.
Mills	W	W	Stone.
Mitchell	W	W	Stone, sand and gravel.
Monona	86	495	Sand and gravel.
Monroe	W	W	Coal, stone.
Montgomery	W	W	Stone, sand and gravel.
Muscatine	W	W	Do.
O'Brien	188	247	Sand and gravel.
Osceola	W	W	Do.

See footnotes at end of table.

Table 2.—Value of mineral production in Iowa, by county<sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Page -----	W	W	Stone, sand and gravel.
Palo Alto -----	W	\$279	Sand and gravel.
Plymouth -----	\$600	662	Do.
Pocahontas -----	W	W	Stone, sand and gravel.
Polk -----	23,505	W	Cement, sand and gravel, clays.
Pottawattamie -----	W	W	Stone, sand and gravel.
Poweshiek -----	W	W	Stone.
Sac -----	841	635	Sand and gravel.
Scott -----	21,857	22,384	Cement, stone, lime, clays.
Shelby -----	W	W	Sand and gravel.
Sioux -----	999	1,113	Do.
Story -----	1,431	W	Sand and gravel, stone, clays.
Tama -----	W	W	Sand and gravel.
Taylor -----	W	W	Stone.
Union -----	W	W	Do.
Van Buren -----	1,279	W	Stone, sand and gravel.
Wapello -----	977	W	Coal, sand and gravel, clays.
Warren -----	W	W	Sand and gravel.
Washington -----	W	W	Stone.
Wayne -----	W	---	---
Webster -----	7,053	W	Gypsum, stone, sand and gravel, clays.
Winnebago -----	W	436	Peat, sand and gravel.
Winneshiek -----	1,481	W	Stone, sand and gravel.
Woodbury -----	223	202	Sand and gravel, clays.
Worth -----	W	W	Stone, sand and gravel, peat.
Wright -----	322	758	Sand and gravel.
Undistributed <sup>2</sup> -----	43,319	149,704	---
Total <sup>3</sup> -----	176,720	195,740	---

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

<sup>1</sup> Ringgold County is not listed because no production was reported.

<sup>2</sup> Includes some stone that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Iowa business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands--	1,306.8	1,301.7	- 0.4
Unemployment ----- do--	89.2	70.8	+ 80.6
<b>Employment (nonagricultural):</b>			
Mining ----- do--	3.0	2.8	- 6.7
Manufacturing ----- do--	248.7	229.6	- 7.7
Contract construction ----- do--	48.1	46.5	- 3.3
Transportation and public utilities ----- do--	55.8	54.7	- 2.0
Wholesale and retail trade ----- do--	242.2	245.0	+ 1.2
Finance, insurance, real estate ----- do--	46.8	47.2	+ .9
Services ----- do--	170.7	176.5	+ 3.4
Government ----- do--	185.1	190.8	+ 3.1
Total nonagricultural employment ----- do--	1,000.4	993.1	- .7
<b>Personal income:</b>			
Total ----- millions--	\$15,883	\$17,440	+ 9.8
Per capita ----- do--	\$5,561	\$6,023	+ 8.3
<b>Construction activity:</b>			
Number of private and public residential units authorized ----- do--	11,501	14,706	+ 27.9
Value of nonresidential construction ----- millions--	\$189.4	\$181.8	- 4.0
Value of State road contract awards ----- do--	\$154.0	\$110.0	- 28.6
Shipments of portland and masonry cement to and within Iowa ----- thousand short tons--	1,792	1,765	- 1.5
<b>Mineral production value:</b>			
Total crude mineral value ----- millions--	\$176.7	\$195.7	+ 10.8
Value per capita, resident population ----- do--	\$61.86	\$63.42	+ 10.6
Value per square mile ----- do--	\$3,139.46	\$3,477.35	+ 10.8

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce; U.S. Department of Labor; Highway and Heavy Construction Magazine; and U.S. Bureau of Mines.

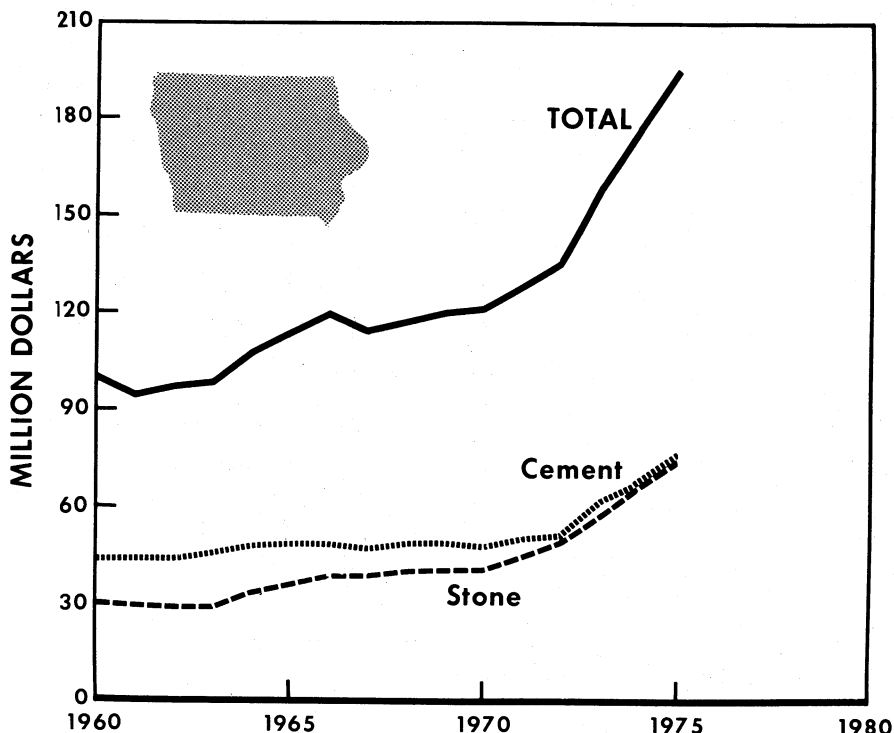


Figure 1.—Value of cement, stone, and total value of mineral production in Iowa.

The Energy Policy Council (EPC), created to develop a comprehensive energy program for Iowa, presented its first annual report to the Governor and the General Assembly in January. The report outlined energy usage trends of the State and discussed alternative energy sources and the effect of various energy conservation measures and possible energy options. A quarterly energy report gives more comprehensive information on certain selected problem areas, and the Iowa Energy Bulletin, published at irregular intervals, is designed to create a body of informed people who can wisely decide on energy issues and accept the responsibility of the energy decisions that need to be made.

In 1975, less than 2% of Iowa's energy came from resources within the State. The largest energy source for Iowa was petroleum comprising almost 44%, followed by natural gas, 37%, and coal, 17%. Less than 10% of the coal used was produced within the State.

Nuclear power now accounts for about 33% of Iowa's electric capacity. Iowa receives nuclear electricity from the Duane Arnold Energy Center at Palo, Iowa, the Quad Cities station at Cordova, Ill., and the Cooper nuclear station at Brownsville, Nebr. The Duane Arnold plant has a capacity of 550 megawatts (MW), the Quad Cities plant has a 400-MW capacity of which 60% is used in Iowa, and the Cooper plant has a 775-MW capacity with about 50% available to Iowans. A few megawatts of nuclear power are also delivered from a small cooperative-owned plant at Genoa, Wis.

Iowa Electric Co. and Iowa Power and Light Co. announced plans for a 1,000-MW nuclear plant to be constructed in central Iowa. The plant is scheduled to be operational before 1983, but at yearend, a site had not been approved.

The EPC completed a comprehensive study on whether there should be a moratorium on construction of nuclear plants.

Its report recommended that no nuclear moratorium be imposed, but suggested that the Iowa State Commerce Commission should have increased power to require approval for establishment and erection of major new electric-generating facilities.

The city of Ames began converting trash into electricity<sup>3</sup> and recyclable materials. The \$5.5 million facility sorts paper, plastic, and other combustibles from household and other municipal wastes for burning in the city-owned powerplant. Iron is removed magnetically and sold as scrap. Aluminum and other nonferrous metals are also removed for recycling by passing over "aluminum magnets." Burning trash as auxiliary fuel will cut the city's coal consumption by 22,000 tons per year. The city of Ames estimated that the gross cost of processing trash is about \$14 per ton, but since the city will save \$9 on coal costs for every ton of trash and \$3 per ton of trash for recycled metals, the net cost of \$2 per ton for recycling compares favorably with \$3 per ton for landfill burial.

The Iowa Coal Project demonstration mine No. 1 was dedicated on August 22 and by yearend had produced over 20,000 tons of coal. The project, funded by the Iowa Legislature for a 3-year period beginning July 1, 1974, is administered by the Energy and Mineral Resources Research Institute (EMRRI) at Iowa State University. The legislative act calls for EMRRI to carry out research to determine whether Iowa coal can be mined economically and in an environmentally acceptable manner and to investigate and demonstrate methods for improving the quality of Iowa coal by removal of the impurities. The research included a study of the economics of coal production and transportation, investigation and development of new exploration methods, demonstration of improved land restoration techniques, and investigation of other potentially useful byproducts that might be produced as a part of the coal mining operation. In addition to progress on the demonstration mine, a "movable beneficiation plant" using a heavy media-type process is under construction and expected to be installed and operating on the campus of Iowa State University early in 1976.

An exploratory drilling program<sup>4</sup> being conducted by the Iowa Geological Survey in Van Buren, Davis, Jefferson, and

Wapello Counties gave preliminary indications that Iowa has more coal of better quality than was previously thought. This drilling program is continuing and the results are encouraging.

**Legislation and Government Programs.**—The Iowa Code relating to surface mining was amended by an act (Senate Bill #314) regulating surface coal mining operations. The act required surface coal mining operations for which application for registration is made on or after July 1, 1976, and with respect to lands from which overburden has not been removed, to comply with the following additional environmental standards: (1) Spoil, debris, soil and waste materials from the cut made to obtain access to the coal seam shall be placed according to a plan approved by the Department of Soil Conservation; (2) a diverse, effective, and permanent vegetative cover capable of self-regeneration and plant succession at least equal in extent of cover to the natural vegetation shall be established on all affected land; (3) topsoil shall be removed in a separate layer and replaced on the backfill area; (4) all coal mine wastes, coal processing wastes, acid-forming or other toxic materials present in the overburden, or other wastes shall be buried in approved pits; and (5) in preparing impoundments for the disposal of coal mine wastes or other liquid or solid wastes, the operator shall incorporate engineering practices approved by the Department of Soil Conservation for design and construction. The new law provides also that the site of a new mine shall be registered prior to mining or removal of overburden and shall include a mine and rehabilitation plan with a bond to assure rehabilitation. The law allows 12 months for rehabilitation to be accomplished after mining of any part of a site has been completed.

The Iowa Department of Environmental Quality conducted an investigation of the use of Iowa coal for power generation and issued a report concluding that flexible standards based on environmental conditions in different areas would allow many plants and utilities to burn Iowa coal and still meet environmental requirements. This

<sup>3</sup> Des Moines Register Newspaper. Ames Converts Story County Garbage Into Electricity. Sept. 17, 1975, p. 3a.

<sup>4</sup> Des Moines Register Newspaper. Find Better Coal in Iowa. October 9, 1975.

decision would be a major breakthrough for industries that must import low-sulfur coal to meet environmental standards and for the coal industry of Iowa.

AMAX, Inc., received an award for distinguished service in environmental planning for its Fort Madison molybdenum-processing plant. The award, presented by the Industrial Development Research Council and the Environmental Planning Guide, noted that an estimated 20% of the total \$43 million cost of the molybdenum compounds facility went for environmental controls.

Dr. Stanley C. Grant became Director of the Iowa Geological Survey on June 1, 1975. Orville Van Eck was appointed Associate State Geologist, and Donald Koch was promoted to Assistant State Geologist. The Survey, with a professional staff of over 20, is involved in serving the State's increasing needs in the fields of water supply and management, coal development, application of remote-sensing techniques, subsurface studies, soils research, economic geology, land use planning and data management. A relief map of Iowa was published by the Survey in 1975.

Scientific studies of the Coldwater Cave in northwest Winneshiek County were concluded in 1975, and the entry shaft reverted to the control of the landowner. The Survey, in its report, recommended options for development of this cave. The natural entrance through Coldwater Spring is under control of the State; however, the greater portion of the cave is under private ownership. This cave was described in an illustrated article.<sup>5</sup>

The Iowa Limestone Producers Association presented safety awards for no lost-time accidents during 1975 to the following 12 companies: Alpha Crushed Stone, Inc., Marion; Bruening Rock Products, Inc., Decorah; Lee Crawford Quarry Co., Cedar Rapids; Greene Limestone Co., Greene; C. D. Hess and Son, Lacona; Hewitt

Brothers, Inc., Fredericksburg; Kaser Construction Co., Des Moines; Kuhlman Construction Co., Colesburg; L & W Construction Co., Centerville; Midwest Limestone Co., Gilmore City; Roverud Construction, Inc., Spring Grove, Minn., and Decorah, Iowa; and Wendling Quarries, Atalissa.

In addition, trophies, based on frequency and severity of accidents averaged over the immediate past 3 years, were awarded in three categories: Zero to 50,000 man-hours; 50,000 to 150,000 man-hours; and 150,000 man-hours and over. The winners in the three categories as shown were: Kuhlman Construction, L & W Construction, and Martin Marietta Aggregates—Central Div.

The National Sand and Gravel Association awarded Martin Marietta Aggregates—Central Div., Clayton silica plant the safety award for plants producing from 60,000 to 169,999 tons of sand and gravel. Other Iowa sand and gravel producers receiving Certificates of Achievement in safety included: Raid Quarries, Div. of Medusa Aggregates—Decatur hydraulics plant, Lincoln sand and gravel plant, Huntsdale sand plant, Rome sand plant, Albany plant, Gallatin plant, and Glasgow plant; Stevens Sand and Gravel Co., Inc.; and Van Dusseldorp Sand and Gravel, Inc.—Colfax plant, Pella plant, and Reasnor plant.

The Raid Quarries Lincoln plant also received a special certificate for 12 consecutive accident-free years, and the Raid Quarries Rome plant received one for 7 consecutive accident-free years.

United States Gypsum Co. Sperry mine and mill, Des Moines County, operated 252,703 man-hours in 1975 without a lost-time accident.

Iowa mines had two fatalities in 1975.

<sup>5</sup> The Iowan, Coldwater Cave—Beauty, Origin, Research. V. 22, No. 2, Dec. 15, 1973, pp. 23-35.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Portland cement shipments decreased 7% in quantity but showed an increase in value of 15%. Iowa ranked eighth in the Nation in shipments of cement and seventh in the value of portland

cement shipped. Most of the decrease in production can be attributed to weakness in highway and commercial construction. The average value for all types of finished portland cement in 1975 increased to \$32.68 per ton.

Five companies operated a total of 17 kilns at 3 wet-process and 2 dry-process plants. Their combined production was 2,208,293 tons, approximately 78% of rated capacity. Most of the Iowa cement production was used in Iowa although some was shipped to customers outside the State and some Iowa customers received cement produced in other States.

About 96% of the portland cement shipped was Type I (general construction use) and Type II (moderate heat). The remainder was Type III (high early strength) and expansive type.

Disposition of portland cement shipped by Iowa manufacturers was as follows: Ready-mix concrete producers, 62%; concrete products (concrete block, concrete pipes, precast, prestressed concrete, and other products), 19%; highway contractors, 12%; building material dealers, 5%; and other contractors, government agencies, and miscellaneous uses, 2%.

Masonry cement was produced by Northwestern States Portland Cement Co., Marquette Cement Manufacturing Co., and Martin Marietta Corp. Shipments decreased 5% in quantity but increased 10% in value. The average value of masonry cement increased to \$47.31 per ton.

The portland and masonry cement industry of Iowa consumed 5.39 billion cubic feet of natural gas and 349 million kilowatt-hours of electrical energy in 1975.

**Clays and Shale.**—Clay and shale were produced by 11 companies operating 15 mines in 12 counties. The five largest companies accounted for 76% of the total production. These companies, in descending order, were Can-Tex Ind., Northwestern States Portland Cement Co., Lehigh Portland Cement Co., Martin Marietta Corp., and Sioux City Brick and Tile Co. Three companies operating in Cerro Gordo County produced 40% of the State's total.

Cement companies utilized 46% of the clay, 16% was used in the manufacture of drain tile, and the remainder was used for building brick, sewer pipe, flue lining, and expanded aggregate for concrete products.

**Gypsum.**—United States Gypsum Co., National Gypsum Co., Georgia-Pacific Corp., The Celotex Corp., and Kaser Construction Co. mined 1,208,000 tons of gypsum in Des Moines, Marion, and Webster Counties. Output declined 14%

and was 18% below the 1973 record. United States Gypsum, Georgia-Pacific, and The Celotex Corp. calcined 851,000 tons of gypsum in Des Moines and Webster Counties. Output decreased 5% and was 13% below the 1973 record. Among the States, Iowa ranked second in calcined and third in crude gypsum production.

**Lime.**—Quicklime and hydrated lime output decreased 15% in quantity and 26% in value. Linwood Stone Products Co., a subsidiary of McCarthy Improvement Co., was the State's sole producer of quicklime and hydrated lime for commercial sale.

**Perlite.**—Crude perlite mined in New Mexico was expanded by National Gypsum Co. and by United States Gypsum in facilities at gypsum plants near Fort Dodge, Webster County. Expanded perlite production decreased, and the Georgia-Pacific Corp. perlite expansion facility in Webster County was inactive during the year. Virtually all of the expanded perlite produced in Iowa was sold for plaster aggregate.

**Sand and Gravel.**—Production of sand and gravel decreased approximately 10% compared with that of 1974, although value remained approximately the same. Over 15 million tons of sand and gravel worth over \$26 million were produced in 1975. Production came from 234 mines operating in 77 of the State's 99 counties. Production from individual reporting mines ranged from 2,000 to several hundred thousand tons each. Twelve of the high-production counties (those producing over 400,000 tons) with 25% of the mines accounted for 48% of the production. At the other extreme, 31 counties with 25% of the mines produced only about 9% of the total.

**Stone.**—Output of stone in Iowa decreased 6%, but the value increased 11%. The 30.3 million tons of stone were produced by 69 companies and 5 county and municipal highway departments from 337 quarries located in 64 of the 99 counties. The 82 largest quarries, producing over 100,000 tons each, accounted for 71% of the production; 143 quarries in the 25,000- to 100,000-ton range accounted for 25% of the production; and 112 of the quarries in the less than 25,000-ton annual production range accounted for less than 4% of the total. More than 28% of the State's production originated from the five counties



Table 4.—Iowa: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Black Hawk	7	437	627	6	357	833
Boone	9	479	619	10	1,233	1,460
Bremer	3	33	48	3	20	26
Buena Vista	4	W	W	3	110	48
Butler	4	108	152	2	W	W
Carroll	2	117	111	5	276	524
Cerro Gordo	5	508	636	4	301	482
Cherokee	7	288	407	5	216	402
Chickasaw	2	W	W	1	11	18
Clay	5	188	200	5	179	176
Clayton	5	212	994	4	236	929
Clinton	4	150	256	4	192	362
Dallas	8	810	1,370	6	355	498
Davis	--	--	--	1	60	150
Des Moines	1	W	W	1	W	266
Dickinson	6	188	266	5	148	219
Emmet	4	405	731	3	191	301
Fayette	6	44	78	5	71	96
Greene	3	301	434	6	235	305
Grundy	1	13	W	1	13	27
Hamilton	2	53	38	3	196	247
Hancock	12	793	945	7	145	209
Hardin	11	401	420	10	421	485
Henry	1	W	W	1	W	185
Howard	1	--	--	2	W	W
Ida	1	21	31	1	20	34
Jones	4	78	138	4	68	142
Kossuth	5	176	121	2	W	W
Lee	2	W	W	1	152	302
Linn	3	570	1,006	3	684	1,614
Lyon	6	437	703	5	443	645
Marion	4	266	312	4	181	324
Marshall	4	W	W	6	364	579
Monona	3	73	86	2	W	495
Muscatine	5	530	725	3	511	782
O'Brien	4	131	188	4	197	247
Palo Alto	2	W	W	1	162	279
Plymouth	5	430	600	5	515	662
Pocahontas	1	41	41	1	120	68
Polk	7	1,597	2,808	3	300	1,788
Sac	5	366	841	4	411	635
Sioux	6	635	999	7	646	1,113
Webster	12	429	577	7	233	395
Winnesiek	2	125	W	2	72	W
Woodbury	3	90	170	3	65	149
Woodbury	3	167	164	4	170	295
Worth	5	167	164	4	170	295
Wright	7	351	322	6	561	758
Undistributed <sup>1</sup>	67	5,046	7,938	53	4,068	7,290
Total <sup>2</sup>	276	17,091	26,104	234	15,410	26,844

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

<sup>1</sup> Includes Allamakee, Audubon, Benton, Buchanan, Calhoun (1974), Cedar, Crawford, Delaware, Dubuque (1974), Floyd, Franklin, Fremont (1975), Guthrie, Harrison, Humboldt, Iowa, Jackson, Jasper, Johnson, Mahaska, Mitchell, Montgomery (1975), Osceola, Page, Pottawattamie, Shelby, Story, Tama, Van Buren, Wapello, Warren, and Winnebago Counties, and some sand and gravel that cannot be assigned to specific counties.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 5.—Iowa: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction	3,187	5,237	4,013	8,956
Highway and bridge construction	895	1,677	402	687
Other construction (dams, waterworks, airports, etc.)	170	319	162	270
Concrete products (cement blocks, brick, pipe, etc.)	863	1,510	791	1,608
Bituminous paving (asphalt and tar paving)	3,606	4,300	1,465	3,057
Roadbase and subbase	1,028	1,621	549	1,000
Fill	661	885	525	695
Other	127	247	54	122
<b>Unprocessed:</b>				
Roadbase and subbase	51	75	103	179
Fill	718	849	526	579
Other	--	--	W	W
Industrial sand and gravel	195	1,012	W	W
<b>Total</b> <sup>1</sup>	<b>11,501</b>	<b>17,732</b>	<b>8,591</b>	<b>17,154</b>

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 6.—Iowa: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction	63	76	157	306
Highway and bridge construction	1,626	3,167	1,886	3,989
Other construction (dams, waterworks, airports, etc.)	15	29	61	112
Concrete products (cement blocks, brick, pipe, etc.)	52	99	69	171
Bituminous paving (asphalt and tar paving)	1,734	1,934	1,492	1,951
Roadbase and subbase	2,015	2,998	2,840	2,765
Fill	19	29	141	188
Other	16	25	120	160
<b>Unprocessed:</b>				
Roadbase and subbase	--	--	9	8
Fill	49	15	43	40
<b>Total</b>	<b>5,589</b>	<b>8,372</b>	<b>6,818</b>	<b>9,690</b>

Table 7.—Iowa: Limestone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975			Type of stone produced in 1975
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Allamakee -----	15	478	860	13	187	391	Crushed.
Benton -----	2	50	98	1	30	65	Do.
Buchanan -----	12	315	592	13	298	542	Do.
Cerro Gordo -----	9	2,238	3,620	7	1,958	3,219	Do.
Clayton -----	23	W	W	22	508	831	Do.
Delaware -----	9	380	567	12	445	942	Do.
Dubuque -----	15	793	1,222	15	791	1,458	Dimension and crushed.
Fayette -----	13	564	951	16	695	1,122	Crushed.
Floyd -----	5	253	511	5	W	W	Do.
Franklin -----	5	211	429	5	425	1,346	Do.
Howard -----	8	206	410	9	152	358	Do.
Jackson -----	5	W	W	5	258	459	Do.
Jefferson -----	1	W	W	1	W	258	Do.
Jones -----	29	1,504	2,785	29	1,340	2,889	Dimension and crushed.
Linn -----	8	1,374	2,768	8	1,101	2,629	Crushed.
Madison -----	9	2,131	5,163	10	2,126	6,450	Do.
Scott -----	8	2,158	4,111	7	2,050	4,392	Do.
Van Buren -----	5	523	W	4	474	1,246	Do.
Webster -----	3	556	W	3	520	1,350	Do.
Winneshieck -----	21	769	1,293	20	500	989	Do.
Undistributed <sup>1</sup> -----	186	17,839	40,737	132	16,476	42,794	
Total <sup>2</sup> -----	341	32,342	66,119	337	30,336	73,732	

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

<sup>1</sup> Includes Adair, Adams, Appanoose, Black Hawk, Bremer, Butler, Cass, Cedar, Chickasaw, Clarke, Clinton, Dallas (1974), Davis, Decatur, Des Moines, Fremont, Grundy, Hamilton, Hancock, Hardin, Harrison, Henry, Humboldt, Jasper, Johnson, Keokuk, Lee, Louisa, Mahaska, Marion, Marshall, Mills, Mitchell, Monroe, Montgomery, Muscatine, Page, Pocahontas, Pottawattamie, Poweshiek, Story, Taylor, Union, Wapello (1974), Washington, Wayne (1974), and Worth Counties and production for which no county breakdown is available.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 8.—Iowa: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	1,953	4,328	3,731	9,968
Concrete aggregate -----	3,929	9,839	3,905	11,307
Dense-graded roadbase stone -----	7,804	14,758	6,787	15,504
Macadam aggregate -----	W	W	151	382
Surface treatment aggregate -----	7,602	15,472	5,673	12,700
Other construction aggregate and roadstone -----	2,249	4,110	1,253	2,729
Agricultural limestone <sup>1</sup> -----	3,322	3,086	3,265	8,189
Cement manufacture -----	3,489	5,390	3,268	6,208
Riprap and jetty stone -----	383	721	320	747
Railroad ballast -----	827	1,290	1,078	2,195
Other uses <sup>2</sup> -----	769	1,733	886	3,395
Total <sup>3</sup> -----	32,327	65,728	30,323	73,324

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

<sup>1</sup> 1974 data include other soil conditioners, poultry grit, and mineral food.

<sup>2</sup> Includes stone used for fill, filter (1975), flux, lime manufacture, manufactured fine aggregate (stone sand) (1974), mineral fillers, extenders, and whitening, roofing aggregates, chips, and granules (1974), terrazzo and exposed aggregate (1974), soil conditioners, and poultry grit, and mineral food (1975).

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 9.—Iowa: Dimension limestone sold or used by producers, by use

Use	1974			1975		
	Short tons	Cubic feet	Value (thousands)	Short tons	Cubic feet	Value (thousands)
Rough stone:						
Irregular shaped stone -----	348	4,094	\$5	996	11,718	\$35
Rubble -----	W	W	W	4,161	48,945	67
Flagging -----	W	W	W	572	6,729	21
Dressed stone:						
Cut stone -----	49	581	6	1,011	11,899	80
Sawed stone -----	W	W	W			
House stone veneer -----	1,922	22,622	88	1,645	19,372	80
Construction -----	5,564	65,459	104	4,690	55,176	126
Other stone <sup>1</sup> -----	6,809	78,514	188	--	--	--
Total -----	14,692	171,270	391	13,075	153,839	409

W Withheld to avoid disclosing individual company confidential data; included with "Other stone."  
<sup>1</sup> Includes rough blocks and uses indicated by symbol W.

Table 10.—Iowa: Bituminous coal production in 1975, by type of mine and county

County	Number of mines			Production (thousand short tons)			Value (thousands)
	Under-ground	Strip	Total	Under-ground	Strip	Total	
Lucas -----	1	--	1	W	--	W	W
Mahaska -----	--	4	4	--	128	128	\$1,425
Marion -----	--	3	3	--	62	62	751
Monroe -----	1	--	1	W	--	W	W
Wapello -----	--	1	1	--	69	69	860
Undistributed -----	--	--	--	363	--	363	3,855
Total -----	2	8	10	363	259	622	6,891

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

producing in excess of 1 million tons each. These counties were Cerro Gordo, Jones, Linn, Madison, and Scott.

The principal uses for Iowa crushed stone were as follows: 41% roadbase and surface treatment; 13% concrete aggregate; 12% bituminous aggregate; 11% cement manufacture; 11% agricultural limestone; and 4% railroad ballast. Other uses included dimension stone, poultry grit, filter stone, riprap, lime manufacture, flux stone, and filler material.

#### MINERAL FUELS

Coal (Bituminous).—Production of coal increased 5% in quantity and 50% in

value. The average price of coal mined in Iowa increased from \$7.78 to \$11.08 per ton.

Slightly more than 58% of the coal was produced at two underground mines in Lucas and Monroe Counties. Eight strip mines in Mahaska, Marion, and Wapello Counties accounted for 42% of the coal output.

Coal supplied 17% of the energy used in Iowa, but less than 10% of the coal used was mined in the State. Over 80% of the coal was imported from Illinois and Wyoming. Utilities used 78% of the coal burned in the State.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Cement:</b>			
Lehigh Portland Cement Co. <sup>1</sup>	Young Bldg. 718 Hamilton St. Allentown, Pa. 18105	Plant -----	Cerro Gordo.
Marquette Cement Manufacturing Co. <sup>1 2</sup>	First American Center Nashville, Tenn. 37238	----do -----	Polk.
Martin Marietta Corp. <sup>1 2 3</sup>	11300 Rockville Pike Rockville, Md. 20852	----do -----	Scott.
Northwestern States Portland Cement Co. <sup>1 2</sup>	12 Second St., N.E. Mason City, Iowa 50401	----do -----	Cerro Gordo.
Penn-Dixie Cement Corp. <sup>2</sup>	60 East 42d St. New York, N.Y. 10017	----do -----	Polk.
<b>Clays and shale:</b>			
Can-Tex Industries, Div. of Harsco.	101 Ashworth Rd. Des Moines, Iowa 50265	Pits and plants ---	Cerro Gordo, Dallas, Keokuk, Mahaska, Polk, Wapello.
Carter-Waters Corp ----	2440 Pennway Kansas City, Mo. 64100	----do -----	Appanoose.
<b>Coal (bituminous):</b>			
Big Ben Coal Co -----	Route 3 Chariton, Iowa 50049	Underground mine	Lucas.
Lovilia Coal Co -----	Route 2 Melrose, Iowa 52569	----do -----	Monroe.
Star Coal Co -----	802 Lincoln St. Pella, Iowa 50219	Strip mines -----	Mahaska.
Ferroalloys: Foote Mineral Co.	320 Concert St. Keokuk, Iowa 52632	Plant -----	Lee.
<b>Gypsum:</b>			
The Celotex Corp -----	1500 North Dale Mabry Tampa, Fla. 33607	Pit and plant ----	Webster.
National Gypsum Co. <sup>4</sup> --	325 Delaware Ave. Buffalo, N.Y. 14202	----do -----	Do.
United States Gypsum Co. <sup>4</sup>	101 South Wacker Dr. Chicago, Ill. 60606	Mines and plant --	Des Moines and Webster.
Lime: Linwood Stone Products Co. <sup>2</sup>	Route 2 Davenport, Iowa 52804	Plant -----	Scott.
<b>Peat:</b>			
Eli Colby Co -----	Box 248 Lake Mills, Iowa 50450	Bog and plant ----	Winnebago and Worth.
Colby Pioneer Peat Co -	Box 8 Hanlontown, Iowa 50444	----do -----	Do.
<b>Sand and gravel:</b>			
L. G. Everist, Inc -----	302 Paulton Bldg. Sioux Falls, S. Dak. 57102	Pit and plant ----	Sioux.
G. A. Finley, Inc -----	Harlan, Iowa 51537 -----	----do -----	Audubon, Crawford, Dallas, Pottawat- tamie, Sac, Shelby.
Hallett Construction Co. <sup>3</sup>	Box 13 Boone, Iowa 50036	----do -----	Boone, Cherokee, Franklin, Iowa, Marshall, Osceola, Page, Polk, Sac, Story, Winne- bago.
Maudlin Construction Co	Box 134 Webster City, Iowa 50595	----do -----	Various.
Sankey Sand and Gravel Inc.	Britt, Iowa 50423 -----	----do -----	Hancock.
Van Dusseldorp Sand and Gravel, Inc.	Box 156 Colfax, Iowa 50054	----do -----	Jasper and Marion.
<b>Stone:</b>			
Alpha Crushed Stone, Inc.	Box 267 Marion, Iowa 52302	Quarries and plants	Clinton.
B. L. Anderson, Inc --	327 Guaranty Bldg. Cedar Rapids, Iowa 52400	----do -----	Linn and Jones.
Kaser Construction Co -	3111 Ingersol Des Moines, Iowa 50312	----do -----	Jasper, Keokuk, Mahaska, Marion, Mills, Mont- gomery, Powe- shiek, Washing- ton.
Medusa Corp. <sup>3</sup> -----	P.O. Box 5668 Cleveland, Ohio 44101	----do -----	Des Moines, Jeffer- son, Lee, Van Buren.
The River Products Co -	220 Savings & Loan Bldg. Iowa City, Iowa 52240	Quarries, under- ground mines, plants.	Johnson, Louisa, Washington.

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Schildberg Construction Co., Inc.	Box 358 Greenfield, Iowa 50849	Quarries and plants	Adair, Adams, Cass, Madison, Pottawattamie, Union.
Welp & McCarten, Inc. <sup>3</sup>	522 South 22d St. Fort Dodge, Iowa 50501	-----do -----	Black Hawk, Howard, Humboldt, Webster, Worth.

<sup>1</sup> Also clays.<sup>2</sup> Also stone.<sup>3</sup> Also sand and gravel.<sup>4</sup> Also expanded perlite.



# 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 H. Johnson <sup>1</sup> and Carol Zarley <sup>2</sup>

Kansas mineral production was valued at \$970.6 million in 1975. Although this is a 9% increase from the value registered in 1974, most of the change can be attributed to inflationary push of higher unit prices rather than increased output.

As historically has been the case, the mineral fuels—crude oil, natural gas and derivative liquids, and coal—accounted for the vast majority of dollar output, specifically 84% in 1975. All these fuels showed production declines but increased dollar

value of total sales. Kansas ranked eighth among the States in oil production, and fifth in both natural gas production and natural gas liquids production.

Other significant mineral commodities produced in Kansas, listed in order of decreasing value, included cement, stone, salt, helium, sand and gravel, gypsum, clay, lime, diatomite, and pumice.

<sup>1</sup> State Liaison Officer (now deceased), Bureau of Mines, Topeka, Kans.

<sup>2</sup> Economist, State Geological Survey of Kansas, Lawrence, Kans.

Table 1.—Mineral production in Kansas <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>Cement:</b>				
Masonry ----- thousand short tons..	64	\$2,203	57	\$2,311
Portland ----- do. ....	1,940	46,940	1,832	55,033
Clays ----- do. ....	1,311	1,785	1,178	1,604
Coal (bituminous) ----- do. ....	718	5,463	479	9,481
Helium (high purity) ----- million cubic feet..	<sup>2</sup> 499	11,477	<sup>2</sup> 497	11,928
Lime ----- thousand short tons..	28	535	W	W
Natural gas ----- million cubic feet..	886,782	147,206	843,625	145,103
<b>Natural gas liquids:</b>				
Natural gasoline and cycle products thousand 42-gallon barrels..	6,630	24,810	6,295	25,062
LP gases ----- do. ....	24,402	78,818	23,563	71,632
Petroleum (crude) ----- do. ....	61,691	490,984	59,106	561,508
Salt <sup>3</sup> ----- thousand short tons..	1,367	27,007	1,446	31,214
Sand and gravel ----- do. ....	11,687	13,388	10,866	13,467
Stone ----- do. ....	<sup>4</sup> 17,869	34,369	15,907	35,850
<b>Value of items that cannot be disclosed:</b>				
Diatomite, helium (crude), gypsum, pumice, and salt (brine) -----	XX	3,913	XX	6,418
Total -----	XX	889,398	XX	970,611
Total 1967 constant dollars -----	XX	420,507	XX	<sup>p</sup> 384,362

<sup>p</sup> Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Helium measured at 14.7 pounds per square inch absolute at 70° F.

<sup>3</sup> Excludes salt in brine; included with "Value of items that cannot be disclosed."

<sup>4</sup> Excludes dimension stone.



Table 2.—Value of mineral production in Kansas, by county<sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Allen -----	\$12,938	W	Cement, stone, clays, natural gas.
Anderson -----	427	W	Stone.
Atchison -----	W	W	Do.
Barber -----	8,378	\$9,940	Petroleum, natural gas, gypsum, natural gas liquids, sand and gravel.
Barton -----	24,780	23,075	Petroleum, sand and gravel, clays, natural gas.
Bourbon -----	1,184	W	Coal, stone.
Butler -----	W	W	Petroleum, stone.
Chase -----	W	441	Stone, petroleum, sand and gravel.
Chautauqua -----	W	W	Stone, natural gas.
Cherokee -----	1,480	W	Sand and gravel, stone, coal, clays.
Cheyenne -----	174	W	Sand and gravel.
Clark -----	W	837	Natural gas, petroleum, sand and gravel.
Clay -----	W	W	Stone, sand and gravel.
Cloud -----	W	W	Sand and gravel, clays, stone.
Coffey -----	426	400	Stone.
Comanche -----	1,089	1,466	Natural gas, petroleum, sand and gravel.
Cowley -----	16,111	19,283	Petroleum, stone, sand and gravel, natural gas.
Crawford -----	W	W	Coal, stone, clays.
Decatur -----	4,562	W	Petroleum, sand and gravel.
Dickinson -----	947	942	Stone, sand and gravel, petroleum.
Doniphan -----	549	W	Stone.
Douglas -----	W	W	Sand and gravel, stone.
Edwards -----	2,359	2,564	Petroleum, natural gas, sand and gravel.
Elk -----	1,593	1,847	Stone, natural gas, sand and gravel.
Ellis -----	41,123	W	Petroleum, sand and gravel, stone.
Ellsworth -----	49,255	47,891	Natural gas liquids, petroleum, salt, natural gas, clays, sand and gravel.
Finney -----	W	13,595	Petroleum, natural gas liquids, sand and gravel, natural gas.
Ford -----	763	846	Natural gas liquids, sand and gravel, natural gas, petroleum.
Franklin -----	886	W	Stone, clays.
Geary -----	W	W	Stone, sand and gravel.
Gove -----	4,172	6,156	Petroleum, sand and gravel.
Graham -----	W	25,070	Petroleum, stone, sand and gravel.
Grant -----	W	W	Natural gas liquids, helium, petroleum, sand and gravel.
Gray -----	W	40	Sand and gravel.
Greeley -----	3	3	Do.
Greenwood -----	12,947	W	Petroleum, sand and gravel, stone.
Hamilton -----	W	1,136	Natural gas, petroleum, sand and gravel.
Harper -----	3,952	4,228	Natural gas liquids, petroleum, natural gas, sand and gravel.
Harvey -----	2,623	W	Petroleum, sand and gravel, natural gas.
Haskell -----	11,646	12,030	Petroleum, natural gas, sand and gravel.
Hodgeman -----	9,594	10,439	Petroleum, sand and gravel.
Jackson -----	92	W	Stone, sand and gravel.
Jefferson -----	W	W	Stone.
Jewell -----	W	1,615	Do.
Johnson -----	W	W	Stone, sand and gravel.
Kearny -----	1,411	2,159	Petroleum, natural gas liquids, sand and gravel, natural gas.
Kingman -----	20,306	22,817	Petroleum, natural gas liquids, natural gas, sand and gravel.
Kiowa -----	6,632	8,239	Petroleum, natural gas, sand and gravel.
Labette -----	W	841	Stone.
Lane -----	W	3,835	Petroleum, sand and gravel.
Leavenworth -----	W	W	Stone.
Lincoln -----	W	W	Stone, sand and gravel.
Linn -----	W	757	Do.
Logan -----	W	1,648	Petroleum, sand and gravel.
Lyon -----	1,572	W	Petroleum, stone, sand and gravel.
McPherson -----	11,884	14,386	Petroleum, clays, natural gas, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Kansas, by county<sup>1 2</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Marion	\$3,338	W	Petroleum, stone, natural gas.
Marshall	1,414	W	Gypsum, sand and gravel, stone.
Meade	5,388	\$5,256	Petroleum, natural gas, sand and gravel.
Miami	512	482	Stone.
Mitchell	W	24	Sand and gravel.
Montgomery	10,080	W	Cement, stone, clays.
Morris	W	W	Petroleum, stone, sand and gravel.
Morton	30,840	29,712	Petroleum, natural gas, helium, natural gas liquids, sand and gravel.
Nemaha	59	W	Stone.
Neosho	13,666	W	Cement, stone, sand and gravel.
Ness	22,123	26,901	Petroleum, sand and gravel.
Norton	2,147	W	Petroleum, sand and gravel, pumice.
Osage	W	266	Stone.
Osborne	W	W	Petroleum.
Ottawa	5	2	Sand and gravel.
Pawnee	5,376	5,648	Petroleum, natural gas, sand and gravel.
Phillips	13,211	W	Petroleum, stone, sand and gravel.
Pottawatomie	455	W	Stone, sand and gravel, petroleum.
Pratt	5,417	W	Petroleum, natural gas, sand and gravel.
Rawlins	W	W	Petroleum, sand and gravel.
Reno	25,210	W	Salt, petroleum, sand and gravel, natural gas, salt.
Republic	W	W	Sand and gravel.
Rice	32,363	36,501	Petroleum, salt, helium, stone, natural gas, sand and gravel.
Riley	1,632	W	Petroleum, stone, sand and gravel.
Rooks	25,263	28,703	Petroleum, sand and gravel.
Rush	8,453	W	Petroleum, helium, natural gas.
Russell	39,656	45,658	Petroleum, sand and gravel.
Saline	W	W	Do.
Scott	11,888	9,052	Natural gas liquids, petroleum, natural gas, helium.
Sedgwick	12,766	W	Petroleum, natural gas liquids, sand and gravel, salt.
Seward	24,228	17,978	Natural gas liquids, petroleum, natural gas, helium, sand and gravel.
Shawnee	W	W	Stone, sand and gravel.
Sheridan	2,715	W	Petroleum, sand and gravel.
Sherman	W	W	Lime, petroleum, sand and gravel.
Smith	1	--	
Stafford	21,653	W	Petroleum, natural gas, sand and gravel.
Stanton	W	127	Petroleum, natural gas.
Stevens	3,268	2,994	Petroleum, natural gas, sand and gravel.
Sumner	10,714	W	Do.
Thomas	296	1,217	Petroleum, sand and gravel.
Trego	5,248	5,896	Do.
Wabaunsee	2,810	W	Petroleum.
Wallace	W	W	Diatomite, sand and gravel.
Washington	W	W	Sand and gravel, stone.
Wichita	W	W	Sand and gravel.
Wilson	9,123	W	Cement, stone, clays, natural gas.
Woodson	--	W	Stone.
Wyandotte	16,367	W	Cement, stone, sand and gravel.
Undistributed <sup>3</sup>	265,804	510,675	
Total <sup>4</sup>	889,398	970,611	

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

<sup>1</sup> Brown County is not listed because no production was reported.

<sup>2</sup> Values of petroleum and natural gas are based on average prices per barrel and cubic foot, respectively, for the State.

<sup>3</sup> Includes some petroleum and natural gas that cannot be assigned to specific counties, and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Kansas business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands--	1,034.5	1,038.6	+0.4
Unemployment ----- do-----	86.9	46.5	+26.0
<b>Employment (nonagricultural):</b>			
Mining ----- do-----	10.2	10.7	+4.9
Manufacturing ----- do-----	166.5	160.5	-3.6
Contract construction ----- do-----	39.3	38.5	-2.0
Transportation and public utilities ----- do-----	56.6	55.0	-2.8
Wholesale and retail trade ----- do-----	187.4	189.9	+1.3
Finance, insurance, real estate ----- do-----	36.8	37.8	+2.7
Services ----- do-----	127.5	132.6	+4.0
Government ----- do-----	166.1	171.9	+3.5
Total nonagricultural employment ----- do-----	790.4	796.9	+0.8
<b>Personal income:</b>			
Total ----- millions--	\$12,723	\$13,655	+7.3
Per capita ----- do-----	\$5,615	\$6,023	+7.3
<b>Construction activity:</b>			
Number of private and public residential units authorized--	9,713	12,106	+24.6
Value of nonresidential construction ----- millions--	\$196.5	\$169.9	-13.5
Value of State road contract awards ----- do-----	\$97.0	\$104.0	+7.2
Shipments of portland and masonry cement to and within the State ----- thousand short tons--	1,175	1,148	-2.3
<b>Mineral production value:</b>			
Total crude mineral value ----- millions--	\$889.4	\$970.6	+9.1
Value per capita, resident population ----- do-----	\$392.50	\$425.71	+8.5
Value per square mile ----- do-----	\$10,811.51	\$11,798.73	+9.1

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

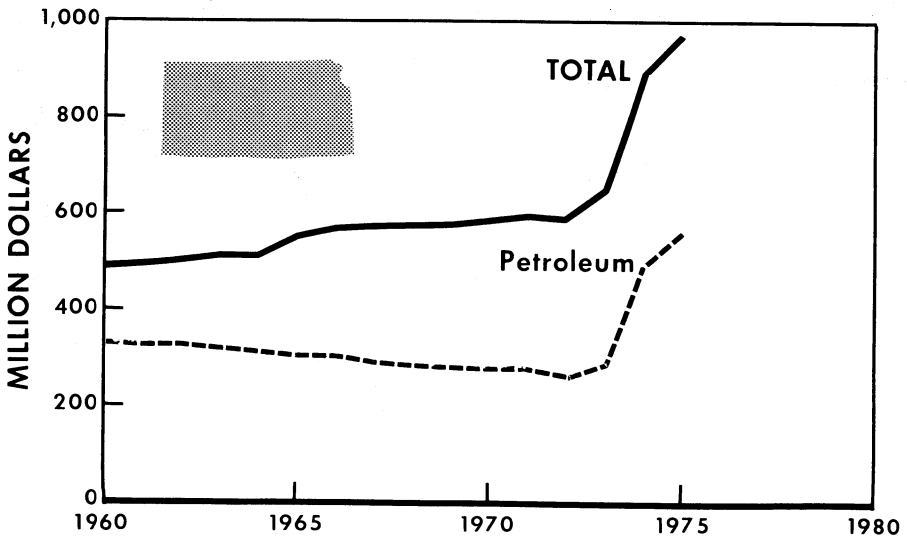


Figure 1.—Value of petroleum and total value of mineral production in Kansas.

**Trends and Developments.**—Crude petroleum production continued to decline in 1975, although the rate of decrease slowed. Production for 1975 was 4.2% below that of 1974; 1974 production was 6.8% below that of 1973. Although diminishing production has characterized the oil industry for many years now, it was encouraging that oil well completions rose slightly.

Helium is found as a natural occurring constituent of natural gas in amounts ranging from less than a trace up to 8% by volume. It is currently considered economically feasible to extract helium from natural gas containing 0.3% or more helium. In the last 15 years, a small but important helium industry has developed in Kansas, with extraction being from the rich (0.3% to 0.5%) gases of the Hugoton field.

Coal production dropped sharply in 1975. The drop in tonnage can be attributed to the discontinuance of coal production in Kansas during 1974 by the Pittsburgh & Midway Coal Mining Co. During 1974, Pittsburgh & Midway contributed over half the total production from two mines in Kansas.

The Governor signed into law a bill creating the State Department of Transportation. The new department replaced the State Highway Department and Highway Commission.

An Energy Research and Development Administration (ERDA) research project in southeast Kansas has had reasonable success in forcing so-called heavy oil from fields thought to have been depleted of recoverable oil. The experiment at Bartlett, using the sol-frac system, succeeded in producing about 200 barrels of oil, about 17% of the oil estimated to be trapped below the 10-acre test site. Also important to oilmen was the recovery of about 85% of the liquid solvent for recycling. It is planned to expand the original 10-acre

plot to 40 acres and to conduct additional experiments for testing methods.

Another Kansas project that has shown potential for increasing domestic oil production is continuing at the Cities Service Oil Co. oilfield at El Dorado. Cities Service is testing an oil recovery method known as micellar-polymer flooding. The project is reported to be on schedule and progressing nicely. ERDA plans to step up efforts to find out how much heavy oil there is in south Kansas, northeast Oklahoma, and southwest Missouri.

**Employment.**—Total employment in the mining and crude petroleum industries continued to increase in 1975. The Employment Security Division of the Kansas Department of Labor reported a total employment of 10,700 persons, up from 10,150 the previous year. Employment in the mining and crude petroleum area increased to 9,100 persons, compared with 8,400 the year before.

Statistics compiled by the Division of Workmen's Compensation of the Kansas Department of Labor show a total of 948 injuries in the mining and crude petroleum industries compared with 771 during 1974. A total of six fatalities occurred in 1975 compared with nine during 1974.

The Kansas Department of Transportation awarded highway improvement contracts totaling \$103,984,683 in 1975. This was a 2.5% decline from 1974 improvement contracts of \$106,700,000. This included construction of interstate and primary State highways, county secondary roads and bridges, as well as maintenance of these facilities. Interstate and primary State highway contracts were 74.2% of the total, or \$77,172,000. County project contracts totaled \$18,892,000, and city projects were \$1,317,000. Highway maintenance resurfacing projects were let on 922 miles of highway during 1975. Bridge repair contracts were approved for 110 bridges on all types of highways. Safety project contracts totaled \$6,600,000.

Table 4.—Kansas: Injuries, fatalities and occupational disease in the mineral industry

Industry	Total	Lost time accidents	No lost time accidents	Fatalities	Occupational disease	
					Lost time	No lost time
Bituminous coal and lignite -----	7	7	--	--	--	--
Crude petroleum and natural gas ---	861	668	193	5	1	1
Nonmetallic mining and quarrying--	59	36	23	1	--	--
Other mining -----	21	18	3	--	1	--
Total -----	948	729	219	6	2	1

Source: Division of Workmen's Compensation, Kansas Department of Labor.

### Legislation and Government Programs.

—Kansas received a \$128,000 grant from the Federal Energy Administration for work in fuel allocation and energy research. The State has research projects underway involving wind power; substitution of coal for natural gas; alternative energy sources; and oil, gas, and coal resources.

A bill enacted by the 1975 legislature and signed into law by the Governor created a permanent State agency to succeed the fuel allocation office set up in response to the energy crisis of 1974. The new office, headed by a State energy director, will act as the State administrator for Federal energy programs and serve as liaison between State and Federal agencies.

Big machines speed strip mine reclamation at a 2,000-acre reclamation project in Cherokee County, a cooperative effort of the Bureau of Mines and Pittsburg & Midway Coal Mining Co. Three pieces of equipment developed by Pittsburg & Midway are being tested—"Big Dude," a 40-foot angle blade; a 24-foot vee-plow called "Veep"; and a 30-foot grading bar. "Big Dude" handles the brunt of the job, moving 6,000 to 11,000 cubic yards of dirt per hour. The "Veep" will be tested in topping out peaks of spoil banks where there is insufficient room for conventional tractors to operate. Also being tested is the grading bar, a 4,000-pound tool for smoothing rough-graded land after it has been reshaped. Goal of the project is to cut reclamation costs in half.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Carbon Black.**—The Columbian Div. of Cities Service Co., sole producer of carbon black in Kansas, continued production at its Hickok plant. Major uses of carbon black are rubber compounding, ink, and paint.

**Coal.**—Coal production dropped from 718,000 tons in 1974 to 479,000 tons in 1975. Value of the coal rose from about \$5.5 million in 1974 to \$9.5 million in 1975. The drop in tonnage can be attributed to the discontinuance of coal production in Kansas during 1974 by Pittsburg & Midway Coal Mining Co. During 1974, Pittsburg & Midway contributed over half the total production from two mines in Kansas. Price increases in coal for the past year were due to (1) increased demand and (2) a decline in the

amount of coal tied to low-value, long-term contracts.

During 1975, one coal mine closed and a second mine started operations in Kansas. The Dell Lamb mine of the Lamb Coal Co., Houston, Tex., was closed during June owing apparently to economic reasons. Opening in late 1974, approximately 35,000 tons of coal was removed from this mine before closing.

Operators of the Fort Scott mine of Bill's Coal Co., Tulsa, Okla., commenced mining in Kansas during June. The Fort Scott mine is located in southeastern Bourbon County and adjacent area of Missouri. Washing and loading facilities of the mine are located at Garland, Kans.

At the end of 1975, Kansas had the following coal mines in operation: Clemens Mine No. 22 and Mine No. 25 in Craw-

ford County; Wilkinson's, Inc., in Cherokee County; and Bill's Coal Co. Fort Scott mine in Bourbon County.

**Helium.**—High-purity helium production decreased from 499 million cubic feet with a value of \$11,477,000 in 1974 to 497 million cubic feet with a value of \$11,928,000 in 1975. The high-purity helium was produced at three plants in Grant, Morton, and Rush Counties.

**Natural Gas.**—Reported gross withdrawals of natural gas were 846,164 million cubic feet, a decline of 4.9% from that of 1974. One-sixth of this production was extracted from oil wells; the remaining five-sixths came from nonassociated gas wells. Marketed natural gas totaled 843,625 million cubic feet in 1975, compared with 886,782 million cubic feet in 1974. Natural gas value in 1975 was \$145,103,000, a decline from the value in 1974 of \$147,206,000.

The quantity of natural gas, in million cubic feet, delivered to consumers was as follows:

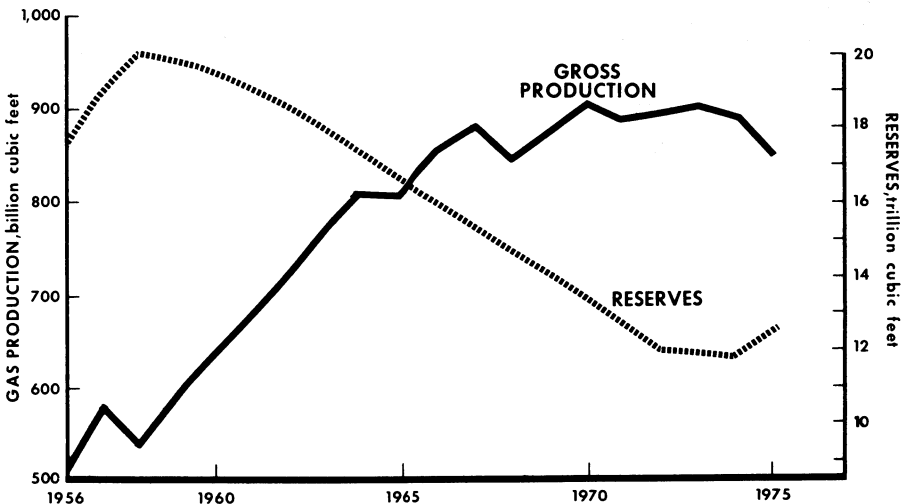
Consumer	1974	1975
Residential .....	93,363	98,372
Commercial .....	50,194	48,714
Industrial, including refinery fuel and carbon black production .....	164,768	124,378
Electric utilities .....	165,479	127,818
Others .....	3,267	2,991

In 1975 there were about 8,865 producing gas wells in the State's approximately 332 fields. Forty-five percent of the gas wells (3,969) were located in the Hugoton gasfield. During the year, 25 wells were completed in the field. Drilling continued to increase the size of the Panoma gasfield with 332 additional wells, bringing this field's total to 1,003 wells. Eighty-one wells were completed in the remainder of the State outside of the Hugoton area.

**Table 5.—Kansas: Gas production by major fields**  
(Million cubic feet)

Field	1974	1975
Hugoton .....	637,362	591,128
Panoma .....	64,187	78,763
Spivey-Grabs-Basil .....	18,581	19,876
Other fields .....	166,652	153,858
Total .....	886,782	843,625

**Natural Gas Liquids.**—According to the Kansas Corporation Commission, there were 24 operating gas processing plants in Kansas during 1975, producing a total of 29,858,000 barrels of liquid products including ethane. The 1975 production showed a decline of 3.8% from the 1974 production of 31,032,000 barrels. In 1975 production breakdown, liquid petroleum



**Figure 2.—Gross natural gas production and reserves in Kansas, 1956-75.**

gases accounted for 19,732,000 barrels; ethane, 3,831,000 barrels; and natural gasoline and cycle products, 6,295,000 barrels. Kansas ranked among the top five largest producing States and accounted for 5% of the U.S. total. The total value declined to \$96,694,000 from \$103,628,000 in 1974. The average price per barrel in 1975 for liquefied petroleum gas and ethane was \$3.04, a decline of 19 cents from that of 1974. Natural gasoline and cycle products average price per barrel increased to \$3.98 from the 1974 price of \$3.74, and plant condensate price per barrel increased to \$6.13 from the 1974 price of \$5.88.

**Petroleum.**—Reported production of crude oil in Kansas reached a 19-year low at 59,106,000 barrels, although the value of that production reached a record \$561.5

million. Preliminary estimates are that 42.5 million barrels came from stripper production and about 13 million barrels from secondary recovery, of which 5.5 million barrels could be classified as stripper production. The remaining 9.1 million barrels was attributed to primary, non-stripper recovery. Although total output declined, Kansas ranked eighth in petroleum production in the Nation.

The five leading counties and their production in thousand barrels were as follows: Ellis, 4,928; Russell, 4,802; Rooks, 3,021; Barton, 2,917; and Ness, 2,829. Combined production from these counties represented 31% of the State output.

Bemis-Shutts and Hall-Gurney were the two leading producing fields, representing 5.9% of the State's output. The two fields also led in production in 1974.

**Table 6.—Kansas: Crude oil production, indicated demand, and stocks in 1975, by month**

(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End-of-month stocks originating within Kansas
January	5,128	5,087	6,085
February	4,541	3,990	6,786
March	5,030	6,011	5,805
April	5,066	4,845	6,026
May	5,097	5,301	5,822
June	4,828	5,413	5,237
July	5,058	5,385	4,910
August	4,919	4,844	4,985
September	4,856	4,578	5,263
October	5,063	5,048	5,273
November	4,426	4,471	5,233
December	5,094	4,906	5,421
1975 total	59,106	59,879	XX
1974 total	61,691	61,858	XX

XX Not applicable.

Table 7.—Kansas: Crude oil production, by county

(Thousand 42-gallon barrels)

County	Production
Barber	606
Barton	2,917
Butler	2,359
Chase	3
Clark	38
Comanche	53
Cowley	1,913
Decatur	552
Dickinson	5
Edwards	164
Ellis	4,928
Ellsworth	709
Finney	1,324
Ford	15
Gove	647
Graham	2,617
Grant	185
Greenwood	1,527
Hamilton	10
Harper	206
Harvey	236
Haskell	1,225
Hodgeman	1,097
Kearny	158
Kingman	2,022
Kiowa	738
Lane	402
Logan	173
Lyon	162
McPherson	1,473
Marion	337
Meade	353
Morris	237
Morton	1,905

Table 7.—Kansas: Crude oil production, by county—Continued

(Thousand 42-gallon barrels)

County	Production
Ness	2,829
Norton	251
Osborne	34
Pawnee	531
Phillips	1,570
Pottawatomie	11
Pratt	599
Rawlins	565
Reno	781
Rice	2,662
Riley	89
Rooks	3,021
Rush	522
Russell	4,802
Saline	182
Scott	126
Sedgwick	547
Seward	550
Sheridan	301
Sherman	22
Stafford	2,529
Stanton	9
Stevens	242
Sumner	1,194
Thomas	119
Trego	609
Wabaunsee	289
Miscellaneous eastern Kansas stripper counties	° 2,774
Total	59,106

° Estimated.

Source: Kansas Corporation Commission.

Table 8.—Kansas: Crude petroleum production by field <sup>1</sup>

(Thousand 42-gallon barrels)

Field <sup>2</sup>	1974	1975	Cumulative to Dec. 31, 1975
Bemis-Shutts	1,933	1,873	220,286
Chase-Silica	1,185	1,120	251,549
El Dorado	1,085	1,056	280,988
Hall-Gurney	1,821	1,612	128,856
Kraft-Prusa	866	845	118,669
Trapp	1,332	1,326	208,349
Other fields <sup>3</sup>	53,469	51,269	NA
Total <sup>3</sup>	61,691	59,106	NA

NA Not available.

<sup>1</sup> Fields with annual production in excess of 1 million barrels.<sup>2</sup> Breakdown for individual fields from the Oil and Gas Journal Annual Forecast and Review.<sup>3</sup> Bureau of Mines figures.

**Drilling Activities.**—Drilling activity in Kansas increased during 1975. Industry drilled a total of 3,059 oil and gas wells, 369 more wells than that in 1974. Production wells attained 2,180 and exploratory wells reached 879; 1,532 resulted in oil and gas recovery and 1,527 were dry. Total development and exploratory drilling footage increased from 7,936,269 feet in 1974 to 10,014,049 feet in 1975, a 26% increase. Approximately 45% of the development oil wells and 18% of the gas wells were completed as successful pro-

ducers; the remaining 37% were dry wells. It is encouraging that oil well completions rose slightly more than 10% in 1975 to 1,094 out of 3,059 total test wells for oil and gas.

Ness, Cowley, and Ellis Counties accounted for 14.5% of total wells drilled in Kansas. These counties, combined with Barton, Coffey, and Greenwood, represented 24.7% of all well completions in 1975. Footage in these counties totaled 2,435,044 feet, averaging 3,221 feet per well. In addition to the wells listed in



table 9, 339 others were drilled; 220 wells were listed as stratigraphic test, and 119 were listed as service wells. The American Petroleum Institute defines these two kinds of wells in the following terms:

A stratigraphic test is a drilling effort, geologically directed, to obtain information pertaining to a specific geological condition that might lead toward the discovery of the accumulation of hydrocarbons. Such wells are customarily drilled without the intention of being completed for hy-

drocarbon production. This classification also includes test identified as core test, and all types of expendable holes related to hydrocarbons.

A service well is a well drilled or completed for the purpose of supporting production in an existing field. Wells in this class are drilled for the following specific purposes: Gas injection, water injection, steam injection, air injection, saltwater disposal, and observation.

Table 9.—Kansas: Oil and gas well drilling completions, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Allen	43	--	7	--	--	--	50	39,487
Anderson	41	--	4	--	--	5	50	44,311
Atchison	--	--	--	--	--	1	1	2,367
Barber	23	10	20	5	2	11	71	326,171
Barton	34	3	43	4	--	20	104	345,792
Bourbon	--	--	2	--	--	--	2	1,389
Brown	--	--	1	--	--	--	1	2,721
Butler	53	--	24	1	--	5	83	197,285
Chase	3	--	1	--	--	3	7	16,844
Chautauqua	48	1	17	2	--	2	70	88,932
Cheyenne	--	--	--	--	--	4	4	12,780
Clark	--	3	3	--	3	12	21	110,496
Clay	--	--	--	--	--	1	1	3,190
Coffey	21	1	19	3	1	58	103	208,992
Comanche	2	2	7	--	1	11	23	113,595
Cowley	86	6	35	8	--	20	155	464,571
Crawford	11	6	3	--	--	--	20	6,804
Decatur	6	--	6	1	--	--	22	86,648
Dickinson	--	--	--	--	--	2	2	5,660
Doniphan	--	--	--	--	--	3	3	8,380
Edwards	2	7	10	--	2	8	29	127,786
Elk	12	1	7	2	--	2	24	53,294
Ellis	43	--	54	5	--	22	124	453,433
Ellsworth	11	4	11	2	--	7	35	104,600
Finney	19	18	5	--	--	8	50	201,947
Ford	1	1	2	1	--	12	17	82,161
Franklin	6	1	5	--	--	1	13	10,241
Gove	11	--	9	5	--	17	42	177,633
Graham	29	--	19	4	--	19	71	279,164
Grant	2	20	6	2	--	--	30	118,964
Gray	--	--	--	--	--	2	2	5,873
Greeley	1	21	3	--	1	5	31	97,132
Greenwood	43	--	23	4	--	34	104	235,093
Hamilton	--	22	3	--	1	1	27	75,546
Harper	13	9	11	2	--	10	45	203,757
Harvey	9	2	7	--	3	3	24	72,647
Haskell	--	15	3	1	1	2	22	76,214
Hodgeman	8	--	16	6	--	20	50	231,047
Jefferson	--	1	--	--	--	1	1	2,492
Johnson	--	1	--	--	--	1	2	1,510
Kearny	7	66	6	3	3	1	86	274,535
Kingman	12	8	13	2	--	18	53	225,282
Kiowa	11	12	23	1	1	11	59	288,833
Labette	--	--	5	--	--	--	5	3,669
Lane	8	--	5	4	--	19	36	163,264
Leavenworth	--	--	2	--	--	1	3	4,246
Linn	6	--	2	--	--	--	8	5,097
Logan	3	--	2	3	--	11	19	89,060
Lyon	7	--	4	--	--	17	28	68,304
McPherson	17	2	13	2	1	10	45	136,315
Marion	7	2	9	--	--	7	25	68,455
Meade	1	13	9	--	2	9	34	191,705
Miami	18	--	9	--	--	--	27	17,568
Montgomery	35	1	10	--	--	--	46	40,011
Morris	--	--	1	--	--	7	8	19,744
Morton	5	27	6	1	--	4	43	159,449
Nemaha	--	--	1	--	--	--	1	2,833
Neosho	22	1	4	--	--	1	28	19,270

See footnote at end of table.

Table 9.—Kansas: Oil and gas well drilling completions, by county—Continued

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Ness	36	--	62	18	--	50	166	737,223
Norton	3	--	--	--	--	5	8	29,681
Osage	--	--	--	--	--	3	3	4,945
Osborne	--	--	--	--	--	1	1	3,580
Pawnee	3	14	17	2	4	15	55	206,013
Phillips	10	--	5	1	--	3	19	65,547
Pottawatomie	--	--	--	--	--	1	1	3,340
Pratt	7	6	14	1	1	10	39	147,095
Rawlins	10	--	6	3	--	13	32	128,846
Reno	8	2	10	--	1	8	29	102,585
Rice	11	7	16	1	--	8	43	134,065
Riley	3	--	3	--	--	1	7	12,197
Rooks	13	--	12	2	--	10	37	130,122
Rush	4	6	22	2	--	10	44	163,887
Russell	44	--	19	3	--	16	82	266,454
Saline	2	--	3	--	--	2	7	19,663
Scott	1	4	--	--	--	7	12	47,078
Sedgwick	1	1	3	--	--	9	14	45,469
Seward	5	7	5	--	4	1	22	110,118
Sheridan	2	--	7	--	--	13	22	87,438
Sherman	--	--	--	--	3	1	4	8,323
Stafford	23	6	27	--	--	11	67	251,478
Stanton	--	23	--	--	--	2	25	71,251
Stevens	1	34	1	--	1	--	37	117,669
Sumner	17	5	23	3	--	35	83	306,972
Thomas	4	--	5	1	--	7	17	77,286
Trego	10	--	16	3	--	15	44	177,298
Wabaunsee	--	--	--	--	--	1	1	3,205
Wallace	--	--	--	--	--	2	2	10,887
Wichita	--	--	--	--	1	6	7	25,855
Wilson	2	--	2	--	--	--	4	3,462
Woodson	19	--	12	1	--	3	35	50,548
Total	979	401	800	115	37	727	3,059	10,014,049

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

**Refineries.**—Eleven refineries operated in Kansas in 1975 with a throughput capacity of 454,831 barrels per day. Crude oil processed at refineries was 141,119,000 barrels in 1975, compared with 133,851,000 barrels in 1974. Intrastate receipts totaled 60,707,000 barrels. The intrastate crude oil was transported to the refineries as follows: 59,345,000 barrels via pipeline; 1,362,000 barrels via rail tank car and truck. Interstate receipts totaled 72,803,000 barrels: 71,784,000 barrels were transported via pipeline and 1,019,000 barrels via rail tank car and truck. Interstate receipts were as follows: From Oklahoma, 25,926,000 barrels; Texas, 21,032,000 barrels; Wyoming, 19,202,000 barrels; and 6,564,000 barrels from other States. Foreign crude oil to Kansas refineries totaled 7,420,000 barrels: From Venezuela, 4,162,000 barrels; Canada, 2,533,000 barrels; and 725,000 barrels from other countries. Opening stock totaled 1,801,000 barrels. Closing stock totaled 1,607,000 barrels, resulting in a negative stock change of 194,000 barrels. Based on total January 1, 1976, capacity, refineries operated at 85% of capacity in 1975.

Kansas' 11 refineries in 1974 and 1975 produced the following finished petroleum products, in thousand barrels:

	1974	1975
Motor gasoline	84,441	88,765
Aviation gasoline	391	366
Jet fuel	4,293	3,708
Liquefied refinery gas and ethane	3,916	3,723
Kerosine	330	386
Distillate fuel oil	36,288	39,726
Residual fuel oil	2,938	5,241
Petrochemical feedstocks	498	379
Special naphtha	1,109	1,033
Lubricating oil	1,470	1,243
Petroleum wax	414	580
Petroleum coke	4,326	4,310
Asphalt and road oil	6,999	5,852
Still gas	3,547	4,337
Miscellaneous products	178	194
Processing gain	-4,316	-3,506

Percent of refinery yields of the major petroleum products from crude and unfinished oil reruns were as follow:

	1974	1975
Gasoline, total <sup>1</sup>	54.1	52.9
Kerosine	.3	.3
Jet fuel, total	3.2	2.6
Distillate fuel oil	27.1	27.9
Residual fuel oil	2.2	3.7
All other products	13.1	12.6

<sup>1</sup> Based on total gasoline output minus input of natural gas liquids.

Table 10.—Kansas: Capacity of petroleum refineries, January 1, 1976  
(Barrels per calendar day)

Company	Location	Crude oil distillation: Cracking, reforming, coking, and alkylation					Other products
		Operating	Shut-down process <sup>1</sup>	Charge, operating, and shutdown	Gasoline output		
					Operating	Shut-down	
American Petrofina Co. of Texas	El Dorado	25,000	--	11,500 5,000 2,500	6,500 4,500 2,000	Asphalt.	
APCO Oil Corp	Arkansas City	46,230	--	9,400 16,500 3,000 3,750	6,320 14,850 2,960 2,300	Do.	
CRA, Inc	Coffeyville	48,338	--	7,800 8,600 8,500 6,100	7,800 7,500 1,400 3,500	Asphalt, coke, lubricants, wax.	
Do	Phillipsburg	26,400	--	7,800 5,300 2,500	5,200 4,700 1,400	Asphalt.	
Derby Refining Co	Wichita	27,982	--	10,176 4,800 3,800 4,082	5,700 4,176 2,985 2,782	Coke.	
Mid-America Refining Co., Inc	Chanute	3,000	--	--	--	Asphalt.	
Mobil Oil Corp	Augusta	50,000	--	19,900 20,000 3,900 3,500	10,500 8,200 1,050 3,500	Do.	
National Cooperative Refinery Association.	McPherson	54,150	--	19,000 6,650 16,150 9,080	11,970 5,850 1,940 5,700	Coke.	
North America Petroleum Corp	Shallow Water	10,000	--	--	--	Asphalt.	
Phillips Petroleum Co	Kansas City	85,000	--	32,000 16,000 11,500	16,000 15,000 9,000	Do.	
Skelly Oil Co	El Dorado	78,731	--	29,301 20,380 11,160 10,284	17,704 16,536 2,443 6,505	Coke.	

<sup>1</sup> CC=catalytic cracking, CR=catalytic reforming, H=hydrocracking, C=coking, TC=thermal cracking, A=alkylation.

## NONMETALS

Total value of nonmetals produced in 1975 was approximately \$144.1 million, compared with \$130.5 million in 1974. More than a third of the total value of nonmetal output was attributed to the production of portland cement. Other leading commodities by value of output were stone, salt, and sand and gravel. Other nonmetal commodities produced in Kansas were clay and shale, masonry cement, gypsum, lime, diatomite, and pumice.

**Cement.**—Portland cement production in 1975 was 1,832,158 tons, a decline from 1974 production of 1,940,267 tons, or 5.6%. The value of portland cement was \$55,033,396, an increase from the 1974 production value of \$46,939,876. The increase of 17.2% was due in part to modest price increase. After the hydrocarbon fuels, cement was the leading mineral commodity in total dollar value of sales.

After a period of rapid escalation in the early 1970's, shipments have fallen steadily for the past 2 years. Production figures show that volume was down about 9.6% from the peak year in 1973. The slack in demand allowed companies time to do plant maintenance work, install dust pollution equipment, and make fuel efficiency improvements.

Cement plants were historically attracted to particular locations in Kansas because of a favorable natural gas situation. In the face of the current shortfall in natural gas supplies, the five operating plants in Kansas have been severely and uniformly curtailed. All of them are served by one interstate transmission line and all have received the next to lowest Federal Power Commission ranking (essentially just above powerplants) in terms of priority of service. Alternate fuels, then, have been a necessity for much of the year, where appropriate coal is being used. One company is reported to have spent \$750,000 in new coal unloading, conveying, and processing equipment.

Using 1975 contract awards in Kansas as a macro-indicator for mineral demands for construction activity, increased production looks promising for construction commodities.

**Clays.**—Production of clay and shale during 1975 was 1,177,605 tons, a decrease of 10% from the 1,310,576 tons produced in 1974. The value of the clay and shale

Table 11.—Kansas: Portland cement salient statistics

	1974	1975
Number of active plants ----	5	5
Production -----	1,996	1,835
Shipments from mills:		
Quantity -----	1,940	1,832
Value -----thousands--	\$46,940	\$55,033
Stocks at mills, Dec. 31 -----	219	222

Table 12.—Kansas: Masonry cement salient statistics

	1974	1975
Number of active plants -----	5	5
Production -----	58	66
Shipments from mills:		
Quantity -----	64	57
Value -----thousands--	\$2,203	\$2,311
Stocks at mills, Dec. 31 -----	13	22

production also decreased about 10%. The 1975 value was \$1,603,860 as compared to \$1,785,130 in 1974. Of the total output, 522,761 tons was consumed in the manufacture of brick, or 44%; another 33%, or 388,294 tons, was consumed in the manufacture of cement; and 16%, or 189,540 tons, was consumed in the manufacture of concrete blocks. The remaining 7% of production was used in the manufacture of drain pipe, sewer pipe, flue lining, highway surfacing, and structural concrete.

**Gypsum.**—National Gypsum Co. and Georgia-Pacific Corp. mined gypsum in Barber and Marshall Counties. Output decreased 4% and was 13% below the 1973 record. National Gypsum Co. and Georgia-Pacific Corp. calcined gypsum in Barber and Marshall Counties; output decreased 1% and was 12% below the 1973 record.

**Lime.**—The only producer of lime in Kansas was The Great Western Sugar Co. in Sherman County. The total output was used in sugar refining at the company's Goodland plant.

**Perlite.**—Crude perlite mined out-of-State was processed by Lite Weight Products, Inc., at its plant located in Wyandotte County. Major uses for expanded perlite in 1975 were horticultural aggregates, 51%; and masonry and cavity fill insulation, 22%. Fertilizers, plaster aggregate, concrete aggregate, filter aids, and

low-temperature insulation uses consumed the other 27%.

**Pumice.**—Production of pumice declined by 50% in 1975 from 1974 production. BASF Wyandotte Corp. was the only producer. All production was sold and used as chinchilla dusting powder.

**Salt.**—The State's salt industry experienced a 5.8% growth in production, with a 9.3% increase in average unit price. The entire 1,446,000 tons of production in 1975 (excluding salt brine) came from the Wellington formation (Lower Permian) mined by five companies operating in Rice, Reno, and Ellsworth Counties. Two firms mined salt through solution techniques producing evaporated salt, another produced rock salt through underground mining, and two others produced both varieties. Vulcan Materials Co. operated in Sedgwick County producing salt brine, which is used extensively in the chemical industry.

Domestic salt sales were down in 1975 owing primarily to the depressed chemical industry, which uses mainly salt brine. However, the different mix in Kansas production (evaporated, first; rock, second; and brine, third) appears to have insulated the State from the national dip. In spite of the national decline in 1975, the Bureau of Mines expects the salt industry, in general, to grow about 4% annually through 1980. For its part, some capacity expansion completed in Kansas during late 1975 should be reflected in continued growth during 1976.

For many years the tonnage of rock and evaporated production has been fairly evenly distributed, favoring slightly the evaporated form. Within the industry, however, there may be a stronger substitution trend from evaporated salt to rock salt, wherever possible. The price of evaporated salt has been recently running about five times that of rock salt, and the higher energy cost involved in producing

**Table 13.—Kansas: Evaporated and rock salt sold or used by producers**

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt	
	Quantity	Value	Quantity	Value
1971	676	15,847	564	2,865
1972	723	17,207	646	3,355
1973	782	19,914	615	3,547
1974	778	23,127	589	3,880
1975	771	26,274	675	4,940

the evaporated variety is expected to contribute to a substantial price increase in the near future.

**Sand and Gravel.**—Sand and gravel was produced in 77 counties from 149 operations. Total output decreased from nearly 11.7 million tons in 1974 to about 10.9 million tons in 1975. Corresponding values increased from \$13.4 million to about \$13.5 million. Of the total volume, about 44.8%, or 4.9 million tons, was used for paving, including bridge construction, and 27% for building construction. Leading counties were those counties in which large cities are located. Based on total volume produced, the leading counties were Sedgwick, Wyandotte, Reno, and Shawnee.

Sand and gravel occurrences are widespread across the State, being a result of natural disintegration of a variety of rocks. Most of the mineral currently being produced is dredged from flood plains and river deposits by producers of various corporate sizes and production facilities. As mentioned earlier, most sand and gravel has been for paving, followed by building, and then fill. Actually, although total production is keyed closely to construction activity, the percentage share of each construction use depends upon the particular current mix of consumptive activity, including the level and type of publicly funded social construction—dams, interstate highways, etc.

Table 14.—Kansas: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	8,055	8,612	7,065	8,068
Gravel -----	1,935	2,993	1,585	2,354
Industrial:				
Unprocessed: Sand and gravel -----	1,494	818	1,975	1,026
Sand -----	203	918	241	856
Total -----	11,687	13,341	10,866	12,304

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

Table 15.—Kansas: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	2,856	3,734	2,763	4,140
Highway and bridge construction -----	504	520	247	327
Other construction (dams, waterworks, airports, etc.) -----	166	289	100	144
Concrete products (cement blocks, brick, pipe, etc.) -----	534	611	499	562
Bituminous paving (asphalt and tar paving) -----	760	1,005	496	603
Roadbase and subbase -----	567	613	204	293
Fill -----	1,019	855	988	1,079
Other -----	153	185	92	185
Unprocessed:				
Roadbase and subbase -----	319	139	128	84
Fill -----	243	181	517	352
Other -----	--	--	W	W
Industrial sand and gravel -----	203	918	241	856
Total -----	7,324	9,050	6,275	<sup>1</sup> 8,624

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

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Table 16.—Kansas: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	53	66	191	341
Highway and bridge construction -----	1,643	1,844	1,072	1,362
Other construction (dams, waterworks, airports, etc.) -----	W	W	118	157
Concrete products (cement blocks, brick, pipe, etc.) -----	393	484	43	47
Bituminous paving (asphalt and tar paving) -----	584	690	917	1,157
Roadbase and subbase -----	632	623	678	801
Fill -----	70	71	155	163
Other -----	55	62	87	135
<b>Unprocessed:</b>				
Roadbase and subbase -----	824	427	1,124	551
Fill -----	108	71	19	10
Other -----	--	--	188	120
<b>Total</b> <sup>1</sup> -----	<b>4,362</b>	<b>4,338</b>	<b>4,591</b>	<b>4,843</b>

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 17.—Kansas: Sand and gravel sold or used by producers, by county**  
(Thousand short tons and thousand dollars)

County	Number of mines	1974		1975		
		Quantity	Value	Quantity	Value	
Barber -----	1	17	12	1	19	5
Barton -----	3	177	157	6	238	258
Chase -----	1	10	2	1	9	3
Cherokee -----	2	W	W	2	W	W
Cheyenne -----	3	140	174	2	W	W
Clark -----	1	28	17	1	25	18
Clay -----	1	W	W	1	W	W
Cloud -----	W	W	W	2	176	W
Comanche -----	3	27	12	2	32	29
Cowley -----	4	320	313	4	319	373
Decatur -----	1	23	17	1	19	5
Dickinson -----	1	W	124	1	W	W
Douglas -----	2	W	W	2	W	W
Edwards -----	2	W	W	2	W	W
Elk -----	1	W	W	1	5	1
Ellis -----	3	162	228	2	W	149
Ellsworth -----	W	W	W	3	W	W
Finney -----	W	W	W	3	W	W
Ford -----	W	W	W	2	148	239
Geary -----	W	W	W	2	148	239
Gove -----	1	37	9	1	36	7
Graham -----	1	W	W	1	30	7
Grant -----	1	23	6	1	21	28
Gray -----	2	W	W	1	49	40
Greeley -----	1	7	3	1	6	3
Greenwood -----	1	W	W	1	W	W
Hamilton -----	1	46	23	1	3	4
Harper -----	W	W	W	2	W	W
Harvey -----	1	125	83	1	145	W
Haskell -----	2	W	42	1	44	17
Hodgeman -----	1	68	27	4	71	18
Jackson -----	1	7	3	1	7	4
Johnson -----	1	W	W	1	W	W
Kearny -----	2	W	W	3	W	W
Kingsman -----	W	W	W	2	W	W
Kiowa -----	W	W	W	1	23	17
Lane -----	1	W	W	1	65	16

See footnotes at end of table.

Table 17.—Kansas: Sand and gravel sold or used by producers, by county—Continued  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Lincoln	1	W	68	2	118	40
Linn	1	32	64	1	30	66
Logan	1	W	W	1	2	4
Lyon	1	29	4	1	30	8
McPherson	1	6	3	1	5	3
Marshall	W	W	W	2	160	331
Meade	1	W	W	1	26	24
Mitchell	1	W	W	2	31	24
Morris	1	W	W	1	W	W
Morton	1	68	300	1	7	4
Nemaha	1	3	2	--	--	--
Neosho	2	W	W	1	W	W
Ness	1	72	19	1	102	26
Norton	1	6	7	1	11	12
Ottawa	1	19	5	1	9	2
Pawnee	3	118	136	3	94	128
Phillips	2	96	95	2	72	71
Pottawatomie	W	W	W	1	79	107
Pratt	W	W	W	2	W	W
Rawlins	2	4	W	5	25	19
Reno	6	529	469	6	595	587
Republic	1	W	W	1	W	W
Rice	W	W	W	3	W	W
Riley	W	W	W	1	W	W
Rooks	W	W	W	1	15	4
Russell	1	40	35	1	45	40
Saline	2	W	W	2	314	W
Scott	1	32	31	--	--	--
Sedgwick	11	2,410	2,161	10	2,359	2,968
Seward	3	W	182	3	131	188
Shawnee	6	612	719	6	512	589
Sheridan	1	51	25	1	15	4
Sherman	1	W	7	1	W	8
Smith	1	1	1	--	--	--
Stafford	W	W	W	1	W	W
Stevens	1	34	25	1	81	80
Sumner	W	W	W	1	W	W
Thomas	3	98	129	1	61	86
Trego	3	W	106	2	117	110
Wallace	1	29	37	1	18	24
Washington	W	W	W	1	W	W
Wichita	W	W	W	2	W	W
Wyandotte	3	1,756	3,148	8	1,591	2,338
Other counties <sup>1</sup>	35	4,428	4,359	--	2,717	3,331
Total <sup>2</sup>	153	11,690	13,389	149	10,866	13,467

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

<sup>1</sup> Includes Marion County (1974) and counties indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

**Stone.**—Tonnage of crushed and broken stone production for 1975 was 15,890,000 tons, valued at \$35,174,000. This is an 11.1% decrease in volume from that of 1974 and a 2.4% increase in value, which is consistent with the reduced level of construction demand along with general inflationary pressures.

Limestone accounted for 97% of the stone produced in Kansas. Most stone was quarry mined, although a few companies had underground operations in Atchison and Wyandotte Counties.

The largest category of use for crushed stone has been as an aggregate in construction and paving—as a concrete, bituminous, macadam, and surface treatment aggregate, and a roadbase stone. The second largest consumptive use was for the manufacture of cement. Riprap consists of crushed stone of irregular sizes used for rough construction. Miscellaneous uses included railroad ballast, fill, filter, and jetty stone. About 3% to 5% of stone was fragmented further for use in agriculture.



**Table 18.—Kansas: Crushed stone sold or used by producers, by use**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate .....	1,907	4,165	2,128	5,813
Concrete aggregate .....	2,956	7,437	2,833	7,858
Dense-graded roadbase stone .....	3,203	6,058	2,473	5,563
Macadam aggregate .....	299	457	206	344
Surface treatment aggregate .....	2,552	5,013	1,979	4,558
Other construction aggregate and roadstone .....	1,593	2,605	1,629	2,830
Agricultural limestone .....	562	1,046	694	1,292
Cement manufacture .....	3,395	5,814	3,209	6,015
Railroad ballast .....	W	W	78	235
Riprap and jetty stone .....	944	997	415	620
Other uses <sup>1</sup> .....	457	766	246	496
<b>Total<sup>2</sup> .....</b>	<b>17,869</b>	<b>34,357</b>	<b>15,890</b>	<b>35,174</b>

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

<sup>1</sup> Includes filter stone, lime manufacture, fill (1974), and uses indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

**Table 19.—Kansas: Stone sold or used by producers, by kind**  
(Thousand short tons and thousand dollars)

Kind of stone	1974		1975	
	Quantity	Value	Quantity	Value
Dimension stone total <sup>1</sup> .....	W	513	17	676
Crushed and broken:				
Limestone .....	17,335	33,244	15,382	33,704
Undistributed <sup>2</sup> .....	534	1,112	508	1,470
Total <sup>3</sup> .....	17,869	34,357	15,890	35,174
Grand total <sup>3</sup> .....	17,869	34,869	15,907	35,850

W Withheld to avoid disclosing individual company confidential data. Dimension limestone and sandstone are combined.

<sup>1</sup> Data represent limestone.

<sup>2</sup> Includes sandstone, quartzite, and other stone.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

**Sulfur.**—Elemental sulfur was recovered in Kansas and showed a slight increase; 1975 production was 11% above the 1974 production. Elemental sulfur was produced in Butler, Montgomery, and Wyandotte

Counties by three companies: Skelly Oil Co., Phillips Petroleum Co., and CRA, Inc. Over half of the production was from Wyandotte County.

Table 20.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Cement:</b>			
Ash Grove Cement Co. <sup>1,2</sup> --	1000 Tenmain Center Kansas City, Mo. 64105	Plant and quarry-	Neosho.
General Portland Inc. <sup>1</sup> ----	4400 Republic National Bank Tower Dallas, Tex. 75201	----do -----	Wilson.
Lone Star Industries, Inc. <sup>2</sup> --	1 Greenwich Plaza Greenwich, Conn. 06830	----do -----	Wyandotte.
The Monarch Cement Co. <sup>1,2</sup>	Humboldt, Kans. 66740	----do -----	Allen.
United States Steel Corp. <sup>1,2</sup>	600 Grant St. Pittsburgh, Pa. 15230	----do -----	Montgomery.
Clays: Excelsior Clay Products, Inc.	342 North Waco Wichita, Kans. 67202	Mine and plant --	Wilson.
<b>Coal:</b>			
Bill's Coal Co -----	5200 S. Yale Ave. Tulsa, Okla. 74135	Strip mine -----	Bourbon.
Clemens Coal Co. <sup>1</sup> -----	Box 62299 Pittsburg, Kans. 66762	----do -----	Crawford.
<b>Gypsum:</b>			
Georgia-Pacific Corp -----	900 SW. Fifth Ave. Portland, Oreg. 97204	Quarry and plant -	Marshall.
National Gypsum Co -----	325 Delaware Ave. Buffalo, N.Y. 14202	----do -----	Barber.
<b>Helium:</b>			
Cities Services Cryogenics, Inc.	Scott City, Kans. 67871	Plant -----	Scott.
Gardner Cryogenics, Inc --	Elkhart, Kans. 67950	----do -----	Morton.
Kansas Refined Helium Co --	Otis, Kans. 67565	----do -----	Rush.
National Helium Corp ----	Liberal, Kans. 67901	----do -----	Seward.
Lime: The Great Western Sugar Co.	Box 5308 Denver, Colo. 80217	----do -----	Sherman.
Petroleum refineries: <sup>3</sup>			
Pumice: BASF Wyandotte Corp.	1609 Biddle Ave. Wyandotte, Mich. 48192	Mine and plant --	Norton.
<b>Salt:</b>			
American Salt Corp -----	3142 Broadway Kansas City, Mo. 64111	Wells and underground mine.	Rice.
Carey Salt Co -----	1800 Carey Blvd. Hutchinson, Kans. 67501	----do -----	Renno.
Morton Salt Co -----	110 North Wacker Dr. Chicago, Ill. 60606	Wells -----	Do.
Vulcan Materials Co.-----	Box 545 Wichita, Kans. 67201	----do -----	Sedgwick.
<b>Sand and gravel:</b>			
Bingham Sand and Gravel Co.	2005 East Ave. Baxter Springs, Kans. 66713	Pits -----	Cherokee.
Holliday Sand and Gravel Co.	6811 W. 63rd. St. Overland Park, Kans. 66202	----do -----	Cherokee, Douglas, Wyandotte. Sedgwick.
Superior Sand Co., Inc ---	6500 West 21st, Route 7 Wichita, Kans. 67212	Dredge -----	
<b>Stone:</b>			
N. R. Hamm Quarries, Inc--	Box 425 Herrington, Kans. 67449	Quarries -----	Various.
Killough-Clark, Inc -----	Box 263 Ottawa, Kans. 66067	----do -----	Do.
Martin Marietta Corp ----	11300 Rockville Pike Rockville, Md. 20852	----do -----	Do.
Midwest Minerals, Inc ----	Box 7 Girard, Kans. 66743	----do -----	Do.
Reno Construction Co ----	Box 4278 Overland Park, Kans. 66204	Quarry -----	Johnson and Wyandotte.

<sup>1</sup> Also clays.<sup>2</sup> Also stone.<sup>3</sup> See table 10.



# 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 and disseminating information on all minerals produced from mines, quarries, and wells.

By William T. Boyd <sup>1</sup> and Preston McGrain <sup>2</sup>

The total value of mineral production in Kentucky increased 7% in 1975 to a record \$2.74 billion. The significant increase in value largely reflects the State's continuing first place in coal production and fluctuating coal prices, especially in spot-market sales during the first part of the year.

During 1975, a record 143.6 million tons of bituminous coal was produced from 2,401 underground and surface mines. Surface mining continued to expand, and for the fifth consecutive year surface coal production surpassed that from underground mining. In 1975, 1,505 surface mines produced 78 million tons; and 896 underground

mines produced about 66 million tons of bituminous coal.

**Legislation and Government Programs.**—The U.S. Geological Survey in cooperation with the Kentucky Geological Survey continued the aerial geologic mapping program. During the year 48 additional 7.5-minute quadrangle maps were produced, and the total of 544 maps produced during this program covers nearly 76% of the State. Two bedrock topographic maps were published as a part of this cooperative work.

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<sup>2</sup> Assistant state geologist, Kentucky Geological Survey, Lexington, Ky.

Table 1.—Mineral production in Kentucky <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays <sup>2</sup> -----thousand short tons--	848	\$1,477	778	\$1,483
Coal (bituminous) -----do-----	137,197	2,340,961	143,613	2,499,295
Natural gas -----million cubic feet--	71,876	35,938	60,511	32,676
Petroleum (crude) -----thousand 42-gallon barrels--	7,837	68,340	7,556	84,520
Sand and gravel -----thousand short tons--	8,710	12,887	8,924	14,466
Stone -----do-----	34,542	66,632	31,734	67,906
Zinc (recoverable content of ores, etc.) short tons--	--	--	41	32
Value of items that cannot be disclosed:				
Cement, clay (ball), fluorspar, lead (1975). lime, natural gas liquids -----	XX	36,975	XX	38,481
Total -----	XX	2,563,210	XX	2,738,859
Total 1967 constant dollar -----	XX	1,211,886	XX	<sup>p</sup> 1,084,588

<sup>p</sup> Preliminary. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes ball clay; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Kentucky, by county<sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adair	\$1,799	W	Petroleum, stone.
Allen	616	W	Do.
Anderson	W	W	Stone.
Ballard	3	\$1	Sand and gravel
Barren	W	W	Stone, petroleum.
Bath	W	W	
Bell	72,332	W	Coal, petroleum.
Boone	W	W	Sand and gravel, stone.
Bourbon	W	W	Stone.
Boyd	4,662	W	Coal, petroleum.
Boyle	W	W	Stone.
Breathitt	73,996	W	Coal, petroleum.
Breckinridge	W	W	Stone, sand and gravel, petroleum.
Bullitt	W	W	Stone, clays.
Butler	W	W	Coal, petroleum, stone.
Caldwell	2,193	W	Stone.
Calloway	125	W	Sand and gravel.
Carlisle	W	W	Clays, sand and gravel.
Carroll	29	--	
Carter	11,336	5,962	Coal, stone, clays.
Casey	287	W	Stone, petroleum.
Christian	6,007	7,529	Stone, coal, petroleum.
Clay	17,053	20,700	Coal, petroleum.
Clinton	W	W	Stone, petroleum.
Crittenden	W	W	Stone, fluorspar.
Cumberland	W	W	Petroleum, stone.
Daviess	W	W	Coal, petroleum, sand and gravel.
Edmonson	W	W	Coal, stone, petroleum.
Elliott	12,239	7,329	Coal, petroleum.
Estill	W	W	Petroleum.
Fayette	W	W	Stone.
Fleming	W	W	Do.
Floyd	W	79,187	Coal, natural gas liquids, petroleum, sand and gravel.
Franklin	W	W	Stone.
Fulton	W	W	Sand and gravel.
Gallatin	W	310	Do.
Garrard	W	W	Stone.
Graves	2,974	W	Clays, sand and gravel.
Grayson	W	W	Stone, coal.
Green	W	W	Petroleum, stone.
Greenup	2,856	W	Coal, clays, petroleum.
Hancock	2,030	W	Coal, sand and gravel, petroleum, clays.
Hardin	2,233	1,534	Stone.
Harlan	W	W	Coal, stone.
Harrison	W	W	Stone.
Hart	505	W	Sand and gravel, stone, petroleum.
Henderson	15,361	W	Coal, petroleum, sand and gravel.
Henry	W	W	Stone.
Hickman	1	1	Sand and gravel.
Hopkins	111,880	W	Coal, petroleum.
Jackson	W	W	Coal, stone.
Jefferson	19,130	W	Cement, stone, sand and gravel, clays.
Jessamine	W	W	Stone.
Johnson	31,194	W	Coal, petroleum.
Knott	97,022	97,030	Do.
Knox	36,041	29,777	Do.
Laurel	W	W	Coal, stone, petroleum.
Lawrence	25,033	14,323	Coal, petroleum.
Lee	W	W	Petroleum, coal, stone.
Leslie	69,680	W	Coal, petroleum.
Letcher	134,571	119,445	Coal, petroleum, stone.
Lewis	W	W	Clays, sand and gravel.
Livingston	14,943	W	Stone, sand and gravel, zinc, lead.
Logan	W	W	Stone.
Lyon	3	--	
McCracken	W	W	Sand and gravel.
McCreary	22,019	18,548	Coal.
McLean	10,487	13,072	Coal, petroleum.
Madison	W	W	Stone.
Magoffin	30,976	27,864	Coal, petroleum.
Marion	W	W	Stone.
Marshall	961	--	
Martin	103,822	94,187	Coal, sand and gravel, petroleum.
Mason	W	W	Sand and gravel.
Meade	8,024	W	Natural gas liquids, stone.
Menifee	W	W	Stone, coal.

See footnotes at end of table.

Table 2.—Value of mineral production in Kentucky, by county<sup>1 2</sup>—Continued

(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Mercer -----	W	W	Stone.
Metcalfe -----	W	W	Stone, petroleum.
Monroe -----	W	W	Do.
Montgomery -----	W	W	Stone.
Morgan -----	W	W	Coal, stone, petroleum.
Muhlenberg -----	W	\$244,629	Coal, petroleum, stone.
Nelson -----	W	W	Stone.
Nicholas -----	\$480	506	Do.
Ohio -----	W	W	Coal, petroleum, stone.
Oldham -----	2,270	W	Stone, sand and gravel.
Owsley -----	8,721	4,714	Coal, petroleum.
Pendleton -----	11,004	W	Lime, stone.
Perry -----	139,939	114,901	Coal, petroleum.
Pike -----	538,083	520,075	Coal, stone, petroleum.
Powell -----	367	W	Petroleum, stone, clays.
Pulaski -----	10,046	9,470	Coal, stone.
Rockcastle -----	W	W	Do.
Rowan -----	W	W	Stone, clays.
Russell -----	11	W	Petroleum.
Scott -----	W	W	Stone.
Simpson -----	W	W	Stone, petroleum.
Spencer -----	--	W	Sand and gravel.
Taylor -----	W	W	Stone.
Todd -----	W	W	Stone, petroleum.
Trigg -----	424	319	Stone.
Trimble -----	W	W	Sand and gravel.
Union -----	W	W	Coal, petroleum, sand and gravel.
Warren -----	W	1,436	Stone, petroleum, coal.
Washington -----	W	W	Stone.
Wayne -----	W	W	Coal, stone, petroleum.
Webster -----	W	57,410	Coal, petroleum.
Whitley -----	W	W	Coal, petroleum, clays.
Wolfe -----	W	W	Coal, petroleum, stone.
Undistributed <sup>3</sup> -----	912,451	1,248,600	
Total <sup>4</sup> -----	2,563,210	2,738,859	

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

<sup>1</sup> The following counties are not listed because no production was reported: Bracken, Campbell, Clark, Grant, Kenton, Larue, Lincoln, Owen, Robertson, Shelby, and Woodford.

<sup>2</sup> Values of petroleum and natural gas are based on an average unit value for the State.

<sup>3</sup> Includes natural gas and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Kentucky business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands---	1,411.0	1,408.0	-0.2
Unemployment -----do-----	64.0	103.0	+60.9
<b>Employment (nonagricultural):</b>			
Mining -----do-----	39.2	44.8	+14.3
Manufacturing -----do-----	290.2	254.2	-12.4
Contract construction -----do-----	54.2	47.0	-13.3
Transportation and public utilities -----do-----	61.7	59.5	-3.6
Wholesale and retail trade -----do-----	216.5	214.0	-1.2
Finance, insurance, and real estate -----do-----	41.9	41.7	-0.5
Services -----do-----	161.9	165.6	+2.3
Government -----do-----	203.2	214.9	+5.8
Total nonagricultural employment -----do-----	1,068.8	1,041.7	-2.5
<b>Personal income:</b>			
Total -----millions-----	\$15,314	\$16,541	+8.0
Per capita -----do-----	\$4,565	\$4,871	+6.7
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----	10,611	10,675	+0.6
Value of nonresidential construction -----millions-----	\$140.6	\$101.0	-28.2
Value of State road contract awards -----do-----	\$185.0	\$184.0	-0.5
Shipments of portland and masonry cement to and within Kentucky -----thousand short tons-----	1,120	988	-11.8
<b>Mineral production value:</b>			
Total crude mineral value -----millions-----	\$2,563.2	\$2,738.9	+6.9
Value per capita, resident population -----do-----	\$764.22	\$808.64	+5.8
Value per square mile -----do-----	\$63,453.65	\$67,801.93	+6.9

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

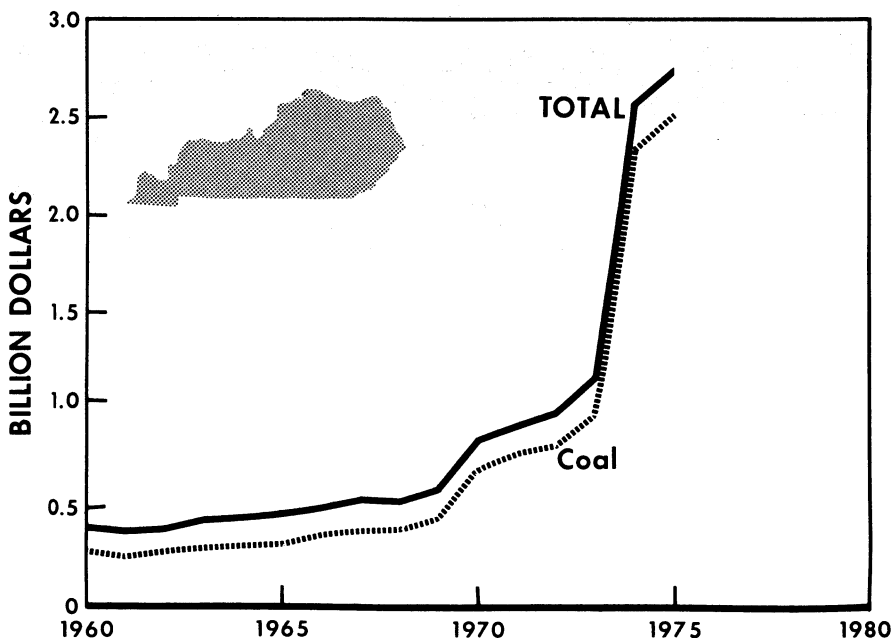


Figure 1.—Value of coal and total value of mineral production in Kentucky.

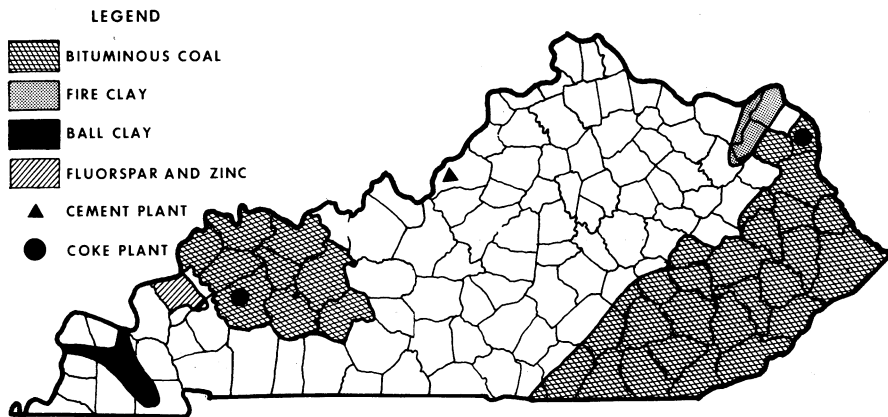


Figure 2.—Mineral resources and mineral industries of Kentucky.

The Kentucky Geological Survey published five reports on geology and mineral resources in selected areas.<sup>3</sup>

The Federal Bureau of Mines continued the cooperative study with the University of Kentucky and Beth-Elkhorn Corp. on ground control problems related to shortwall recovery of medium-thick coalbeds in mountainous terrain. A cooperative study with Morehead State University has been started for devising methods for predetermining areas of high stress in underground mines and then alining mine workings to reduce roof control problems during mining. An intensive search was made in eastern Kentucky for appropriate watershed areas required for the long-range cooperative investigation between the Bureau of Mines, the Tennessee Valley Authority (TVA), the U.S. Forest Service and selected coal companies to document water quality changes and soil erosion problems created by three different surface mining methods used in this steep terrain, which has high annual rainfall.

The Environmental Protection Agency (EPA) joined with the Louisville Gas and Electric Co. in a \$1.7 million study to develop methods for economic disposal of sludge resulting from lime-scrubber removal of SO<sub>2</sub> from stack gases. Also, EPA and the State's Division of Reclamation started a \$1.5 million cooperative study for determining the environmental impacts of surface coal mining. The National Aeronautics and Space Administration (NASA)-sponsored study was continued for deter-

mining the feasibility of using satellite photographs to detect illegal surface mining.

The FMC Corp., Island Creek Coal Co., and the Bureau of Mines study for developing and demonstrating an inherently safe conventional coal mining system was completed. TVA announced plans for borrowing \$23 million to develop a new mine in western Kentucky, which will be operated by Peabody Coal Co. TVA paid western Kentucky farmers a total of \$231,000 for sulfur dioxide damages to crops near the Shawnee powerplant. TVA will provide funds to the State's Division of Reclamation for partial restoration of nearly 41,000 acres of abandoned stripped coal lands in 12 southeastern Kentucky counties.

The State has started a federally funded program for training emergency medical technicians in the coal mining industry. These training classes are being conducted

<sup>3</sup> Black, D. F. B., and D. C. Haney. Selected Structural Features and Associated Dolostone Occurrences in the Vicinity of the Kentucky River Fault System. Ky. Geol. Survey, 1975, 27 pp.

McGrain, P. Scenic Geology of Pine Mountain in Kentucky. Ky. Geol. Survey, ser. 10, Spec. Pub. 24, 1975, 24 pp.

McGrain, P., and J. C. Currens. Bibliography of Industrial and Metallic Minerals in Kentucky Through August 1973. Ky. Geol. Survey, ser. 10, Spec. Pub. 23, 1975, 90 pp.

Schwalb, H. R. Oil and Gas in Butler County, Kentucky. Ky. Geol. Survey, ser. 10, Rept. Inv. 16, 1975, 65 pp.

Vincent, J. W. Lithofacies and Biofacies of the Haney Limestone (Mississippian), Illinois, Indiana, and Kentucky. Ky. Geol. Survey, ser. 10, Thesis Ser. 4, 1975, 64 pp.



by Morehead State and Eastern Kentucky Universities in the eastern coalfield and by Madisonville and Murray Community Colleges in the western coalfield.

The lack of high-capacity truck haulways continued to hamper coal production in eastern Kentucky. The State has requested nearly \$110 million from the U.S. Department of Transportation for developing new and improving existing roadways necessary for meeting the Project Independence goal of doubling coal production from this geographic area.

The State licensed a total of 3,570 coal mines in 1975 including 1,925 surface mines. Legislation was enacted increasing the coal severance tax to 4½% of the sales price with a minimum of 50 cents per ton. The State developed a plan for sharing this \$100 million revenue source with the coal-producing counties. Strip mine reclamation laws were amended by increasing bonding requirements to \$3,000 per acre for lands difficult to reclaim, with a minimum bond of \$500 per acre on all other lands. New legislation was enacted governing the reclamation of disturbed surfaces around new underground mines. All highways and bridges were reclassified to permit gross load increases.

A Supreme Court decision requiring TVA to install SO<sub>2</sub> continuous-scrubbing equipment may sharply curtail the use of western Kentucky coals for thermal power purposes. Several cooperative proposals have been developed for using large quantities of these coals for onsite coal gasification purposes.

The Division of Oil and Gas issued 1,399 drilling permits during the year, compared with 1,160 in 1974. Oil production continued to decline, but at a lesser rate (4%) than in previous years. This gradual reduction indicates that many stripper wells were returned to production.

The Department of Mines and Minerals continued sponsorship of the federally funded education and training program being conducted at Pikeville College and Morehead State University. Nearly 200 graduates of the Pikeville program are now working in the coal industry. Plans have been developed for extending this cooperative training program into Eastern Kentucky and Western Kentucky Universities and selected vocational schools.

Franchise taxes enacted earlier by 15 coal-producing counties were declared unconstitutional.

Possible ground water leakage at the nuclear waste disposal site in Fleming County has caused much concern among environmental groups and the State Department of Human Resources, which has responsibility for monitoring the safe disposal of these industrial waste products.

**Economic Indicators.**—Personal income increased 8% in 1975 to a total of \$16,541 million. Kentucky ranked 45th nationally in per capita income and was 9th in the 12-State Southeast region. Total unemployment increased. Sales of electric power to large industries, manufacturers, mines, and residences increased 8%. Farm market receipts decreased 1%. Mineral production value increased substantially as Kentucky retained the lead in national bituminous coal production and was second in production of ball clay and sixth in fluorspar production.

Despite many industrial, safety, and regulatory problems, Kentucky's mineral production reached an alltime high of \$2.74 billion in 1975. The reported value of mineral production for the State was 7% above the previous peak year of 1974, making 1975 the sixth consecutive year of significant increase in mineral production and value. During the past 6 years, the value of mineral production has increased nearly fivefold. The sizable gain in 1975 mineral value was primarily due to the production gains and unit price increases in the energy resources, principally coal.

**Trends and Developments.**—In 1975, 12 minerals were produced in Kentucky, 1 more than in 1974. Six were classified as nonmetallic, which showed only slight gains, while the fuel resource minerals showed significant increases in unit value. Total value of the nonmetallic minerals increased slightly over \$2 million in 1975. Stone and sand and gravel production made significant contributions to the total value of minerals produced during the year.

Environmental concerns regarding air and water pollution problems caused by the expanding surface mining industry and thermal-power-generating plants within the State continued to receive attention in 1975. Farmers in western Kentucky were compensated for crop damages caused by

sulfur dioxide emissions from a large TVA power-generating plant. New surface mining regulations were issued, and overall enforcement was expanded by the State's purchase of a helicopter. Environmental groups stopped planned construction of the Red River Dam by the Corps of Engineers in eastern Kentucky.

Mineral fuels accounted for 96% of the value of all minerals produced in 1975, compared with 96% in 1974 and 91% in 1973. Bituminous coal production, which alone accounted for 91% of the total value of all mineral output, increased 5% over the 1974 tonnage and 12% over the 1973 tonnage. Owing to the continuing inflationary trend in energy resource prices, the value of mineral fuels increased nearly 149% above the 1973 value. Petroleum production was 4% less than in 1974 and 13% less than 1973. The value of this resource, however, increased nearly 145% during this period. Values of natural gas and natural gas liquids production increased nearly 50% and nearly 20% respectively compared with 1973 values.

Gondola shortages continued to hamper some of the small coal mines which operate without storage facilities, and the continuing advances in the cost of coal haulage trucks, mining equipment, diesel fuel, and labor have sharply decreased the profitability of many mines that are largely dependent upon spot-market sales. The

number of coal mines operating increased from 1,789 in 1974 to 2,401 in 1975.

The coal mine safety record plummeted in 1975 as 45 miners were killed in coal mine accidents. No lives were lost as a result of mine fires or gas explosions, and analysis of the 45 accidents indicated that the vast majority resulted from unsafe work habits. About 65% were caused by the workmen disregarding safety regulations in the installation and use of mining machinery and supporting equipment.

Although three deep (13,000 to 14,000-foot) holes drilled in the Grayson-Webster and Wolfe County areas were dry, oil and gas drilling activities increased markedly during the year in all principal producing areas.

Cleancoal Terminals Corp. announced plans to build a 2,500-ton-per-hour coal terminal on the Ohio River near Ghent, Ky. This facility will handle mainly low-sulfur coals from eastern Kentucky.

American Smelting and Refining Co. and its Australian affiliate, M.I.H. Holdings, Ltd., have agreed on a planned cooperative development of a \$200 million zinc smelting facility in the Breckinridge County area. The Cominko Corp. of Seattle, Wash., started exploration work on zinc deposits near Burkesville, Cumberland County.

Aluminum Company of America (Alcoa) canceled all plans for constructing a rolling mill in Meade County.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Coal (Bituminous).**—The 1975 production of 143.6 million tons from 2,401 mines surpassed the earlier record production year of 1974 by 5%. Eighteen producers mined more than 1 million tons each during the year, and Peabody Coal Co. again dominated in coal production by mining 24.9 million tons. Island Creek Coal Co. was a distant second, producing 6.5 million tons. The total annual production was valued at \$2,499,295,000, an average value of \$17.40 per ton compared with the average value of \$17.06 per ton in 1974. During the year 896 underground and 1,505 surface mines operated in 45 counties. Pike and Muhlenberg Counties continued to lead in

underground and surface coal production, respectively.

In eastern Kentucky 2,219 mines in 31 counties produced 87.3 million tons of coal valued at \$1.8 billion. In 1974, 1,684 mines in 30 counties produced 85.4 million tons having an average value of \$22.01 per ton. The number of surface mines increased from 910 in 1974 to 1,350 in 1975, and production from these operations increased from 44.8 million tons in 1974 to 46.6 million tons in 1975. Underground mining activity also increased, from 774 mines in 1974 to 869 operations in 1975, and these mines produced 40.6 million tons compared with 40.5 million tons in 1974.

With the rapid expansion of underground mining, the use of both conven-

tional and continuous-mining equipment increased markedly. This was estimated to include 481 cutting machines, which undercut 17.4 million tons; 596 handheld hole drills; 252 mobile coal drills; 560 rotary drills; and 74 percussion rock drills. Some 499 mobile loading machines loaded 16.5 million tons produced at conventional minesites, and 235 continuous-mining machines were used to produce 20.1 million tons. This production was transported by 207 trolley-type locomotives, 28 battery-powered locomotives, 661 shuttle buggies and rubber-tired tractors, 1,055 cable-type shuttle cars, 201 battery-type shuttle cars, and 942 gathering conveyors.

The eastern Kentucky surface mining industry used 72 draglines and power shovels, 876 bulldozers, and 703 front-end loaders. Reportedly, 23.8 million tons was mechanically cleaned at 45 preparation plants.

In western Kentucky, 182 mines in 14 counties produced 56.4 million tons of coal with an average value of \$12.16 per ton. In 1974, 105 mines in 12 counties produced 51.8 million tons having an average value of \$8.92 per ton. The number of surface coal mining units increased from 76 in 1974 to 155 in 1975, and production from these operations increased from 28.9 million tons in 1974 to 31.3 million tons in 1975. Underground mining activity increased slightly,

from 29 mines producing 23 million tons in 1974 to 27 mines producing 25 million tons in 1975.

In the western Kentucky underground mines, equipment included 116 cutting machines, 119 mobile handheld drills, 128 mobile loading machines, 6 continuous-mining machines, 287 cable-type shuttle cars, and 8 battery-powered shuttle cars. No hand-loaded production was reported, and continuous mining extracted only about 4% of the total production.

Surface mining equipment included 104 power shovels of various dipper capacities, 72 draglines, 507 bulldozers, 261 front-end loaders, 57 carryall scrapers, and 34 horizontal and 137 vertical overburden drills.

TVA continued to be a large consumer of Kentucky coals, purchasing approximately 8 million tons from both eastern and western Kentucky operations.

**Natural Gas.**—Natural gas production showed a decrease from 71,876 million cubic feet in 1974 to 60,511 million cubic feet in 1975, with a value of \$32.7 million. The number of producing wells increased from 7,307 in 1974 to 7,386 in 1975.

**Petroleum.**—Even though 246 new wells were completed during the year, oil production continued to decline from 7.8 million barrels in 1974 to 7.6 million barrels, a 4% decrease.

Table 4.—Kentucky: Oil and gas well drilling completions in 1975, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Adair	24	--	13	10	--	24	71	102,400
Allen	5	--	12	2	--	3	22	8,795
Barren	3	--	4	3	--	6	16	7,921
Bath	--	--	1	--	--	--	1	600
Bell	--	--	--	--	--	--	1	2,686
Boyd	--	--	--	--	--	1	1	8,439
Breathitt	--	1	--	--	--	1	2	3,875
Breckinridge	2	--	3	--	--	1	6	1,777
Butler	--	--	6	1	--	1	8	8,666
Caldwell	--	--	--	--	--	3	3	4,709
Carroll	--	--	--	--	--	1	1	1,605
Casey	--	--	--	--	--	5	5	4,205
Christian	1	1	2	--	--	7	11	14,098
Clay	--	9	5	--	3	2	19	27,341
Clinton	8	--	8	3	1	10	30	28,903
Crittenden	--	--	--	--	--	5	5	3,920
Cumberland	14	--	20	6	1	22	63	67,904
Daviess	38	3	31	4	1	15	92	139,127
Edmonson	1	--	--	--	--	2	3	2,862
Elliott	2	--	--	--	2	3	7	13,704
Estill	2	--	--	--	--	2	4	1,286
Floyd	1	--	--	--	--	--	1	3,663
Grayson	--	5	--	--	1	2	8	21,367
Green	12	--	14	6	--	5	37	51,582
Hancock	4	3	9	3	1	4	24	31,292
Hardin	--	--	--	--	1	--	1	915
Hart	1	--	--	--	--	2	3	3,354
Henderson	15	1	16	--	--	2	34	60,725
Hopkins	11	2	12	3	1	14	43	100,891
Jackson	--	1	1	--	--	1	3	12,391
Jefferson	--	--	--	--	--	1	1	320
Johnson	1	--	2	--	1	--	4	7,595
Knott	1	4	1	--	--	--	6	17,201
Knox	1	3	3	--	--	3	10	15,556
Laurel	--	1	--	--	--	1	2	2,573
Lawrence	2	8	3	--	--	--	13	29,880
Lee	14	--	--	--	--	--	14	16,126
Leslie	--	20	3	--	--	--	23	63,550
Letcher	1	4	3	--	--	--	8	26,962
Lincoln	--	--	1	--	--	2	2	2,115
Logan	--	--	--	--	--	2	3	5,165
McCreary	--	--	--	--	1	1	2	2,029
McLean	3	--	1	--	--	4	8	17,049
Magoffin	8	1	--	--	--	--	9	8,856
Martin	--	--	--	--	--	--	2	1,503
Menifee	--	--	2	--	--	1	1	6,786
Metcalfe	5	--	7	--	--	16	28	10,661
Monroe	2	--	5	1	--	5	13	6,817
Morgan	1	--	5	--	--	2	8	23,804
Muhlenberg	14	3	4	5	3	20	49	88,508
Nelson	--	--	--	--	--	1	1	1,525
Ohio	13	1	18	2	1	8	43	45,561
Perry	5	9	--	--	--	--	14	36,668
Pike	2	18	1	--	1	1	23	65,984
Powell	9	--	--	--	--	--	9	9,383
Pulaski	--	--	--	--	--	2	2	1,195
Russell	2	--	6	--	--	3	11	6,389
Simpson	1	--	5	--	--	--	6	3,198
Spencer	--	--	--	--	--	1	1	1,615
Taylor	--	--	--	--	--	1	1	611
Todd	--	--	1	--	--	2	3	4,230
Union	6	--	11	--	--	--	17	36,928
Warren	3	--	4	--	--	1	8	4,175
Wayne	--	--	3	--	--	6	9	6,590
Webster	5	--	6	3	--	3	17	55,235
Whitley	--	4	4	1	2	--	11	16,075
Wolfe	3	--	1	5	--	2	11	15,353
Total	246	102	257	58	21	234	918	1,404,774

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 5.—Kentucky: Crude oil production, by county  
(Thousand 42-gallon barrels and thousand dollars)

County	1974	1975
Adair	143	183
Allen	30	29
Barren	9	7
Bath	( <sup>1</sup> )	--
Bell	( <sup>1</sup> )	1
Boyd	2	2
Bracken	--	1
Breathitt	14	20
Breckinridge	9	7
Butler	40	37
Casey	4	4
Christian	128	107
Clay	7	6
Clinton	25	35
Crittenden	--	( <sup>1</sup> )
Cumberland	33	50
Daviess	580	618
Edmonson	( <sup>1</sup> )	1
Elliott	29	31
Estill	111	101
Floyd	11	11
Green	34	40
Greenup	1	1
Hancock	72	73
Hart	16	16
Henderson	1,018	929
Hopkins	482	427
Johnson	170	182
Knott	8	9
Knox	3	3
Laurel	2	2
Lawrence	121	128
Lee	1,243	1,041
Leslie	4	4
Letcher	344	450
Logan	( <sup>1</sup> )	( <sup>1</sup> )
McCreary	( <sup>1</sup> )	( <sup>1</sup> )
McLean	414	353
Magoffin	135	120
Martin	9	11
Metcalfe	15	10
Monroe	8	9
Morgan	1	1
Muhlenberg	274	335
Ohio	205	195
Owsley	1	1
Perry	220	250
Pike	43	44
Powell	20	78
Pulaski	( <sup>1</sup> )	( <sup>1</sup> )
Russell	1	2
Simpson	8	7
Taylor	--	( <sup>1</sup> )
Todd	2	1
Union	1,156	1,055
Warren	17	17
Wayne	5	4
Webster	486	424
Whitley	9	10
Wolfe	110	77
Total <sup>2</sup>	7,837	7,556
Value	68,340	84,520

<sup>1</sup> Less than 500 barrels.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

## NONMETALS

**Cement.**—The Kosmos Cement plant, subsidiary of The Flintkote Co., located in Jefferson County, was the State's only cement plant. Most of the production was used for ready-mix purposes. Raw materials used included limestone, clay, gypsum, and iron-bearing materials. Both production and value data were withheld to protect the confidentiality of company data.

**Clays.**—Two companies mined ball clay from four operations. This clay was mined, processed, and packaged or shipped in bulk to manufacturers of pottery ware and floor and wall tile, or for use as paper filler, refractory ware, and firebrick.

**Fluorspar.**—Cerro Spar Co. continued operating at its new mine-mill complex in

Crittenden County. Production and value data were withheld.

**Lime.**—The Black River Mining Co. produced quicklime in Pendleton County for steel furnaces and other uses. Production and value data were withheld.

**Mullite.**—NL Industries Inc. started producing synthetic mullite at its Greenup County plant, primarily for refractory products. Production and value data were withheld.

**Stone.**—Operations at 111 quarries produced 31.7 million tons of stone valued at \$67.9 million. (See tables 6 and 7.) The Dravo Corp. started construction of a \$46 million underground mine and processing facilities near Maysville.

Table 6.—Kentucky: Crushed stone<sup>1</sup> sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Allen	1	217	351	1	115	241
Bourbon	1	215	W	1	229	W
Boyd	1	15	38	--	--	W
Caldwell	2	923	2,193	2	W	W
Carroll	1	9	29	--	--	W
Carter	3	748	1,251	3	977	1,841
Casey	1	W	246	1	W	W
Christian	4	W	3,201	5	1,917	3,651
Clinton	1	348	W	1	351	W
Cumberland	1	51	W	1	76	W
Edmonson	2	123	194	2	W	W
Garrard	1	121	W	1	76	W
Greenup	1	W	100	--	--	--
Hardin	5	1,201	2,233	5	784	1,534
Hart	1	118	W	1	W	W
Letcher	3	W	W	3	767	1,559
Livingston	5	6,148	W	5	5,221	11,124
Marion	1	101	W	1	W	W
Marshall	2	640	960	--	--	--
Mason	1	2	4	--	--	--
Meade	3	W	W	3	1,390	3,086
Metcalfe	1	89	W	1	85	W
Monroe	1	125	W	1	W	W
Muhlenberg	1	W	W	1	553	1,245
Nicholas	1	320	480	1	225	506
Oldham	3	786	1,432	3	806	1,611
Pike	1	362	891	1	614	1,358
Powell	1	W	150	1	W	573
Pulaski	3	675	1,243	3	614	1,297
Trigg	1	257	424	1	150	319
Warren	4	633	1,130	4	592	1,225
Undistributed <sup>2</sup>	60	20,220	49,687	58	16,192	36,736
Total	118	34,447	66,237	111	31,734	67,906

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

<sup>1</sup> 1974 data represent crushed limestone.

<sup>2</sup> Includes Adair, Anderson, Barren, Boone, Boyle, Breckinridge, Bullitt, Butler, Crittenden, Fayette, Fleming, Franklin, Grayson, Green, Harlan, Harrison, Henry, Jackson, Jefferson, Jessamine, Laurel, Lee, Logan, Madison, Menifee, Mercer, Montgomery, Morgan, Nelson, Ohio, Pendleton, Rockcastle, Rowan, Scott, Simpson, Taylor, Todd, Washington, Wayne, and Wolfe Counties, and counties indicated by symbol W.

Table 7.—Kentucky: Crushed stone<sup>1</sup> sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	3,176	6,165	3,498	7,494
Concrete aggregate -----	3,736	6,904	3,934	8,469
Dense-graded road base stone -----	10,353	19,203	9,751	20,585
Macadam aggregate -----	721	1,340	517	1,067
Surface treatment aggregate -----	1,041	1,978	1,314	2,735
Other construction aggregate and roadstone -----	5,984	11,623	5,596	11,499
Agricultural limestone <sup>2</sup> -----	2,239	4,779	2,059	4,706
Cement -----	W	W	940	1,624
Railroad ballast -----	387	733	373	780
Riprap and jetty stone -----	3,765	7,529	2,313	5,126
Other uses <sup>3</sup> -----	3,046	5,984	1,439	3,821
Total <sup>4</sup> -----	34,447	66,237	31,734	67,906

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

<sup>1</sup> 1974 data represent crushed limestone.

<sup>2</sup> 1974 data include stone used in other soil conditioners, poultry grit, and mineral food.

<sup>3</sup> Includes stone used in fill, filter stone, ferrosilicon (1975), flux stone, mine dusting, miscellaneous fillers, bedding (1975), acid neutralization (1974), building products (1974), lime manufacture, drain fields, soil conditioners, poultry grit and mineral food (1975), and uses indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

### METALS

The value of metallic ores was less than 1% of the total value of mineral production.

The National-Southwire Aluminum Co. continued operations at Hawesville, Han-

cock County. Production and value data were withheld.

The Cerro Spar Corp. produced small quantities of lead and zinc as a byproduct at its Babb-Barnes mine in Livingston County. During 1975, a small amount of lead was recovered along with 41 tons of zinc valued at \$32,000.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum (primary):			
Anaconda Aluminum Co.	Box 1654 Louisville, Ky. 40201	Smelter -----	Henderson.
National-Southwire Aluminum Co.	Box M Hawesville, Ky. 42348	----do -----	Hancock.
Cement: The Flintkote Co. <sup>1</sup>	Dixie Highway Kosmosdale, Ky. 40272	Plant -----	Jefferson.
Clays:			
Kentucky-Tennessee Clay Co.	Box 77 Mayfield, Ky. 42066	Mines and plants -	Graves.
Old Hickory Clay Co. ---	Box 271 Paducah, Ky. 42351	Mines -----	Do.
Coal:			
Amax Coal Co. -----	150 South Meridan St. Indianapolis, Ind. 46225	Strip mine -----	Muhlenberg.
Beth-Elkhorn Corp. -----	701 East 3d St. Bethlehem, Pa. 18016	Underground mines	Letcher and Pike.
Island Creek Coal Co. ---	Wheelwright, Ky. 41669	----do -----	Floyd, Hopkins, Muhlenberg, Pike, Union.
Peabody Coal Co. -----	301 North Memorial Dr. St. Louis, Mo. 63102	Underground and strip mine.	Muhlenberg, Ohio, Union.
Pittsburg & Midway Coal Mining Co.	Tenmain Center Kansas City, Mo. 64105	Underground and strip mines.	Hopkins and Muhlenberg.
United States Steel Corp. -	525 William Penn Place Pittsburgh, Pa. 15230	Underground and auger mines.	Harlan.
Coke:			
Allied Chemical Corp. ---	40 Rector St. New York, N.Y. 10006	Plant -----	Boyd.

See footnotes at end of table.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Ferroalloys:</b>			
Airco Alloys and Carbide	Box 217 Calvert City, Ky. 42029	Plant -----	Marshall.
<b>Fluorspar:</b>			
Calvert City Chemical Co.	Box 305 Calvert City, Ky. 42029	Underground mine.	Crittenden.
<b>Graphite (artificial):</b>			
Carborundum Co -----	Hickman, Ky. 42050 -----	Plant -----	Fulton.
<b>Iron (pig):</b>			
Armco Steel Corp -----	Middletown, Ohio 45202 --	---do -----	Boyd.
Interlake, Inc -----	9th & Lowell Sts. Newport, Ky. 41071	---do -----	Campbell.
<b>Lime:</b>			
Black River Mining Co --	Route 1 Butler, Ky. 41006	---do -----	Pendleton.
<b>Natural gas:</b>			
Columbia Gas Transmission.	Charleston, W. Va. 25325 -	Gas wells -----	Various.
Inland Gas Co -----	340 17th St. Ashland, Ky. 41101	---do -----	Do.
Kentucky-West Virginia Gas Co.	Second National Bank Bldg. Ashland, Ky. 41101	---do -----	Do.
Texas Gas Transmission Co.	Owensboro, Ky. 42301 ---	---do -----	Do.
Wiser Oil -----	Box 192 Sistersville, W. Va. 26175	---do -----	Do.
<b>Perlite (expanded):</b>			
W. R. Grace & Co. <sup>2</sup> ----	62 Whittemore Ave. Cambridge, Mass. 02140	Plant -----	Campbell.
Grefco, Inc -----	Box 35 Florence, Ky. 41042	---do -----	Kenton.
<b>Petroleum (crude):</b>			
Ashland Oil and Refining Co. <sup>3</sup>	1409 Winchester Ave. Ashland, Ky. 41101	Wells -----	Various.
Har-Ken Oil Co -----	Box 616 Owensboro, Ky. 42301	---do -----	Do.
Humble Oil & Refining Co.	2010 West Ohio St. Evansville, Ind. 47712	---do -----	Do.
Sun Oil Co -----	Box 5026, Lawnsdale Evansville, Ind. 47715	---do -----	Do.
<b>Sand and gravel:</b>			
Evansville Materials, Inc.	624 NW, Riverside Dr. Evansville, Ind. 47708	Dredge -----	Henderson.
Ingram Materials, Inc ---	Box 1049 Nashville, Tenn. 37202	---do -----	Livingston.
Martin Marietta Corp. <sup>4</sup> --	Box 120 Mercersburg, Pa. 17236	---do -----	Boone, Jefferson, Oldham.
Nugent Sand Co -----	Box 6072 Louisville, Ky. 40206	---do -----	Jefferson.
E. T. Slider, Inc -----	Box 6041 Louisville, Ky. 40206	Pit -----	Do.
<b>Stone:</b>			
Kentucky Stone Co -----	400 Sherburn La. Louisville, Ky. 40207	Underground mines, quarries, and plants.	Various.
Reed Crushed Stone Co., Inc.	Box 35 Gilbertsville, Ky. 42044	Quarry and plant -	Livingston.
Three Rivers Rock Co ---	Box 218 Smithland, Ky. 42081	---do -----	Do.

<sup>1</sup> Also clays.<sup>2</sup> Also exfoliated vermiculite.<sup>3</sup> Also a refinery in Boyd County.<sup>4</sup> Also stone.





# The Mineral Industry of Louisiana

By Owen W. Jones <sup>1</sup> and Leo W. Hough <sup>2</sup>

Louisiana's mineral output in 1975 was valued at \$8.51 billion, an increase of 4.5% over the 1974 figure and a new record value, although all commodities, except sand and gravel, were produced in smaller quantities than in 1974. Louisiana continued its second-place ranking in value of domestic mineral production. Natural gas, natural gas liquids, and crude petro-

leum contributed 96% of the total value. Natural gas production was down 8.6%, and petroleum production was down 11.7%. A 38% increase in the price of natural gas was largely responsible for the increased total value.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Baton Rouge, La.

<sup>2</sup> State geologist, Louisiana Geological Survey, Baton Rouge, La.

Table 1.—Mineral production in Louisiana <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays -----thousand short tons--	770	\$1,425	531	\$1,132
Lime -----do-----	796	17,665	485	12,484
Natural gas -----million cubic feet--	7,753,631	2,380,365	7,090,645	2,999,179
Natural gas liquids:				
Natural gasoline and cycle products				
thousand 42-gallon barrels--	35,860	234,954	31,808	178,930
LP gases -----do-----	108,439	423,996	103,714	392,039
Petroleum (crude) -----do-----	737,324	4,811,772	650,840	4,611,879
Salt -----thousand short tons--	13,543	76,960	12,166	77,116
Sand and gravel -----do-----	12,341	27,781	14,587	35,990
Stone -----do-----	<sup>2</sup> 10,940	<sup>2</sup> 24,046	10,489	38,260
Sulfur (Frasch) -----thousand long tons--	3,426	W	2,672	W
Value of items that cannot be disclosed:				
Cement, gypsum, stone (miscellaneous), and values indicated by symbol W ---	XX	147,614	XX	166,266
Total -----	XX	8,146,578	XX	8,513,275
Total 1967 constant dollars -----	XX	3,951,702	XX	<sup>p</sup> 3,371,257

<sup>p</sup> Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Shell only; miscellaneous stone included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Louisiana, by parish <sup>1 2</sup>  
(Thousands)

Parish	1974	1975	Minerals produced in 1975, in order of value
Acadia -----	\$166,835	\$163,452	Natural gas liquids, natural gas, petroleum.
Allen -----	8,620	8,976	Petroleum, natural gas, sand and gravel, natural gas liquids.
Ascension -----	86,885	82,116	Natural gas liquids, petroleum, salt, natural gas.
Assumption -----	44,260	51,909	Natural gas, petroleum, salt.
Avoyelles -----	5,535	5,333	Petroleum, natural gas.
Beauregard -----	11,547	11,660	Petroleum, sand and gravel, natural gas, natural gas liquids.
Bienville -----	17,879	22,155	Natural gas, petroleum, clays.
Bossier -----	33,679	36,765	Natural gas, petroleum, natural gas liquids, sand and gravel.
Caddo -----	35,622	36,122	Petroleum, natural gas, natural gas liquids, clays.
Calcasieu -----	91,675	84,876	Petroleum, natural gas liquids, natural gas, salt, lime, stone.
Caldwell -----	W	W	Natural gas.
Cameron -----	589,063	671,737	Natural gas, petroleum, natural gas liquids, salt.
Catahoula -----	15,640	W	Petroleum, sand and gravel, natural gas.
Claiborne -----	34,552	35,153	Petroleum, natural gas, natural gas liquids.
Concordia -----	23,321	22,978	Do.
De Soto -----	15,601	17,281	Natural gas, petroleum.
East Baton Rouge -----	20,360	12,369	Sand and gravel, petroleum, cement, lime, natural gas, clays.
East Carroll -----	260	W	Sand and gravel, petroleum.
East Feliciana -----	W	618	Sand and gravel.
Evangeline -----	20,383	20,180	Petroleum, natural gas, natural gas liquids.
Franklin -----	2,361	2,318	Petroleum, natural gas.
Grant -----	7,914	6,534	Petroleum, sand and gravel, natural gas.
Iberia -----	432,670	469,761	Natural gas, petroleum, salt, natural gas liquids.
Iberville -----	73,077	70,084	Petroleum, salt, natural gas, natural gas liquids.
Jackson -----	1,314	1,587	Natural gas, petroleum.
Jefferson -----	526,343	547,223	Petroleum, natural gas, sulfur, natural gas liquids, salt.
Jefferson Davis -----	62,238	67,196	Natural gas, petroleum, natural gas liquids, sand and gravel.
Lafayette -----	21,751	24,830	Do.
Lafourche -----	582,091	583,366	Petroleum, natural gas, sulfur, natural gas liquids.
La Salle -----	34,770	33,821	Petroleum, natural gas, sand and gravel.
Lincoln -----	13,262	15,348	Natural gas, natural gas liquids, petroleum, clays.
Livingston -----	--	W	Sand and gravel.
Madison -----	W	W	Do.
Morehouse -----	13,125	W	Natural gas, petroleum.
Natchitoches -----	58,306	61,326	Petroleum, natural gas, natural gas liquids, clays.
Orleans -----	29,875	38,333	Cement, stone, lime, natural gas, petroleum.
Ouachita -----	11,146	W	Natural gas, sand and gravel, petroleum.
Plaquemines -----	1,682,763	1,697,159	Petroleum, natural gas, sulfur, natural gas liquids, salt.
Pointe Coupee -----	33,706	33,210	Petroleum, natural gas, natural gas liquids, clays.
Rapides -----	8,166	W	Petroleum, sand and gravel, natural gas.
Red River -----	427	380	Natural gas, sand and gravel, petroleum.
Richland -----	47,631	45,968	Petroleum, natural gas liquids, natural gas.
Sabine -----	1,357	W	Petroleum, natural gas.
St. Bernard -----	90,183	91,576	Natural gas liquids, petroleum, natural gas, clays.
St. Charles -----	129,800	127,781	Petroleum, natural gas, natural gas liquids.
St. Helena -----	W	W	Sand and gravel, clays.

See footnotes at end of table.

Table 2.—Value of mineral production in Louisiana, by parish <sup>1,2</sup>—Continued

(Thousands)

Parish	1974	1975	Minerals produced in 1975, in order of value
St. James	\$24,391	\$24,418	Petroleum, natural gas, natural gas liquids.
St. John the Baptist	9,770	W	Petroleum, natural gas.
St. Landry	52,705	50,806	Natural gas, petroleum, natural gas liquids.
St. Martin	95,802	97,852	Petroleum, natural gas, salt, natural gas liquids, clays.
St. Mary	961,699	1,016,590	Petroleum, natural gas, natural gas liquids, stone, salt, lime.
St. Tammany	12,405	W	Stone, sand and gravel, clays.
Tangipahoa	W	W	Sand and gravel, petroleum, clays.
Tensas	4,721	4,890	Petroleum, natural gas.
Terrebonne	1,196,121	1,265,588	Petroleum, natural gas, natural gas liquids, sulfur, salt.
Union	2,906	3,051	Petroleum, natural gas.
Vermilion	506,944	569,723	Natural gas, petroleum, natural gas liquids, sand and gravel.
Vernon	r W	W	Sand and gravel, natural gas.
Washington	1,748	2,938	Sand and gravel.
Webster	40,866	43,535	Natural gas, natural gas liquids, petroleum, sand and gravel.
West Baton Rouge	8,556	8,117	Petroleum, natural gas, clays.
West Feliciana	W	W	Sand and gravel.
Winn	5,012	5,103	Petroleum, stone, gypsum, natural gas.
Undistributed <sup>3</sup>	136,962	219,164	
Total <sup>4</sup>	8,146,578	8,513,275	

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

<sup>1</sup> Values for petroleum and natural gas are based on an average price per barrel for the State.

<sup>2</sup> No production was reported for West Carroll Parish.

<sup>3</sup> Includes some petroleum and natural gas that cannot be assigned to specific counties and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Louisiana business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force	1,375.0	1,442.0	+4.9
Unemployment	97.0	106.0	+9.3
<b>Employment (nonagricultural):</b>			
Mining	54.1	55.5	+2.6
Manufacturing	186.9	182.4	-2.4
Contract construction	89.4	90.1	+.8
Transportation and public utilities	99.4	97.1	-2.3
Wholesale and retail trade	271.9	276.4	+1.7
Finance, insurance, real estate	58.2	58.8	+1.0
Services	192.7	193.2	+.2
Government	240.4	245.9	+2.3
Total nonagricultural employment	1,193.0	1,199.4	+.5
<b>Personal income:</b>			
Total	\$16,766	\$18,591	+10.9
Per capita	\$4,466	\$4,904	+10.1
<b>Construction activity:</b>			
Number of private and public residential units authorized	12,297	11,699	-4.4
Value of nonresidential construction	\$315.8	\$266.1	-15.7
Value of State road contract awards	\$250.0	\$290.0	+16.0
Shipments of portland and masonry cement to and within the State	2,426	2,250	-7.3
<b>Mineral production value:</b>			
Total crude mineral value	\$8,146.6	\$8,513.3	+4.5
Value per capita, resident population	\$2,165.49	\$2,236.80	+3.3
Value per square mile	\$167,891.06	\$175,448.24	+4.5

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

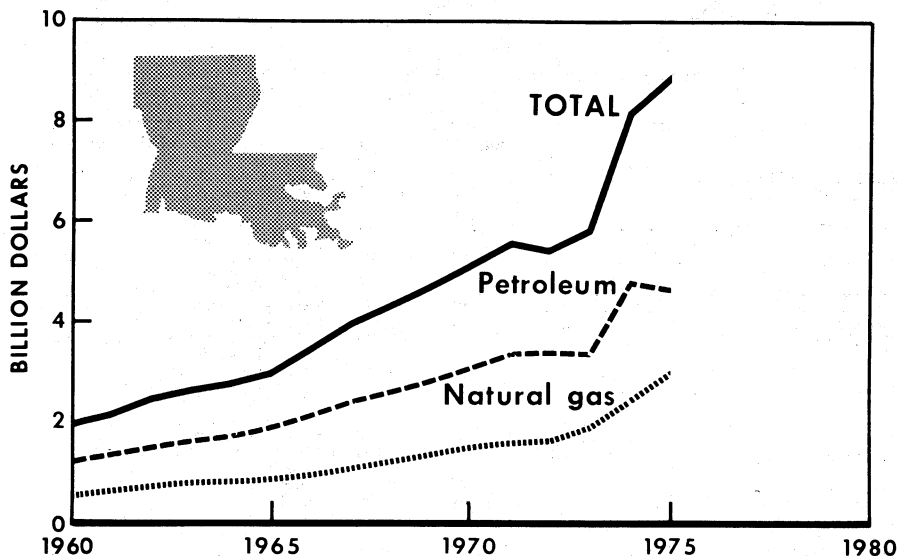


Figure 1.—Value of petroleum, natural gas, and total value of mineral production in Louisiana.

**Trends and Developments.**—The Louisiana Board of Commerce and Industry approved 10-year property tax exemptions for industrial developments totaling \$1.5 billion. Investment in mineral-related industrial categories accounted for 82% of the total. The largest investments were ECOL, Ltd. (a new petroleum refinery), \$241.2 million; C. F. Industries, \$198.3 million; Shell Chemical Co., \$74.4 million; and Cosden Oil and Chemical, \$45 million.

The ECOL, Ltd., refinery was under construction at Garyville on the Mississippi River about 35 miles upstream from New Orleans. Completion was expected in the fall of 1976.

Construction work was begun on Louisiana's first nuclear generating plant, Louisiana Power and Light Co.'s Waterford 3 facility being built at Taft in St. Charles Parish. The company hopes to have construction completed in the early 1980's. The company canceled plans to build two nuclear-fueled generating units at its St. Rosalie station at Alliance in Plaquemines Parish, citing increased construction costs as the main reason. The estimated plant cost had jumped from \$1.2 billion to approximately \$2.3 billion.

Central Louisiana Electric Co. began operating the \$70 million Rodemacher generating plant at Boyce. The power station is rated at 430,000 kilowatts and is powered by natural gas and oil.

Five Louisiana cities decided to build an innovative generating plant that uses low-cost high-sulfur fuel oil, residual oil, or petroleum coke. Joining in the \$46 million project were the cities of Franklin, Morgan City, Thibodaux, Opelousas, and Natchitoches. The Environmental Protection Agency licensed the plant to use the high-pollutant fuels because waste gas from turbine generators will be recovered and used to generate more electricity by steam-boiler turbogenerators. Sulfur will be filtered out and collected. The plant's 115 megawatts of power will be transmitted to the five communities through existing lines of private power companies.

Cajun Electric Power Cooperative, Inc., began constructing a \$600 million coal-fired electricity-generating plant near New Roads in Pointe Coupee Parish. The facility, to be named Big Cajun No. 2, will include two 540-megawatt generators and is expected to be completed in 1979. It will service the State's 12 rural electric

cooperatives. Low-sulfur Montana coal will be shipped by unit train to a point on the Mississippi River near St. Louis, Mo. It will then be barged to the plant site. The plant will require 80 million tons of coal over a 20-year period.

It will be at least 4 years before Louisiana's first offshore crude-oil-unloading facility will become operative. Louisiana Offshore Oil Port (LOOP), a consortium of six companies (Shell, Texaco, Ashland, Marathon, Murphy, and Union of California), planned to build a \$450 million terminal 18 miles off the Louisiana coast. LOOP planned to store imported oil in the Clovelly salt dome near Galliano. Company officials say such storage will cost more than conventional surface facilities, but being stored 1,500 feet underground, the oil will be safe from disruption by hurricane, fire, wind, water, and explosion, and there will be significant environmental advantages in both construction and land use. LOOP wants to dissolve 14 storage caverns with a total capacity of 56 million barrels in the dome.

Over 200 million tons of waterborne commerce were handled in Louisiana's three major deep-water ports, according to the U.S. Army Corps of Engineers. New Orleans led with 140.4 million tons, followed by Baton Rouge with 60.2 million tons and Lake Charles with 17.4 million tons. Highest volume was due to grain shipments, but crude oil and products made up nearly 54 million tons.

**Legislation and Government Programs.**—Five southwestern oil-producing States, Arkansas, Louisiana, New Mexico, Texas, and Oklahoma, formed the Southwest Regional Energy Council to represent energy interests of the five governors' offices and State legislatures.

A bill, Act 784, to provide for the development, production, and distribution of potentially valuable geothermal energy in Louisiana, was passed by the legislature. Preliminary studies by professional staffs at

Louisiana State University and by private firms had indicated that Louisiana may have large reservoirs of superheated, highly pressurized water which may also be saturated with natural gas in solution.

**Environment.**—The National Science Foundation gave Louisiana \$750,000 for two solar energy projects. Planning for an industrial plant powered by solar energy was to receive \$500,000; the remaining \$250,000 was to go toward efforts to convert a sugar factory to sun power.

Louisiana State University received a \$670,000 Sea Grant appropriation to examine the ecology of the State's coastal marshes and carry out a variety of other marine research, education, and advisory programs. The National Oceanic and Atmospheric Administration grant will be matched by \$602,946 from nonfederal sources. Scientists will study the role of the major elements and physical processes in the salt-marsh ecosystem. The program will also study the stresses placed on the State's wetlands by urban development, petroleum operations, and recreational activities.

The U.S. Atomic Safety and Licensing Board held public hearings to consider the environmental impact and site suitability of the nuclear plant proposed by Gulf States Utilities Co., southeast of St. Francisville. Opponents cited economic, environmental, and safety risks. At yearend the construction clearance had not been given.

The Louisiana Department of Conservation sponsored a study of surface mining laws in other States, including Indiana, Kentucky, and Wyoming. They plan to draft and introduce a surface mining bill in the legislature in 1976. A similar bill to regulate sand and gravel surface mining was introduced in 1974. That bill, however, died in committee. The new bill would include mining of lignite. Deposits of lignite were being surveyed in north-west Louisiana at yearend.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

The value of mineral fuel production totaled \$8.18 billion in 1975, a 4% increase from the 1974 value. Fuels represented more than 96% of the entire value

of mineral production in Louisiana. At yearend, the State listed 30,560 productive wells (30,966 in 1974) as follows: north Louisiana—12,445 oil and 5,501 natural gas wells; south Louisiana—onshore, 7,883 oil and 3,284 natural gas wells; offshore,

1,050 oil and 397 natural gas wells in zone I. In addition, the U.S. Geological Survey reported 3,020 producing oil completions and 1,773 producing gas completions in the Louisiana Outer Continental Shelf (OCS).

**Leasing Activity.**—<sup>3</sup> In North Louisiana, leasing activity appeared to be appreciably less than in 1974. Lease bonuses ranged from \$10 to \$100 per acre, with an average of about \$25 per acre.

In south Louisiana, onshore leasing activity was up 37%. Chevron's major Cretaceous strikes in Pointe Coupee Parish, northwest of Baton Rouge, rekindled interest along the entire trend, where activity had been slowed because of lack of significant discoveries.

Leasing activity in the Federal OCS was down sharply. Sale 38 on May 28 offered 185 tracts; only 90 drew bids, and 13 of these were rejected. Sale 38 A on July 29 offered 171 tracts; 51 tracts received bids, and 8 of these were rejected. The indication was that most operators believed the choice acreage had been leased in previous years.

**Geophysical Activity.**—<sup>4</sup>In north Louisiana, geophysical activity reportedly decreased from 332 crew-weeks in 1974 to 270 crew-weeks in 1975. The most active parishes were Sabine, Natchitoches, Bossier, Claiborne, Webster, and Union. Subsurface geology has become the most important exploration tool in the Smackover state line play, the Paluxy, Hosston, and Cotton Valley sand play on the Sabine Uplift, and in the Wilcox Formation.

In south Louisiana onshore, geophysical activity increased from 541 crew-weeks in 1974 to 577 in 1975. Although the coastal parishes continued with relatively high activity, exploration in 1975 was distributed somewhat more evenly across south Louisiana than in recent years. The major new Tuscaloosa Sandstone discovery in Pointe Coupee Parish caused greatly increased activity in the Cretaceous trend, accounting for 37% of the total crew-weeks in south Louisiana onshore.

Geophysical activity declined 11% to 332 crew-weeks in the offshore area. Most of the area has already been surveyed several times by most companies. Operators largely have been confining their efforts to acreage near that already under lease, using the new shooting and bright-spot

analysis in conjunction with well control to define reserve size and location. These new techniques have saved considerably on exploratory drilling efforts prior to setting drilling and production platforms.

**Exploration and Development Drilling.**—The American Petroleum Institute (API) is the source of the drilling and completion statistics published in the Minerals Yearbook. These statistics include data both from the area under State jurisdiction and from the OCS area under Federal control. According to the API, 3,036 wells were drilled in Louisiana in 1975, including 640 offshore wells. Total onshore footage drilled was 16.0 million feet. Average depth of north Louisiana wells was 3,791 feet, compared with 9,743 feet for south Louisiana wells and 9,369 feet for offshore wells. Overall average depth was 7,257 feet.

In the 26 parishes of north Louisiana, a total of 1,228 oil and gas wells was drilled, 5% more than the 1,171 drilled in 1974. Exploration drilling totaled 204 wells, 7% less than the 219 drilled in 1974. Of the exploratory wells, 33 (16%) were completed successfully. Development drilling totaled 1,024 wells, of which 393 were completed as oil wells and 389 were completed as gas wells for a success ratio of 76%. Fifty-two service wells were drilled; 37 were in Getty's Bellevue field fireflood. Again the two most active areas of development drilling were the old Monroe gas field and the old Caddo—Pine Island oil and gas field. Development drilling also continued relatively high in the Wilcox trend in Catahoula, Concordia, LaSalle, Rapides, and Tensas Parishes.

Onshore in the 38 parishes of southern Louisiana, a total of 1,168 wells was drilled. There were 355 exploratory wells, of which 19 were completed as oil wells, 53 as gas wells, and 283 as dry holes. The success ratio was 20%. The 813 development wells included 355 completed as oil wells, 169 completed as gas wells, and 289 dry holes for a 64.5% success ratio. Offshore development drilling accounted for a total of 491 wells, down 11 wells (2%) compared with 1974. Of the offshore development wells, 178 were completed as oil wells and 175 as gas wells; 138 were

<sup>3</sup> Adapted from the American Association of Petroleum Geologists Bulletin, v. 60, No. 8, August 1976.

<sup>4</sup> Work cited in footnote 3.

dry holes. The success ratio was 72%. Offshore exploratory drilling accounted for 149 wells, down 2 wells from 1974. Of these exploratory wells, only 2 were completed as oil wells and 5 as gas wells, while 142 were dry holes. The success ratio was 4.7%.

For the State, there were 2,328 developmental wells, up 204 from the 2,124 drilled in 1974. A total of 708 exploratory wells was drilled in 1975, up 62 from the 646 drilled in 1974. Of the 3,036 wells drilled in 1975, 956 were completed as oil wells and 815 as gas wells; 1,265 were dry. The State success ratio was 58%, same as in 1974.

Exploratory drilling in north Louisiana yielded 21 new-field discoveries. Significant discoveries were made in the Smackover state line play.

In south Louisiana onshore, there were 19 new-field discoveries, several of which were potentially significant producers. The

most important discovery was Chevron's False River field in Pointe Coupee Parish. The discovery well, Chevron Alma Plantation 1, tested 20 million cubic feet of gas per day from Cretaceous Tuscaloosa Sandstones perforated from 19,836 to 19,916 feet. The field will be developed on 1,280-acre spacing. Chevron anticipates that each of four wells will produce about 12 million cubic feet per day after a sulfur extraction plant is constructed. McMoran drilled a significant discovery in St. Mary Parish. They report four reservoirs, three gas and one oil, with about 100 feet of net productive sand.

Offshore discovery information is sketchy. A most significant discovery was the Shell-Conoco OCS-G-2638 in Mobile South 2 Block N660-E062. The discovery well logged 130 feet of oil-productive sandstone and 8 feet of gas-productive sandstone in four intervals.



Table 4.—Louisiana: Oil and gas well drilling completions in 1975, by parish

Parish	Development wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
<b>NORTH LOUISIANA</b>								
Bienville	--	12	10	--	1	7	30	262,125
Bossier	86	21	15	1	3	4	130	366,352
Caddo	159	20	59	--	1	6	245	624,592
Caldwell	--	4	6	--	5	21	36	118,736
Catahoula	9	--	11	--	--	19	39	198,374
Claiborne	18	4	6	2	4	7	41	372,670
Concordia	15	--	25	1	--	23	64	394,426
De Soto	2	31	12	--	3	10	53	295,033
East Carroll	--	--	--	--	--	3	3	18,147
Franklin	--	--	1	1	--	4	6	33,103
Grant	6	--	1	--	--	--	7	14,702
Jackson	--	--	--	--	1	2	3	28,219
La Salle	--	5	38	--	--	8	82	268,592
Lincoln	--	4	2	--	--	2	8	78,201
Madison	--	--	--	--	--	3	3	17,761
Morehouse	--	79	4	--	1	1	85	212,164
Natchitoches	--	--	--	--	--	1	1	8,251
Ouachita	--	54	2	--	1	3	60	222,156
Red River	12	8	2	--	1	4	27	124,051
Richland	3	--	8	--	--	3	14	56,265
Sabine	11	3	8	2	1	2	27	112,861
Tensas	5	1	4	1	--	6	17	133,883
Union	2	138	13	--	--	9	162	469,105
Webster	5	5	2	1	2	3	18	110,557
West Carroll	--	--	--	--	--	3	3	8,359
Winn	29	--	13	--	--	17	59	106,581
<b>Total</b>	<b>393</b>	<b>389</b>	<b>242</b>	<b>9</b>	<b>24</b>	<b>171</b>	<b>1,228</b>	<b>4,655,266</b>
<b>SOUTH LOUISIANA</b>								
Acadia	9	12	19	1	2	14	57	575,639
Allen	--	1	5	--	--	8	14	141,633
Ascension	2	--	2	--	--	1	5	49,560
Assumption	--	3	5	--	1	3	12	149,598
Avoyelles	6	--	8	--	--	6	20	165,210
Beauregard	7	2	10	1	2	7	29	234,063
Calcasieu	22	5	18	2	2	7	56	396,307
Cameron	33	14	23	1	6	30	107	967,091
East Baton Rouge	--	--	--	--	--	1	1	10,567
Evangeline	2	7	7	1	1	3	21	242,106
Iberia	18	7	4	1	3	14	47	450,107
Iberville	19	4	4	3	1	11	42	404,795
Jefferson	2	5	6	--	1	6	20	247,844
Jefferson Davis	18	7	15	2	1	14	57	562,306
Lafayette	1	--	6	--	2	1	10	112,221
Lafourche	26	17	21	3	3	23	93	1,029,665
Livingston	--	--	--	--	--	1	1	8,980
Plaquemines	34	14	33	1	2	17	101	861,116
Pointe Coupee	2	1	1	--	1	--	5	64,049
Rapides	2	--	3	--	--	--	6	38,780
St. Bernard	3	2	4	--	1	6	16	148,104
St. Charles	1	3	2	--	1	8	15	171,973
St. James	2	--	1	--	1	12	16	157,900
St. John the Baptist	1	--	--	--	--	2	3	31,706
St. Landry	31	5	8	--	1	9	54	360,485
St. Martin	20	9	12	--	1	9	51	504,806
St. Mary	34	11	15	--	3	12	75	531,266
Terrebonne	55	30	33	--	8	24	150	1,606,514
Vermilion	3	10	21	3	9	30	76	996,786
West Baton Rouge	2	--	3	--	--	3	8	78,395
<b>Total</b>	<b>355</b>	<b>169</b>	<b>289</b>	<b>19</b>	<b>53</b>	<b>283</b>	<b>1,168</b>	<b>11,379,622</b>
Offshore wells	178	175	138	2	5	142	640	5,996,261
<b>State total</b>	<b>926</b>	<b>733</b>	<b>669</b>	<b>30</b>	<b>82</b>	<b>596</b>	<b>3,036</b>	<b>22,031,149</b>

Source: American Petroleum Institute.

**Carbon Black.**—Louisiana production decreased 25.6% from that of 1974 for a total of 888 million pounds; the 1973 peak level was 1,208 million pounds. Louisiana continued to rank second after Texas and accounted for 32.4% of the total national production. Texas and Louisiana together accounted for 77.2% of total production in the United States.

**Table 5.—Louisiana: Carbon black production and value**

(Million pounds and million dollars)

Year	Quantity	Value
1971	1,079	78.2
1972	1,078	78.8
1973	1,208	96.8
1974	1,193	131.8
1975	888	102.7

Natural gas consumed in production of carbon black totaled 13,984 million cubic feet (23,668 million in 1974). This figure includes gas used for fuel as well as gas used as raw material. Liquid hydrocarbon usage totaled 156.3 million gallons (175.5 in 1974). Total value of production was \$102.66 million, or 11.56 cents per pound.

At yearend 1975, the nine Louisiana plants (all furnace plants) had a total capacity of 3.735 million pounds per day. The three plants in St. Mary Parish accounted for a high percentage of total State production. Other plants are located in Avoyelles, Calcasieu, Evangeline, Ouachita (two plants), and West Baton Rouge Parishes.

**Lignite.**—The Louisiana Geological Survey continued to investigate the lignite deposits in northwest Louisiana, and planned to publish the results of this field mapping program in mid-1976. The program was designed to drill and core as many locations as possible in the most promising near-surface deposits of the State. The lignite cores recovered are being analyzed by the Energy Research and Development Administration at the Pittsburgh Coal Preparation and Analysis Laboratory. The investigation was initiated to find an additional source of energy to supplement the declining oil and gas resources of the State.

The initial investigation will cover approximately 100 square miles in the Dolet Hills southeast of the town of Mansfield

in southeastern De Soto Parish. Investigators hope to enlarge the area of investigation, providing time and funds can be made available.

**Natural Gas.**—Marketed production of natural gas in Louisiana decreased 8.6% from 7.754 trillion cubic feet to 7.091 trillion cubic feet, but value increased from \$2.38 billion to \$3.00 billion. This represented an average wellhead price change from 30.7 cents per thousand cubic feet (Mcf) to 42.3 cents per Mcf. Louisiana was the second-ranked producing State with 35% of total U.S. production. Gas well completions during the last 5 years, according to the API, follow:

Year	North	South	Offshore	Total
1971	237	200	184	621
1972	451	234	133	818
1973	269	284	231	784
1974	458	190	141	789
1975	413	220	182	815

At the end of 1975, Louisiana had 9,182 producing gas and condensate wells.

According to the American Gas Association (AGA) reserves report, natural gas discoveries, extensions, and revisions in 1975 added 4.4 trillion cubic feet to natural gas reserves; in the same period they report production of 7.2 trillion cubic feet and a reserve of 61,309 trillion cubic feet. The natural gas reserve has decreased every year since 1968, when the AGA reserve at yearend was 88.016 trillion cubic feet. Most of the Louisiana natural gas reserve is offshore in the Outer Continental Shelf area. Proved reserve at the beginning of 1974 and 1975 is shown in table 7.

At the end of 1975, Louisiana had six dry-gas storage reservoirs. Total capacity of the six storage reservoirs was 274,022 million cubic feet. Stored gas on that date totaled 196,501 million cubic feet. Transcontinental Gas Pipeline Corp. received Federal Power Commission approval to develop the Washington field in St. Landry Parish into a gas storage field. Development plans include 39 new wells, field pipeline facilities, and a 16,500 horsepower compressor station. Construction will be over a 3-year period.

Approximately 1,978 billion cubic feet of natural gas was consumed in Louisiana

in 1975, a 225-billion-cubic-foot decline from the 2,203 billion cubic feet used in 1974. Consumption was equal to 27.9% of production. Louisiana accounted for 35.3% of total U.S. marketed production. Texas, Louisiana, and Oklahoma furnished 80.5% of the total 20.1 trillion cubic feet of marketed production in the United States.

**Table 6.—Louisiana: Natural gas data**  
(Million cubic feet)

Year	Withdrawals			Disposition			
	From gas wells	From oil wells	Total	Marketed production <sup>1</sup>	Value at wells (thousand dollars)	Repressuring	Vented and wasted <sup>2</sup>
1971	7,011,666	1,306,885	8,318,551	8,081,907	1,632,545	133,080	103,564
1972	6,924,204	1,235,559	8,159,763	7,972,678	1,626,426	123,418	63,667
1973	7,347,732	1,143,462	8,491,194	8,242,423	1,846,303	146,680	102,091
1974	7,037,239	882,571	7,919,810	7,753,631	2,380,365	134,607	31,572
1975	6,455,690	786,718	7,242,408	7,090,645	2,999,179	126,304	25,459

<sup>1</sup> Marketed production plus quantities used in repressuring, vented, and wasted.

<sup>2</sup> Partly estimated. Includes waste on producing properties and residue blown to the air.

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

Commodity	Proved reserves on Dec. 31, 1974	Changes in proved reserves due to net revisions, extensions, and discoveries in 1975	Proved reserves on Dec. 31, 1975 (API production deducted)	Changes from 1974 (percent)
Crude oil -----thousand barrels--	4,226,514	159,148	3,827,187	-9.4
Natural gas liquids -----do-----	1,882,331	34,064	1,717,700	-8.3
Natural gas -----million cubic feet--	64,052,445	4,400,215	61,309,423	-4.2

Sources: American Gas Association, American Petroleum Institute, and the Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States and Canada; and United States Productive Capacity as of December 31, 1974. V. 29, May 1975.

**Table 8.—Louisiana: Marketed production, interstate shipments, and total consumption of natural gas in selected producing States, in 1975**  
(Billion cubic feet)

State	Marketed production	Receipts	Deliveries	Net receipts (+) or deliveries (-)	Change in underground storage	Transmission loss and unaccounted for	Consumption
Louisiana	7,091	1,182	6,218	-5,036	+58.7	17.0	1,978
Oklahoma	1,605	1,221	2,090	-869	+3.0	4.2	729
Texas	7,486	545	3,623	-3,078	+3.5	24.4	4,380
Total	16,182	2,948	11,931	-8,983	+65.2	45.6	7,087

Table 9.—Louisiana: Quantity and value of natural gas delivered to Louisiana consumers and other intrastate consumption of natural gas

	Number of consumers (thousands)		Quantity (million cubic feet)		Value (thousand dollars)	
	1974	1975	1974	1975	1974	1975
<b>Delivered to consumers:</b>						
Residential -----	904	914	91,844	96,221	102,865	181,630
Commercial -----	69	66	29,211	27,427	23,369	27,811
Industrial <sup>1</sup> -----	XX	XX	1,091,472	922,673	687,627	702,154
Electric utilities -----	XX	XX	343,617	355,130	168,372	191,954
Other consumers -----	XX	XX	28,886	29,235	11,554	12,640
Total -----	XX	XX	1,585,030	1,425,686	993,787	1,066,189
<b>Extraction loss:</b>						
Natural gas processing -----	XX	XX	194,329	189,541	102,994	127,561
Lease and plant fuel -----	XX	XX	347,098	301,816	97,187	98,694
Pipeline fuel -----	XX	XX	76,236	61,086	21,346	23,701
Total natural gas consumption -----	XX	XX	2,202,693	1,978,129	1,215,314	1,316,145
<b>Marketed natural gas production (includes consumption by producers)</b> -----	XX	XX	7,753,631	7,090,645	2,380,365	2,999,179
<b>Intrastate use as percent of production and value</b> -----	XX	XX	28.4	27.9	51.1	43.8

XX Not applicable.

<sup>1</sup> Includes refinery fuel use and carbon black production.

**Natural Gas Liquids.**—Louisiana continued to rank second after Texas in natural gas liquids production. Production in 1975 was 135.5 million barrels, down from 144.3 million barrels in 1974. Average value of LPG (including ethane) was \$3.78 per barrel; average value of natural gasoline and cycle products was \$5.63 per barrel.

According to an Oil and Gas Journal survey,<sup>5</sup> there were 112 natural gas processing plants in Louisiana at yearend 1975, with a total capacity of 22,610.4 million cubic feet per day. Natural gas throughput at these plants averaged 16,409.8 million cubic feet per day, representing a plant capacity utilization of 72.6%. Total plant capacity, total throughput, and capacity utilization were all less than in 1974. This has been a nationwide trend for the past 3 years. Decreases in both capacity and number of plants and the phasing out of facilities where gas supplies have been depleted reflect the fact that fewer new gas reserves are being found.

The AGA and API estimated that the natural gas liquids reserve at the end of 1975 totaled 1.718 billion barrels. This was 8.7% less than in 1974, making 1975 the seventh consecutive year that reserves declined. Louisiana accounted for 27.4% of

the Nation's total natural gas liquids reserve.

Consumption of LPG and ethane was down 8% in 1975 as follows:

Sector	Consumption (thousand barrels)		Change, percent
	1974	1975	
Residential and commercial -----	2,981	2,454	-17.7
Internal combustion engine fuel -----	830	757	-8.8
Industrial <sup>1</sup> -----	3,178	2,665	-16.1
Miscellaneous uses <sup>2</sup> -----	536	1,033	+92.7
Total -----	7,525	6,909	-8.2

<sup>1</sup> Includes refinery fuel.<sup>2</sup> Includes secondary recovery of petroleum, agricultural uses, and use as substitute natural gas feedstock.

**Petroleum.**—Louisiana ranked second in petroleum production, accounting for 21.3% of the U.S. total. Crude oil production rates continued to decline for the fourth consecutive year. Production of 650.8 million barrels in 1975 (1.78 million barrels per day) represented an 11.7% decline from 1974 production. According to API statistics, the crude oil reserve at yearend totaled 3,827 million barrels,

<sup>5</sup> Oil and Gas Journal, Survey of Gas Processing Plants, V. 74, No. 27, July 5, 1976, pp. 67-69.

down 400 million barrels from 1974. Additions to reserves based on reevaluation of known reservoirs, extensions of known fields, and discoveries of new fields and reservoirs amounted to 159 million barrels, only 24.4% of the amount lost by production.

The National Stripper Well Association survey for the year ending January 1, 1975, credited Louisiana with 12,808 stripper wells which produced 7.5 million barrels of oil, or only 1% of total production.

According to a Bureau of Mines survey, there were 22 refineries operating in Louisiana with a total operating capacity of 1,754,100 barrels per calendar day at yearend 1975. This was a decrease of 1,700 barrels per day. One major refinery, ECOL, Ltd., was under construction at Garyville (200,000 barrels per day). Atlas Processing Co. in Shreveport and Exxon Co., USA, in Baton Rouge had under construction minor additional capacity for a total additional capacity of 244,500 barrels per day.

Table 10.—Louisiana: Crude oil production, indicated demand, and stocks in 1975, by month  
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End-of-month stocks originating within State
January	56,628	57,344	28,678
February	53,421	51,626	30,486
March	56,434	57,164	29,751
April	55,112	55,040	29,823
May	55,236	60,031	29,845
June	54,040	54,122	29,763
July	54,853	54,996	29,619
August	53,737	56,763	26,571
September	50,678	50,381	26,870
October	54,723	51,392	30,224
November	52,714	52,735	30,203
December	53,264	56,492	26,952
Total:			
1975	650,840	653,086	XX
1974	737,324	735,979	XX

XX Not applicable.

**Table 11.—Louisiana: Production of crude petroleum, by district and selected fields**

(Thousand 42-gallon barrels)

District and field <sup>1</sup>	1974	1975
<b>Gulf coast onshore:<sup>2</sup></b>		
Bay de Chene	5,464	4,870
Bay Ste. Elaine	4,804	3,857
Bayou Sale	2,793	2,618
Black Bay West	7,068	6,245
Caillou Island	18,023	14,035
Cote Blanche Island	6,982	3,643
Garden Island Bay	8,408	7,504
Golden Meadow	2,266	2,478
Grand Bay	3,934	3,067
Hackberry East	1,753	1,529
Hackberry West	2,944	2,203
Lafitte	5,727	5,524
Lake Barre	4,613	3,518
Lake Pelto	3,110	3,364
Lake Salvador	1,662	1,264
Lake Washington	6,488	5,493
Leeville	2,419	3,183
Paradis	4,057	4,749
Quarantine Bay	3,523	3,090
Romere Pass	2,218	1,764
Timbalier Bay	7,985	6,115
Venice	4,400	3,788
Winton	2,994	2,750
Weeks Island	6,446	5,035
West Bay	6,679	5,692
West Cote Blanche Bay	7,880	7,877
Other fields	166,747	141,780
<b>Total</b>	<b>301,372</b>	<b>257,045</b>
<b>Gulf coast offshore:<sup>2</sup></b>		
Bay Marchand Block 2 (Includes onshore)	32,632	22,416
Eugene Island Block 126	4,429	3,690
Eugene Island Block 330	19,747	27,903
Eugene Island Block 276	4,687	4,365
Eugene Island Block 330	19,747	27,903
Grand Isle Block 16	13,156	11,377
Grand Isle Block 43	20,999	17,592
Grand Isle Block 47	3,972	2,996
Grand Pass Block 35	2,155	1,620
Main Pass Block 41	10,396	9,058
Main Pass Block 69	7,973	5,565
Main Pass Block 306	5,573	4,794
Ship Shoal Block 204	5,732	4,359
Ship Shoal Block 207	6,223	5,075
Ship Shoal Block 208	10,559	8,361
S. Marsh Island Block 73	5,020	3,633
South Pass Block 24 (Includes onshore)	15,223	12,968
South Pass Block 27	11,568	9,628
South Pass Block 61	--	3,619
South Pass Block 62	6,446	5,454
South Pass Block 65	10,105	8,471
Timbalier Bay Block 21	9,449	5,557
West Delta Block 30	22,586	17,731
West Delta Block 58	10,035	9,026
West Delta Block 73	7,654	8,288
Other fields	142,738	138,123
<b>Total</b>	<b>397,116</b>	<b>356,457</b>
<b>Northern:</b>		
Caddo-Pine Island	3,348	2,966
Delhi	6,583	6,658
Haynesville (Ark., La.)	1,644	1,674
Other fields	27,261	26,040
<b>Total</b>	<b>38,836</b>	<b>37,338</b>
<b>Grand total</b>	<b>737,324</b>	<b>650,840</b>

<sup>r</sup> Revised.

<sup>1</sup> Breakdown for individual fields from the Oil and Gas Journal.

<sup>2</sup> Some fields include onshore and offshore production.

**Petrochemicals.**—According to the Louisiana Department of Commerce and Industry, the petrochemical, chemical, and refining industry investment in 1975 was \$1.1 billion, or 72.6% of the total investment funds qualifying for industrial tax exemption.

In 1975 the petrochemical and refining industries in Louisiana accounted for payrolls of \$603 million and 37,000 jobs, and the \$1.5 billion value added by manufacture in 1971 (the latest statistics available) represented some 30% of the total value added by manufacture for the entire State in that year.

The petrochemical industry is extremely dependent on natural gas. In 1974 Louisiana's total natural gas usage was 2.11 trillion cubic feet. Approximately 1.25 trillion cubic feet were used to support industry in the State, and 35% of this was for direct feedstock raw material and other process uses as opposed to simple boiler fuel use. These statistics are an indication of the impact any curtailment of natural gas would have on the industry of the State.

Louisiana's existing petrochemical plants represent an estimated replacement investment of more than \$9 billion. The industry is oriented toward feedstock raw material, some basic commodities, and multipurpose intermediate products. As the products approach final consumer market form, the Louisiana industry is not nearly so prominent; in 1975 Louisiana ranked 38th in the nation in manufacturing employment. There is great opportunity for expansion of this portion of the industry.

The Dow Chemical Co. will build two new petrochemical plants at its Plaquemine complex. The two plants will produce alkanolamines and glycol ethers. Each will have a capacity of 100 million pounds per year. Completion is expected in 1978. These new plants are in addition to the \$186 million expansion announced last year. There are presently 14 production plants at the Dow complex.

The largest single-train phosphoric acid plant in the world has begun operation at Agrico Chemical Co.'s Faustina Complex near Donaldsonville. Design capacity of the facility is 1,263 tons per day, using a recently developed wet phosphate rock grinding process. This process requires no rock drying equipment, pollution con-

trol equipment for prevention of dust emission, nor structures to support this equipment. Energy usage is also reduced because of reduced fuel and power consumption, normally used to dry the rock before processing.

Georgia-Pacific Corp.'s new chlorine and caustic plant at Plaquemine was opened. The new plant has a combined annual capacity of 598,000 tons and will supply chemicals for the market, for raw materials for an adjacent new polyvinyl chloride plant, and for the firm's expanded pulp and paper operations at Port Hudson.

Shell Chemical Co. announced plans for a new methyl ethyl ketone plant at Norco with an annual capacity of 230 million pounds, three times the capacity of the existing unit at the Shell facility. The plant is expected to be completed in late 1977. Shell is currently involved in a \$300 million expansion program in Louisiana at the oil refinery and chemical plant at Norco and the Geismar chemical plant.

Uniroyal, Inc., announced that it would close its Baton Rouge synthetic rubber and latex plant. Some 110 employees will be terminated or retired, and some will be transferred to the Scotts Bluff plant of Uniroyal, which will not be affected by the closure.

### NONMETALS

Value of nonmetals production was \$331 million, up \$36 million from the 1974 figure, and comprised 3.9% of the State's total mineral value.

**Barite.**—Crude barite, imported from Arkansas, Missouri, and foreign countries, was crushed and ground in Louisiana plants for use as a weighting material in well-drilling fluids. Three grinding plants operated in Orleans Parish and one each in Assumption, Calcasieu, St. Martin, and Terrebonne Parishes. Output of ground barite was 621,305 short tons valued at \$23.2 million.

**Cement.**—Ideal Cement Co., Baton Rouge; Louisiana Cement Co., a division of O.K.C. Corp., New Orleans; and Lone Star Cement Corp., New Orleans, all produced portland cement. Louisiana Cement

produced masonry cement, and Lone Star Cement sold masonry cement. Portland cement accounted for nearly 99% of the total production. Ready-mix companies, highway and other contractors used approximately 75% of portland cement production. Raw materials used in making portland cement included shell, limestone, clay, sand, gypsum, and iron ore. All plants used natural gas in their kilns. Lone Star was capable of using fuel oil. At the end of 1974, Ideal Basic Industries announced that it would cease cement production at the Baton Rouge plant at the end of March 1975. The plant was closed, and 1975 production at this plant was small. The plant site is being used as a distribution terminal. For several years, Ideal has supplemented its Baton Rouge production with cement transferred from its plants at Mobile, Ala., Houston, Tex., Ada, Okla., and Okay, Ark. This practice will continue, and the volumes will be increased to offset former Baton Rouge production. The company will continue to distribute cement from its New Orleans and Lake Charles terminals.

**Clays.**—Production of common clay and shale decreased in 1975. Output was 530,900 tons compared to 770,300 tons in 1974. Average unit value increased from \$1.85 per ton to \$2.13 per ton, making total production value of \$1.13 million. Eight brick companies at nine plants, one lightweight aggregate company, and two cement companies mined clay. Principal producing parishes in descending order of production were Pointe Coupee, St. Bernard, St. Helena, East Baton Rouge, and Caddo.

Lightweight aggregate manufacture consumed 38% of the clay output, cement manufacture 34%, and brick manufacture 28%.

The Louisiana Geological Survey continued sampling Louisiana clays for testing and evaluation by the Bureau of Mines clay test laboratory at the Bureau's Metallurgy Research Center in Tuscaloosa, Ala. The testing program is authorized by a mineral evaluation cooperative agreement between the State and the Bureau of Mines.

**Table 12.—Louisiana: Clays sold or used by producers**

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1971 -----	1,073	1,606
1972 -----	1,000	1,454
1973 -----	979	1,329
1974 -----	770	1,425
1975 -----	531	1,132

**Gypsum.**—Winn Rock, Inc., mined gypsum at Winnfield in Winn Parish. The product was used as a retarder in portland cement. Output declined 33% and was 44% below the 1972 record. United States Gypsum Co. and National Gypsum Co. calcined gypsum in Jefferson and Orleans Parishes. Output declined 33% and was 45% below the 1972 record.

**Lime.**—Allied Chemical Corp. in East Baton Rouge Parish, Olin Corp. in Calcasieu Parish, Pelican State Div. of S. I. Lime Co. in St. Mary Parish, and United States Gypsum Co. in Orleans Parish produced lime. Output decreased 39% to 484,600 tons, less than one-half the record 1970 production. Lime consumption in Louisiana was principally for use in chemical plants, aluminum smelters, and water purification facilities.

**Perlite.**—Perlite produced outside Louisiana was expanded by Filter Media Co. of Louisiana, Inc., at Reserve, St. John the Baptist Parish. This company is one of the principal producers of filter materials. Principal uses were for filter aids,

concrete aggregate, and low-temperature insulation.

**Salt.**—Salt sold or used totaled 12,166,000 tons valued at \$77,116,000, or \$6.34 per ton. This quantity was a decrease of 10%; the 12% price increase more than offset the decreased production. Louisiana ranked first in the Nation and accounted for 30% of the U.S. total. Fourteen companies produced salt at 18 active operations in 10 parishes. Of these, 12 operations produced brine only, 3 produced both evaporated and rock salt, 2 produced rock salt only, and 1 produced evaporated salt only. Evaporated salt averaged \$54.95 per ton; rock salt, \$6.87; and brine salt, \$3.87.

**LOOP,** the group of companies planning to build the proposed Louisiana superport, planned to store imported oil in the Clovelly salt dome near Galliano. LOOP officials say such storage will provide safety from disruption by hurricanes, fire, wind, water, and explosion, and will provide significant environmental advantages in both construction and land use. LOOP wants to dissolve 14 storage caverns with a total capacity of 56 million barrels in Clovelly dome.

The Federal Energy Administration (FEA) awarded a contract to locate potential underground storage sites for Government petroleum reserves in salt domes in Louisiana and Texas. The study would cover potential sites to store 1 billion barrels of strategic petroleum reserves for civilian usage and 300 million barrels of reserves for military usage.

**Table 13.—Louisiana: Salt sold or used by producers**

(Thousand short tons and thousand dollars)

Year	Evaporated salt		Rock salt		Brine		Total <sup>1</sup>	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1971 -----	275	9,399	5,794	32,976	7,283	25,574	13,352	67,950
1972 -----	269	8,840	6,142	34,032	7,104	24,592	13,514	67,464
1973 -----	285	9,976	5,411	30,065	7,456	26,170	13,152	66,211
1974 -----	296	11,386	6,024	33,641	7,223	26,932	13,543	76,960
1975 -----	275	15,112	5,320	36,542	6,572	25,462	12,166	77,116

<sup>1</sup> Data may not add to totals shown because of independent rounding.



**Sand and Gravel.**—Production was 14.6 million short tons, an 18% increase over that of 1974. Production value was up 30%. Average unit value was \$2.47 per short ton. A total of 55 companies with 84 operations reported from 24 parishes. Leading parishes in descending rank of production were East Baton Rouge, Washington, St. Tammany, Webster, and Rapides. These five parishes produced 55.4% of the State's total output.

Gravel shortages delayed construction

and increased costs of 1975 road projects totaling 1,700 miles. Until recently gravel could be obtained close to most construction sites, but now it is being hauled increased distances at a cost of both time and money. Northwest Louisiana projects are obtaining gravel from Arkansas; central Louisiana projects are obtaining it from southeast Louisiana, which has one of the few remaining large deposits in the State. The State Highway Director predicts it will all be used up in a few years.

**Table 14.—Louisiana: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
<b>Construction:</b>				
<b>Processed:</b>				
Sand .....	4,046	7,989	5,289	10,159
Gravel .....	7,040	16,623	7,778	21,056
Unprocessed: Sand and gravel .....	973	1,443	1,179	1,736
<b>Industrial:</b>				
Sand .....	282	1,648	341	2,069
<b>Total</b> .....	<b>12,341</b>	<b>27,703</b>	<b>14,587</b>	<b><sup>2</sup> 35,019</b>

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

**Table 15.—Louisiana: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ..	4,733	11,212	5,597	13,906
Highway and bridge construction .....	470	854	1,111	1,997
Other construction (dams, waterworks, airports, etc.) .....	210	366	347	635
Concrete products (cement blocks, brick, pipe, etc.) .....	1,438	3,559	1,179	3,451
Bituminous paving (asphalt and tar paving) .....	602	1,306	911	1,896
Roadbase and subbase .....	391	1,069	147	218
Fill .....	77	167	83	23
Other .....	130	317	132	357
<b>Unprocessed:</b>				
Roadbase and subbase .....	737	1,190	317	569
Fill .....	227	250	315	426
Other .....	--	--	W	W
<b>Industrial sand and gravel</b> .....	<b>282</b>	<b>1,648</b>	<b>341</b>	<b>2,069</b>
<b>Total</b> .....	<b>9,297</b>	<b>21,938</b>	<b>10,430</b>	<b><sup>1</sup> 25,553</b>

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

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Table 16.—Louisiana: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction --	W	W	190	527
Highway and bridge construction -----	1,228	2,333	1,255	3,294
Other construction (dams, waterworks, airports, etc.) -----	W	W	--	--
Concrete products (cement blocks, brick, pipe, etc.) -----	82	164	113	207
Bituminous paving (asphalt and tar paving) -----	1,022	2,359	1,349	3,974
Roadbase and subbase -----	678	965	674	1,645
Fill -----	W	W	23	18
Other -----	--	--	8	8
Unprocessed:				
Roadbase and subbase -----	--	--	530	744
Fill -----	34	22	17	19
Other -----	--	--	--	--
<b>Total <sup>1</sup> -----</b>	<b>3,044</b>	<b>5,843</b>	<b>4,157</b>	<b>10,437</b>

W Withheld to avoid disclosing individual company confidential data. "Nonresidential and residential construction" and "Other construction (dams, waterworks, airports, etc.)" included with "Highway and bridge construction." "Fill" included with "Unprocessed fill."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 17.—Louisiana: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used by producers, by parishes**  
(Thousand short tons and thousand dollars)

Parish	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Allen -----	1	W	W	2	W	W
Beauregard -----	2	W	W	1	541	1,639
Bossier -----	--	--	--	1	75	125
Catahoula -----	4	420	879	4	493	911
East Baton Rouge -----	6	1,171	1,363	8	2,023	4,956
East Carroll -----	1	100	253	1	90	261
East Feliciana -----	1	W	W	3	418	618
Grant -----	3	W	4,004	3	W	W
Jefferson Davis -----	2	W	W	2	W	W
Lafayette -----	2	W	W	3	156	234
La Salle -----	2	W	W	1	W	W
Livingston -----	--	--	--	1	W	W
Madison -----	1	W	W	1	W	W
Ouachita -----	4	W	W	4	626	1,993
Rapides -----	5	487	1,229	6	886	3,339
Red River -----	3	51	166	2	W	71
St. Helena -----	7	1,555	3,063	6	627	1,096
St. Tammany -----	3	546	1,370	6	1,715	3,205
Tangipahoa -----	6	845	1,354	3	750	1,822
Union -----	1	9	3	--	--	--
Vermilion -----	1	145	296	1	W	W
Vernon -----	--	--	--	2	W	W
Washington -----	8	1,115	1,748	13	1,831	2,939
Webster -----	5	1,223	3,517	8	1,628	4,658
West Feliciana -----	1	W	W	2	W	W
Undistributed -----	--	4,673	8,535	--	2,728	7,625
<b>Total <sup>1</sup> -----</b>	<b>69</b>	<b>12,341</b>	<b>27,781</b>	<b>84</b>	<b>14,587</b>	<b>35,990</b>

W Withheld to avoid disclosing individual company confidential data; included in total as "Undistributed."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Sulfur.**—Five Louisiana Frasch sulfur mines produced 3.1 million long tons in 1975. Sales were 2,672,000 tons, down 22% from 1974.

Sulfur was recovered from sour crude oil at four refineries. Recovered sulfur totaled 90,350 tons, and 91,300 tons valued at \$4.3 million was marketed.

Freeport Minerals Co. announced closure of its Lake Pelto mine in September, citing higher costs and depleted reserves. Planning for reactivation of Freeport's Caminada mine in the Gulf of Mexico continued. The company is still attempting to secure an adequate supply of natural gas to fuel this operation. In March, Freeport increased its Tampa price from \$57.00 per ton to \$62.50 per ton and in October further increased the price to \$66.00 per ton.

**Table 18.—Louisiana: Sulfur produced and shipped from Frasch mines**

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1971	3,616	3,646	W
1972	3,534	3,765	W
1973	3,311	3,329	W
1974	3,308	3,426	W
1975	3,070	2,672	W

W Withheld to avoid disclosing individual company confidential data.

## METALS

**Aluminum.**—Kaiser Aluminum & Chemical Corp. produced alumina at its Gramercy and North Baton Rouge plants. The bauxite, imported from Jamaica, was processed and shipped downriver to the Kaiser reduction plant at Chalmette. Ormet Corp. produced alumina at its Burnside plant. Bauxite was imported from Surinam. The alumina was shipped upriver to Ormet's reduction plant in Ohio.

Consolidated Aluminum Corp. (CONALCO) at Lake Charles received alumina from out-of-State sources and reduced it to metallic aluminum. The CONALCO plant also produced calcined coke for electrodes used in aluminum production.

Aluminum production rates were reduced (as much as 50%) in response to a continuing decreased demand begun in 1974. Markets and production were returning to normal at yearend 1975.

**Nickel.**—AMAX Nickel Refining Co., Inc., Braithwaite, La., operated throughout 1975, producing nickel powder, copper cathodes, cobalt powder, and ammonium sulfate. Production exceeded 30% of capacity during the year. Shipment of finished products were made throughout the year to domestic and international destinations.

The price of nickel was increased 19 cents per pound to \$2.20 in the third quarter of 1975. This applied to most forms of refined nickel (briquets, electrolytic cathodes, pellets, and powder).

**Table 19.—Principal producers**

Commodity and company	Address	Type of activity	Parish
<b>Aluminum:</b>			
Consolidated Aluminum Corp.	Box LL Lake Charles, La. 70601	Plant	Calcasieu.
Kaiser Aluminum & Chemical Corp.	Box 1600 Chalmette, La. 70043	---do	St. Bernard.
<b>Carbon black:</b>			
Ashland Chemical Co	Box 1503 Houston, Tex. 77005	---do	St. Mary.
Cabot Corp	125 High St. Boston, Mass. 02110	---do	Evangeline and St. Mary.
Columbian Carbon Co	380 Madison Ave. New York, N.Y. 10017	---do	Avoyelles, Ouachita, St. Mary.
Continental Carbon Co	Box 22085 Houston, Tex. 77027	---do	Calcasieu.
Sid Richardson Carbon & Gasoline Co.	1200 Fort Worth National Bank Bldg. Fort Worth, Tex. 76102	---do	West Baton Rouge.
Theratomic Carbon Co., Inc.	245 Park Ave. New York, N.Y. 10017	---do	Ouachita.

Table 19.—Principal producers—Continued

Commodity and company	Address	Type of activity	Parish
<b>Cement:</b>			
Lone Star Industries, Inc -	1 Greenwich Plaza Greenwich, Conn. 06830	Plant -----	Orleans.
OKC Corp. <sup>1,2</sup> -----	Box 10426 Dallas, Tex. 75207	----do -----	Do.
<b>Clays:</b>			
Big River Industries, Inc --	Box 66377 Baton Rouge, La. 70806	Mine and plant --	Pointe Coupee.
Ideal Basic Industries, Inc. <sup>2</sup>	821 17th St. Denver, Colo. 80202	Plant -----	East Baton Rouge.
Kentwood Brick & Tile Manufacturing Co., Inc.	Drawer F Kentwood, La. 70444	Mine and plant --	St. Helena.
<b>Gypsum:</b>			
Winn Rock, Inc. <sup>2</sup> -----	Box 790 Winnfield, La. 71483	Mine -----	Winn.
<b>Lime:</b>			
Allied Chemical Corp. <sup>3</sup> ----	Box 1219R Morristown, N.J. 07960	Plant -----	East Baton Rouge.
Olin Corp -----	Box 2896 Lake Charles, La. 70601	----do -----	Calcasieu.
<b>Natural gas and petroleum <sup>4</sup></b>			
<b>Salt:</b>			
Cargill, Inc -----	Cargill Bldg. Minneapolis, Minn. 55402	Underground mine-	St. Mary.
Diamond Crystal Salt Co -	916 Riverside Ave. St. Clair, Mich. 48079	----do -----	Iberia.
Domtar Chemicals, Inc., Shifto Salt Div.	9950 West Lawrence Suite 400 Shiller Park, Ill. 60176	----do -----	St. Mary.
The Dow Chemical Co ----	Midland, Mich. 48640 -----	Brine wells -----	Iberville.
International Salt Co ----	Clarks Summit, Pa. 18411-	Underground mine-	Iberia.
Morton Salt Co -----	110 North Wacker Dr. Chicago, Ill. 60606	----do -----	Do.
PPG Industries, Inc -----	Box 1000 Lake Charles, La. 70604	----do -----	Calcasieu.
<b>Sand and gravel:</b>			
Gifford-Hill & Co., Inc ----	Box 47127 Dallas, Tex. 75247	Plant and dredge -	Jefferson Davis, Tangipahoa, Webster.
Louisiana Sand and Gravel Co.	Box 963 Baton Rouge, La. 70800	----do -----	East Baton Rouge.
Standard Gravel Co., Inc --	Rt. 4, Box 17 Franklinton, La. 70438	----do -----	Washington.
<b>Stone:</b>			
Lake Charles Dredging & Towing Co.	Lafayette, La. 70501 -----	Dredge -----	St. Mary.
Louisiana Materials Co. <sup>1</sup> --	Box 8214 New Orleans, La. 70122	----do -----	St. Tammany.
Southern Industries, Inc --	Drawer 946 Mobile, Ala. 36601	----do -----	Orleans.
<b>Sulfur, native:</b>			
Freeport Minerals Co ----	161 East 42d St. New York, N.Y. 10017	Frasch process ---	Jefferson and Terrebonne.
Texas Gulf, Inc -----	200 Park Ave. New York, N.Y. 10017	----do -----	Lafourche.
<b>Sulfur, recovered:</b>			
Cities Service Oil Co ----	Box 300 Tulsa, Okla. 74102	Refinery -----	Calcasieu.
Exxon Co., U.S.A -----	Box 551 Baton Rouge, La. 70821	Plant -----	East Baton Rouge.
<b>Vermiculite, exfoliated:</b>			
W. R. Grace & Co -----	62 Whittemore Ave. Cambridge, Mass. 02140	----do -----	Orleans.

<sup>1</sup> Also clays.<sup>2</sup> Also stone.<sup>3</sup> Also salt.<sup>4</sup> Most major companies and many smaller companies operate in Louisiana. Commercial directories contain listings of operators.



# 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 Bureau of Geology of Maine, for collecting information on all minerals except fuels.

By Herbert R. Babitzke,<sup>1</sup> Edwina F. Bagley,<sup>2</sup> and Robert G. Doyle<sup>3</sup>

The value of mineral production in Maine in 1975 was \$36.7 million, an increase of 1% over that of 1974. Production value has increased every year since 1971. Major increases were noted in production of copper and sand and gravel, while a significant decline was noted for zinc.

Value of manufactured mineral related products was \$757 million in 1975<sup>4</sup> compared with \$806 million in 1974. Total product value of all industries was \$3.7 billion in 1975.

Kerramerican, Inc., completed its third year of operation of the zinc-copper mine near Blue Hill. Because of the slackening demand for zinc, 7,150 tons of concentrates were stockpiled at the property.

In April 1975, the dry-ground feldspar mill at West Paris was opened under the name of Oxford Feldspar Corp. Shipments started in October and about 200 tons were

shipped during the year for use in ceramics.

Watershed Corp. started production of water-struck bricks at Edgecomb. The bricks are in considerable demand because of their antique appearance.

Exploration activity in 1975 was mostly centered around northern Franklin and Oxford Counties, near the New Hampshire-Quebec-Maine border.

Hanna Mining Co. (Knox Mining Corp.) discontinued its drilling program near Union. The company is continuing its research in beneficiation of nickel-copper ore.

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<sup>2</sup> Liaison Program Assistant, Augusta, Maine.

<sup>3</sup> State Geologist, Department of Conservation, Bureau of Geology, Augusta, Maine.

<sup>4</sup> Census of Maine Manufactures, 1975. Maine Department of Manpower Affairs, BL Bulletin 532, p. 3.

Table 1.—Mineral production in Maine<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays -----thousand short tons--	146	\$183	125	\$202
Copper (recoverable content of ores, etc.) --short tons--	1,522	2,353	2,024	2,599
Lead -----do-----	279	126	364	157
Peat -----thousand short tons--	4	194	4	207
Sand and gravel -----do-----	8,755	10,673	9,875	11,403
Stone -----do-----	1,491	4,255	<sup>2</sup> 1,253	<sup>2</sup> 3,741
Zinc (recoverable content of ores, etc.) ----short tons--	10,425	7,485	8,318	6,488
Value of items that cannot be disclosed -----	XX	11,079	XX	11,944
Total -----	XX	36,348	XX	36,741
Total 1967 constant dollars -----	XX	17,185	XX	<sup>P</sup> 14,549

<sup>P</sup> Preliminary. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes dimension stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Maine, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Androscoggin -----	W	W	Sand and gravel, clays.
Arroostook -----	W	W	Sand and gravel, stone.
Cumberland -----	\$2,972	W	Sand and gravel, stone, clays.
Franklin -----	W	\$131	Sand and gravel.
Hancock -----	10,507	W	Zinc, copper, sand and gravel, lead, stone, silver, peat, clays.
Kennebec -----	W	W	Sand and gravel, stone.
Knox -----	13,615	W	Cement, stone, sand and gravel, clays.
Lincoln -----	--	10	Sand and gravel.
Oxford -----	209	110	Do.
Penobscot -----	W	W	Sand and gravel, stone.
Piscataquis -----	W	W	Do.
Sagadahoc -----	--	283	Sand and gravel.
Somerset -----	683	1,359	Sand and gravel, stone.
Waldo -----	W	352	Sand and gravel.
Washington -----	W	W	Sand and gravel, peat, stone.
York -----	W	W	Sand and gravel, stone.
Undistributed <sup>1</sup> -----	8,363	34,493	
Total <sup>2</sup> -----	36,348	36,741	

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

<sup>1</sup> Includes gem stones and values indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Maine business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands---	439.0	431.5	-1.7
Unemployment -----do-----	29.3	40.4	+37.9
<b>Employment (nonagricultural):</b>			
Manufacturing -----do-----	105.4	95.8	-9.1
Contract construction -----do-----	19.4	17.4	-10.3
Transportation and public utilities -----do-----	18.4	17.5	-4.9
Wholesale and retail trade -----do-----	75.2	74.0	-1.6
Finance, insurance and real estate -----do-----	14.2	14.0	-1.4
Services <sup>1</sup> -----do-----	57.0	59.0	+3.5
Government -----do-----	74.8	78.4	+4.8
Total nonagricultural employment -----do-----	364.4	356.1	-2.3
<b>Personal income:</b>			
Total -----millions---	\$4,760	\$5,071	+6.5
Per capita -----do-----	\$4,536	\$4,786	+5.5
<b>Construction activity:</b>			
Number of private and public residential units authorized-----	4,695	4,100	-12.7
Value of nonresidential construction -----millions---	\$81.2	\$161.3	+98.6
Value of State road contract awards -----do-----	\$14.0	\$34.0	+142.9
Shipments of portland and masonry cement to and within the State -----thousand short tons---	269	285	+5.9
<b>Mineral production value:</b>			
Total crude mineral value -----millions---	\$36.3	\$36.7	+1.1
Value per capita, resident population -----do-----	\$34.65	\$34.73	+0.2
Value per square mile -----do-----	\$1,094.32	\$1,106.16	+1.1

<sup>p</sup> Preliminary.

<sup>1</sup> Includes Mining.

Source: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

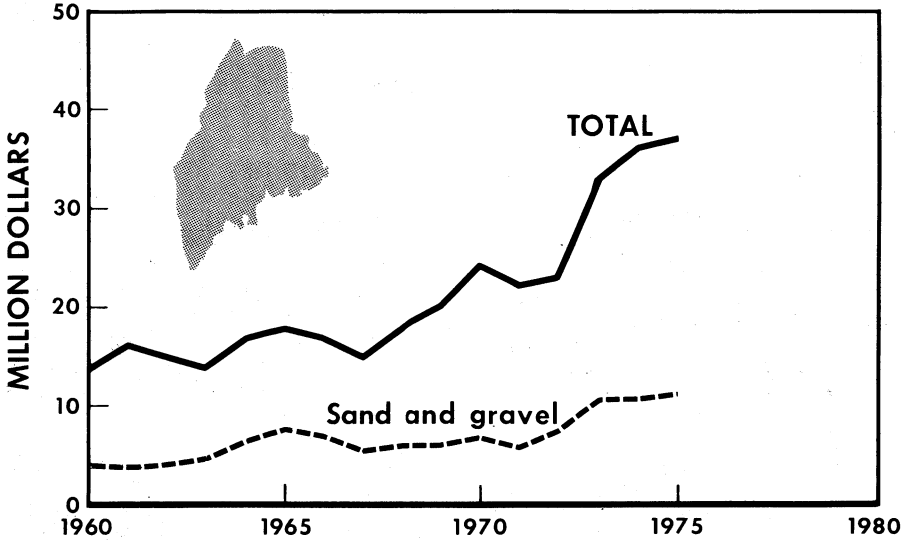


Figure 1.—Value of sand and gravel, and total value of mineral production in Maine.

**Trends and Developments.**—Maine has a tremendous potential for production of peat moss. Sales of Maine peat in 1975 totaled 3,782 tons while 28,582 tons were imported, duty free, from Canada. If the Canadian imports were entirely replaced by Maine peat, Washington County reserves alone would last for more than 70 years.

The Pittston Co.'s proposal to construct an oil refinery at Eastport has been under continuous review during the year. Studies commenced to develop information needed for an environmental impact statement. The Maine Board of Environmental Protection voted final approval of the project, but the Canadian Government opposed passage of oil tankers through Canadian waters to Eastport.

Canadian limestone manufacturers are able to produce agricultural lime at less cost than American manufacturers. The Aroostook County potato market consumes half of the agricultural limestone sold in Maine which is virtually monopolized by Canadian producers. Only one agricultural limestone manufacturer remains in Maine.

Maine's coastal planning program began in 1969 and predates the Federal Coastal Zone Management Act of 1972. During 1974 and 1975, the State Planning Office has been the recipient of program development

funds provided by the Federal Coastal Zone Management Act of 1972.

Sobin Chlor-Alkali, Inc., of Orrington was granted a \$240,000 tax exemption on electricity it uses to produce chlorine and caustic soda.

#### Legislation and Government Programs.

—Some changes were made in the mining laws at the regular session of the 107th Legislature and became effective in November 1975. The most significant change was the elimination of statutorily confined lease terms. The Bureau of Geology now has the authority, in agreement with the State Public Lands Bureau, to have open negotiation of mining lease terms. Other changes included revision of present makeup of the Mining Bureau and the fee structure of license and rental costs.

The State of Maine has five Section 208 planning agencies. Section 208 was an amendment to the Federal Water Pollution Control Act which established regional water quality planning and management agencies in areas with complex problems which could not be readily solved by municipalities working independently.

The Maine 208 planning agencies received aggregate grants of \$2.12 million to draft plans to protect the high-quality water areas and restore those waters that



were allowed to become polluted. The agencies that were formed were: Southern Maine Regional Planning Commission, Alfred; Greater Portland Council of Governments, Portland; Androscoggin Valley

Regional Planning Commission, Auburn; Northern Maine Regional Planning Commission, Caribou; and Southern Kennebec Valley Regional Planning Commission, Augusta.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Martin Marietta Corp., at its Thomaston plant increased production of cement over that of 1974. The company's cement division experienced a significant increase in energy costs, with the plant in Maine realizing a higher proportion than the corporation's other plants. In addition to the high price of oil, a depressed building trades industry and Canadian competition cut into the profits of the only cement producing plant in New England.

The company is reviewing alternatives to the "wet" process it now uses. A "dry" process would require less oil, coal, or natural gas.

The Martin Marietta plant channeled \$12.4 million into the State's economy in 1975. Major markets for the cement produced were Maine, New Hampshire, and eastern Massachusetts. The plant was one of Maine's largest commodity shippers; about 60% of the product was for ready-mix customers, 20% was shipped for use in concrete products, 10% for highway construction, and 10% was transported from the plant as masonry cement.

**Clays.**—Production of clay in 1975 was 125,474 tons valued at \$202,380, a decrease of 14% in quantity but an increase of 10% in value. Clays were produced in Androscoggin, Cumberland, Hancock, and Knox Counties, most of which was used in the production of cement and to a lesser extent common brick and brick facing. A small amount of stoneware clay was also produced in Hancock County for use in pottery. The blue clay deposits are largely untapped except by a few potters who regard the Maine clay as a high-quality material.

Watershed Corp. started making water-struck bricks in Edgecomb. The method was used for more than 100 years along the Maine coast. At Watershed, bricks are shaped in wooden frames, dried, and fired in either of two 40,000-brick kilns. The new brick has the appearance of antique brick.

**Feldspar.**—In April 1975, the dry-ground feldspar mill at West Paris was opened under the name of Oxford Feldspar Corp. Shipments started in October and about 200 tons were shipped during the year for use in the ceramics industry. The plant had been inactive since 1970. All of the raw material used in the plant was purchased from independent miners in the State.

**Gem Stones.**—Oxford and Androscoggin Counties continued to be areas of considerable interest for rockhounds, collectors, and tourists. The areas have been opened for more than a century. Vast quantities of feldspar are visible in many of the quarries, and much was mined and processed a century ago. Plumbago Mining Corp. opened two popular areas for collectors—Mount Mica and the Plumbago mining pit. Plumbago Mining Corp. did no mining during the year but it is selling tourmaline from inventory mined during the last 2 years. The company is continuing its exploration in the Oxford County area.

**Perlite.**—Chemrock Corp. expanded crude perlite from New Mexico at its plant near Thomaston. Most of the expanded perlite was sold to Marine Colloids, Inc., in Rockland, which used it as filter aid in the production of carrageen from seaweed. Marine Colloids, Inc., is the world's largest producer of food stability compounds made from seaweed.

**Sand and Gravel.**—Production of sand and gravel was 9.9 million tons valued at \$11.4 million, an increase of 13% in quantity and 7% in value over that of 1974. A total of 87 companies and Government-and-contractors were active during the year producing from 97 pits. Leading producing counties were Penobscot with over 2 million tons followed by Cumberland and Somerset each with over 1 million tons. More than half the sand and gravel used in 1975 was for publicly funded projects.

During the year 52.4 miles of interstate highway projects were started. Several proj-

ects were completed during the year which encompassed 3.7 miles of I-295 and 19 miles of I-95.

**Stone.**—Production of stone decreased from that of 1974. Knox County supplied 50% of the stone during the year and Cumberland County supplied 29%. Stone was produced in 10 counties from 19 quarries. Crushed granite, quartzite, and traprock were produced for use as concrete aggregate. Limestone was produced for cement manufacture, agricultural lime, ag-

gregates, poultry feed, paper mills, and other uses. Lime-marl production continued in Aroostook County. All of the marl mined was used for agriculture.

Throughout 1975 the Portland-Monson Slate Co. at Monson continued work on its production shaft. The 12- by 12-foot shaft was being sunk in a way to allow recovery of the slate. At yearend a depth of about 300 feet had been reached. Final depth was planned for 500 feet at which stage the conventional modified cut and fill mining

**Table 4.—Maine: Sand and gravel sold or used by producers, by county**

(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Androscoggin -----	7	991	1,487	10	735	1,306
Aroostook -----	4	547	656	5	736	533
Cumberland -----	14	1,286	1,543	14	1,500	1,835
Franklin -----	--	W	W	3	162	131
Hancock -----	3	537	403	4	332	369
Kennebec -----	6	533	853	8	332	767
Knox -----	--	W	W	4	635	1,024
Lincoln -----	--	--	--	1	40	10
Oxford -----	4	417	209	4	207	110
Penobscot -----	7	771	925	10	2,309	2,117
Piscataquis -----	2	441	529	4	58	72
Sagadahoc -----	--	--	--	3	319	283
Somerset -----	4	569	683	6	1,331	1,331
Waldo -----	--	W	W	5	331	352
Washington -----	--	W	W	5	228	208
York -----	6	855	1,026	11	621	952
Undistributed -----	8	1,808	2,360	--	--	--
Total <sup>1</sup> -----	65	8,755	10,673	97	9,875	11,403

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 5.—Maine: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
<b>Construction:</b>				
Processed:				
Sand -----	4,003	4,009	2,122	2,564
Gravel -----	4,030	5,037	3,630	5,049
Unprocessed:				
Sand and gravel -----	722	453	4,123	2,310
Industrial sand and gravel -----	W	W	W	W
Total -----	8,755	9,499	9,875	9,923

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

**Table 6.—Maine: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	605	1,107	682	1,539
Highway and bridge construction -----	152	327	22	88
Other construction (dams, waterworks, airports, etc.) -----	65	217	82	174
Concrete products (cement blocks, bricks, pipe, etc.) -----	325	656	102	261
Bituminous paving (asphalt and tar paving) -----	489	832	375	885
Roadbase and subbase -----	168	313	517	693
Fill -----	217	145	383	481
Other -----	57	137	226	309
<b>Unprocessed:</b>				
Roadbase and subbase -----	223	182	685	498
Fill -----	500	270	897	502
Other -----	--	--	36	15
Industrial sand and gravel -----	W	W	W	W
Total -----	2,801	4,186	<sup>1</sup> 4,008	5,445

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

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Table 7.—Maine: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	554	753	5	13
Highway and bridge construction -----	1,753	2,454	79	198
Other construction (dams, waterworks, airports, etc.) -----	742	757	41	57
Concrete products (cement blocks, brick, pipe, etc.) -----	--	--	9	32
Bituminous paving (asphalt and tar paving) ----	1,181	1,299	1,492	2,481
Roadbase and subbase -----	805	757	993	820
Fill -----	739	377	155	230
Other -----	180	90	590	725
<b>Unprocessed:</b>				
Roadbase and subbase -----	--	--	1,148	544
Fill -----	--	--	1,179	788
Other -----	--	--	177	71
Total -----	5,954	6,487	5,868	<sup>1</sup> 5,958

<sup>1</sup> Data do not add to total shown because of independent rounding.

method will be used. The product is a high-quality slate and most will be used for floor tile and electrical fixtures.

The Rockland-Rockport Lime Co. discontinued its quarry and limerock crushing operations after 75 years. The crushing plant occupied 13 waterfront acres in Rockland with 1,500 feet of deepwater frontage.

The Lime Products Corp. at Union obtained a permit for expansion. The project will include development of a new quarry, new dust collectors, and noise reduction.

#### METALS

Kerramerican, Inc., was the only metal mine in the State in 1975. The property

is owned jointly by Kerr-Addison Mines, Ltd., 60%, and Black Hawk Mining Ltd., 40%. Kerr-Addison was the operating company for the joint venture. The mine and mill is located in Hancock County, near Blue Hill.

The Blue Hill joint venture made a small operating profit, but a net loss was realized after depreciation and depletion during 1975. During the year the mill treated 211,210 tons of ore with an average grade of 1.1% copper and 4.9% zinc. The production in 1974 was 206,400 tons of ore with an average grade of 0.89% copper and 6.4% zinc.

Copper production was 2,024 tons, an increase of 33% over that of 1974. The copper concentrates were sent to Gaspé, Quebec, for smelting. Minor values of silver and lead were carried with the copper concentrates.

Zinc production was 8,318 tons (recoverable content of zinc in ore), a decrease of 20% from that of 1974. The zinc concentrate was shipped to National Zinc Co. at Bartlesville, Okla., for smelting. Because of the slackening demand for zinc that continued through 1975 and the decline in zinc production at zinc smelters, it became necessary to stockpile 7,150 tons of concentrate at the property.

Mineable ore reserves, including an allowance for dilution were estimated on December 31, 1975, at 525,000 tons with an average grade of copper of 1.46% and an average grade of zinc of 3.4%. In addition, the Carlton area south of the current workings and 700 to 1,200 feet deeper contains a drill-indicated reserve of 1.4 million tons at an average grade of 8.1% zinc. Development of this reserve was not contemplated because it would require substantial capital to bring it into production.<sup>5</sup>

The American Hoist and Derrick Co. in Portland was the only consumer of zinc in Maine. The plant has a hot-dip galvanizing operation and galvanizes parts produced at its foundry.

National Metal Converters, Inc., of Leeds produced about 50,000 tons of fragmented ferrous scrap. Some of the scrap was converted to steel billets and reinforcing bar at a melting facility in Windham.

Hanna Mining Co. (Knox Mining Corp.) discontinued its drilling program near Union. Exploration drilling has been

underway for 3 years on a nickel-copper prospect. The company's laboratory is continuing research to beneficiate the complex ore.

Standard Metals Corp., a subsidiary of Gulf and Western Industries, has reported exploration drilling for zinc and lead on Brown Co. land in Maine and New Hampshire. Standard Metals had an agreement with Brown Co. to prospect 250 square miles.

#### MINERAL FUELS

There was no production of fossil fuels for use as such in Maine in 1975, but the State has examined other sources of energy potential to help achieve energy independence. Maine's vast forest land can be a renewable energy resource of considerable magnitude and only that portion which is normally wasted or lost needs to be considered.

The Governor established within the Office of Energy Resources the Maine Energy Resources Development Fund to pursue research and development of Maine's own indigenous energy resources, including small-scale applications usable by families and businesses and developing the renewable energy resources of wood, wind, and tides.

The Portland Pipeline Co. delivered 161,685,782 barrels of crude oil in 1975 through its three pipelines from Portland to the Montreal, Canada refineries.

The State of Maine consumed 6.3 billion kilowatt hours of electricity in 1975, an increase of 2% over that of 1974. In addition, there were deliveries of 41 million barrels of various fuels into the State of which 8 million barrels were used for generation of electricity.

Several electric generating plants are on the drawing boards or are under construction: 1) Dickey-Lincoln hydroelectric power project is currently being studied by the Corps of Engineers and the U.S. Department of the Interior; 2) Passamaquoddy Bay tidal power is undergoing extensive feasibility studies by the Corps of Engineers; 3) Brunswick-Topsham hydroelectric project is undergoing redevelopment by Central Maine Power Co.; 4) Sears Island nuclear plant was postponed

<sup>5</sup> Kerr-Addison Mines, Ltd. 1975 Annual Report. Pp. 4-6.

due to regulatory considerations; and 5) William F. Wyman oil-fired generating plant of Central Maine Power Co. will be increasing capacity with the addition of one generator to the three already in operation.

The Maine Board of Environmental Protection voted to allow Pittston Co. to go ahead with plans to build the east coast's first supertanker port and a 250,000-barrel-per-day refinery complex at Eastport. Approval finally came after 2 years of hearings and a decade of blocking by environmentalists to keep deepwater oil ports off the Maine coast. The approval does not mean that the project will go forward because the supertankers serving the refinery will have to pass through Canadian waters and

Canada has shown strong opposition to the presence of heavy tankers in its waters.

**Peat.**—Quality sphagnum moss was produced by three firms: Acadia Peat Corp., Penobscot; Eric Kelly Peat Moss Co., Centerville; and International Peat Moss Co., Inc., Jonesport. The peat was harvested, dried, packaged, and sold for soil conditioning. Three of Maine's largest peat bogs, containing a potential 16.5 million short tons of processed peat, are "off limits" to mining interests. The three bogs that industry probably will not mine are Meddybemps Heath, Crystal Bog, and the Great Heath. Northeast Peat Co. has been trying to obtain an operating permit from the Land Use Regulation Commission. As of yearend the decision was pending.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Cement:</b>			
Martin Marietta Cement Corp., Eastern Div. <sup>1</sup>	11300 Rockville Pike Rockville, Md. 20852	Quarry and plant.	Knox.
<b>Clays:</b>			
Dennis Brick Co., Inc	Mt. B Washington St. Auburn, Maine 04210	Pit and mill	Androscoggin.
Lachance Brick Co., Div. of Morin Brick Co.	Mosher Rd. Gorham, Maine 04038	do	Cumberland.
Morin Brick Co	Danville, Maine 04223	do	Androscoggin.
Rowantrees, Inc	Union St. Blue Hill, Maine 04614	Pit	Hancock.
Royal River Brick Co., Inc	Box 191 Gray, Maine 04039	Pit and mill	Cumberland.
<b>Feldspar:</b>			
Oxford Feldspar Corp	P. O. Box 115A W. Paris, Maine 04289	Mill	Oxford.
<b>Peat:</b>			
Acadia Peat Corp	Penobscot, Maine 04476	Bog and plant	Hancock.
Eric Kelly Peat Moss Co	Centerville, Maine 04649	do	Washington.
International Peat Moss Co., Inc.	430 Trapelo Rd. Belmont, Mass. 02178	do	Do.
<b>Perlite (expanded):</b>			
Chemrock Corp	End of Osage St. Nashville, Tenn. 37208	Plant	Knox.
<b>Sand and gravel:</b>			
Blue Rock Industries	58 Main St. Westbrook, Maine 04092	5 pits and mills	Androscoggin, Cumberland, Franklin, York.
Cianbro Corp	P. O. Box D Pittsfield, Maine 04967	7 pits and mills	Franklin, Hancock, Oxford, Penobscot, Somerset.
Harry C. Crooker & Sons, Inc.	R. D. No. 3 Brunswick, Maine 04011	3 pits and mill	Cumberland and Lincoln.
Durham Paving Co	Cundy's Harbor, Maine 04011	Pit and mill	Androscoggin.
Granite Paving Co	P. O. Box 176 Brunswick, Maine 04011	2 pits and mills	Androscoggin and Sagadahoc.
D. J. Gurney, Inc	Route 1, River Rd. Waterville, Maine 04901	2 pits	Kennebec and Somerset.
George C. Hall Excavating	P. O. Box 506 Rockland, Maine 04841	Pit and plant	Knox.
Houlton Redi-Mix, Inc	Box 383 Houlton, Maine 04730	Pit and mill	Aroostook.
Lane Construction Corp	965 E. Main St. Bangor, Maine 04401	5 pits and mills	Aroostook, Penobscot, Waldo, Washington.

See footnotes at end of table.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Sand and gravel—Continued</b>			
Harold D. MacQuinn, Inc ---	Bar Harbor, Maine 04609 --	2 pits and mill --	Hancock.
Marriner, Inc -----	Camden, Maine 04843 -----	Pit and mill ----	Knox.
Portland Sand and Gravel Co., Inc.	Gray Road Cumberland, Maine 04021	2 pits and mills -	Knox and Cumberland.
Leroy S. Prout Sand and Gravel.	Scarborough, Maine 04074 --	Pit and mill ----	Cumberland.
H. E. Sargent, Inc -----	101 Bennoch Road Stillwater, Maine 04489	5 pits and mills -	Kennebec, Penobscot, Sagadahoc, Somerset.
Warren Bros. Co -----	Fairfield, Maine 04937 -----	6 pits and mills -	Kennebec, Penobscot, Somerset, York.
<b>Stone:</b>			
<b>Granite, dimension:</b>			
The John Swenson Granite Co., Inc.	North State St. Concord, N.H. 03301	3 quarries -----	York and Hancock.
<b>Limestone, crushed:</b>			
Blue Rock Industries ----	58 Main St. Westbrook, Maine 04092	----do -----	Cumberland and Kennebec.
Lane Construction Corp -	965 E. Main St. Bangor, Maine 04401	Quarry -----	Aroostook.
Lime Products Corp ----	P. O. Box 357 Union, Maine 04862	Quarry and mill -	Knox.
Marine Trading and Transportation Co.	Box 449 Rockland, Maine 04841	----do -----	Do.
<b>Marl:</b>			
Stanley Giles -----	17 Mechanic Rd. Presque Isle, Maine 04769	----do -----	Aroostook.
<b>Miscellaneous stone:</b>			
Cook Concrete Co -----	960 Ocean Ave. Portland, Maine 04103	Quarry -----	Cumberland.
Thomas DiCenzo Inc ----	75 Barker St. Calais, Maine 04619	----do -----	Washington.
<b>Slate:</b>			
Portland-Monson Slate Co.	Monson, Maine 04464 -----	Underground mine and plant.	Piscataquis.
<b>Zinc:</b>			
Kerramerican, Inc. <sup>2</sup> -----	P. O. Box D Blue Hill, Maine 04614	2 underground mines and plant.	Hancock.

<sup>1</sup> Portland and masonry.

<sup>2</sup> Also produced copper, lead, and silver.



# The Mineral Industry of Maryland

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

By Joseph A. Sutton <sup>1</sup>

Maryland's mineral production decreased in value in 1975 to \$165 million, about 5% below the \$173 million for 1974. The decrease in value was mainly the result of reduced activity in the construction industry for such materials as sand and gravel and cement.

Bituminous coal was again the most valuable commodity produced and accounted for 31% of the State's mineral wealth. In response to increased demand for fuel, coal production was 12% above that of 1974.

Stone was the second most valuable mineral commodity produced in the State. In spite of an 18% drop in production to 14.8 million tons, the industry contributed 26%

of Maryland's mineral wealth in 1975. The total value of stone produced was \$43.1 million, 9% below the 1974 value.

Sand and gravel contributed 18% to the State's mineral wealth in 1975. Production increased about 1% to 11.8 million tons, and value increased less than 1% to \$29.5 million.

Portland and masonry cement contributed significantly to the economy of the State in 1975, but the actual figures must be concealed to avoid disclosing individual company confidential data.

<sup>1</sup> State Liaison Officer—Maryland and Delaware, Bureau of Mines, Washington, D.C.

Table 1.—Mineral production in Maryland <sup>1</sup>

Mineral	1974		1975		
	Quantity	Value (thousands)	Quantity	Value (thousands)	
Clays <sup>2</sup> .....	thousand short tons..	884	\$2,066	580	\$1,450
Coal (bituminous) .....	do....	2,337	48,630	2,606	50,502
Gem stones .....	.....	NA	8	NA	W
Lime .....	thousand short tons..	23	527	15	434
Natural gas .....	million cubic feet..	133	32	93	25
Peat .....	thousand short tons..	3	45	2	39
Sand and gravel .....	do....	11,690	29,386	11,786	29,477
Stone .....	do....	18,072	47,630	14,796	43,110
Value of items that cannot be disclosed:					
Cement, ball clay, talc (1974), and values indicated by symbol W .....					
		XX	44,556	XX	39,882
Total .....		XX	172,880	XX	164,919
Total 1967 constant dollars .....		XX	81,738	XX	<sup>p</sup> 65,308

<sup>p</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes ball clay; included with "Value of items that cannot be disclosed."



Employment.—Final 1974 statistics and preliminary data for 1975 on business activity of the State are given in table 3.

Legislation and Government Programs.—According to the P.S. Railway Association preliminary reorganization plan to con-

Table 2.—Value of mineral production in Maryland, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Allegany -----	W	W	Coal, stone.
Anne Arundel -----	\$2,819	\$3,118	Sand and gravel.
Baltimore <sup>2</sup> -----	25,125	W	Stone, sand and gravel, clays.
Carroll -----	W	W	Cement, stone, clays.
Cecil -----	8,406	8,693	Stone, sand and gravel.
Charles -----	W	W	Sand and gravel.
Dorchester -----	368	372	Do.
Frederick -----	19,329	W	Cement, stone, clays, lime.
Garrett -----	W	W	Coal, stone, sand and gravel, peat.
Harford -----	W	W	Sand and gravel, stone.
Howard -----	W	W	Stone.
Kent -----	51	W	Clays.
Montgomery -----	W	5,765	Stone.
Prince Georges -----	13,525	11,464	Sand and gravel, clays.
St. Marys -----	--	W	Sand and gravel.
Washington -----	W	W	Cement, stone, clays.
Wicomico -----	W	W	Sand and gravel.
Worcester -----	396	395	Do.
Undistributed <sup>3</sup> -----	102,859	135,111	
Total <sup>4</sup> -----	172,880	164,919	

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

<sup>1</sup> Calvert, Caroline, Queen Annes, Somerset, and Talbot Counties are not listed because no production was reported.

<sup>2</sup> Includes Baltimore City.

<sup>3</sup> Includes some natural gas, gem stones, and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Maryland business activity

	1974	1975 <sup>p</sup>	Change, percent
Employment and labor force, annual average:			
Total labor force -----thousands--	1,792.0	1,842.0	+2.8
Unemployment -----do-----	84.0	127.0	+51.2
Employment <sup>1</sup> (nonagricultural):			
Mining -----do-----	1.8	1.7	-5.6
Manufacturing -----do-----	254.2	229.9	-9.6
Contract construction -----do-----	103.8	91.9	-11.5
Transportation and public utilities -----do-----	80.9	78.7	-2.7
Wholesale and retail trade -----do-----	349.3	355.3	+1.7
Finance, insurance, and real estate -----do-----	80.0	79.5	-.6
Services -----do-----	278.8	285.4	+2.4
Government -----do-----	235.7	301.9	+5.7
Total nonagricultural employment -----do-----	1,434.5	1,424.3	-.7
Personal income:			
Total -----millions--	\$24,425	\$26,533	+8.6
Per capita -----do-----	\$5,973	\$6,474	+8.4
Construction activity:			
Number of private and public residential units authorized	23,299	19,661	-15.6
Value of nonresidential construction -----millions--	\$369.1	\$306.6	-16.9
Value of State road contract awards -----do-----	\$80.0	\$93.0	+16.2
Shipments of portland and masonry cement to and within the State -----thousand short tons--	1,490	1,196	-19.7
Mineral production value:			
Total crude mineral value -----millions--	\$172.9	\$164.9	-4.6
Value per capita, resident population -----do-----	\$42.28	\$40.01	-5.4
Value per square mile -----do-----	\$16,344.90	\$15,592.23	-4.6

<sup>p</sup> Preliminary.

<sup>1</sup> Excludes Federal employment in Maryland sector of the Washington Standard Metropolitan Statistical Area.

Sources: U.S. Department of Commerce; U.S. Department of Labor; Highway and Heavy Construction Magazine; and Federal Bureau of Mines.

solidate seven financially ailing railroads in the Northeast and Midwest, Maryland was scheduled to lose 81 miles of intrastate freight lines and 149 miles of track linking the State with other States.

Laws enacted at the 1975 regular session of the General Assembly of Maryland, follow: Section 7-505 (j) of Article—Natural Resources of the Annotated Code of Maryland (1974 Volume and 1974 Supplement) was amended by Senate Bill No. 1029 to the issuance of a permit for strip mining on slopes of 20 degrees or more from the horizontal, except in the case of a previously orphaned mining operation where the Land Reclamation Committee declares that the land could be restored to its original contour. New Sections (7-6A01 through 7-6A31) were added to the Article—Natural Resources of the Annotated Code of Maryland (1974 Volume and 1974 Supplement) by Senate Bill No. 340 for the purpose of regulating the surface mining of minerals other than coal, establishing a

Surface Mined Land Reclamation Fund, providing for uses of the surface mine inspectors, requiring licenses and permits for surface mining, establishing fees, requiring reclamation plans, providing for exemptions, authorizing the Secretary of Natural Resources to adopt rules and regulations to administer this Act, and generally relating to the surface mining of minerals other than coal. New Sections (6-501 to 6-511) were added to the Article—Natural Resources of the Annotated Code of Maryland (1974 Volume and 1974 Supplement) by House Bill No. 319 for the purpose of expressing the finding and intent of the General Assembly in relation to certain coastal facilities, defining certain terms, providing a procedure for application for permits for construction of certain coastal facilities, providing penalties for violations, providing for judicial review, and generally relating to the construction of certain coastal facilities.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Output of portland and masonry cement continued to decline in 1975 and was about 25% below that of 1974. However, the unit value of both cements continued to increase.

**Clays.**—Various types of clay were produced at nine operations located in Baltimore, Carroll, Frederick, Kent, Prince Georges, and Washington Counties. Approximately 93% of the clay produced in the State was used to manufacture brick and concrete block. Demand for such products was considerably below that of the previous year, and therefore clay production was about 34% below that of 1974.

**Gem Stones.**—Production of semiprecious stones was limited to small quantities collected by dealers and amateur collectors.

**Gypsum.**—United States Gypsum Co. and National Gypsum Co. calcined gypsum at Baltimore in Baltimore County. Output decreased 16% and was 18% below the 1972 record.

**Lime.**—S.W. Barrick & Sons, Inc., produced 14,529 tons of lime in Frederick County for use in agriculture. Output decreased 37% and was 61% below the 1963

record. The lime was consumed in Maryland, Virginia, Delaware, and Pennsylvania.

**Peat.**—Only one company produced peat in Maryland in 1975. Production of peat decreased to 2,345 short tons, about 18% below that of 1974, and the average unit value of the peat increased about 4% to bring the total valuation of Maryland's output to \$38,557. The peat was sold in bulk and packaged for soil improvement.

**Perlite.**—Relatively small amounts of raw perlite from the Western United States were processed in 1975 at a plant in Baltimore County. All of the perlite production was utilized as aggregates in plastering.

**Sand and Gravel.**—Production of sand and gravel was slightly above that of 1974. In value, sand and gravel was the fourth ranking mineral activity of the State. Sand was 14 cents per ton higher in value, and gravel was 13 cents per ton lower than the 1974 values.

Sand and gravel was utilized in residential and nonresidential construction, 36%; paving, 34%; concrete products, 16%; and fill, 9%. The remainder went to miscellaneous uses. Counties leading in value of sand and gravel production, in order of rank,

**Table 4.—Maryland: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	6,624	16,004	5,619	14,036
Gravel -----	4,455	12,209	4,517	11,811
Unprocessed: Sand and gravel -----	611	914	1,650	2,415
Total -----	11,690	29,127	11,786	28,262

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

**Table 5.—Maryland: Construction aggregate and industrial sand and gravel sold or used commercially by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	5,001	13,335	4,161	11,908
Highway and bridge construction -----	228	637	181	565
Other construction (dams, waterworks, airports, etc.) -----	163	405	133	396
Concrete products (cement blocks, brick pipe, etc.) -----	1,862	4,650	1,839	4,634
Bituminous paving (asphalt and tar paving) -----	642	1,312	324	898
Roadbase and subbase -----	306	486	361	483
Fill -----	129	196	461	656
Other -----	W	W	W	W
Unprocessed:				
Roadbase and subbase -----	424	754	354	617
Fill -----	157	206	416	611
Other -----	--	--	W	W
Total -----	8,912	21,981	8,230	<sup>1</sup> 20,719

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

<sup>1</sup> Data do not add to total shown because of independent rounding.

were Prince Georges, Cecil, Anne Arundel, Charles, and Baltimore.

**Stone.**—Stone production in Maryland had an 18% decrease in tonnage to 14,796,000 short tons in 1975. The total value of the stone produced was \$43,110,000, 9.5% below that of 1974. Stone was the second most valuable mineral product of the State, contributing 26% of the State's mineral wealth. Baltimore County produced the largest tonnage of stone in the State and also had the highest unit value of all the major stone producing counties. Baltimore was followed by Montgomery, Frederick, Cecil, and Carroll Counties in order of stone production. There were 38 stone quarries in 10 counties. Twenty-two of the

quarries produced both dimension stone and crushed and broken stone, and 16 produced only crushed and broken stone.

Dimension stone made up less than 1% of the total tonnage and slightly more than 1% of total value of the commodity. Of the total stone produced, 72% was limestone; the remaining 28% was divided among traprock, granite, sandstone, and other types of stone.

Seventy percent of all stone produced in Maryland went to aggregates, 13% went to cement manufacture, 10% went to roadbase stone, and the remaining 7% was utilized in miscellaneous applications such as lime manufacture and riprap stone.

**Talc.**—Talc was mined by one relatively small producer in Harford County, and the material was used to make electrical insulators and roofing materials.

**Vermiculite (Exfoliated).**—W.R. Grace & Co., Prince Georges County, processed raw vermiculite into the exfoliated product at Muirkirk, Md., in 1975. The finished material was utilized primarily as aggregate for concrete and plaster.

#### MINERAL FUELS

**Coal (Bituminous).**—Bituminous coal was mined from five fields or basins in western Maryland. About 95% of the coal production came from open pit or strip mines, 4% from underground or deep mines, and 1% from auger mines.

Production of bituminous coal in 1975 increased to 2,606,000 short tons, about 12% above that of 1974. The average unit value of the coal decreased to \$19.38 per ton, 7% below the 1974 price. Of the 69 mines in the State, 31 were in Allegany County and 38 were in Garrett County. Sixty-one of these mines were open pit operations, six were auger type, and two were underground.

A State law passed in 1969 continued to be effective in regulating mining and in promoting the reclamation of strip-mined land. Revegetation of strip-mined areas was accomplished at a record pace in 1975. The 961 acres of land that was planted was more than the acres that were backfilled or the 887 acres that were stripped.<sup>2</sup> This was the first time since the law was passed that planting has kept pace with backfilling in the reclamation cycle.

The revegetation costs of strip-mined areas in Allegany and Garrett Counties follow: Revegetation work by coal operator, \$213 per acre; revegetation work by State of Maryland, \$250 per acre; and revegetation work by private contractor, \$450 per acre.<sup>3</sup>

The Appalachian Subsidence Control Project No. 20 on the Frostburg State College Campus, Frostburg, Md., was completed. A total of 55 holes were drilled around Residence Halls I and II, and the voids caused by prior underground mining of coal seams were filled with a mixture of cement and fly ash. This process also cemented broken rock strata beneath the buildings.

**Coke and Coal Chemicals.**—Bethlehem Steel Corp. produced coke for internal use at Sparrows Point. Byproducts recovered from the distillation of coal included oven coke gas, ammonia, crude light oil, benzene, toluene, xylene, oven coke tar, and other minor components in addition to the primary product, coke.

**Natural Gas and Petroleum.**—Natural gas production from fields in Garrett County during 1975 was 93 million cubic feet, a decrease of 30% from the 1974 production. An exploratory gas well drilled by the Texas Eastern Transmission Corp. on Negro Mountain, Garrett County, to a depth of 8,973 feet proved to be a dry hole.

A liquefied natural gas import terminal, designed to have a send-out capacity of approximately 1 billion cubic feet of gas per day, was being constructed by the Columbia LNG Corp., a subsidiary of the Columbia Gas System, Inc., at Cove Point on the Chesapeake Bay. The terminal, when completed in 1977, will pump Algerian liquefied natural gas into receiving vessels located on an offshore pier. From there, booster pumps will relay it through a tunnel to onshore tanks where it will be regasified and transported through a pipeline to markets served by the Columbia Gas System, Inc., and the Consolidated Natural Gas Co.

Two small petroleum refineries near Baltimore converted crude oil into asphalt products, but none of the feedstock originated in Maryland.

#### METALS

**Aluminum.**—No bauxite or other aluminum ore was mined in Maryland, but there was a significant production of metallic aluminum at two facilities in the State, Eastalco Aluminum Co. (Howmet Corp.) in Frederick County, and Tomke Aluminum Co. in Baltimore County. Company activities of the Howmet Aluminum Corp. (Eastalco Aluminum Co.) and the Howmet Turbine Components Corp. were purchased by the Pechiney Ugine Kuhlmann Corp., a U.S. subsidiary of Pechiney Ugine Kuhlmann of France, with executive offices in Greenwich, Conn., and the business activities of the Howmet Corp. ceased to be a publicly held company as of August 1975.

<sup>2</sup> Maryland Bureau of Mines. Fifty-second Annual Report, Calendar Year 1975. P. 25.

<sup>3</sup> Page 20 of work cited in footnote 2.

**Copper.**—Two copper refineries produced metal in Maryland by using raw materials obtained from outside the State, American Smelting and Refining Co. (ASARCO) in Baltimore, and Kennecott Refining Corp. at Hawkins Point, Anne Arundel County. The ASARCO plant, which has been reported to be outdated and not economically adaptable to modern concepts of copper refining and materials

handling, was closed in December.

**Iron and Steel.**—Bethlehem Steel Corp. of Sparrows Point continued to produce pig iron, raw steel, and semifabricated steel products from imported ore during the year.

**Lead.**—Lead, lead alloys, and other alloys and products were produced at three plants in Baltimore. The plants utilized primary metals and scrap as raw materials.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Cement:</b>			
<b>Portland:</b>			
Alpha Portland Cement Co. <sup>1</sup>	15 South 3d St. Easton, Pa. 18042	Plant -----	Frederick.
Lehigh Portland Cement Co. <sup>2</sup>	718 Hamilton St. Allentown, Pa. 18101	----do -----	Carroll.
Portland and masonry: Marquette Cement Manufacturing Co. <sup>1</sup>	First American Center Nashville, Tenn. 37238	----do -----	Washington.
Masonry: M.J. Grove Lime Co. <sup>1</sup>	Frederick, Md. 21701	----do -----	Frederick.
<b>Clays:</b>			
Baltimore Brick Co -----	501 St. Paul Pl. Baltimore, Md. 21202	Pits -----	Baltimore and Frederick.
Cyprus Industrial Materials Co	555 South Flower St. Los Angeles, Calif. 90071	Pit -----	Baltimore.
Victor Cushwa & Sons, Inc ---	201 West Potomac St. Williamsport, Md. 21795	Pit -----	Washington.
<b>Coal:</b>			
Buffalo Coal Co -----	Box 275 Bayard, W. Va. 26707	5 strip mines --	Garrett.
Grafton Coal Co -----	Box 188 Mt. Lake Park, Md. 21550	3 strip mines --	Do.
Moran Coal Co., Inc -----	Drawer E Westernport, Md. 21562	Strip mine ----	Do.
Winner Brothers Coal Co., Inc	Box 300 Frostburg, Md. 21532	5 strip mines --	Allegheny.
<b>Gypsum (calcined):</b>			
National Gypsum Co -----	325 Delaware Ave. Buffalo, N.Y. 14202	Plant -----	Baltimore.
United States Gypsum Co ----	101 South Wacker Dr. Chicago, Ill. 60606	----do -----	Do.
<b>Finished iron oxide pigments (natural and manufactured):</b>			
Minerals Pigments Corp -----	7011 Muirkirk Rd. Beltsville, Md. 20705	----do -----	Prince Georges.
Lime: S. W. Barrick & Sons, Inc	Woodsboro, Md. 21798	----do -----	Frederick.
Peat: Garrett County Processing & Packaging Corp.	R.F.D. #1 Accident, Md. 21520	Bog -----	Garrett.
<b>Petroleum refineries:</b>			
Amoco Oil Co -----	910 South Michigan Ave. Chicago, Ill. 60680	Refinery -----	Baltimore.
Chevron Asphalt Co -----	Baltimore, Md. 21200	----do -----	Do.
<b>Sand and gravel:</b>			
Campbell Sand and Gravel, Inc	4911 Calvert Rd. College Park, Md. 20740	Pit -----	Prince Georges.
Contee Sand & Gravel Co., Inc	Box 460 Laurel, Md. 20810	Pit -----	Do.
York Building Products Co., Inc.	Box 1708 York, Pa. 17405	Pit -----	Cecil.
<b>Stone:</b>			
Arundel Corp -----	501 St. Paul Pl. Baltimore, Md. 21202	Quarries -----	Baltimore, Harford, Howard.
Martin-Marietta Aggregates ---	66 Long Clove Rd. Congers, N.Y. 10920	Quarry -----	Washington.
Maryland Materials, Inc -----	Box W North East, Md. 21901	----do -----	Cecil.
Rockville Crushed Stone, Inc --	Box 407 Rockville, Md. 20850	----do -----	Montgomery.
D. M. Stoltzfus & Sons, Inc --	Talmage, Pa. 17580	Quarries -----	Cecil and Harford.

<sup>1</sup> Also stone.<sup>2</sup> Also clay and stone.

# The Mineral Industry of Massachusetts

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

By William R. Barton<sup>1</sup> and Joseph A. Sinnott<sup>2</sup>

The value of mineral production declined dramatically in Massachusetts during 1975. The total value of \$58.8 million was almost 5% less than the \$62.1 million reported in 1974. The decline was due to the general slowdown in the economy during 1975, which was reflected in lessened demand for the major mineral commodities produced in Massachusetts, especially for mineral commodities such as sand, stone, and gravel used mostly in construction.

A unified Massachusetts Office of Environmental Affairs became functional on July 1, 1975, under Secretary of Environmental Affairs Evelyn Murphy. It absorbed the previously existing Department of Natural Resources (DNR) but abolished the old DNR Division of Mineral Resources. That left State Geologist Joseph A. Sinnott as the only mineral resource and mining professional in the Commonwealth government.

Senator Robert E. McCarthy of East Bridgewater began drafting proposed legislation to protect the environment and population from possible adverse effects

of any future coal mining in the Narragansett Basin. He formed an ad hoc advisory group with a broad range of skills and backgrounds to help him in his endeavor.

The Massachusetts Office of State Planning completed a draft growth policy paper that may eventually lead to a land use plan being developed for the Commonwealth.

Plans for the Lowell incinerator residues processing plant were dropped because of unforeseen increases in ancillary project costs. The DeMatteo/Wheelabrator-Frye plant in Saugus began processing trash from 16 suburban Boston towns to produce steam and byproduct ferrous scrap. Operated at full capacity, the plant will supply energy equivalent to 73,000 gallons of No. 6 fuel oil daily. The generated steam is supplied to the General Electric Co. jet-engine manufacturing plant in Lynn. Several other energy from refuse projects were in various stages of planning during 1975.

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<sup>1</sup> State Liaison Officer, Bureau of Mines, Newmarket, N.H.

<sup>2</sup> Massachusetts State Geologist, Boston, Mass.

Table 1.—Mineral production in Massachusetts<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays -----thousand short tons--	218	\$379	124	\$228
Gem stones -----	NA	5	W	W
Lime -----thousand short tons--	170	4,972	152	5,215
Peat -----do-----	3	85	W	W
Sand and gravel -----do-----	17,334	26,565	13,281	24,556
Stone -----do-----	8,103	30,103	7,170	28,681
Value of items that cannot be disclosed:				
Values indicated by symbol W -----	XX	XX	XX	166
Total -----	XX	62,109	XX	58,846
Total 1967 constant dollars -----	XX	29,365	XX	P 23,303

<sup>P</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Massachusetts, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Barnstable -----	\$1,417	\$1,267	Sand and gravel.
Berkshire -----	12,374	12,126	Stone, lime, sand and gravel.
Bristol -----	4,463	3,849	Sand and gravel, stone.
Dukes -----	W	W	Sand and gravel.
Essex -----	6,178	5,524	Stone, sand and gravel.
Franklin -----	W	W	Sand and gravel, stone.
Hampden -----	W	W	Stone, sand and gravel.
Hampshire -----	W	W	Sand and gravel, stone.
Middlesex -----	16,201	W	Stone, sand and gravel, peat.
Nantucket -----	--	--	
Norfolk -----	W	W	Sand and gravel, stone, clays.
Plymouth -----	W	W	Sand and gravel, clays, stone.
Suffolk -----	545	W	Stone.
Worcester -----	5,988	W	Sand and gravel, stone, peat.
Undistributed <sup>1</sup> -----	14,944	36,080	
Total -----	<sup>2</sup> 62,109	58,846	

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

<sup>1</sup> Includes gem stones.

<sup>2</sup> Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Massachusetts business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	2,638.0	2,735.0	+3.7
Unemployment -----do-----	190.0	305.0	+60.5
<b>Employment (nonagricultural):</b>			
Mining -----do-----	(1)	(1)	(1)
Manufacturing -----do-----	636.9	593.8	-6.8
Contract construction -----do-----	97.4	78.8	-19.1
Transportation and public utilities -----do-----	123.0	113.9	-7.4
Wholesale and retail trade -----do-----	526.3	527.4	+0.2
Finance, insurance, and real estate -----do-----	139.8	138.3	-1.1
Services -----do-----	<sup>2</sup> 499.3	<sup>2</sup> 509.2	+2.0
Government -----do-----	355.0	366.2	+3.2
Total nonagricultural employment -----do-----	2,377.7	2,327.6	-2.1
<b>Personal income:</b>			
Total -----millions--	\$32,834	\$35,568	+8.3
Per capita -----do-----	\$5,667	\$6,114	+7.9
<b>Construction activity:</b>			
Number of private and public residential units authorized	23,745	17,984	-24.3
Value of nonresidential construction -----millions--	\$450.1	\$339.4	-24.6
Value of State road contract awards -----do-----	\$135.8	\$187.0	+37.7
Shipments of portland and masonry cement to and within Massachusetts -----thousand short tons--	1,232	948	-23.1
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$62.1	\$58.8	-5.3
Value per capita, resident population -----do-----	\$10.71	\$10.12	-5.5
Value per square mile -----do-----	\$7,521.98	\$7,126.80	-5.3

<sup>p</sup> Preliminary.<sup>1</sup> Included with services.<sup>2</sup> Includes mining.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.



Table 4.—Worktime and injury experience in the Massachusetts mineral industry in 1975<sup>1 2</sup>

	Men	Man-hours	Fatal injuries	Fatal frequency rate	Non-fatal disabling injuries	Non-fatal disabling frequency rate	Non-disabling injuries	Non-disabling frequency rate
<b>METAL—NONMETAL</b>								
<b>Gold-silver:</b>								
Underground	2	600	--	--	--	--	--	--
Office	1	45	--	--	--	--	--	--
<b>Total</b>	<b>3</b>	<b>645</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>
<b>Sand and gravel:</b>								
Surface	1,084	1,276,633	--	--	8	5.48	9	7.05
Office	216	242,060	--	--	--	--	--	--
<b>Total</b>	<b>1,250</b>	<b>1,518,693</b>	<b>--</b>	<b>--</b>	<b>8</b>	<b>4.61</b>	<b>9</b>	<b>5.93</b>
<b>Stone:</b>								
Surface	403	662,838	1	1.51	10	15.09	--	--
Mill	310	579,774	--	--	13	20.70	1	1.72
Office	145	241,575	--	--	--	--	--	--
<b>Total</b>	<b>858</b>	<b>1,484,187</b>	<b>1</b>	<b>.67</b>	<b>23</b>	<b>14.82</b>	<b>1</b>	<b>.67</b>
<b>Clay:</b>								
Surface	16	23,244	--	--	--	--	--	--
Mill	10	8,792	--	--	--	--	--	--
Office	3	3,096	--	--	--	--	--	--
<b>Total</b>	<b>29</b>	<b>35,132</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>
<b>Peat:</b>								
Surface	16	6,904	--	--	--	--	--	--
Mill	4	4,411	--	--	--	--	--	--
Office	2	2,005	--	--	--	--	--	--
<b>Total</b>	<b>22</b>	<b>13,320</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>
<b>State totals:</b>								
Underground	2	600	--	--	--	--	--	--
Surface	1,469	1,969,619	1	.51	18	8.63	9	4.57
Mill	324	592,977	--	--	13	20.24	1	1.69
Office	367	488,781	--	--	--	--	--	--
<b>Total or average</b>	<b>2,162</b>	<b>3,051,977</b>	<b>1</b>	<b>.33</b>	<b>31</b>	<b>9.50</b>	<b>10</b>	<b>3.28</b>

<sup>1</sup> All data are preliminary.<sup>2</sup> Data supplied by Mining Enforcement & Safety Administration.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Cement is not produced in Massachusetts. In 1975, preliminary data indicated that domestic producers shipped 914,000 tons of finished portland cement and 34,000 tons of prepared masonry cement into the State. These were decreases from the equivalent 1974 figures of 1,188,000 and 44,000 tons, respectively.

**Clay and Shale.**—Common clay and shale production in 1975 decreased 43% in tonnage and 40% in value compared with 1974. The principal producers of brick and common clay products were K-F Brick Co., Inc. (Susquehanna Corp.) at Middleboro, and Stiles & Hart Brick Co. at Bridgewater. The Masslite Div. of Plainville Corp. produced expanded light-

weight aggregate from shales of the carboniferous Narragansett Basin.

**Gem Stones.**—Small amounts of gem stones and specimens were collected by hobbyists. Amethyst from Bellingham was of particular interest in recent years.

**Gypsum.**—United States Gypsum Co. calcined raw gypsum from Canada at Charlestown (Boston) in Suffolk County. Output of gypsum products decreased 15% from 1974.

**Graphite.**—Small quantities of synthetic graphite were reportedly produced in Massachusetts.

**Lime.**—Pfizer, Inc. and Lee Lime Corp. produced 152,000 tons of lime in Berkshire County for food products, precipitated calcium carbonate, masons lime, sewage treatment, and other uses. Production de-

creased 11% compared with that in 1974. The lime was used in Massachusetts, New York, Connecticut, and other States. Total consumption of lime in Massachusetts was 44,716 tons compared with 62,090 tons in 1974. Residents of Adams complained to selectmen that the Pfizer lime operations were coating the area with dust and pitting their automobile windshields. As far as could be determined Pfizer was in compliance with Massachusetts air pollution regulations.

**Perlite (Expanded).**—Crude perlite mined outside the State was expanded at two plants in Suffolk County that sold the product mainly for lightweight aggregate, low-temperature insulation, masonry and cavity fill insulation, and horticultural aggregate.

**Sand and Gravel.**—Sand and gravel production in 1975 decreased 23% in quantity and 8% in value compared with 1974. The \$24.6 million of sand and gravel produced was 42% of the total value of Massachusetts mineral output, making sand and gravel second only to stone as a mineral commodity produced in the Commonwealth. Processed gravel accounted for 34% of the 13.3 million tons of sand and gravel output. Commercial operations produced 78% of the total tonnage, the rest was mined at Government-and-contractor extraction sites.

Commercial sand and gravel was produced in all counties in the State except Suffolk and Nantucket. Building and

paving markets consumed the major portion of the production. Small quantities of sand were used for fill, molding, blast, and filtration. Besides building and paving, gravel was used for railroad ballast and fill.

**Stone.**—Stone production decreased 12% in tonnage and 5% in value in 1975. Stone, valued at \$28.7 million, was the leading mineral product in Massachusetts in 1975, contributing 49% of the State's total mineral production value.

Dimension stone production decreased 18% in tonnage and 5% in value compared with 1974, while crushed and broken stone decreased 11% in tonnage and 5% in value in 1975 compared with the previous year.

Stone, produced at 39 quarries in 11 of the 14 counties, included basalt, granite, limestone, dolomite, sandstone, and miscellaneous stone. Basalt was the most important stone in both quantity and value. Crushed and broken stone accounted for 99% of the total stone output in 1975.

Crushed and broken stone producers were the quantity leaders in the stone field. They included John S. Lane & Son, Inc., Ashland Oil & Refining Co., Inc., and Simeone Stone Corp. The value leaders, however, were H. E. Fletcher Co., a producer of granite dimension stone, and Pfizer, Inc., a producer of ground limestone products. Both products had a much higher unit value than stone for construction aggregate.

Table 5.—Massachusetts: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand .....	6,140	10,689	4,960	8,882
Gravel .....	5,976	12,285	4,571	10,060
Unprocessed:				
Sand and gravel .....	5,218	3,535	3,687	3,315
Industrial:				
Sand .....	W	W	62	525
Gravel .....	--	--	( <sup>2</sup> )	4
Total .....	17,334	26,509	<sup>3</sup> 13,281	22,786

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit of value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Less than 1/2 unit.

<sup>3</sup> Data do not add to total shown because of independent rounding.

Table 6.—Massachusetts: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction --	4,815	10,536	3,812	8,678
Highway and bridge construction -----	432	956	334	804
Other construction (dams, waterworks, airports, etc.) -----	278	646	172	496
Concrete products (cement blocks, brick, pipe, etc.) -----	1,098	2,069	957	2,365
Bituminous paving (asphalt and tar paving) ---	1,281	2,133	1,163	2,120
Roadbase and subbase -----	1,142	1,798	561	1,050
Fill -----	773	813	630	868
Other -----	446	822	222	466
<b>Unprocessed:</b>				
Roadbase and subbase -----	2,435	1,715	837	977
Fill -----	2,781	1,820	1,452	1,294
Other -----	--	--	123	50
Industrial sand and gravel -----	W	W	63	528
Total -----	15,481	23,308	10,326	<sup>1</sup> 19,697

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>1</sup>Data do not add to total shown because of independent rounding.

Table 7.—Massachusetts: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction --	243	406	501	1,149
Highway and bridge construction -----	302	670	170	444
Other construction (dams, waterworks, airports, etc.) -----	85	143	121	288
Concrete products (cement blocks, brick, pipe, etc.) -----	85	93	137	230
Bituminous paving (asphalt and tar paving) ---	509	974	324	673
Roadbase and subbase -----	440	602	217	379
Fill -----	55	112	37	93
Other -----	134	257	174	390
<b>Unprocessed:</b>				
Roadbase and subbase -----	--	--	450	514
Fill -----	W	W	811	678
Other -----	--	--	14	21
Total <sup>1</sup> -----	1,853	3,257	2,955	4,860

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction".

<sup>1</sup>Data may not add to totals shown because of independent rounding.

Crushed basalt was produced in 9 counties. Essex County led in value and quantity. The value of crushed basalt accounted for 53% of the total value of stone. The crushed basalt was used mainly for construction aggregate; other uses were rip-rap, railroad ballast, and filter stone.

Granite, sold as crushed and dimension stone, was quarried in four counties. Middlesex County led in value of granite produced. Granite was the second highest

value stone produced in the State. The chief use for cut granite was for curbing; other uses were rubble, irregular shaped stone, paving blocks, cut stone, and house stone veneer. Crushed granite was used mainly for construction aggregate; smaller quantities were used for roadbase stone and railroad ballast.

Limestone was quarried in Berkshire County. The chief uses of crushed limestone in descending order were lime, con-

struction aggregate, asphalt fill, whiting, poultry grit, agricultural limestone, other filter, and flux stone.

Crushed miscellaneous stone was quarried in Bristol, Hampden, Norfolk, and Worcester Counties.

The White Marble Co. (subsidiary of Joseph Weiss and Sons) in Lee benefited under the Trade Act of 1974 by an \$800,000 adjustment assistance loan to expand activities and to install cost-saving equipment.

Table 8.—Massachusetts: Stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Dimension stone total -----	79	5,355	65	5,096
Crushed stone:				
Bituminous aggregate -----	3,133	9,246	2,580	7,621
Concrete aggregate -----	479	986	344	892
Dense-graded roadbase stone -----	706	1,617	631	1,567
Macadam aggregate -----	93	230	71	229
Surface treatment aggregate -----	133	300	133	291
Other construction aggregate and roadstone -----	1,964	4,756	1,742	4,746
Agricultural purposes <sup>1</sup> -----	216	1,476	203	1,504
Filter stone -----	W	W	169	530
Railroad ballast -----	342	783	338	921
Riprap and jetty stone -----	61	136	115	245
Roofing aggregates, chips, and granules -----	160	320	138	421
Other uses <sup>2</sup> -----	736	4,898	639	4,619
Crushed total <sup>3</sup> -----	8,023	24,748	7,105	23,584
Grand total <sup>3</sup> -----	8,103	30,103	7,170	28,681

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

<sup>1</sup> Includes agricultural limestone, other soil conditioners, poultry grit, and mineral food.

<sup>2</sup> Data include stone used for manufactured fine aggregate (stone sand), lime manufacture, fill, flux stone, asphalt filler, whiting, and drain fields.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

**Roofing Aggregate.**—Output of rhyolite to make roofing granules decreased slightly. The rhyolite was quarried in Norfolk County and for statistical purposes is classified as miscellaneous stone.

**Vermiculite.**—The quantity of vermiculite processed in Massachusetts during 1975 decreased slightly. W. R. Grace & Co. in Hampshire County exfoliated vermiculite mined outside the State. The material was used mainly as insulation; other uses in descending order were concrete aggregate, soil conditioning, and plaster.

#### MINERAL FUELS

Statistics on Massachusetts fuel consumption are published annually by the New England Fuel Institute in the March issue of "Yankee Oilman." Data for 1973 were published in 1975.

**Anthracite.**—As a result of interest generated by Bureau of Mines analyses of specimens from Mansfield, during 1974, an application was made for a National

Science Foundation (NSF) grant to investigate the coal potential of the Narragansett Basin. The proposal was submitted by Father James Skehan, Director of Boston College—Weston Observatory, and had the support of many Massachusetts political leaders, industrial firms, and Federal and State agencies. At yearend, an NSF grant of about \$175,000 was expected, an additional \$75,000 had been pledged by the New England Regional Commission, and about \$60,000 more was promised by various private firms as a result of efforts by the Massachusetts Science and Technology Foundation, Associated Industries of Mass., the State Geologist, and the Federal Energy Administration. The Bureau of Mines and the U.S. Geological Survey committed themselves to analytical and other supporting services. Great Eastern Minerals and Engineering Co., a Massachusetts corporation, was trying to raise \$250,000 to commence private exploration in the basin.

Masslite Div. of the Plainville Corp. continued to burn unknown quantities of Massachusetts anthracite at Plainville where three poor-quality coal beds are mined, mixed with shale, and fired together with anthracite from Pennsylvania to produce lightweight aggregate.

The Massachusetts Science and Technology Foundation published a 23-page booklet titled "The Geological, Economic, and Technological Prospects for Narragansett Basin Coal."

**Peat.**—Reed-edge peat was mined by Sterling Peat Co. in Worcester County. The peat was used mainly by nurserymen, landscapers, and greenhouse owners.

**Petroleum.**—Cumberland Farms, Inc. proposed an exchange of land with the Commonwealth of Massachusetts to build a refinery at a Freetown State Forest location near Fall River. The move was opposed by Wampanoag Indians who want the forest as a reservation under a 1939 law permitting them to make such a claim.

Department of the Interior calls for nomination of Georges Bank tracts resulted in expression of interest in 10.9 million acres, some of it as close as 24 miles to Nantucket Island. The Department announced that to protect coastlines and coastal waters no drilling would be permitted within 50 miles of shore. The U.S. House of Representatives Ad Hoc Select Committee on the Outer Continental Shelf (OCS) conducted a hearing in Boston during September. Most witnesses urged greater State roles in OCS development and earmarking of lease money to compensate New England States for adverse impacts which might result from offshore drilling. The New England River Basins Commission was awarded a \$350,-

000 contract by the U.S. Geological Survey to study possible land-based facilities and impacts that might result from Georges Bank development.

The Cabot Corp. liquefied natural gas (LNG) plant at Everett was unable to obtain planned quantities of LNG from Algeria where production at liquefaction plants was far below anticipated output. New England Liquefied Natural Gas Co. has proposed a new LNG storage plant at Fall River. The first LNG tanker to be built at a U.S. shipyard was launched by General Dynamics Inc. at Quincy. The first of eight to be built by 1979, the tanker is 936 feet long with a capacity of 125,000 cubic meters of LNG.

#### METALS

**Gallium.**—Arthur D. Little Inc. of Cambridge formed a new enterprise to be known as Intermet Corp. The firm will design, manufacture, and sell high-pressure, high-yield furnace systems for commercial production of gallium phosphide and similar materials.

**Manganese.**—Chemetron Inc. dewatered and cleaned out the old south pit of the Anson Betts manganese mine. The firm was to decide whether or not to drill the deposit under an option from Anson Betts.

**Silicon.**—Tyco Laboratories Inc. of Waltham formed a joint venture with Mobil Oil Corp. to develop and commercialize silicon ribbon solar cells made by Tyco's "edge-defined, film-fed, growth" (EFG) process. The new firm, Mobil Tyco Solar Energy Corp., was owned 80% by Mobil and 20% by Tyco. Mobil will invest \$30 million and Tyco will provide the joint venture with proprietary EFG technology.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Clays:</b>			
K-F Brick Co., Inc. (Susquehanna Corp.).	River St. Middleboro, Mass. 02346	Pit -----	Plymouth.
Plainville Corp., Masslite Div. <sup>1</sup>	P.O. Box 327 Walpole, Mass. 02081	Pit -----	Norfolk.
Stiles & Hart Brick Co -----	Box 367 Bridgewater, Mass. 02324	Pit -----	Plymouth.
<b>Gypsum calcined:</b>			
United States Gypsum Co. <sup>2</sup> ---	101 South Wacker Dr. Chicago, Ill. 60606	Plant -----	Suffolk.
<b>Industrial sand:</b>			
Southeastern Sand and Gravel, Inc.	Kingston, Mass. 02364 ----	Pit -----	Plymouth.
Whitehead Bros. Co -----	60 Hanover Rd. Florham Park, N.J. 07932	Pit -----	Do.
<b>Lime:</b>			
Lee Lime Corp. <sup>1,3</sup> -----	Marble St. Lee, Mass. 01238	Plant -----	Berkshire.
Pfizer, Inc. <sup>3</sup> -----	260 Columbia St. Adams, Mass. 01220	----do -----	Do.
<b>Peat:</b>			
Sterling Peat Co -----	Sterling Junction, Mass. 01565	Bog -----	Worcester.
<b>Perlite, expanded:</b>			
Whittemore Products, Inc ----	35 Harrison St. Roslindale, Mass. 02131	Plant -----	Suffolk.
<b>Roofing granules:</b>			
Bird & Son, Inc -----	49 Washington St. East Walpole, Mass. 02032	----do -----	Norfolk.
<b>Sand and gravel:</b>			
J. J. Cronin Co -----	P.O. Box 176 North Reading, Mass. 01864	Pit -----	Middlesex.
Glenview Sand and Gravel Corp	152 Steadman St. Chelmsford, Mass. 01824	Pit -----	Do.
Hyannis Sand and Gravel Co --	Box 96 Hyannis, Mass. 02601	Pit -----	Barnstable.
J. L. Construction Co -----	5 Cypruss Dr. Burlington, Mass. 01803	Pit -----	Middlesex.
Marshfield Sand and Gravel, Inc	Clay Pit Rd. Marshfield, Mass. 02050	Pit -----	Norfolk.
Merrimack Paving Corp -----	Yemma Rd. Groveland, Mass 01830	Pit -----	Essex.
Namasket Construction Co ---	Box 296 Middleboro, Mass. 02341	Pit -----	Plymouth.
A. A. Will Sand & Gravel Corp	Turnpike St. Canton, Mass. 02021	Pit -----	Norfolk.
Worcester Sand & Gravel Co --	182 Holden St. Shrewsbury, Mass. 01545	Pit -----	Worcester.
<b>Stone:</b>			
G. Brox, Inc -----	1471 Methuen St. Dracut, Mass. 01826	Quarry -----	Middlesex.
H. E. Fletcher Co -----	West Chelmsford, Mass. 01863	----do -----	Middlesex and Worcester.
John S. Lane & Son, Inc -----	P.O. Box 125 Westfield, Mass. 01085	----do -----	Hampden and Hampshire.
LeMasurier Granite Quarry, Inc	Box 71, Ledge Rd. N. helmsford, Mass. 01863	----do -----	Middlesex.
Lynn Sand & Stone Co -----	30 Danvers Rd. Swampscott, Mass. 01907	----do -----	Essex.
Manchester Stone & Gravel Co	Box 402 Manchester, Mass. 01944	----do -----	Do.
Old Colony Crushed Stone Co -	P.O. Box 230 Quincy, Mass. 02169	----do -----	Norfolk.
Simeone Stone Corp -----	1185 Turnpike St. Stoughton, Mass. 02072	----do -----	Do.
Trimount Bituminous Products Co.	1840 Revere Beach Parkway Everett, Mass. 02149	----do -----	Essex.
Warren Bros. Co., Division of Ashland Oil & Refining Co., Inc.	490 Howard St. Brockton, Mass. 02402	----do -----	Bristol.
<b>Vermiculite, exfoliated:</b>			
W. R. Grace & Co -----	62 Whittemore Ave. Cambridge, Mass. 02140	Plant -----	Hampshire.

<sup>1</sup> Also sand and gravel.<sup>2</sup> Also expanded perlite.<sup>3</sup> Also stone.



# The Mineral Industry of Michigan

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division of the Michigan Department of Natural Resources, under a memorandum of understanding for collecting information on all minerals except coal and liquid fuels.

By Edward C. Peterson<sup>1</sup> and Esther A. Middlewood<sup>2</sup>

Spurred by record petroleum and natural gas production and continued inflationary pressures, the value of Michigan's raw mineral output rose to an alltime high of \$1.3 billion in 1975. This was an increase of 24.7% over that of 1974. Iron ore continued to be the leading commodity in terms of value followed by crude petroleum, cement, copper, stone, and sand and gravel.

Production of nonmetallic minerals declined for the fifth successive year. These commodities, however, contributed the major portion of Michigan's total mineral value, accounting for \$515.6 million or 39.9% of the total. The drop in production was attributed to the continued slowness in the construction industry which utilizes most of these minerals.

Metals accounted for \$436.5 million, or 33.8% of the total mineral value. Although production of iron ore nationally was lower in 1975, Michigan's shipments and value rose 21% and 59%, respectively, over 1974. Initial production from the Tilden mine and the Empire mine expansion was responsible for the increase. Copper production increased 10% over that of 1974, but its value decreased almost 9%, reflecting the depressed copper prices prevalent throughout 1975.

Output of mineral fuels (natural gas, natural gas liquids, peat, and petroleum) was valued at \$339.6 million, or 26.3% of the total mineral value. Petroleum and natural gas production increased almost 45% over that of 1974. Michigan continued

to be the largest domestic producer of peat. A small amount of coal was mined for local consumption. This was the first coal actually produced in the State since 1952.

A milestone was reached during 1975 when the 1-billionth ton of Michigan iron ore was produced. The total iron ore mined in the State since the first mine on the Marquette Range of the Upper Peninsula began production in 1845 would make almost 653 million tons of steel. The ore, at current prices, would be valued at more than \$14 billion. Due to fluctuating prices during the past 130 years, however, the ore probably had a value of only about \$6 billion.

With the startup of the Tilden mine in late 1974 and the completion of the Empire mine expansion in 1975, Michigan's annual iron ore production capacity increased by almost 6 million tons. In addition, Cleveland-Cliffs Iron Co. (CCI) officials announced plans for a new expansion of the Empire mine. The \$150 million project will boost iron ore pellet production at the facility by an additional 2.8 million tons annually, bringing the mine's yearly capacity to 8 million tons. Production from the expanded facility is slated to start early in 1980.

Michigan's production of sand and gravel continued to be adversely affected by the depressed conditions existing in the con-

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Table 1.—Mineral production in Michigan<sup>1</sup>

Mineral	1974		1975		
	Quantity	Value (thousands)	Quantity	Value (thousands)	
Cement:					
Portland .....	thousand short tons..	5,903	\$140,513	4,573	\$131,324
Masonry .....	do.....	217	6,309	183	6,429
Clays .....	do.....	2,161	4,074	1,818	3,530
Copper (recoverable content of ores, etc.)	short tons..	67,012	103,601	73,690	94,618
Gem stones .....	NA	8	NA	8	8
Gypsum .....	thousand short tons..	1,482	7,258	1,224	5,936
Iron ore (usable)	thousand long tons, gross weight..	11,602	213,598	14,089	339,113
Lime .....	thousand short tons..	1,528	30,036	1,434	36,540
Magnesium compounds	short tons, MgO equivalent..	503,281	53,302	W	W
Natural gas .....	million cubic feet..	69,133	34,843	102,113	64,740
Natural gas liquids:					
Natural gasoline .....	thousand 42-gallon barrels..	466	3,089	656	3,294
LP gases .....	do.....	849	5,383	1,348	5,945
Peat .....	thousand short tons..	244	3,811	245	3,206
Petroleum (crude) .....	thousand 42-gallon barrels..	18,021	154,746	24,420	262,352
Salt .....	thousand short tons..	4,445	62,055	4,020	68,353
Sand and gravel .....	do.....	60,027	82,617	47,051	73,397
Silver (recoverable content of ores, etc.)	thousand troy ounces..	643	3,028	632	2,795
Stone .....	thousand short tons..	47,479	72,748	39,946	73,800
Value of items that cannot be disclosed:					
Bromine, calcium chloride, iodine, and values indicated by symbol W .....	XX	† 54,411	XX	116,223	
Total .....	XX	† 1,035,430	XX	1,291,653	
Total 1967 constant dollars .....	XX	489,551	XX	† 511,495	

<sup>P</sup> Preliminary. <sup>†</sup> Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Michigan, by county<sup>1</sup>

(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Alcona .....	\$134	\$124	Sand and gravel.
Alger .....	88	77	Do.
Allegan .....	1,823	2,474	Sand and gravel, petroleum, natural gas, stone, peat.
Alpena .....	66,819	61,660	Cement, stone, clays, sand and gravel.
Antrim .....	785	W	Petroleum, natural gas, clays, sand and gravel.
Arenac .....	2,271	W	Petroleum, stone, sand and gravel.
Baraga .....	126	110	Sand and gravel.
Barry .....	845	W	Sand and gravel, petroleum.
Bay .....	11,632	11,801	Cement, petroleum, sand and gravel, lime.
Benzie .....	23	33	Sand and gravel.
Berrien .....	4,487	4,691	Sand and gravel, stone.
Branch .....	355	488	Do.
Calhoun .....	11,752	17,909	Petroleum, natural gas, sand and gravel, stone.
Cass .....	W	W	Sand and gravel, stone.
Charlevoix .....	W	W	Cement, stone, sand and gravel.
Cheboygan .....	179	138	Stone, sand and gravel.
Chippewa .....	W	W	Do.
Clare .....	3,107	3,930	Petroleum, sand and gravel, natural gas.
Clinton .....	W	W	Sand and gravel, clays.
Crawford .....	5,639	9,741	Petroleum, natural gas, sand and gravel.
Delta .....	223	W	Sand and gravel, stone.
Dickinson .....	W	W	Iron ore, sand and gravel, stone.
Eaton .....	3,388	4,969	Petroleum, natural gas, stone, sand and gravel, clays, peat.
Emmet .....	13,957	16,025	Cement, stone, sand and gravel, clays.
Genesee .....	692	W	Sand and gravel, petroleum.
Gladwin .....	2,182	W	Petroleum, sand and gravel.
Gogebic .....	162	249	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Michigan, by county<sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Grand Traverse -----	\$12,221	\$36,065	Petroleum, natural gas, sand and gravel.
Gratiot -----	9,343	11,030	Magnesium compounds, calcium chloride, salt, bromine, sand and gravel, petroleum, natural gas.
Hillsdale -----	19,146	20,410	Petroleum, natural gas, natural gas liquids, sand and gravel.
Houghton -----	332	1,375	Copper, sand and gravel, stone, silver.
Huron -----	W	W	Stone, sand and gravel, lime.
Ingham -----	21,036	30,872	Petroleum, natural gas, natural gas liquids, sand and gravel, peat.
Ionia -----	397	627	Sand and gravel.
Iosco -----	W	W	Gypsum, sand and gravel.
Iron -----	5,164	W	Iron ore, sand and gravel.
Isabella -----	1,905	W	Petroleum, sand and gravel.
Jackson -----	6,793	6,984	Petroleum, natural gas, sand and gravel, stone.
Kalamazoo -----	W	W	Sand and gravel, stone.
Kalkaska -----	39,028	64,541	Petroleum, natural gas, natural gas liquids.
Kent -----	6,011	5,028	Sand and gravel, petroleum, gypsum, peat, natural gas.
Keweenaw -----	23	31	Sand and gravel.
Lake -----	778	W	Petroleum, sand and gravel.
Lapeer -----	3,750	2,832	Sand and gravel, petroleum, peat, calcium chloride, natural gas.
Leelanau -----	371	W	Sand and gravel.
Lenawee -----	W	W	Sand and gravel, clays.
Livingston -----	W	W	Sand and gravel, natural gas, petroleum.
Luce -----	44	W	Sand and gravel.
Mackinac -----	14,097	W	Stone, sand and gravel.
Macomb -----	2,922	W	Sand and gravel, natural gas, petroleum.
Manistee -----	45,993	61,375	Magnesium compounds, salt, petroleum, natural gas, bromine, sand and gravel.
Marquette -----	171,177	W	Iron ore, sand and gravel, stone.
Mason -----	50,278	57,984	Magnesium compounds, calcium chloride, lime, bromine, petroleum, natural gas, sand and gravel.
Mecosta -----	971	845	Sand and gravel, petroleum, peat, natural gas.
Menominee -----	46	174	Sand and gravel.
Midland -----	* 38,934	38,178	Bromine, calcium chloride, magnesium compounds, salt, petroleum, iodine.
Missaukee -----	W	7,558	Petroleum, natural gas, sand and gravel.
Monroe -----	28,925	23,538	Cement, stone, clays, sand and gravel, petroleum, peat.
Montcalm -----	1,082	W	Petroleum, sand and gravel.
Montmorency -----	W	4	Sand and gravel, petroleum.
Muskegon -----	W	W	Sand and gravel, salt, petroleum.
Newaygo -----	W	W	Sand and gravel, petroleum.
Oakland -----	W	16,434	Sand and gravel, natural gas, petroleum, peat.
Oceana -----	W	W	Sand and gravel, petroleum.
Ogemaw -----	4,457	W	Petroleum, sand and gravel, natural gas.
Oshtemo -----	W	W	Copper, silver, sand and gravel.
Oscoda -----	4,413	W	Petroleum, natural gas liquids, sand and gravel.
Oscoda -----	W	W	Sand and gravel, petroleum.
Otsego -----	38,235	68,324	Petroleum, natural gas, sand and gravel.
Ottawa -----	6,424	5,264	Sand and gravel, petroleum, natural gas.
Presque Isle -----	31,328	30,144	Stone, sand and gravel, petroleum.
Roscommon -----	3,130	4,115	Petroleum, natural gas, sand and gravel.
Saginaw -----	2,714	2,440	Sand and gravel, lime, petroleum, clays.
St. Clair -----	30,990	40,988	Salt, petroleum, natural gas, sand and gravel.
St. Joseph -----	W	W	Sand and gravel, stone, peat.
Sanilac -----	W	W	Peat, sand and gravel, lime.
Schoolcraft -----	W	W	Stone, sand and gravel.
Shawasssee -----	1,202	951	Peat, sand and gravel, clays, petroleum.
Tuscola -----	W	W	Sand and gravel, petroleum, lime.
Van Buren -----	706	W	Sand and gravel, petroleum.
Washtenaw -----	2,248	W	Do.
Wayne -----	69,235	77,175	Lime, cement, salt, stone, sand and gravel, clays, petroleum.
Wexford -----	1,017	3,167	Petroleum, natural gas, sand and gravel.
Undistributed <sup>2</sup> -----	227,854	538,727	
Total <sup>3</sup> -----	* 1,085,430	1,291,653	

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

<sup>1</sup> Value of petroleum and natural gas are based on an average price per barrel and cubic foot, respectively, for the State.

<sup>2</sup> Includes values for gem stones, some sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Michigan business activity

	1974	1975 P	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands--	3,943.0	3,922.0	-0.5
Unemployment ----- do-----	337.0	490.0	+45.4
<b>Employment (nonagricultural):</b>			
Mining ----- do-----	13.4	13.5	+0.7
Manufacturing ----- do-----	1,105.9	980.0	-11.4
Contract construction ----- do-----	125.0	96.1	-23.1
Transportation and public utilities ----- do-----	153.6	143.7	-6.4
Wholesale and retail trade ----- do-----	669.7	657.4	-1.8
Finance, insurance, and real estate ----- do-----	131.0	128.9	-1.6
Services ----- do-----	521.0	519.7	-.2
Government ----- do-----	561.9	588.0	+4.6
Total nonagricultural employment ----- do-----	3,281.4	3,127.3	-4.7
<b>Personal income:</b>			
Total ----- millions-----	\$53,302	\$56,526	+6.0
Per capita ----- do-----	\$5,846	\$6,173	+5.6
<b>Construction activity:</b>			
Number of private and public residential units authorized ----- do-----	44,291	36,980	-16.5
Value of nonresidential construction ----- millions-----	\$720.3	\$605.8	-15.9
Value of State road contract awards ----- do-----	\$218.0	\$266.0	+22.0
Shipments of portland and masonry cement to and within Michigan ----- thousand short tons-----	3,180	2,475	-22.2
<b>Mineral production value:</b>			
Total crude mineral value ----- millions-----	\$1,035.4	\$1,291.7	+24.7
Value per capita, resident population ----- do-----	\$113.57	\$141.77	+24.8
Value per square mile ----- do-----	\$17,786.00	\$22,187.25	+24.7

P Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

struction and automotive industries. Construction Aggregates Corp.'s gravel plant on the Grand River, near Ferrysburg, reportedly the world's largest shipper of gravel, was closed half the summer. Normally the plant loads more than 100 lake freighters each shipping season, but less than a third of that number were loaded in 1975, leaving the plant yards piled high with gravel. Major customers of the company include the automobile manufacturers for foundry sand and the construction industry for gravel products.

Construction on Detroit Edison Co.'s new coal-loading terminal at Superior, Wis., began in late 1974 and continued through 1975. The new \$35 million facility, owned by Midwest Energy Resources Co., a wholly owned subsidiary of Detroit Edison, is expected to be in operation by the middle of 1976. The terminal is designed to handle coal produced in southeastern Montana and transported to Superior by 110-car unit trains. At the Wisconsin site, the coal will be loaded into self-unloading lake vessels for delivery to Detroit Edison's powerplants in St. Clair, Mich. The terminal is equipped to handle 12 million tons of coal annually and can be expanded to handle 20 million tons.

Scientists from The Dow Chemical Co. at Midland predict the time is approaching when they can tap some 2.5 trillion barrels of oil from Michigan shale. The Antrim shale holding the oil covers two-thirds of the State's lower peninsula in beds up to 200 feet thick, down to a depth of 2,500 feet. Dow has had a demonstration shale drilling site in Sanilac County since 1972. In 1975, the Energy Research and Development Administration (ERDA) asked Congress for a \$42 million grant for a 7-year demonstration project for Dow. No final decision was reached by yearend.

Scientists hope that a 57-foot rock core extracted from more than 3 miles below the ground will provide a record of an ancient segment of Michigan's geologic history. The core was extracted from a 17,400-foot well drilled in Gratiot County, near Ithaca, in the heart of the Michigan basin. McClure Oil Co., operator of the well, and Amoco Production Co., a participant in the drilling, are working with scientists from the universities of Wisconsin, Michigan, Northwestern, and Purdue in the extraction of the core and in a number of other geological and geophysical tests. Oil company scientists plan to study portions of the core to gain additional knowledge

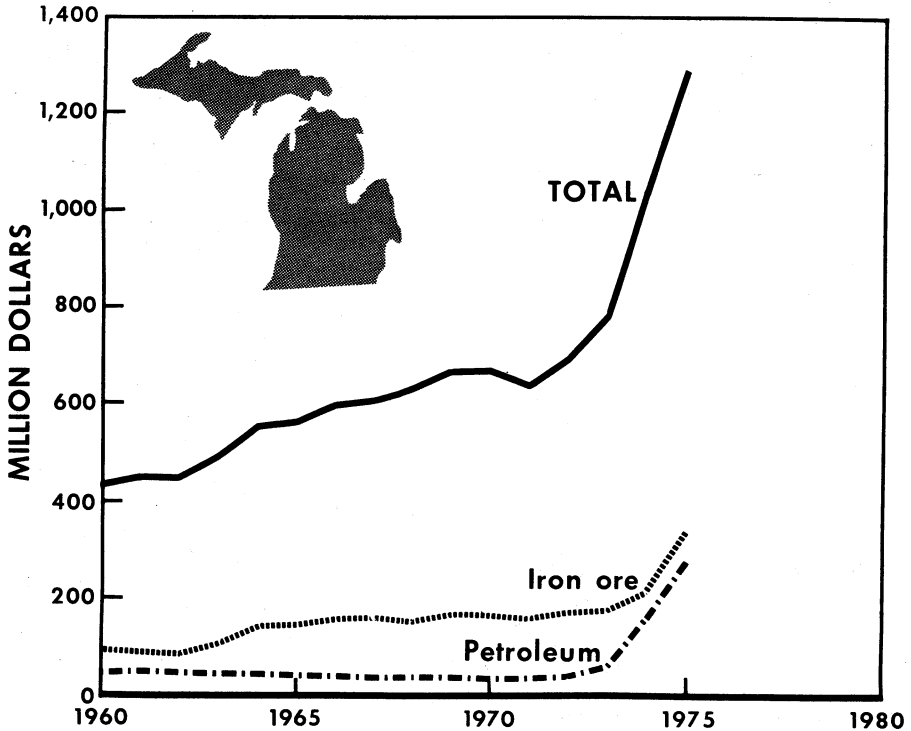


Figure 1.—Value of iron ore, petroleum, cement, and total value of mineral production in Michigan.

of the Michigan Basin as it pertains to oil and gas accumulations, while university scientists, under the auspices of the National Science Foundation, conduct other geologic tests.

Bethlehem Steel Corp. and CCI continued to explore for nonferrous minerals in the Lake Superior region through efforts of their Beth-Cliffs joint venture. In November of 1975, however, Bethlehem Steel withdrew from the joint venture. CCI has indicated that they will continue the exploration program.

Samples were taken by Michigan's Department of Natural Resources (DNR) from the State's only active coal mine at Williamston and at another deposit near Grand Ledge in 1975. The samples, analyzed by the U.S. Geological Survey, proved to be unusually high in germanium content and additional samples will be taken during 1976.

A Canadian firm was hired by the Tennessee Valley Authority (TVA) to prospect for uranium in the western part of Michigan's Upper Peninsula. Neither the company nor the State has released the exact location nor the size of the proposed area. Uranium exploration is not new to Michigan. In the early 1950's the Atomic Energy Commission explored large areas of the region.

Chevron Minerals, a wholly owned subsidiary of Chevron Oil Co., conducted drilling and exploration in Marquette County as part of a joint venture with CCI during 1975. The property under survey is the Kona-copper prospect in Michigan's Upper Peninsula owned by CCI and once drilled by Bear Creek. It is believed that the area may be an important stratabound copper deposit.

Environmental matters continued to be increasingly important elements in the

various phases of oil and gas exploration and development, and in the administration of Michigan's oil and gas statutes. Environmental impact statements (EIS) are part of each drilling application and for many other phases of oil and gas activities, such as pipeline construction and conversion of gas reservoirs to gas storage use. While these controls may add to the costs of drilling and producing oil and gas, to date they have not seriously impeded the orderly development of Michigan's energy resources.

**Transportation.**—The possibility of a deepwater harbor at Monroe, Mich., took a major step forward based on findings of an economic development study prepared by a firm of port consultants. During the course of the study, port shipping increased from 27,400 tons in 1973 to 215,423 tons in 1974. Projected shipments for 1975 amounted to 695,000 tons. All shipments are coal.

One State senator introduced a resolution in the State legislature (S.C.R. 341) calling for a study leading to a Michigan port development plan. He proposed creation of a special senate committee to examine the status of Michigan's commercial ports and the problems surrounding the development of those ports. Michigan utilizes the Great Lakes to transport coal consumed by electric power companies, as well as to ship many mineral commodities.

The Michigan State Highway Commission approved a 1-year, \$34.5 million State rail program that could preserve virtually all of the 1,100 miles of rail threatened with abandonment by the Federal CONRAIL system. The commission said its purpose would assure continuation of freight service to more than 100 communities along the bankrupt Penn Central and Ann Arbor railroad lines not included in the CONRAIL reorganization plan. The program went to the State legislature for consideration. The railroad lines in question are used to transport industrial sand, sand and gravel, petrochemical feedstocks, and coal used as fuel in some areas of Michigan.

**Legislation.**—Michigan legislators faced many controversial issues during the 1975 session. Numerous bills designed to protect the environment were introduced, only to be defeated or referred to legislative committees.

One such bill, H.B. 5455 (S.B. 1003) was introduced to alter Michigan's 1970 Environmental Protection Act. The bill was defeated, but only after months of debate. The bill would have exempted the construction and operation of mining facilities which extract and process metallic mineral resources from legal action and jurisdiction under the act, after all required environmental impact reports had been filed and required permits had been obtained from appropriate State agencies. The bill was strongly opposed by many of Michigan's citizen environmental groups.

The unique composition of dune sand from the Lake Michigan area makes its use integral in a variety of industries. Dune sand is used to make highway concrete, glass moldings, and metal castings for the automotive industry, among others. At the present time, sand mining in the dune area is unregulated. Mining permits, impact statements, and reclamation plans are not required of sand mining operations. An attempt was made during 1975 to establish legislative controls over the mining of dune sand (H.B. 4038). The measure, which passed the house in November, was routed to the senate for approval. At the end of 1975, the bill remained in the Senate Committee on Conservation.

Legislation to repeal P.A. 264 of 1967, entitled "Mine Safety Act of 1967," was introduced in mid-1975. The act originally provided for the inspection of mining operations in Michigan by the State Department of Labor, but has not been funded since 1973. The bill (H.B. 5580) was referred to the Committee on Labor for review.

Michigan's Resource Recovery Commission, established by P.A. 366 of 1974, held its organizational meeting in August 1975. The purpose of the commission is to "encourage the conservation of natural resources through the promotion or development of systems to collect, separate, reclaim, and recycle metals, glass, paper, and other materials from waste, for energy production uses, and to provide a coordinated statewide waste management and resource recovery program."

Executive Order 1974-4 established an Environmental Review Board in the State of Michigan. During the 1975 legislative session, bills (H.B. 5398 and S.B. 1127) were introduced to create the Environ-

mental Review Board as an autonomous entity within the Department of Natural Resources. The board's duties would include providing advice and making recommendations to the legislature and State agencies on environmental issues and policies, administering an environmental report program to be established by the bill, and publishing rules for the implementation of the bill.

Under Section 2, P.A. 17 of 1921, "persons contracting to remove oil, gas, coal, or other mineral products from State lands are required to obtain approval of the State administrative board." Provisions of H.B. 5505, introduced in 1975, amend this section to specify only metallic minerals would need prior approval for removal. The bill was referred to the Committee on Conservation, Environment, and Recreation.

A bill to regulate the construction and use of oil and gas pipeline facilities (H.B. 4846) was again introduced during the 1975 session. The bill was referred to the Committee on Public Utilities for consideration.

The senate introduced legislation (S.B. 852) designed to "regulate nonmetallic surface mining, to protect the environment, to encourage and maintain essential mining activities, to provide for the orderly development of surface mining, to guarantee environmental reclamation, and to provide penalties." The bill, known as the "non-metallic surface mining conservation and reclamation act," remained in the Committee on Conservation at the close of 1975.

**Government Programs.**—Active Federal Bureau of Mines contracts and grants to State universities and private industry in Michigan total a little over \$2 million. Some of these projects are continued from previous years, but approximately \$600,000 of new contracts were issued during calendar year 1975. The contracts and grants involve such areas as industrial safety, mining technology, industrial hygiene, ground control, and mineral availability.

A \$42,500 fellowship program in mining

and minerals research was awarded to Michigan Technological University during 1975. The eight fellowships are for masters degree candidates in the fields of mineral exploration, mineral extraction, and rock mechanics. The program is scheduled to run from September 1975 through August 1976. The grants are available under Title IX of the Higher Education Assistance Act.

**Employment.**—Michigan was hard-hit in terms of unemployment during 1975. Unemployment for the State averaged 14% during the year, according to statistics released by the Michigan Employment Security Commission. Most of the layoffs centered around the declining production of automobiles which also affected the metal industries, including foundries.

A total of 13,700 workers were employed in Michigan's mining industries (including metal mining, oil and gas extraction, and nonmetallic mining—except fuels) as of December 31, 1975. This was an increase in employment when compared with the 1974 figure of 12,800 workers. However, Copper Range Co. announced a scheduled layoff of 2,100 workers at the White Pine mine, accompanied by a reduction in production, due to depressed conditions existing in the world copper market. The layoff was scheduled to begin in January 1976.

According to data gathered by the Michigan field offices of the Mining Enforcement and Safety Administration (MESA), 38 women were employed in the mining industry in various capacities during the year. Of the total, 31 women were employed by iron mining companies in Michigan's Upper Peninsula.

The two Michigan field offices of MESA conducted a total of 1,045 inspections<sup>3</sup> during 1975. At the close of 1975, the Upper Peninsula field office moved to new quarters in Marquette.

Data for 1974 and 1975, compiled by MESA's Health and Safety Analysis Center, regarding employment and injuries in Michigan's mineral industries (excluding petroleum) are shown in table 4.

<sup>3</sup> Includes spot and special investigations, as well as regular inspections.

Table 4.—Michigan: Employment and injury statistics in the mineral industry

	Number of men	Man-hours worked	Number of injuries		Frequency injury rate per million man-hours <sup>1</sup>	
			Fatal	Nonfatal disabling	Fatal injuries	Nonfatal disabling injuries
1974						
<b>Metal:</b>						
Iron -----	3,587	6,339,916	1	233	.16	36.75
Copper -----	2,876	5,302,283	3	196	.57	36.97
Total metal -----	6,113	11,642,199	4	429	.34	36.85
<b>Nonmetal:</b>						
Sand and gravel -----	1,585	1,857,953	--	31	--	15.07
Stone -----	1,483	2,525,140	--	27	--	10.69
Other nonmetals <sup>2</sup> -----	970	1,615,432	--	47	--	29.09
Total nonmetal -----	4,038	5,998,525	--	105	--	17.51
Total, 1974 -----	10,151	17,640,724	4	534	.23	29.42
1975						
<b>Metal:</b>						
Iron -----	4,324	8,905,153	--	340	--	37.96
Copper -----	2,793	5,448,222	1	134	.18	23.68
Total metal -----	7,117	14,353,375	1	474	.07	32.54
<b>Nonmetal:</b>						
Sand and gravel -----	1,627	2,249,507	--	39	--	16.89
Stone -----	1,873	3,745,167	--	24	--	5.61
Other nonmetals <sup>2</sup> -----	697	1,318,483	--	6	--	4.55
Total nonmetal -----	4,197	7,313,157	--	69	--	9.44
Total, 1975 -----	11,314	21,666,532	1	543	.05	24.55

<sup>1</sup> All injuries and all man-hours reported and in file will be tabulated, but when computing injury-frequency rates, only those injuries for which man-hours are reported and in file will be used.

<sup>2</sup> Includes clay, gypsum, peat, and salt.

NOTE.—All data are preliminary.

Source: Mining Enforcement and Safety Administration.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Abrasives, Manufactured.**—Michigan remained second to Ohio in the manufacture of metallic abrasives in 1975, although production and value in the State declined 9.3% and 2.3%, respectively. Metallic abrasives were produced by three companies during 1975: Abrasive Materials, Inc. at its Hillsdale plant; Cleveland Metal Abrasives, Inc. at its Howell plant; and Ervin Industries, Inc. at its plant in Adrian.

**Bromine.**—Bromine was recovered from well brines in Michigan by The Dow Chemical Co. at its Ludington and Midland plants in Mason and Midland Counties, respectively; by Morton Chemical Co. at its Manistee plant, Manistee County; and by Michigan Chemical Corp. at its St. Louis plant, Gratiot County. Output of elemental bromine decreased 4.7% in quan-

tity and 1.7% in value in 1975. Michigan ranks second in production and value of bromine in the United States.

**Calcium Chloride.**—The Dow Chemical Co., Michigan Chemical Corp., and Wilkinson Chemical Corp. produced calcium chloride from brine in Gratiot, Lapeer, Mason, and Midland Counties. Although production decreased in 1975, Michigan remained the leading U.S. producer of calcium chloride.

**Cement.**—In July 1975, the administrative offices of Peerless Cement Co. moved to the company's plant location. The move placed all Peerless personnel in the Detroit area at the same location.

Also during 1975, Huron Cement Div. of National Gypsum Co. completed a major modernization and pollution control program which reflected a cooperative effort by National Gypsum, company employees, the

**Table 5.—Michigan: Portland cement salient statistics**  
(Short tons)

	1974	1975
Number of active plants -----	8	8
Production -----	5,844,211	4,634,247
Shipments from mills:		
Quantity -----	5,902,599	4,572,739
Value -----	\$140,513,188	\$131,323,993
Stocks at mills, Dec. 31 -----	685,264	691,376

**Table 6.—Michigan: Masonry cement salient statistics**  
(Short tons)

	1974	1975
Number of active plants -----	4	5
Production -----	199,594	220,129
Shipments from mills:		
Quantity -----	217,400	183,456
Value -----	\$6,309,322	\$6,429,396
Stocks at mills, Dec. 31 -----	50,688	78,885

county of Alpena, and State governmental agencies to keep the plant operating and to bring the facility into compliance with environmental standards. Two new kilns, scheduled for completion in August and October, came onstream early. Kiln 722 came onstream June 30, and kiln 723 came onstream on August 7. On July 2, 1975, the sale of \$13.6 million of tax-exempt pollution control bonds was completed. Proceeds of the sale were used to partly finance the kiln modernization project.

**Clays.**—The manufacture of clay products is one of Michigan's oldest mineral industries. Present operations include tile plants at Tecumseh and Grand Ledge, a brick plant at Corunna, and a pottery plant at Rockwood. In addition, clay and shale resources are used by six cement companies at plants in Michigan. Approximately 93% of the clay and shale produced in the State during 1975 was used in manufacturing cement, compared with 89% in 1974. The remaining clay and shale was used in manufacturing such products as drain tile, sewer pipe, brick, and pottery. Clays and shale were mined in 10 counties and 11 pits during 1975. Output of clay and shale decreased 15.9% in quantity and 12.1% in value compared with 1974. Prin-

cipal producing counties were Alpena, Antrim, Emmet, Monroe, and Wayne.

Because of the increasing price of fuel and other economic considerations, Construction Aggregates Corp. ceased production of clay in Ottawa County at the close of 1974. A decision to permanently discontinue operations was made early in 1975.

**Gem Stones.**—Semiprecious stones found in Michigan include algondine, chlorastrolite, datolite, Petoskey stones, prehnite, quartz crystal, agates, thompsonite, and wollastonite. An undetermined number of these stones are collected each year through the activities of hundreds of amateur "rockhounds." The stones are polished and often cut for use in jewelry and other art objects. Other stones are preserved as specimens for exhibit in collections.

**Gypsum.**—Production of gypsum in Michigan for use in the plaster industry began in the period 1837–41, when gypsum quarried from a ledge in Plaster Creek, near Grand Rapids, was ground on a small scale in corn mills.<sup>4</sup> The industry has grown to rank second in production of crude gypsum in the United States. Michigan ranks third among the States in the value of crude gypsum, preceded by Iowa and California.

National Gypsum Co., United States Gypsum Co., Michigan Gypsum Co., Georgia-Pacific Corp., and Grand Rapids Gypsum Co. mined 1,223,961 short tons of crude gypsum valued at \$5,936,000 in Iosco and Kent Counties during 1975. Output declined 17.4% compared with 1974. The decline reflected the continued depressed home construction industry. National Gypsum's mine at Tawas was reported as the second largest producing gypsum mine in the United States during 1975.

United States Gypsum Co., Georgia-Pacific Corp., National Gypsum Co., and Grand Rapids Gypsum Co. calcined gypsum in Iosco, Kent, and Wayne Counties during the year. Output declined 13.1% to 384,838 tons valued at \$9,689,000 in 1975. Calcined gypsum is used in manufacturing plaster board, lath, and plaster.

**Iodine.**—Crude iodine continued to be recovered at Midland by The Dow Chemi-

<sup>4</sup> Grimsley, G. P. *The Gypsum of Michigan and the Plaster Industry*. Geol. Survey of Michigan, v. 9, pt. 2, 1904, pp. 42–52.



cal Co., sole U.S. producer during 1975. Production showed a 12% decrease in 1975, with a 2% increase in value compared with 1974 levels. The decrease reflected the impact of imports from Japan on the U.S. market.

**Lime.**—Six companies produced 1,433,810 tons of quicklime during 1975 compared with 1,528,000 tons in 1974. Wayne and Mason Counties accounted for 97% of the total production. Leading producers were BASF Wyandotte Corp., Detroit Lime Co., Marblehead Lime Co., and The Dow Chemical Co. Michigan continued to rank fifth among the States in both production and value.

BASF Wyandotte Corp., one of the State's leading lime producers, purchased a powerplant in October 1975 from the Detroit Edison Co. The plant, Edison's Wyandotte South plant, was originally purchased from BASF Wyandotte's predecessor company, Wyandotte Chemicals Corp. It is the first time any U.S. power company has sold a working generating plant to one of its customers according to officials at Detroit Edison.

**Magnesium Compounds.**—Michigan maintained its position as the Nation's leading producer of magnesium compounds in 1975, accounting for 59% of the U.S. total. Production, originating in four counties, decreased in quantity and rose in value over 1974 levels.

Martin Marietta Chemical Corp.'s remodeling and construction program at the former Kaiser Aluminum & Chemical Co. plant at Midland continued during 1975. Work is scheduled for completion in late 1976. The plant will produce a form of magnesium oxide used to maintain steel-producing furnaces. Employment of 35 to 40 people is anticipated with an estimated annual payroll of \$600,000. The plant has been idle since 1970.

Martin Marietta Refractories Div. expanded its periclase manufacturing facility at Manistee with two additions during the year. The first was brought online in the first quarter of 1975; the second, nearing completion at yearend, is scheduled to begin producing periclase in the first quarter of 1976. Combined, the two additions will nearly triple production.

**Perlite.**—Crude perlite, mined in Western States, continued to be expanded in Michigan during 1975. Output of expanded

perlite from the State's three manufacturers in Kalamazoo, Wayne, and Iosco Counties decreased 25% in quantity and 4.2% in value from those of 1974. The expanded perlite was used for filter aid and plaster aggregate.

**Salt.**—Michigan is fifth in the national ranking of salt producers. Salt is produced by evaporating natural brines at the St. Louis plant of Michigan Chemical Co. (Grafton County). Salt is manufactured from artificial brines in Manistee, St. Clair, and Wayne Counties. Rock salt is mined in only one locality in Michigan, at Detroit (Wayne County), by the International Salt Co., Inc. The salt in this mine is obtained from a depth of approximately 1,150 feet beneath the surface. Production of salt in 1975 amounted to 4,020,000 short tons, a decrease of 9.6% from 1974 levels. The value of salt sold or used during the year was \$68,352,591, an increase of 10% in value over 1974.

A work stoppage at a large salt mine in Ojibway, Ontario, Canada, left two of Michigan's main salt companies, Diamond Crystal and Morton, short a total of 100,000 to 150,000 tons of rock salt at the beginning of the 1975-76 winter season. Both of these companies usually spend the summer months stockpiling rock salt imported from the Canadian mine. Meanwhile, International Salt Co., Inc. experienced high levels of production during the 1975-76 winter season that could lead to a substantial increase in 1976 production totals. In late 1975, poor weather conditions in the northern part of the United States, including frequent snow and ice storms, combined with the Canadian work stoppage, contributed towards an increased demand for rock salt.

In May 1975, Morton Salt Co. announced a \$2.8 million expansion program at its Manistee salt plant aimed at raising annual production of evaporated salt by 100,000 tons. The expansion will consist of adding a new vacuum pan to the existing evaporation process. Completion of the project is scheduled for early 1977.

In September 1975, Diamond Crystal Salt Co. officials authorized a \$2.5 million expansion and modernization program for the company's refinery at St. Clair. Production capacity will be increased by one-third by adding a new evaporator. In addition, Diamond Crystal plans to replace an old

building housing two units of the company's exclusive Alberger process for producing flake salt. Scheduled completion of the project is approximately 2 years.

**Sand and Gravel.**—A continued slump in the construction industry resulted in a further decrease in Michigan's annual production of sand and gravel. Output for the year amounted to 47,051,000 short tons valued at \$73,397,000. This compares with 60,027,000 tons and \$82,617,000 in 1974. Nearly every county in the State reported sand and gravel production and output exceeded 1 million tons in each of nine counties. These counties provided approximately 50.1% of the total State production.

A breakdown of sand and gravel statistics for the 1975 calendar year is provided in tables 7 and 8.

Completion of American Aggregate Corp.'s newest gravel processing operation at Milford was accomplished during 1975. The facility, under construction during 1974, uses a 20-inch hydraulic dredge as the primary pit excavator to extract pebble sizes of gravel for sale in the Detroit area. Deposits at the existing Brighton plant-site were exhausted in the fall of 1975. The new modular concept of plant design engineered in 1970 made it possible to dismantle and move the facility to another location in the same general area. Sand

will be the primary product at the Brighton location. American Aggregate's smaller plant at Kalamazoo has reserves indicating less than 5 years of plant life.

Mining operations at the sand and gravel plant operated by Construction Aggregates Corp. were suspended in midsummer for the first time in more than 40 years because of a decline in roadbuilding and general construction. The plant was closed through August. The temporary shutdown of mining and barge operations at Ferrysburg resulted in a layoff of 40 employees. Normal production of the screening and processing plant is 8,000 tons per hour. Major customers are the automotive industry for foundry sand and the construction industry for gravel products.

Michigan continued to lead the Nation in the production of industrial sand during 1975. Most of the sand is from the sand dunes found along the Lake Michigan shoreline. Secondary production comes from other sources in Wexford County and the Saginaw Bay area. The sand is in demand by foundries and other automotive-related industries because of its physical and chemical properties. Declines registered in both quantity (15.3%) and value (6.7%) reflected the general slowdown of the automotive industry during 1975. Table 9 presents a comparison of industrial sand

Table 7.—Michigan: Construction aggregate<sup>1</sup> and industrial sand sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>2</sup>	Quantity	Value <sup>2</sup>
<b>Processed:</b>				
<b>Construction aggregate:</b>				
Nonresidential and residential construction -----	11,791	18,671	8,208	15,211
Highway and bridge construction -----	3,819	4,763	3,480	5,276
Other construction uses (dams, waterworks, airports, etc.) -----	1,013	1,281	518	846
Concrete products (cement blocks, brick, pipe, etc.) -	3,366	5,617	2,697	4,709
Bituminous paving (asphalt and tar paving) -----	7,518	10,171	6,250	9,492
Roadbase and subbase -----	17,955	22,152	13,945	19,430
Fill -----	1,248	1,385	1,592	1,692
Other -----	494	736	478	1,022
<b>Total</b> -----	<b>47,204</b>	<b>64,776</b>	<b>37,168</b>	<b>57,678</b>
<b>Unprocessed:</b>				
Roadbase and subbase -----	2,761	1,522	2,046	764
Fill -----	4,895	2,280	3,396	1,799
Other -----	--	--	69	57
<b>Total</b> -----	<b>7,656</b>	<b>3,802</b>	<b>5,511</b>	<b>2,620</b>
<b>Industrial sand</b> -----	<b>5,167</b>	<b>14,039</b>	<b>4,372</b>	<b>13,099</b>
<b>Total construction aggregate and industrial sand</b> ----	<b>60,027</b>	<b>82,617</b>	<b>47,051</b>	<b>73,397</b>

<sup>1</sup> Includes blended sand and gravel.

<sup>2</sup> Values f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

Table 8.—Michigan: Sand and gravel sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines <sup>1</sup>	Quantity	Value	Number of mines <sup>1</sup>	Quantity	Value
Alcona	3	149	134	4	146	124
Alger	1	75	88	3	55	77
Allegan	9	1,121	936	12	944	1,215
Alpena	4	185	213	2	W	W
Antrim	2	W	W	4	208	224
Arenac	2	W	W	1	27	7
Baraga	3	138	126	4	67	110
Barry	7	561	744	7	442	697
Bay	2	W	W	1	W	W
Benzie	1	16	23	1	32	33
Berrien	11	1,718	4,487	11	1,683	4,689
Branch	3	238	353	4	360	486
Calhoun	12	849	957	11	541	603
Cass	10	960	1,021	12	706	1,337
Charlevoix	4	176	265	4	153	177
Cheboygan	5	187	73	4	86	76
Chippewa	3	159	170	5	138	118
Clare	4	352	297	5	307	303
Clinton	11	919	1,098	13	1,153	1,785
Crawford	2	W	W	3	118	145
Delta	5	116	223	7	433	432
Dickinson	4	144	244	5	272	433
Eaton	9	674	701	8	264	408
Emmet	5	183	243	6	146	198
Genesee	3	268	375	3	183	298
Gladwin	—	—	—	1	W	W
Gogebic	3	188	162	6	225	249
Grand Traverse	5	254	551	4	141	426
Gratiot	7	572	569	13	385	426
Hillsdale	4	500	554	5	584	669
Houghton	3	255	267	2	W	W
Huron	6	422	394	7	255	281
Ingham	7	779	833	9	483	534
Ionia	5	415	397	14	534	627
Iosco	2	W	W	3	W	W
Iron	4	136	197	3	W	W
Isabella	6	908	824	4	620	655
Jackson	4	681	987	4	515	720
Kalamazoo	11	3,168	6,144	9	783	1,386
Kent	20	2,710	4,529	24	1,728	3,713
Keweenaw	1	62	23	1	37	31
Lake	1	W	21	2	35	37
Lapeer	8	1,056	999	11	775	919
Leelanau	4	260	371	3	W	W
Lenawee	7	747	963	6	683	1,023
Livingston	8	2,711	4,001	14	2,371	3,494
Luce	1	57	44	3	W	W
Mackinac	3	134	89	6	252	217
Macomb	8	2,010	2,785	7	1,205	2,151
Manistee	3	322	882	3	121	80
Marquette	5	602	805	6	696	1,115
Mason	2	W	W	2	W	W
Mecosta	3	633	595	5	331	437
Menominee	3	56	46	13	166	174
Missaukee	3	66	55	3	193	133
Monroe	2	W	W	2	W	W
Montcalm	8	547	326	4	385	281
Montmorency	2	W	W	1	16	4
Muskegon	3	606	1,783	2	W	W
Newaygo	2	W	W	8	294	405
Oakland	33	14,303	17,133	28	10,256	15,194
Oceana	6	282	320	7	630	1,184
Ogemaw	4	432	356	5	445	502
Ontonagon	3	201	128	1	145	48
Osceola	4	350	405	5	400	588
Oscoda	1	W	W	1	W	W
Otsego	5	230	269	4	157	197
Ottawa	15	2,971	5,736	15	2,346	4,534
Presque Isle	3	386	313	3	437	305
Roscommon	3	39	65	2	34	57
Saginaw	5	1,079	2,234	5	889	1,890
St. Clair	5	277	865	2	W	W
St. Joseph	5	537	485	5	549	521
Sanilac	5	369	355	3	724	891

See footnotes at end of table.

Table 8.—Michigan: Sand and gravel sold or used by producers, by county—Continued  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines <sup>1</sup>	Quantity	Value	Number of mines <sup>1</sup>	Quantity	Value
Schoolcraft -----	1	43	27	2	W	W
Shiawassee -----	10	531	668	7	247	356
Tuscola -----	9	1,249	1,682	11	1,056	1,798
Van Buren -----	7	587	642	5	245	351
Washtenaw -----	9	2,122	2,237	9	2,225	2,810
Wayne -----	4	881	1,223	3	765	1,373
Wexford -----	4	470	971	5	413	764
Undistributed <sup>2</sup> -----	--	2,642	3,537	--	2,811	5,872
Total <sup>3</sup> -----	430	60,027	82,617	478	47,051	73,397

W Withheld to avoid disclosing individual company confidential data.

<sup>1</sup> Reflects only mines that have reported production in response to the annual canvass of operators.

<sup>2</sup> Includes data withheld and some sand and gravel that cannot be assigned to specific counties.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 9.—Michigan: Industrial sand sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Glass -----	124	291	W	W
Molding -----	2,904	8,819	2,104	7,102
Blast -----	601	1,204	W	W
Fire or furnace -----	W	W	W	W
Engine -----	32	103	207	451
Chemical -----	W	W	--	--
Foundry -----	1,167	3,013	W	W
Metallurgical -----	--	--	W	W
Other uses -----	339	609	2,061	5,545
Total -----	5,167	14,039	4,372	<sup>1</sup> 13,099

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

<sup>1</sup> Data do not add to total shown because of independent rounding.

sold or used, by use category, for 1974 and 1975.

**Slag (Iron and Steel).**—Michigan remained one of the Nation's leading producers of slag during 1975. Edward C. Levy Co., in Detroit (Wayne County), processed all slag from the Ford Motor Co. Steel Div., Great Lakes Steel Co., and McLouth Steel Corp. Slag is categorized as a manufactured mineral, along with cement and lime, and used by the construction industry.

**Stone.**—Production of 39,946,000 tons of stone from 54 reporting quarries in 1975 placed Michigan sixth in the Nation. Five producers in the State accounted for 80% of the total output. Tables 10 and 11 provide detailed information on the type of stone quarried and its use.

Limestone is the most important type of stone produced in Michigan. Large deposits of high-grade limestone exist in Alpena, Presque Isle, Cheboygan, Emmet, Charlevoix, Mackinac, and Schoolcraft Counties; and similarly, extensive belts of dolomite exist in Chippewa, Mackinac, and Schoolcraft Counties. Limestone and dolomite beds are also found, to a lesser extent, in Arenac, Huron, Wayne, Monroe, and Eaton Counties in the southern part of the State.

Sandstone, mined in Jackson County, was used as building and decorative stone. The Sylvania sandstone, used for industrial sand, was mined in Wayne County by Otawa Silica Co., Michigan Div.

Marl is a form of limestone found throughout Michigan in small deposits. It

is used for treating soils that are deficient in lime. In 1975, Michigan ranked fifth in the Nation, with production of marl amounting to 85,173 tons reported from seven counties. The bulk of the material came from Allegan, Calhoun, Cass, and Kalamazoo Counties.

In addition to the three major types of stone (limestone/dolomite, sandstone, and marl), there are appreciable amounts of other types of stone produced in Michigan. In the western part of the Upper Peninsula, considerable quantities of traprock are quarried for road metal, concrete ag-

gregate, and railroad ballast. Much of the production is by county road commissions, but additional quantities are produced by private companies. Other types of stone produced in smaller amounts include feldspar, amphibolite, marble, granite, and rhyolite. An isolated deposit of Kona-dolomite, in Marquette County, is individually owned by a sand and gravel operator. The dolomite, found during regular mining operations, is sold to a local rock shop to be cut, polished, and used for making table tops, bookends, and other decorative purposes.

Table 10.—Michigan: Stone sold or used by producers, by kind  
(Thousand short tons and thousand dollars)

Kind	1974		1975	
	Quantity	Value	Quantity	Value
Dimension stone total <sup>1</sup>	6	117	7	138
Crushed and broken:				
Limestone	37,223	50,897	30,672	52,104
Dolomite	9,228	17,232	7,970	16,565
Marl	151	258	85	153
Traprock	W	W	9	17
Other <sup>2</sup>	872	4,243	1,202	4,822
Total <sup>3</sup>	47,474	72,631	39,938	73,662
Grand total <sup>3</sup>	47,479	72,748	39,946	73,800

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

<sup>1</sup> Includes limestone, dolomite, and sandstone.

<sup>2</sup> Includes granite and sandstone, and kinds indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 11.—Michigan: Crushed stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate	984	1,397	754	1,258
Concrete aggregate	5,287	7,292	5,087	8,586
Dense graded roadbase stone	1,332	2,273	797	1,633
Macadam aggregate	1,933	3,368	1,214	2,520
Surface treatment aggregate	194	377	120	290
Other construction aggregate and roadstone	1,482	2,635	1,430	2,151
Agricultural purposes <sup>1</sup>	642	1,107	635	1,231
Cement manufacture	8,730	9,322	7,334	12,253
Lime manufacture	10,412	15,450	8,707	14,932
Flux stone	13,681	22,435	10,192	19,356
Railroad ballast	223	335	278	496
Riprap and jetty stone	400	589	255	409
Other uses <sup>2</sup>	2,173	6,051	3,184	8,547
Total <sup>3</sup>	47,474	72,631	39,938	73,662

<sup>1</sup> Includes agricultural limestone, agricultural marl and other soil conditioners, poultry grit, and mineral food.

<sup>2</sup> Includes filter stone (1975), manufactured fine aggregate, terrazzo, refractory stone, chemical stone, bedding material (1974), glass, paper manufacture, and sugar refining.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

## METALS

**Copper.**—The Lake Superior copper district of Michigan's Upper Peninsula was the first American copper area of importance and is now one of the oldest of the leading copper-producing districts in the world. Although copper sulfides are extensively mined at White Pine Copper Co.'s operation in Ontonagon County, Michigan is one of the few places in the world where pure native copper exists in any quantity.

In 1975, the Quincy Mining Co. of Hancock made a grant of \$5,000 to the Michigan Technological University for studies on the development of an underground leaching process for treating the local native copper ores found in the Upper Peninsula. This brings the total amount provided by the company for these studies to \$15,000. Although unstable economic conditions have caused Quincy to proceed cautiously, the company plans to reopen its No. 8 shaft for exploration purposes. Quincy ceased mining operations at the end of World War II.

At Calumet, also part of the native copper area, Homestake Copper Co. officially launched operation of a pilot concentrator in June 1975. The concentrator is capable of processing 750 tons of copper ore per day. The first copper to be mined in 7 years at the Centennial mine of the former Calumet & Hecla Co. was processed at the concentrator and shipped in early September 1975. The shipment, consisting of 65 tons of concentrate, went to the Clarabelle, Ontario, plant of International Nickel Co. of Canada for smelting. The property is being operated by Homestake Copper Co. in a joint venture with International Nickel Co. which owns 40% of the project.

Presently, work is being conducted by Homestake Copper Co. to determine the existence of sufficient mineralization and to study the mining and concentrating characteristics of native copper deposits on the Keweenaw Peninsula. By 1977, when this part of the project is scheduled for completion, more than 4,200 feet of shaft will have been sunk, 7,500 feet of exploration and development drifting will have been driven, and over 400,000 tons of ore will have been processed. At that time, a decision is expected to be made whether to proceed with a major new mining operation at the Centennial property.

In December 1975, officials of Homestake Copper announced the discovery of a new copper deposit west of Gratiot Lake in Keweenaw County. The ore encountered is a disseminated copper sulfide rather than the native copper generally found in the area. Diamond drilling continued in the area to outline the formation and to assess the grade of mineralization and tonnage.

According to the 1975 annual report of the Copper Range Co., White Pine copper mine produced an average of 25,291 tons of copper ore per day at an average grade of 20.22 pounds of copper per ton of ore. The average price received per pound was \$0.58 compared with \$0.83 in 1974. Productivity gains at the mine were made possible through the installation of new mobile rock breaking devices known as feeder breakers. These devices permit the reduction of ore vehicle haulage distances from the mining face to conveying points. Fourteen feeder breakers were on the property by the end of 1975. The installation of major belt systems also contributed to more efficient operations. The company installed belting for approximately 12,000 feet of conveyors. The mine also completed renovation of belt systems started in 1974.

The White Pine mill (concentrator) set a new record in 1975 by processing 8,975,366 tons of ore for an average daily milling rate of 25,212 tons. The recovery rate of 85.59% of copper-bearing minerals from the ore during the year was slightly down from the 85.71% figure of 1974.

During 1975, the White Pine smelter produced 145,831,000 pounds of marketable copper compared with 134,024,000 pounds of copper in the previous year. The highlight of the year occurred during April when a monthly record of 15,172,052 pounds of copper was produced.

At the end of 1975, Copper Range announced a temporary curtailment of operations at the White Pine mine and concentrator. The curtailment, part of a cash conservation and cost reduction plan for 1976, reportedly would result in the layoff of approximately 2,100 employees as of January 4, 1976. The principal impact of the cutback will be at the mine, where ore production is expected to be at about 20% of capacity.

**Gold.**—In January 1975, the Ropes gold mine, owned by Arcadian Copper Mine Tours, Inc., of Hancock, was pur-

Table 12.—Michigan: Mine production (recoverable) of silver and copper

	1973	1974	1975
Mines producing: Lode .....	1	1	2
Material sold or treated:			
Copper ore .....	8,884	8,301	9,033
thousand short tons ..			
Production (recoverable):			
Quantity:			
Silver .....	850,273	642,944	632,336
troy ounces ..			
Copper .....	72,221	67,012	73,690
short tons ..			
Value:			
Silver .....	\$2,175	\$3,028	\$2,795
thousands ..			
Copper .....	85,943	103,601	94,618
do ..			
Total .....	88,118	106,629	97,413
do ..			

chased by the Callahan Mining Corp. of Darien, Conn. The company has no immediate plans to reopen the mine. Exploration of the mine to evaluate its potential is being considered.

Over a 14-year mining period (1883–1897), the Ropes gold mine in Marquette County reached a depth of 800 feet and had extracted \$647,902 in gold and silver.<sup>5</sup>

**Iron Ore.**—Michigan's iron mining has grown from its first shipment of 200 pounds of ore in 1846 to 14,089,000 long tons in 1975. The later figure could not have been so large without the development of an ore-milling process called beneficiation. The introduction of this process has effectively guaranteed the Nation a steady future supply of iron ore for hundreds of years.<sup>6</sup>

Iron ore is produced at four open pit and two underground mines in Michigan. Producers are CCI at four locations in Marquette County, Inland Steel Co. in Iron County, and Hanna Mining Co. in Dickinson County.

Pellet production at CCI's Michigan operations rose to a new high of 12.3 million tons in 1975, an increase of 41% from the 1974 figure of 8.7 million tons.<sup>7</sup> The increase is attributable to the new Tilden mine and the Empire mine expansion.

Tilden's production of 2.8 million tons in 1975 was only 70% of the facility's designed capacity. It should be noted that Tilden has yet to reach its designed capacity on a sustained basis owing to difficulty in controlling moisture levels in the filtering section of the plant. As a result, an expansion of the mine's annual capacity is temporarily being deferred to provide additional time for evaluating operations.

The Empire mine also operated short of its designed capacity in 1975. This was due in part to gearing failures in the five

primary autogenous mill lines in the expansion section of the concentrating plant. Empire's 1975 production of 4.7 million tons was 90% of its annual capacity.<sup>8</sup> By yearend these problems had been resolved. Further expansion of the Empire mine, the third in the past 10 years, is currently being planned. The expansion will increase Empire's annual capacity to 8 million tons of pellets per year.

Iron ore pellet production at the Republic mine in Humboldt and the Pioneer Pellet Plant at Eagle Mills amounted to 4.8 million tons, slightly below the record 5 million tons of a year ago.

Production at the Mather B mine, CCI's only underground mine, amounted to 1.7 million tons in 1975. Natural ore production from the Mather B is treated at the company's Ore Improvement Plant and most of the treated ore is delivered to the Pioneer Pellet Plant for pelletizing.

Inland Steel Co. shipped 242,186 long tons of natural ore from the Sherwood underground mine at Iron River during 1975.<sup>9</sup> The 49% decrease in shipments was due in part to the development of a new level at the Sherwood mine.

**Iron Oxide Pigments.**—Shipments of crude iron oxide pigments in Michigan decreased 37% in quantity and 28% in value from 1974 levels. The decrease was caused by the depressed automotive and construction industries during 1975. The primary use of these pigments, produced by

<sup>5</sup> Segall, R. T., and Glenna. Fourteen Years of 24-Karat Mining. Michigan Natural Resources, November–December 1975, p. 7.

<sup>6</sup> Michigan Department of Natural Resources, Geological Survey Division. Michigan Mineral Producers, 1975. Ninth Annual Directory. P. 15.

<sup>7</sup> Cleveland-Cliffs Iron Co. Annual Report 1975, p. 5.

<sup>8</sup> Work cited in footnote 7.

<sup>9</sup> Skillings' Mining Review. V. 65, No. 8, Feb. 21, 1975, p. 8.

Table 13.—Michigan: Usable iron ore<sup>1</sup> produced (direct-shipping and all forms of concentrates), by range  
(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total		
				Gross weight		Iron content (percent)
				Ore	Iron content	
1854-1970 -----	390,098	292,926	249,625	932,649	NA	NA
1971 -----	9,495	2,424	--	11,919	7,384	61.95
1972 -----	9,131	2,533	--	11,664	7,332	62.56
1973 -----	9,036	2,404	--	11,440	7,210	63.02
1974 -----	8,920	2,419	--	11,339	7,153	63.08
1975 -----	12,443	2,331	--	14,774	9,327	63.13
Total ---	439,123	<sup>2</sup> 305,037	<sup>2</sup> 249,625	993,785	NA	NA

NA Not available.

<sup>1</sup> Exclusive after 1905 of iron ore containing 5% or more manganese.

<sup>2</sup> Distribution by range partly estimated before 1906.

Table 14.—Michigan: Iron ore shipped from mines  
(Thousand long tons)

Year	Direct-shipping ore <sup>1</sup>	Concentrates and agglomerates, total	Total usable ore <sup>2</sup>	Proportion of beneficiated ore to total usable ore (percent)
1971 -----	1,439	10,393	11,833	87.8
1972 -----	727	11,965	12,692	94.3
1973 -----	463	11,927	12,389	96.3
1974 -----	548	11,054	11,602	95.3
1975 -----	288	13,801	14,089	98.0

<sup>1</sup> Includes crushed, screened, and sized ore not further treated.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Cleveland-Cliffs Iron Co. in Marquette County, is the manufacture of paint.

Construction continued on a new finished iron oxide pigment facility at Wyandotte. The plant, owned by BASF Wyandotte and controlled by its Colors and Chemicals Div., is expected to begin production during 1976. Original plans called for completion of the facility by the end of 1975; however, testing is still being conducted.

**Iron and Steel.**—According to the American Iron and Steel Institute (AISI), Michigan's production of raw steel continued its decline in 1975. A figure of 9,093,000 tons was recorded, compared with 10,459,000 tons in 1974, and 10,945,000 tons in 1973. Michigan, with a total of 7,282,000 short tons, placed fourth in the national ranking of pig iron consumption in 1975. Pig iron production during the year decreased 7.9%, while value increased 17.3% over comparable figures for 1974.

Ford Motor Co. completed the addition of a new electric furnace for the Steel Div.'s Rouge plant at Dearborn during 1975. The furnace is part of a continuing expansion program that will increase Ford's production capacity to 3.75 million tons per year.

In November 1975, North Star Steel Co., jointly owned by Cargill Inc. of Minneapolis and Co-Steel International of Canada, cancelled plans to build a new minimill at Muskegon. According to company officials, the plans were cancelled because of delays in obtaining approval for the project from the U.S. Corps of Engineers and also because of environmental suits from some local citizens. North Star is still considering five other Michigan communities for the minimill. Key elements in the firm's decision were Michigan's role as a major consumer of products made by its mills, an adequate supply of raw materials, and its central location to major ports. The \$50



million plant will initially employ about 500 persons.

At the Detroit plant of McLouth Steel Corp., capital expenditures for 1975 included the installation of the No. 11 continuous anneal and pickle line for stainless steel. The 660-foot facility is a sophisticated, high-speed stainless line. It will enable McLouth to improve material flow. Other improvements included installing a new 165-ton crane in the melt shop and relining a stove at No. 2 blast furnace.

Construction of the MacSteel (a division of Michigan Seamless Tubing Co.) electric steel plant in Jackson was completed in early 1975. A second furnace, added in December 1975, brought rated annual capacity to 180,000 tons per year. The plant, using a French-developed centrifugal casting process never before tried in the United States, is now casting between 5,000 to 6,500 tons of steel per month. The plant produced high-quality, 1½-ton round bars used to make seamless tubing and forgings. Michigan Seamless Tubing also manufactures specialty steel in plants located at South Lyons and Detroit.

Some 1,000 Warren, Mich., steelworkers received Federal benefits averaging \$2,000 each because imported steel resulted in their layoff. The payments were made under the Trade Readjustment Act of 1974, which provides special Federal assistance to workers laid off because of foreign imports. Increased imports of steel products created layoffs also at the Jones & Laughlin Corp.'s (J&L) stainless steel plant in Detroit beginning December 1975. As many as 800 workers were on indefinite layoff at one point. The J&L plant is one of the major producers of stainless steel in Michigan.

**Iron and Steel Scrap.**—Work continued at the steel wire rod plant of Hoover Ball & Bearing Co. The plant, located in Bridgman, was established in 1973 in joint ownership with Pechiney Ugine Kuhlmann of France. The company expected to be in full production by July 1975, but met with some delays. The plant will process scrap steel into wire rod without remelting, thus eliminating the larger per-ton capital investment required for melting. The raw material, scrap steel, will be shredded at various locations and shipped to the plant for further refining and processing.

At the end of 1974, Grede Foundries, Inc. completed a major plant addition at its foundry in Kingsford for the production of hydraulic valves and related parts for the fluid power industry. The new facility, under construction for the last 18 months, is a self-contained module consisting of its own automated molding unit, a 28-ton channel induction holding furnace, a turntable pouring line, and a conveyORIZED shakeout and cleaning room operation. The Kingsford foundry was originally placed in operation by Grede Foundries, Inc. in January 1947.

Kelsey-Hayes Co. closed its McGraw Avenue foundry in Detroit in June. The foundry produced drum castings. The closing affected about 400 hourly employees who were given the right to transfer to other Kelsey-Hayes operations in the area.

**Silver.**—White Pine Copper Co. (Copper Range) continued to recover silver from copper ore mined in Ontonagon County during 1975. Production of silver dropped 1.7%, while value fell 7.7% below 1974 levels.

**Uranium.**—The Tennessee Valley Authority (TVA) contracted with a Canadian firm, David Robertson Associates, Ltd. of Ontario, Canada, during 1975 to conduct preliminary exploration for uranium west of Marquette in Michigan's Upper Peninsula. At the close of 1975, several other mining companies had applied for leases on State land in the general area for exploration purposes.

In conjunction with growing interest in the possibility of commercial deposits of uranium in Michigan, ERDA granted a 1-year contract to the Michigan Technological University, Department of Geological Engineering. The contract, in the amount of \$16,000, is for the purpose of evaluating the uranium and thorium potential of Michigan's Precambrian rocks. The objectives of the study are to assemble information on uranium occurrences in the region, to interpret the geology in terms of its resemblance to geological settings for known types of uranium deposits, and to evaluate some of the settings for their possible uranium potential. The contract expires on June 30, 1976.

#### MINERAL FUELS

**Coal.**—Identified bituminous coal resources in Michigan, as of January 1, 1974,

amounted to 205 million short tons.<sup>10</sup> Michigan Aggregates Corp., a sand and gravel operator in Ingham County, was the sole producer of coal in the State. Production for 1975 amounted to approximately 10,000 tons, all of which was sold to a local utility.

The Dow Chemical Co. announced plans for a small-scale continuous coal liquefaction pilot plant during 1975, along with several supportive projects. No actual construction had begun at yearend.

An experimental pilot plant is being constructed at Ann Arbor to determine the feasibility of removing approximately 50% of the sulfur and ash from coal, by means of a coal beneficiation process, before burning. The project is being funded jointly by Detroit Edison, and the Townsend and Bottum Co. of Ann Arbor.

In early 1975, the Bureau of Mines awarded a \$17,000 grant to the Michigan Technological University, Institute of Mineral Research for a study concerning the magnitude and quality of the State's coal resources. The objectives of the yearlong study were to determine the extent and thickness of the coal beds, to obtain coal samples and analyze them to determine the quality of the coal beds, to determine the thickness of glacial overburden, and to update reserve estimates.

**Natural Gas.**—According to the DNR's Geological Survey Div., natural gas production increased substantially during 1975, rising from 69,807 million cubic feet in 1974 to a record 102,678 million cubic feet in 1975. The large increase in production is directly due to Niagaran reef developments over the past few years. Gas production, which represents actual sales of Michigan-produced gas, is expected to continue to rise over the next few years. Michigan's no-flare order is an important element in increasing gas production. In effect since late 1971 and applying primarily to the new areas of actual or potential Niagaran reef production, the order requires Niagaran oil wells to be shut-in until market connections are made for the sale of oil-well gas. As of January 1, 1976, about 100 oil wells and 60 gas-condensate wells were waiting sales connections or pipeline construction.

New figures for natural gas reserves, provided by the American Gas Association, credit Michigan with 1,607 billion cubic

feet. After allowing for a 1975 alltime record production, this represented a net increase of 148.5 billion cubic feet.

Natural gas imports to Michigan markets and gas storage fields by way of pipelines from Texas, Louisiana, Oklahoma, and Kansas fields remained at a high level. Preliminary import figures, compiled by the Gas Section, Public Utilities Div., Michigan Department of Commerce, indicated gas imports amounted to 769,958 million cubic feet during 1975. This was a decrease from the 851,903 million cubic feet imported in 1974.

The gross value of Michigan-produced gas amounted to \$65,098,000 in 1975. The average value of this resource was calculated to be \$0.634 per thousand cubic feet.<sup>11</sup>

The Williamsburg gas eruptions, which occurred in 1973, continued to be a subject of concern for some local citizens, State agencies, and environmental groups. The well that caused the gas eruptions remains temporarily sealed and has not yet been properly completed for gas production. Environmental impact statements (EIS) prepared by the DNR to justify reopening and completing the well have been rejected as inadequate by review groups. A new EIS has been prepared and will be reviewed early in 1976.

Michigan Consolidated Gas Co., a Detroit-based utility, has signed an agreement with Shell Oil Co. to buy up to 400 billion cubic feet of natural gas from reserves under development in a geological formation extending from Manistee County northeast to Otsego County in the northwestern Lower Peninsula. The gas involved is enough to heat about 200,000 homes for a period of 10 years.

Michigan Wisconsin Pipe Line Co., an affiliate of American Natural Gas Co., began operating its new 463-acre Muttonville storage field near Detroit. The field has an ultimate working capacity of 11 billion cubic feet.

After a yearlong study contracted by the Michigan Public Service Commission, Stanford Research Institute of Menlo Park, Calif., recommended that Consumers Power

<sup>10</sup> Averitt, P. Coal Resources of the United States, January 1, 1974. U.S. Geol. Survey Bull. 1412, p. 11.

<sup>11</sup> Production and Proration Unit, Geological Survey Division, Michigan Department of Natural Resources.

Co.'s Marysville processing plant should be eventually closed if spiraling costs can't be brought under control. Much of the high cost of the plant's operation was blamed on the \$5.20 per barrel export duty Canada puts on the liquid natural gas feedstock. The plant, which supplies 20% of Consumers' natural gas requirements, uses 50,000 barrels of liquid natural gas feedstock per day, piped in from Alberta, Canada. Wellhead costs of the feedstock have also risen dramatically and, with the export charge, now have risen to \$12.27 per barrel. Instead of being able to produce synthetic gas for \$1 to \$1.25 per million British thermal units, the cost has risen to \$3.40. Other options suggested by Stanford are for Consumers to buy supplemental feedstock, that the Canadian contract be renegotiated, or that the firm be allowed to include the cost of the plant in its gas rate base. Consumers Power is currently under a 15-year contract with Canadian suppliers.

**Natural Gas Liquids.**—According to the American Gas Association, proved reserves

of natural gas liquids totaled 20.6 million barrels at yearend 1975, up approximately 400,000 barrels from 1974 levels.<sup>12</sup>

**Peat.**—Michigan is the Nation's leading producer of peat, accounting for about 31.7% of the U.S. total in 1975. Fifteen operators produced 272,066 tons of peat, registering a drop of approximately 10% below the level of 1974. This decrease was due in part to heavy rains in the early part of 1975 which hindered operations. Most of Michigan's peat was used as a soil conditioner, with the remainder used as an ingredient for potting soils, for mushroom beds, and for packing flowers.

**Petroleum.**—At present oil is produced in 50 counties in Michigan. The principal fields are located in northern lower Michigan—primarily Otsego, Kalkaska, Grand Traverse, and Manistee Counties. These counties accounted for almost 51% of the oil and approximately 67% of the State's natural gas production in 1975.

<sup>12</sup> Oil and Gas News. V. 82, No. 17, Apr. 23, 1976, p. 16.

Table 15.—Michigan: Natural gas production and value, by county

County	1974		1975	
	Quantity (million cubic feet)	Value <sup>1</sup> (thou- sands)	Quantity (million cubic feet)	Value <sup>1</sup> (thou- sands)
Allegan	189.8	\$95.7	49.4	\$31.3
Antrim	130.7	65.9	1,394.8	884.3
Calhoun	4,434.7	2,235.0	5,024.2	3,185.3
Clare	102.0	51.4	112.6	71.4
Crawford	266.4	134.2	598.1	379.2
Eaton	467.1	235.4	2,950.0	1,870.3
Grand Traverse	10,716.2	5,401.0	19,842.9	12,580.3
Gratiot	2.7	1.3	2.3	1.5
Hillsdale	4,615.6	2,326.3	4,507.5	2,857.8
Ingham	5,238.5	2,640.2	3,991.0	2,530.3
Jackson	2,390.0	1,204.4	2,316.3	1,468.5
Kalkaska	25,105.6	12,653.2	36,313.2	23,022.6
Kent	7.4	3.8	6.1	3.9
Lapeer	30.1	15.1	33.6	21.3
Livingston	487.9	246.0	1,361.0	862.9
Macomb	787.1	397.0	324.3	205.6
Manistee	—	—	1,956.1	1,240.2
Mason	1,191.2	600.3	3,927.9	2,490.3
Mecosta	18.2	9.2	14.5	9.2
Missaukee	660.1	332.8	632.2	400.8
Oakland	968.6	485.2	1,327.0	841.3
Ogemaw	263.7	132.9	254.3	161.2
Osceola	—	—	56.1	35.6
Otsego	7,050.2	3,553.3	10,601.0	6,721.0
Ottawa	84.4	42.5	51.5	32.7
Roscommon	333.7	163.2	370.3	234.8
St. Clair	4,260.0	2,146.9	2,843.0	1,802.4
Wexford	4.6	2.3	1,817.0	1,152.0
Total	69,806.5	35,182.5	102,678.2	65,098.0

<sup>1</sup> County values calculated by using State average value per Mcf: \$0.504 for 1974 and \$0.634 for 1975.

Source: Michigan Department of Natural Resources, Geological Survey Division, Petroleum Geology Unit.

According to data supplied by the DNR, a new State record of crude oil production was established in 1975. The 1975 production figure of just over 24 million barrels represented the largest volume ever produced by Michigan wells in a 12-month period, exceeding 1939's high mark of 23.4 million barrels. Daily production, amounting to 56,800 barrels of crude in January 1975, rose steadily to reach over 77,160 barrels per day in December.<sup>13</sup> Northern counties in the productive Niagaran reef area from Ludington to just east of Gaylord made the most significant contributions to the State's increased production, accounting for nearly 54% of the total crude oil production. In all, six fields produced in excess of 1 million barrels of crude in 1975.

According to records kept by the Production and Proration Unit, Geological Survey Div. of the DNR, the gross value of Michigan-produced oil amounted to \$262,351,653 in 1975. The average value per barrel was calculated to be \$10.74.

Michigan registered a continued gain in crude oil reserves in 1975, according to the American Petroleum Institute. Reserve estimates, as of December 31, 1975, were 93.3 million barrels. This represents a net gain of approximately 11 million barrels, after accounting for actual production during the year.<sup>14</sup>

Total imports of crude oil into Michigan refineries through pipeline from Western and Midwestern States and from Western Canadian oilfields amounted to 37,599,514 barrels, compared with 42,099,556 barrels reported in 1974. Of the total 1975 imports, Canadian crude amounted to 22,277,674 barrels, a decrease from 27,317,964 barrels of the previous year.

The decrease in imports of Canadian crude oil was not the result of a slack in demand. It was the result of Canadian governmental curtailment of exports to the United States. The flow is expected to be reduced even further in 1976. TOTAL Petroleum (North America) Ltd., has been hit heavily by the cutbacks and allocation practices. At one time TOTAL was using as much as 23,000 barrels daily from Canadian sources. During the past 2 years, however, daily imports for the plant have reached the 16,000- to 17,000-barrel mark. Other refiners in Michigan may not feel the cutbacks so quickly, but eventually the

allocation of Canadian crude may be eliminated entirely.

Although the bulk of Michigan-produced crude oil has always been consumed by Michigan refineries, some is exported to other States. In recent years, the amount of exports has increased. Records kept by DNR's Production and Proration Unit show exports amounting to 6,889,744 barrels in 1975, compared with 2,766,487 barrels in 1974.

*Exploration and Development.*—Kenting Exploration Services Ltd. of Calgary, Canada, requested permission from Michigan's DNR to take seismic soundings in Lakes Erie, Huron, and Michigan during 1975. This is normally a preliminary step in drilling for oil. Oil firms believe substantial oil pools may exist under the Great Lakes. The Natural Resources Commission (NRC), the DNR's policymaking body, supported an executive decision by the director of the DNR to deny the request because it would violate a policy against offshore drilling adopted by the NRC in 1945 and affirmed in 1961. Shell Oil Co. received approval from DNR for similar soundings in 1971, but plans were never executed.

Members of the privately owned Canada Creek Ranch, a wildlife reserve in Montmorency County, considered a leasing arrangement offered by Northern Michigan Exploration Co. during the year. Northern Michigan, a subsidiary of Consumers Power Co. of Jackson, offered nearly \$6 million to lease all of Canada Creek Ranch's mineral rights on its 14,000-acre property for drilling purposes. To finalize the agreement, about 1,400 shareholders in the wildlife reserve must be polled. A decision is expected early in 1976.

The Michigan Audubon Society is also considering an offer of \$18,000 made by Mobil Oil Co. for drilling rights in the Baker Sanctuary in Calhoun County. Opposition by members caused the measure to be tabled at the end of 1975. The issue is expected to be resolved during a statewide meeting in January 1976. Mobil Oil Co. has offered to follow a system of rigid controls to be laid down by the sanctuary committee after seismic work is completed.

<sup>13</sup> Oil and Gas News. V. 82, No. 9, Feb. 27, 1976, p. 6.

<sup>14</sup> Work cited in footnote 12.

Table 16.—Michigan: Crude oil production and value, by county  
(Thousand 42-gallon barrels and thousand dollars)

County	1974 <sup>r</sup>		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Allegan	85.9	735	111.2	1,194
Antrim	36.5	312	205.9	2,211
Arenac	179.5	1,536	187.8	2,017
Barry	10.4	89	10.3	111
Bay	198.0	1,695	193.6	2,079
Calhoun	1,000.1	8,561	1,313.9	14,111
Clare	322.3	2,759	331.1	3,556
Crawford	647.1	5,539	857.8	9,213
Eaton	79.6	681	177.3	1,904
Genesee	37.1	317	12.4	133
Grand Traverse	738.5	6,321	2,152.3	23,116
Gladwin	254.9	2,182	236.1	2,536
Gratiot	.7	6	5.2	56
Hillsdale	1,441.1	12,336	1,312.0	14,091
Huron	.1	1	--	--
Ingham	2,017.3	17,268	2,462.7	26,449
Isabella	126.3	1,081	117.6	1,263
Jackson	524.4	4,489	432.1	4,641
Kalkaska	2,835.8	24,274	3,463.3	37,196
Kent	68.2	534	59.7	641
Lake	88.4	757	87.1	936
Lapeer	70.6	604	77.9	837
Livingston	--	--	1.4	15
Macomb	2.8	24	2.1	23
Manistee	13.1	112	1,040.9	11,179
Mason	152.3	1,304	283.7	3,047
Mecosta	40.9	350	36.5	392
Midland	160.0	1,369	166.8	1,791
Missaukee	701.7	6,006	654.7	7,032
Monroe	5.5	47	5.9	63
Montcalm	88.3	756	79.9	858
Montmorency	--	--	.1	1
Muskegon	9.8	84	9.5	102
Newaygo	11.4	97	14.3	154
Oakland	--	--	33.3	358
Oceana	34.5	295	33.2	357
Ogemaw	464.5	3,976	509.4	5,471
Osceola	362.7	3,104	368.7	3,960
Oscoda	.9	8	.7	8
Otsego	4,038.5	34,569	5,719.2	61,424
Ottawa	58.1	497	65.4	702
Presque Isle	.5	4	.2	2
Roscommon	338.4	2,896	355.8	3,821
Saginaw	16.6	142	16.9	181
St. Clair	764.3	6,542	1,029.3	11,055
Shiawassee	5.6	48	5.2	56
Tuscola	47.5	406	46.8	503
Van Buren	7.5	64	9.3	100
Washtenaw	1.3	11	2.0	21
Wayne	7.3	63	4.0	43
Wexford	5.0	43	117.4	1,260
Total	18,101.8	154,944	24,419.9	262,270

<sup>r</sup> Revised.

<sup>1</sup> County values calculated using State average value per barrel: \$8.54 for 1974 and \$10.74 for 1975.

Source: Michigan Department of Natural Resources, Geological Survey Division, Petroleum Geology Unit.

The Pigeon River State Forest area (Otsego, Montmorency, and Cheboygan Counties) continued to be a matter of controversy throughout 1975. At yearend, the NRC had still not released a decision either approving or denying plans for exploration and drilling in the area. According to DNR, Geological Survey Div., total recoverable oil is estimated at more than

143 million barrels; total recoverable natural gas is estimated at 143.5 billion cubic feet. Value of the oil is estimated at a little under \$1.6 billion and of the gas, \$107 million. In addition to considerable revenue already paid for the original lease, the State would receive an estimated \$190 million in royalties and \$44 million in severance tax.

The original lease was auctioned to Amoco Production Co. by the State in August 1968. Amoco assigned a 50% interest to Northern Michigan Exploration Co. Amoco and Northern Michigan applied for a drilling permit on the lease in early 1971. The permit was denied. In January 1972, Amoco and Northern Michigan assigned a portion of the lease to the Michigan Oil Co., an affiliate of McClure Oil Co. Michigan Oil filed for a drilling permit in July 1972. It was also denied on environmental grounds. The permit denial was immediately appealed to the NRC. At least 78 separate leases in the area could be affected by the final ruling by NRC. About 90% of the 100,000 acres involved

is under lease to Shell, Amoco, and Northern Michigan.

*Petroleum Pipelines.*—The new 10-inch-diameter, 44-mile crude oil pipeline between Bay City and Alma was completed on schedule in 1975, according to the 1975 annual report of TOTAL Petroleum (North America) Ltd. The completion of this line gives the necessary capacity to transport increased quantities of northern Michigan crude to the refinery at Alma. The new line enabled TOTAL to abandon 110 miles of obsolete pipeline that has been environmentally troublesome in recent years. The new pipeline represented the first stage of a 3-year modernization program for the TOTAL pipeline network.

Table 17.—Michigan: Oil and gas well drilling completions, by county, in 1975

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Allegan	--	--	--	--	--	1	1	2,675
Antrim	--	--	--	--	--	3	3	16,141
Arenac	--	--	1	--	--	1	2	4,352
Barry	--	--	--	--	--	1	1	5,390
Benzie	--	--	--	--	--	4	4	21,934
Berrien	--	--	1	--	--	2	3	2,226
Calhoun	21	4	20	6	1	15	67	227,283
Cass	3	--	--	--	--	--	3	2,148
Cheboygan	--	--	--	--	--	1	1	4,740
Clare	--	--	--	--	--	1	1	4,270
Crawford	2	--	1	1	--	--	4	28,141
Eaton	6	--	5	1	--	7	19	78,617
Gladwin	--	--	1	--	--	--	1	3,900
Grand Traverse	13	6	18	12	9	34	92	547,302
Graziot	--	--	--	--	--	4	4	14,351
Hillsdale	7	--	2	--	--	1	4	40,396
Ingham	3	--	3	1	--	9	16	67,439
Ionia	--	--	--	--	--	1	1	2,862
Isabella	1	--	4	--	--	2	7	23,703
Jackson	--	--	1	--	--	1	2	8,340
Kalamazoo	--	--	--	--	--	1	1	2,976
Kalkaska	7	1	6	6	2	17	39	258,388
Kent	--	--	--	--	--	1	1	2,610
Lapeer	3	--	--	--	--	--	3	9,198
Livingston	--	--	--	--	--	1	1	4,490
Macomb	--	1	1	--	1	3	6	22,497
Manistee	27	3	26	16	2	22	96	465,996
Mason	4	--	2	--	--	3	9	35,839
Mecosta	--	--	2	--	--	1	3	11,522
Midland	--	--	--	2	--	1	3	13,049
Missaukee	4	--	1	--	--	--	5	22,251
Montcalm	--	--	--	--	--	7	7	27,182
Montmorency	--	--	3	--	1	6	10	45,942
Oakland	--	--	--	--	--	3	3	12,939
Oceana	--	--	1	--	--	8	9	22,271
Ogemaw	1	--	--	--	--	--	1	92
Osceola	--	--	3	--	--	1	4	10,788
Otsego	8	1	10	6	1	20	46	258,524
Ottawa	--	--	--	--	--	1	1	1,550
Presque Isle	--	--	--	--	--	7	7	19,169
Roscommon	3	--	--	--	--	--	3	13,441
St. Clair	--	--	1	--	--	5	6	18,728
Van Buren	1	--	1	--	--	--	2	2,284
Washtenaw	--	--	--	--	--	1	1	3,460
Wexford	--	--	--	4	--	3	7	38,102
Total	114	16	114	55	17	200	516	2,429,528

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Operator of the new line will be Michigan-Ohio Pipeline Co., a TOTAL subsidiary. The route taken by the artery will cross portions of Bay, Saginaw, Midland, and Gratiot Counties.

Buckeye Pipeline Co. received approval for a 12-inch products line which will run northwest from the Michigan-Ohio border of Monroe County to the company's Ann Arbor junction. This leg of the pipeline is approximately 12.3 miles long. The line will then turn northeast and extend an additional 8.9 miles to the company's Ostrander junction. Both the Michigan-Ohio and Buckeye facilities will operate as common carriers.

**Refineries.**—Refining activity in Michigan is a stable and relatively little-noticed industry. There are six refining operations currently active in Michigan. They have a combined rated daily capacity of 131,300 barrels per day, and the current total throughput is 121,200 barrels of crude daily. Capacities vary from the 3,000-barrel-per-day capability of Bay Refining (Dow Chemical) at Bay City, to the 65,000-barrel-per-day potential at Marathon's refinery in Detroit. Michigan's refiners employ nearly 2,700 people and have an annual payroll of \$32 million.

The following tabulation lists the refineries, their capacities and sources of crude oil:<sup>15</sup>

Operation	(Barrels per day)	Source
Bay Refining (Dow Chemical) -----	3,000	Canada.
Lakeside Refining Co. --	5,600	Canada and Michigan.
Crystal Refining Co. --	6,200	Canada and United States.
Osceola Refining Co. --	9,500	Canada and Michigan.
TOTAL Petroleum (N.A.) Ltd. -----	42,000	Canada, 75%; United States, 25%.
Marathon Oil Co. -----	65,000	Michigan, Louisiana, Wyoming, Canada, Libya.

In August 1975, Dow Chemical halted production and marketing of gasoline from its Bay Refining Div. High costs of imported crude oil and decreasing sales at retail stations were reasons given for the closure. Bay Refining continued to operate its topping unit as an "in-house" facility to feed the Dow Chemical complex at Midland. No layoffs at the refinery occurred when the change took place because employees were transferred elsewhere in the plant. Dow has operated the refinery at Bay City since 1956.

Crude oil processed by TOTAL Petroleum (North America) Ltd. at its Alma refinery totaled 13,728,523 barrels in 1975, according to the company's 1975 annual report. This amount represented an increase of 1.7% over the quantity processed in 1974, and also represented a record crude run. The volume of gasoline produced at the refinery increased from 48.7% in 1974 to 52.5% in 1975, as a percentage of crude oil run. This was largely because of improved operation of the fluid catalytic cracking unit. A comprehensive energy conservation program initiated at the refinery resulted in a 7.5% reduction in energy use in 1975 compared with 1972 figures.

<sup>15</sup> Oil and Gas News. V. 82, No. 16, Apr. 16, 1976, p. 11.

Table 18.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Abrasives:</b>			
Abrasive Materials, Inc -----	Box 291 Hillsdale, Mich. 49242	Plant -----	Hillsdale.
Cleveland Metal Abrasive Co. -----	887 E. 67th St. Cleveland, Ohio 44103	---do -----	Livingston.
Ervin Industries, Inc -----	Box 1168 Ann Arbor, Mich. 48106	---do -----	Lenawee.
<b>Cement:</b>			
Amcord, Inc. <sup>1</sup> -----	610 Newport Center Dr. Newport Beach, Calif. 92660	---do -----	Wayne.
Dundee Cement Co. <sup>1</sup> -----	Box 317 Dundee, Mich. 48131	---do -----	Monroe.
Edward C. Levy Co. <sup>2</sup> -----	8941 W. Jefferson Ave. Detroit, Mich. 48209	---do -----	Wayne.
Medusa Cement Co. <sup>1</sup> -----	Box 5668 Cleveland, Ohio 44101	---do -----	Charlevoix.
<b>Clays:<sup>3</sup></b>			
Coke: Allied Chemical Corp -----	Box 70 Morristown, N.J. 07960	---do -----	Wayne.
Copper: White Pine Copper Co. <sup>4</sup> -----	Box 427 White Pine, Mich. 49971	Mine and plant ---	Ontonagon.
<b>Gypsum:</b>			
Georgia-Pacific Corp -----	900 SW. Fifth Ave. Portland, Oreg. 97204	---do -----	Kent.
Grand Rapids Gypsum Co ---	Grand Rapids, Mich. 49501	---do -----	Do.
Michigan Gypsum Co -----	2840 Bay Rd. Saginaw, Mich. 48601	Surface mine -----	Iosco.
National Gypsum Co. <sup>5</sup> -----	325 Delaware Ave. Buffalo, N.Y. 14202	Surface mine and plant.	Do.
United States Gypsum Co. <sup>6</sup> --	101 S. Wacker Dr. Chicago, Ill. 60606	---do -----	Wayne.
<b>Iron ore:</b>			
Cleveland-Cliffs Iron Co. <sup>7</sup> ----	1460 Union Commerce Bldg. Cleveland, Ohio 44115	Surface and under- ground mines, plants.	Marquette.
Hanna Mining Co -----	100 Erieview Plaza Cleveland, Ohio 44114	Surface mine and plant.	Dickinson.
Inland Steel Co. <sup>8</sup> -----	30 W. Monroe St. Chicago, Ill. 60603	Mine -----	Iron.
<b>Iron and steel</b>			
Ford Motor Co. <sup>9</sup> -----	The American Rd. Dearborn, Mich. 48121	Plant -----	Wayne.
McLouth Steel Corp -----	300 S. Livernois Ave. Detroit, Mich. 48217	---do -----	Do.
National Steel Corp. <sup>9</sup> -----	2800 Grant Bldg. Pittsburgh, Pa. 15219	---do -----	Do.
<b>Lime:</b>			
BASF Wyandotte Corp. <sup>10</sup> ---	100 Cherry Hill Rd. Parsippany, N.J. 07054	---do -----	Do.
The Dow Chemical Co. <sup>11</sup> ----	2020 Dow Center Midland, Mich. 48640	---do -----	Mason.
Marblehead Lime Co -----	300 W. Washington St. Chicago, Ill. 60606	---do -----	Wayne.
<b>Magnesium compounds: Martin Marjetta Corp.</b>			
Natural gas processors:	Executive Plaza II Hunt Valley, Md. 21030	Brine wells -----	Manistee.
<b>Natural gas processors:</b>			
Consumers Power Co -----	212 W. Michigan Jackson, Mich. 49201	Plant -----	St. Clair.
Michigan Wisconsin Pipe Line Co. -----	1 Woodward Ave. Detroit, Mich. 48226	---do -----	Osceola.
Mobile Oil Corp -----	P.O. Box 253 Mason, Mich. 48854	---do -----	Ingham.
<b>Peat:</b>			
Anderson Peat Co -----	332 Graham Rd. Imlay City, Mich. 48444	Bog and plant ----	Lapeer.
Fletcher and Rickard -----	54001 Grand River Rd. New Hudson, Mich. 48165	---do -----	Oakland.
Michigan Peat Inc -----	P.O. Box 66388 Houston, Tex. 77006	---do -----	Sanilac.
Scenic Lakes, Inc -----	Box 926 East Lansing, Mich. 48823	---do -----	Shiawassee.
<b>Expanded perlite: Harborlite Corp.</b>			
Petroleum refineries:	P.O. Box 458 Escondido, Calif. 92025	Plant -----	Kalamazoo.
Crystal Refining Co -----	901 N. Williams Carson City, Mich. 48811	---do -----	Montcalm.

See footnotes at end of table.



Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Petroleum refineries—Continued</b>			
Lakeside Refining Co -----	2705 E. Cork Kalamazoo, Mich. 49001	Plant -----	Kalamazoo.
Marathon Oil Co. <sup>12</sup> -----	1300 S. Fort St. Detroit, Mich. 48217	---do -----	Wayne.
Osecola Refining Co -----	Box 178 Reed City, Mich. 49677	---do -----	Ogemaw.
TOTAL Petroleum (N.A.) Ltd. -----	E. Superior St. Alma, Mich. 48801	---do -----	Gratiot.
<b>Salt:</b>			
Diamond Crystal Salt Co ---	916 S. Riverside St. Clair, Mich. 48079	Brine wells and plant.	St. Clair.
Hardy Salt Co -----	Drawer 449 St. Louis, Mo. 61366	Plant -----	Manistee.
Hooker Chemical Corp -----	Box 295 Montague, Mich. 49437	Brine wells -----	Muskegon.
International Salt Co., Inc --	Clarks Summit, Pa. 18411	Mine -----	Wayne.
Michigan Chemical Corp. <sup>14</sup> --	351 E. Ohio St. Chicago, Ill. 60611	Brine wells and plant.	Gratiot.
Morton-Norwich Products, Inc. <sup>15</sup> -----	Chicago, Ill. 60606	---do -----	Manistee.
Pennwalt Corp -----	3 Penn Center Philadelphia, Pa. 19102	---do -----	Wayne.
<b>Sand and gravel:</b>			
American Aggregates Corp --	Drawer 160 Greenville, Ohio 45331	Pits and plants ---	Kalamazoo, Livingston, Macomb, Oakland.
Sargent Sand Co -----	2840 Bay Rd. Saginaw, Mich. 48604	---do -----	Bay, Mason, Saginaw, Tuscola.
<b>Stone:</b>			
Bethlehem Steel Corp -----	701 E. Third St. Bethlehem, Pa. 18016	Quarry -----	Chippewa.
The France Stone Co -----	1800 Toledo Trust Bldg. Toledo, Ohio 43603	---do -----	Monroe.
Ottawa Silica Co -----	33620 Streicher Rd. Rockwood, Mich. 48173	Quarry and plant ---	Wayne.
Presque Isle Corp -----	Box 426 Alpena, Mich. 49707	Quarry -----	Presque Isle.
United States Steel Limestone Operation.	Rogers City, Mich. 49770	Quarries and plant -	Mackinac and Presque Isle.
Vermiculite (exfoliated): W. R. Grace & Co. -----	62 Whittemore Ave. Cambridge, Mass. 02140	Plant -----	Wayne.

<sup>1</sup> Also clays.<sup>2</sup> Also lime.<sup>3</sup> Principal producers of clay are listed under other nonmetallic materials.<sup>4</sup> Also silver, and smelting facilities.<sup>5</sup> Also clays, stone, and expanded perlite.<sup>6</sup> Also expanded perlite.<sup>7</sup> Also iron oxide pigments.<sup>8</sup> Also stone.<sup>9</sup> Also coke.<sup>10</sup> Also salt.<sup>11</sup> Also bromine, calcium compounds, magnesium compounds, and natural gas and petroleum refining.<sup>12</sup> Also natural gas and recovered elemental sulfur.<sup>13</sup> Also recovered elemental sulfur.<sup>14</sup> Also bromine, calcium, and magnesium compounds.<sup>15</sup> Also bromine and magnesium compounds.

# The Mineral Industry of Minnesota

By Ronald C. Briggs <sup>1</sup> and Wanda J. West <sup>2</sup>

Mineral production in Minnesota in 1975 was valued at a record \$1,097 million, a 7% increase over that of 1974. The value of iron ore shipments surpassed the \$1 billion mark for the first time and accounted for nearly 93% of the total output value. Sand and gravel and stone comprised the bulk of the remaining value.

Except for cement and lime, all mineral commodities recorded decreases in quantities sold or used, reflecting depressed market conditions. Higher unit values, however, resulted in increased total values for some minerals.

One or more mineral commodities were produced in each of the State's 87 counties. St. Louis and Itasca Counties, because of the large iron ore mining operations, ranked first and second in value of mineral production with 84% and 10% of the State total. The value of mineral production exceeded \$1 million in 18 counties.

During 1975, the 20th anniversary of the beginning of commercial taconite production, northeastern Minnesota was experiencing significant economic growth because of the rapidly expanding taconite industry. Approximately \$1 billion was being spent on the expansion of three existing taconite plants and in the development of two new operations. Completion of the current construction projects will raise Minnesota's annual output of taconite pellets to about 65 million tons. Estimates of the number of construction workers employed ranged from 6,000 to 9,600. Nearly 4,000 new permanent jobs in the iron ore mining and related industries were expected to be created by 1980 as the new and enlarged taconite processing pellet plants begin production.

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<sup>2</sup> Liaison program assistant, Bureau of Mines, Twin Cities, Minn.

Table 1.—Mineral production in Minnesota <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones .....	NA	\$14	NA	\$14
Iron ore (usable)				
thousand long tons, gross weight...	59,422	949,678	49,167	1,015,272
Manganiferous ore .....	225,560	W	108,749	W
Peat .....	20	471	13	230
Sand and gravel .....	36,720	42,370	33,398	45,214
Stone .....	8,301	22,041	6,854	23,302
Value of items that cannot be disclosed:				
Abrasive stone, cement, clays, lime, and values indicated by symbol W...	XX	11,792	XX	13,056
Total .....	XX	1,026,366	XX	1,097,088
Total 1967 constant dollars .....	XX	485,266	XX	P 434,448

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

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Minnesota, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975, in order of value
Aitkin	87	\$729	Sand and gravel, peat.
Anoka	W	W	Sand and gravel.
Becker	218	578	Do.
Beltrami	300	321	Do.
Benton	50	W	Do.
Big Stone	1,074	W	Stone, sand and gravel.
Blue Earth	1,644	W	Do.
Brown	W	W	Sand and gravel, clays.
Carlton	W	W	Sand and gravel, peat.
Carver	430	485	Sand and gravel.
Cass	387	194	Do.
Chippewa	226	395	Do.
Chisago	231	219	Do.
Clay	W	W	Sand and gravel, lime, stone.
Clearwater	153	210	Sand and gravel.
Cook	W	466	Do.
Cottonwood	W	132	Do.
Crow Wing	W	W	Manganiferous ore, sand and gravel.
Dakota	W	W	Sand and gravel, stone.
Dodge	W	W	Stone, sand and gravel.
Douglas	W	142	Sand and gravel.
Faribault	--	408	Do.
Fillmore	1,254	398	Stone, sand and gravel.
Freeborn	414	997	Sand and gravel.
Goodhue	568	819	Sand and gravel, stone.
Grant	W	W	Sand and gravel.
Hennepin	W	W	Sand and gravel, clays.
Houston	621	W	Stone, sand and gravel.
Hubbard	206	183	Sand and gravel.
Isanti	47	76	Do.
Itasca	W	109,804	Iron ore, sand and gravel, peat.
Jackson	300	127	Sand and gravel.
Kanabec	55	W	Do.
Kandiyohi	572	689	Do.
Kittson	102	W	Do.
Koochiching	23	73	Do.
Lac qui Parle	237	285	Stone, sand and gravel.
Lake	W	105	Sand and gravel.
Lake of the Woods	W	600	Do.
Le Sueur	W	W	Sand and gravel, stone.
Lincoln	W	W	Sand and gravel.
Lyon	W	W	Do.
McLeod	190	311	Do.
Mahnomen	54	43	Do.
Marshall	264	W	Do.
Martin	245	249	Do.
Meeker	191	302	Do.
Mille Lacs	W	W	Stone, sand and gravel.
Morrison	1,310	662	Sand and gravel.
Mower	W	W	Stone, sand and gravel.
Murray	W	W	Sand and gravel.
Nicollet	W	W	Stone, sand and gravel.
Nobles	W	W	Sand and gravel.
Norman	27	W	Do.
Olmsted	2,302	1,434	Stone, sand and gravel.
Otter Tail	70	55	Sand and gravel.
Pennington	W	1	Do.
Pine	W	501	Sand and gravel, peat.
Pinestone	W	W	Sand and gravel.
Polk	W	W	Lime, sand and gravel.
Pope	81	81	Sand and gravel.
Ramsey	W	W	Do.
Red Lake	W	259	Do.
Redwood	W	W	Sand and gravel, stone, clays.
Renville	W	W	Lime, stone, sand and gravel.
Rice	372	W	Sand and gravel, stone.
Rock	W	W	Sand and gravel, abrasives, stone.
Roseau	100	W	Sand and gravel.
St. Louis	846,718	920,693	Iron ore, cement, sand and gravel, stone, peat.
Scott	2,515	2,361	Stone, sand and gravel.
Sherburne	1,747	1,415	Sand and gravel.
Sibley	--	W	Do.
Stearns	7,198	7,902	Stone, sand and gravel.
Steele	772	1,213	Sand and gravel, stone.
Stevens	W	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Minnesota, by county—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975, in order of value
Swift -----	W	\$179	Sand and gravel.
Todd -----	\$422	705	Do.
Traverse -----	---	W	Do.
Wabasha -----	W	W	Stone, sand and gravel.
Wadena -----	7	9	Sand and gravel.
Waseca -----	11	W	Do.
Washington -----	W	5,681	Sand and gravel, stone.
Watsonwan -----	40	12	Sand and gravel.
Wilkin -----	365	66	Do.
Winona -----	1,645	2,184	Stone, sand and gravel.
Wright -----	W	741	Sand and gravel.
Yellow Medicine -----	W	W	Stone, sand and gravel.
Undistributed <sup>1</sup> -----	150,606	31,088	
Total <sup>2</sup> -----	1,026,366	1,097,088	

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

<sup>1</sup> Includes some sand and gravel (1974) that cannot be assigned to specific counties, values of gem stones, and values indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

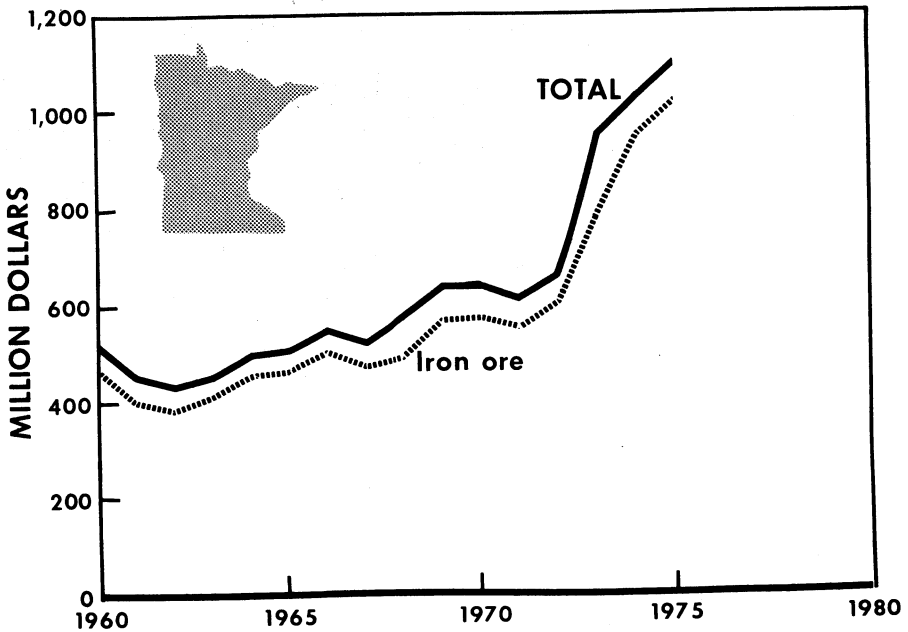


Figure 1.—Value of iron ore shipments and total value of mineral production in Minnesota.

Table 3.—Indicators of Minnesota business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands---	1,778.0	1,799.0	+1.2
Unemployment ----- do-----	77.0	107.0	+39.0
<b>Employment (nonagricultural):</b>			
Mining ----- do-----	14.2	13.9	-2.1
Manufacturing ----- do-----	341.3	312.7	-8.4
Contract construction ----- do-----	65.8	62.3	-5.3
Transportation and public utilities ----- do-----	91.9	90.3	-1.7
Wholesale and retail trade ----- do-----	364.2	369.8	+1.5
Finance, insurance, real estate ----- do-----	73.0	74.7	+2.3
Services ----- do-----	268.6	278.7	+3.8
Government ----- do-----	263.8	267.5	+1.4
Total nonagricultural employment ----- do-----	1,482.8	1,469.9	-0.9
<b>Personal income:</b>			
Total ----- millions---	\$21,351	\$22,793	+6.8
Per capita ----- do-----	\$5,469	\$5,807	+6.2
<b>Construction activity:</b>			
Number of private and public residential units authorized---	20,550	19,162	-6.8
Value of nonresidential construction ----- millions---	\$489.5	\$250.6	-48.8
Value of State road contract awards ----- do-----	\$71.0	\$117.9	+66.1
Shipments of portland and masonry cement to and within Minnesota ----- thousand short tons---	1,772	1,519	-14.3
<b>Mineral production value:</b>			
Total crude mineral value ----- millions---	\$1,026.4	\$1,097.1	+6.9
Value per capita, resident population ----- do-----	\$262.83	\$279.80	+6.5
Value per square mile ----- do-----	\$12,208.76	\$13,050.01	+6.9

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

According to the Lake Superior Industrial Bureau, the iron ore mining industry (including both taconite and natural ore operations) payroll in 1975 totaled \$229 million, and the industry purchased supplies and services totaling \$337 million. Of that total, the organization stated that the taconite industry payroll costs exceeded \$198 million and direct purchases by the taconite facilities totaled more than \$306 million.

Potential development of the State's vast copper-nickel resources prompted State and Federal studies to evaluate the possible effects of copper-nickel mining in northern Minnesota. One of the provisions of the copper-nickel resolution adopted by the Minnesota Environmental Quality Council (EQC) in October 1974, was that an adequate regional Environmental Impact Assessment be completed prior to the acceptance of any site specific Environmental Impact Statement (EIS) on a mining development prospect. In 1975, a copper-nickel project under the EQC began to develop plans for a \$3.6 million study of the environmental, economic, and social effects of a copper-nickel mining venture. The study will provide State of-

ficials with the best available information needed to decide whether to allow such mining.

Meanwhile, the U.S. Forest Service was in charge of preparing a site specific EIS on a proposal by International Nickel Co., Ltd. (INCO) to develop a mine on 4,500 acres of federally leased land in the Superior National Forest south of Ely. Work on the EIS was suspended in May. Forest Service personnel continued a water quality monitoring program throughout the remainder of the year as a part of Forest Service commitments to cooperate with the State of Minnesota on its regional assessment.

In November, INCO withdrew its request for permits to develop a copper-nickel mine and suspended further activities in the State. The company emphasized proposed changes in State policy with regard to copper-nickel development as one of its principal reasons for withdrawing.

On November 1, AMAX Exploration, Inc. (AMAX) started construction of the surface facilities required for a 1,705-foot exploration shaft near Babbitt. This new phase of exploration followed nearly 15 years of exploration activity by Bear Creek

Mining Co. and AMAX on lands held by the two companies. Should additional exploration indicate that development is economically feasible, AMAX claimed that it would be at least 1984 before mining operations could begin. No mining permits will be approved by the State before completion of the regional environmental assessment now underway.

An energy project announced by Minnesota Gas Co. (Minnegasco) during 1975 may hold the promise of reducing Minnesota's dependence on out-of-State and foreign energy. Minnesota has no reserves of coal, petroleum, or natural gas. It does, however, have more than half the Nation's total reserves of peat, or about 7.5 million acres. Minnegasco has applied for a lease on 200,000 acres of State-owned peat land in Koochiching, Beltrami, and Lake of the Woods Counties. If the results of current studies and proposed demonstration plant operations prove favorable, the company hopes to construct a peat gasification plant in the lease area which would be capable of producing 250 million cubic feet of synthetic natural gas per day. The annual output of such a plant would about equal 25% of Minnesota's 1974 natural gas consumption.

**Employment and Injuries.**—Employment in the mining and quarrying industry at yearend 1975 totaled 13,100, 5% less than at the end of 1974. Nearly 91% were employed in the metal mining industries, according to statistics published by the Minnesota Department of Employment Services.

**Legislation and Government Programs.**—An omnibus tax bill enacted during 1975 included a provision that increased the production tax on taconite pellets by 39 cents per gross ton. The new rate, coupled with the wholesale price escalators, raised the production tax on iron ore concentrates produced from taconite in 1975 to about 75 cents per gross ton.

A lawsuit to determine the constitutionality of the 1973 Minnesota law requiring owners of severed mineral rights to register and pay an annual tax was brought before the Ramsey County District Court but

remained unsettled as of the yearend. The action was brought by a group of companies and individuals owning mineral interests under the surface of land in St. Louis County and other areas of the State. The 17 plaintiffs in the action brought against the State included United States Steel Corp., Burlington Northern Inc., the Boise-Cascade Co., two Minneapolis banks, five other corporations, and seven individuals who owned severed mineral rights on Minnesota acreage. The statute at issue provided for an annual 25-cents-per-acre levy on mineral interests held by persons or companies other than those owning the surface rights to the land. It further required that such ownership must be registered with the State with forfeiture of the rights coming if the owner of the rights failed to comply.

The plaintiffs contended that the 1973 law, which took effect in 1975, was discriminatory and that it took away private property without due process of the law. The State contended the tax was a proper one and simply sought to equalize the burden throughout the State and place a levy against highly valuable property that had long escaped taxation. There are an estimated 8 to 14 million acres in Minnesota subject to severed mineral interests.

As part of an effort toward mine land cleanup and reclamation, the Mineral Leases Subcommittee of the State Executive Council was granted \$21,000 to conduct an inventory of inactive iron ore mines. The cost of the cleanup work itself—ridding the mines of debris, potential safety hazards, etc.—was to be paid by the mining companies, with the work being awarded to low-bidding salvage companies.

The Minnesota Department of Natural Resources placed on open file the preliminary results of studies on the geology, geophysics, and/or geochemistry of select portions of five counties. The studies were conducted for the development of exploration methods and the evaluation of mineral potential of State-administered mineral lands in Koochiching, Lake, Lake of the Woods, Pine, and St. Louis Counties.

## REVIEW BY MINERAL COMMODITIES

## METALS

**Copper-Nickel.**—Interest expressed by two major mining companies in developing mines in northern Minnesota's extensive copper-nickel deposits, and the proximity of those deposits to the Boundary Waters Canoe Area (BWCA), made the prospective copper-nickel industry the subject of studies by both the State and Federal Governments.

In October 1974, the EQC voted to require a regional environmental impact assessment before any mining of copper-nickel ore would be permitted. Initially, a joint interagency task force under the direction of the Minnesota Pollution Control Agency and the Minnesota Department of Natural Resources (DNR) concentrated on plans for a 3-year effort covering an area that has the greatest likelihood for copper-nickel mining within the next 25 years. Responsibility for the project was later placed under the authority of the chairman of the EQC. The estimated cost of the exhaustive study was \$3.6 million. The workplan submitted to the EQC focuses primarily on the area between Hoyt Lakes and the BWCA, and will examine the socioeconomic impact of commercial mining ventures and the effects of mining on the environment, economy, and recreational resources of the State.

INCO had applied to the U.S. Forest Service in April 1974 for permission to construct an open pit mine on national forest land near Ely. A Federal project team, headed by the Forest Service, was engaged in preparing a site-specific EIS; however, the work was curtailed in May 1975 because an agreement had not been reached with INCO on its financial participation in the EIS, and the company had not provided necessary information on its mining plans. INCO withdrew its request to the Forest Service in November and suspended further exploration and development activities in the State citing proposed changes in State policy with regard to copper-nickel development as the reason. The company did maintain its leases and suggested that it might actively pursue development work when the State reaffirmed its policy or established new policies.

AMAX began construction of surface facilities for sinking a 1,705-foot exploratory shaft near Babbitt in November. The new phase of exploration followed approximately 15 years of prospecting and geological activities by Bear Creek Mining Co., and nearly 2 years of intensive evaluation of the environment with further geologic studies by AMAX. If the additional exploration indicates that mining would be economically feasible, the company claimed it would be at least 1984 before mining operations could begin.

Research to develop environmentally acceptable methods for treating the Minnesota copper and nickel sulfide ores continued at the Federal Bureau of Mines Twin Cities Metallurgy Research Center. A report on the mineralization of the Duluth complex was published.<sup>3</sup>

**Iron Ore.**—Minnesota mines shipped 49.2 million long tons of usable iron ore (excluding ore containing 5% or more manganese), 17% less than in 1974. The decrease was due mainly to a lower production rate in the steel industry. Total mine value of shipments increased by 7% and topped the \$1 billion mark for the first time. The State contributed 65% of the total usable iron ore produced in the United States. All production was by nine companies operating in Itasca and St. Louis Counties. Shipments of pellets from the six taconite plants in the State totaled 38.6 million long tons, a decrease of 6% from the previous year. The remaining shipments were virtually all concentrates from 28 hematite-type mines or mine groups. Only one mine, the Pierce mine, made shipments of "direct-shipping ore" during 1975.

Since the first 3.8-million-ton capacity taconite processing plant was opened by Reserve Mining Co. at Silver Bay in October 1955, the State's total pellet capacity has increased dramatically and in 1975 exceeded 40 million tons. The 20th anniversary of the beginning of commercial taconite production was a year of continued expansion of the industry. When present construction activity is completed

<sup>3</sup> Boucher, M. L. Copper-Nickel Mineralization in a Drill Core from the Duluth Complex of Northern Minnesota. BuMines RI 8084, 1975, 55 pp.

at two new plants and three existing plants, the combined annual capacity of all taconite plants in the State will be about 65 million tons.

Construction at the new Hibbing Taconite Co. complex continued. The startup schedule for plant operation in late 1976, at the rate of 5.4 million tons of pellets annually, was expected to be maintained. Early in 1975 while initial construction work progressed, Bethlehem Steel Corp. and Pickands Mather & Co. announced plans for a further expansion that would increase production capacity of the Hibbing plant to 8.1 million tons of pellets by 1979. The additional work will increase the total project costs to \$300 million and will include a second primary crusher, added grinding and concentrating units, and a third pelletizing machine. Additional mining equipment will also be necessary.

Construction work by Inland Steel Mining Co. on the second new Mesabi range taconite facility, the Minorca project at Virginia, continued on schedule. Initial production is slated for mid-1977, and the plant is expected to attain the designed production rate of 2.6 million tons of pellets annually in 1978. Production from the \$100 million facility would provide one-fourth of Inland Steel Co.'s total iron ore requirements at capacity operation. Inland Steel Mining Co., a subsidiary of Inland Steel Co., also constructed a new general office building in Virginia to serve as the firm's headquarters in providing technical services and managing its iron ore and stone operations in the Great Lakes region. Inland Steel Mining Co. operations served by the new office include mines and quarries in Minnesota, Wisconsin, Michigan, and Canada.

In an expansion which will increase Eveleth Taconite Co.'s annual pellet capacity to 6 million tons, three steel companies joined Oglebay Norton to hold ownership in Eveleth. The additional facilities will be operated as Eveleth Expansion Co. with controlling interests including Armco Steel Corp., 40%; The Steel Co. of Canada Ltd., 23.5%; Dominion Foundries & Steel Ltd., 16%; and Oglebay Norton Co., 20.5%. When the expanded plant reaches full production, Eveleth Expansion Co. will be combined with Eveleth Taconite in a joint venture to be known as Eveleth Mines. The additional facilities, requiring

a capital investment estimated at \$200 million, are scheduled for completion late in 1976.

At Mountain Iron, United States Steel Corp. began construction which will increase pellet output at the Minntac operation by 50%, to more than 18 million tons annually. Site preparations for the project began in 1974. The \$200 million program is the second major expansion at Minntac in the last 5 years. Initial operation of the new unit is expected to begin in 1977, with full production to be reached in 1978.

National Steel Pellet Project's Keewatin Plant, owned 85% by National Steel Corp. and 15% by The Hanna Mining Co., was the scene of construction activity which will more than double the plant's current capacity. When the project is completed in early 1977 at an estimated capital cost of about \$150 million, the production capacity will be increased from 2.5 million to 5.8 million tons of pellets annually.

United States Steel Corp. closed the Stephens natural ore mine near Aurora at the close of the 1975 shipping season. More than 50 million tons have been shipped from the Stephens since it opened.

The controversy which began in 1968 concerning Reserve Mining Co.'s tailings discharge into Lake Superior continued and was still unresolved at yearend. The States of Minnesota, Wisconsin, and Michigan, the Federal Environmental Protection Agency, and several private environmental organizations continued to seek the cessation of the tailings discharge into the lake. A March 14 ruling by the U.S. Eighth Circuit Court of Appeals declared that discharges from Reserve Mining Co.'s taconite processing plant at Silver Bay do violate several environmental laws. The Court decided that the company need not shut down but should take reasonable, immediate steps to eliminate discharges into the air and should, within a reasonable time, switch to an on-land disposal site for its taconite tailings. The appeals court further suggested that a final decision between the firm and the State on a mutually acceptable on-land site should be reached within 1 year. State public hearings on Reserve's proposal to discharge its taconite wastes at the so-called Lax Lake, or Milepost 7, site began on June 23 and continued intermittently throughout most of the remainder of the year in Silver Bay



and at the Roseville offices of the Minnesota Pollution Control Agency. The draft EIS on Reserve's Milepost 7 disposal plan was presented at the hearings in December.

Late in 1975, a \$35.5 million bond issue for the construction of harbor improvements and the upgrading of taconite storage and loading capabilities at Two Harbors was approved. The bonds will be issued by the City of Two Harbors under the State's Municipal Industrial Development program and will enable the Duluth, Missabe & Iron Range Railway Co. to enlarge its pellet storage capacity to 2 million tons and to build a shuttle belt loading system to handle the wide-beam super-carriers at a rate of 10,000 tons per hour. The project is the most significant development at the port since the original railroad and dock were completed in 1884. Construction was expected to begin early in 1976 and to be completed in approximately 30 months. A significant increase in ore shipments through the facility is anticipated in the next few years as all pellets from the 2.6-million-ton-capacity Minorca plant of Inland Steel Mining Co. and a portion of United States Steel Corp's Minntac production will be shipped by way of Two Harbors.

Published prices for Lake Superior iron ores at the beginning of the year were as follows: Mesabi non-Bessemer, \$17.28 per ton (coarse, \$18.08, and fine, \$16.83); Old Range non-Bessemer and manganiferous, \$17.53; and Mesabi Bessemer, \$17.43. At midyear, prices were increased by \$1.22 per ton for all classes, to compensate for increases arising from higher labor rates and benefits under union contracts, higher prices for materials and supply items, increased power rates, and higher mining taxes. The foregoing prices were

for ore delivered at rail-of-vessel at lower lake ports and were based on a natural iron content of 51.5%. The lower lake price of pellets as of January 1 was 44.559 cents per long ton unit of iron, and following lesser adjustments early in the year mainly to compensate for increases in freight and other charges, the price of pellets was adjusted in midyear to 47.2 cents per long ton unit of iron. The adjusted prices remained in effect throughout the remainder of 1975. The average weighted mine value for Minnesota iron ores was \$20.65 per ton, compared with \$15.98 in 1974.

According to rates published in mid-1975, the cost of transporting iron ore from the Mesabi range to lower lake ports in 1975 ranged from \$6.30 to \$6.64 per long ton. The rates included a dock-handling charge of \$0.36. The 1975 transportation rates represented a 10% to 15% increase over those of mid-1974.

The first year-round shipping season was completed on the Great Lakes. Vessels in the United States Steel Corp. fleet made transportation history as the iron ore shipping activity that began in April 1974 continued into the start of the 1975 season. The vessels carried taconite pellets from Two Harbors to steel furnaces at Gary and East Chicago, Ind. A relatively mild winter was the single biggest aid to year-round navigation. The average cargo size during the 1975-76 season was nearly 19,300 gross tons, compared with 18,550 for the previous season. At Two Harbors and Taconite Harbor, however, cargoes averaged over 26,000 tons as a result of their serving as loading ports for some of the huge new and enlarged lakers.<sup>4</sup>

<sup>4</sup>The Great Lakes News Letter, Great Lakes Commission, v. 20, No. 3, January-February 1976, p. 4.

Table 4.—Minnesota: Iron ore<sup>1</sup> data, in 1975, by county and range  
(Thousand long tons)

County and range	Crude ore production <sup>2</sup>	Usable ore				Stocks Dec. 31
		Stocks Jan. 1	Production	Iron content of production	Shipments	
County:						
Itasca -----	18,166	315	5,992	3,576	6,037	270
St. Louis <sup>3</sup> -----	125,130	2,073	45,185	27,428	43,130	4,128
Total -----	143,296	2,388	51,177	31,004	49,167	4,398
Mesabi Range -----	143,296	2,388	51,177	31,004	49,167	4,398

<sup>1</sup> Exclusive of ore containing 5% or more manganese.

<sup>2</sup> Entire production from open pit mines.

<sup>3</sup> Includes Lake County.

Table 5.—Minnesota: Usable iron ore<sup>1</sup> produced (direct-shipping and all forms  
of concentrate), by range  
(Thousand long tons)

Year	Cuyuna	Mesabi	Vermilion	Spring Valley District	Total <sup>2</sup>
1884-1970 -----	70,336	2,776,525	103,527	8,150	2,958,537
1971 -----	--	51,283	--	--	51,283
1972 -----	--	48,998	--	--	48,998
1973 -----	--	60,021	--	--	60,021
1974 -----	--	58,484	--	--	58,484
1975 -----	--	51,177	--	--	51,177
Total <sup>2</sup> -----	70,336	3,046,488	103,527	8,150	3,228,500

<sup>1</sup> Exclusive, after 1905, of iron ore containing 5% or more manganese.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 6.—Minnesota: Production of usable iron ore  
(Thousand long tons)

Year	Natural ore			Taconite pellets	Total usable ore <sup>1</sup>	Iron content (percent)
	Direct shipping ore	Concen- trates	Total			
1971 -----	3,335	14,178	17,513	33,771	51,283	59.89
1972 -----	W	W	14,452	34,546	48,998	60.20
1973 -----	W	W	13,420	41,601	60,021	60.53
1974 -----	W	W	17,541	40,944	58,484	60.02
1975 -----	W	W	10,466	40,711	51,177	60.58

W Withheld to avoid disclosing individual company confidential data; included in "Total."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 7.—Minnesota: Shipments of iron ore<sup>1</sup> from mines**  
(Thousand long tons)

Year	Natural ore			Taconite pellets	Total usable ore	Proportion of taconite pellets to total usable ore (percent)
	Direct shipping ore <sup>2</sup>	Concentrates	Total			
1971 -----	3,335	13,100	16,435	32,619	49,054	66.50
1972 -----	W	W	15,229	35,366	50,595	69.90
1973 -----	W	W	19,013	43,601	62,614	69.63
1974 -----	W	W	18,282	41,140	59,422	69.23
1975 -----	W	W	10,553	38,615	<sup>3</sup> 49,167	78.53

W Withheld to avoid disclosing individual company confidential data; included in "Total."

<sup>1</sup> Exclusive of ore containing 5% or more manganese.

<sup>2</sup> Includes crushed, screened, and sized ore not further treated.

<sup>3</sup> Data do not add to total shown because of independent rounding.

**Table 8.—Dates of first and final cargoes of iron ore at Minnesota and Wisconsin upper Great Lakes**

Port and dock	1974		1975	
	First	Final	First	Final
Duluth, Minn.: DM&IR -----	Apr. 8	Jan. 10 <sup>1</sup>	Mar. 26	Dec. 20
Silver Bay, Minn.: Reserve -----	Apr. 13	Jan. 21 <sup>1</sup>	Apr. 12	Dec. 28
Superior, Wis.: Burlington Northern -----	Apr. 17	Jan. 27 <sup>1</sup>	Apr. 11	Jan. 7 <sup>2</sup>
Taconite Harbor, Minn.: Erie -----	Apr. 16	Jan. 23 <sup>1</sup>	Mar. 26	Jan. 9 <sup>2</sup>
Two Harbors, Minn.: DM&IR -----	Apr. 9	( <sup>3</sup> )	( <sup>3</sup> )	( <sup>3</sup> )

<sup>1</sup> 1975.

<sup>2</sup> 1976.

<sup>3</sup> Because of favorable navigation conditions permitting vessel loading to continue without interruption, the ore docks operated by the DM&IR at Two Harbors were not closed for the 1974 or 1975 seasons.

Source: Skillings' Mining Review.

The Twin Cities Metallurgy Research Center of the Federal Bureau of Mines continued research on the beneficiation of nonmagnetic taconite. The studies are aimed at augmenting the iron reserve base by developing processes for beneficiating a variety of nonmagnetic taconites that are not economically amenable to conventional iron beneficiation technology. Research was also conducted to advance the technology of iron ore agglomeration in such areas as altering the pattern of energy used in agglomerating iron concentrates and fines. The investigations were designed to determine the feasibility of indurating green iron oxide pellets using more abundant energy sources such as lignite, subbituminous, and bituminous coals as substitutes for natural gas. Feasibility studies were undertaken to determine the effects of

utilization of unmethanated low and intermediate Btu gas, such as obtained in coal gasification, on induration and production of both oxide and metallized pellets.

**Iron and Steel.**—Lakehead Alloys, Inc., a ministeel plant in Duluth that started operations in 1973, closed its doors in early 1975. Originally intended to produce bar steel for use by a local company, the firm had devoted most of its capacity to manufacturing grinding balls for the taconite industry. The plant was the first new concern given financial aid through the Duluth Port Authority's industrial revenue bonding program authorized by the Minnesota Legislature in 1971. The venture was financed with about \$250,000 in revenue bonds and \$300,000 of private capital. Before closing, the revenue bonds and public investment were all paid.

North Star Steel Co. continued to produce steel from ferrous scrap at its St. Paul facility. The company has grown steadily since it was first organized in 1965 and it is now planning construction of a \$5 million plant in Duluth to produce grinding balls for the expanding taconite industry. The new plant is scheduled to be in operation in 1977.

**Manganiferous Ore.**—Shipments of manganiferous ore from the Cuyuna range in 1975 totaled 109,000 short tons, less than half the quantity shipped during 1974. All shipments were classed as ferruginous manganese ore, containing 10% to 35% manganese. Stockpiled concentrates from the Louise mine were shipped by Pittsburgh Pacific Co., and The Hanna Mining Co. completed stockpile shipments at the Lauretta mine. Production activity by The Hanna Mining Co. ceased at the Lauretta mine in 1970, and the company shipped from stockpiles since then. Late in 1975, Pittsburgh Pacific Co. acquired the operating lease on the Lauretta mine and planned to resume production of manganiferous ore at the property during 1976, under the name of Algoma-Zeno.

Table 9.—Minnesota: Shipments of ferruginous manganiferous ores<sup>1</sup> from the Cuyuna Range

	Quantity (long tons)	Ferruginous manganese ore (10% to 35% Mn, natural)	
		Contents (natural)	
		Fe (percent)	Mn (percent)
1971 -----	151,547	28.16	13.56
1972 -----	106,539	27.09	12.64
1973 -----	152,653	27.69	12.59
1974 -----	201,393	29.64	12.74
1975 -----	97,097	30.83	11.84

<sup>1</sup> All manganiferous ores shipped from the Cuyuna Range in 1971-75 were ferruginous manganese ore containing 10% to 35% manganese. There have been no shipments of manganiferous iron ore containing 5% to 10% manganese since 1969.

#### NONMETALS

**Abrasive Stone.**—Grinding pebbles and tube-mill liners were produced by Jasper Stone Co. from a quartzite deposit near Jasper in Rock County. Sales of both products decreased sharply in quantity and value from 1974.

**Cement.**—Portland and masonry cements were produced at Duluth by Universal Atlas Cement Div. of United States Steel Corp., the sole producer of cement in Minnesota. Sales of both portland and masonry cements increased over those of 1974. Portland cement output consisted of types I and II (general use and moderate heat). Forty-six percent of the portland cement sales were to ready-mix concrete companies. The remainder was sold to highway and other contractors, building material dealers, and concrete product manufacturers. Shipments to consumers were by truck (64%) and rail (36%).

At the end of the year, Universal Atlas permanently closed its Duluth plant. Prior to closing, the firm stated that this was the oldest (built in 1915), the smallest, and the most expensive to operate of its domestic cement plants. It was the only cement plant in the State and provided cement to paving contractors and ready-mix plants in Minnesota, North Dakota, and Wisconsin. Since 1971, the company has been working with the Pollution Control Agency to comply with State environmental regulations. For use in the plant the company brought in by boat limestone from Michigan and slag from the United States Steel blast furnaces in Gary, Ind.

**Clays.**—Common clay and shale was produced by Ochs Brick & Tile Co. and by North Central Lightweight Aggregate Co., Inc., in Brown and Hennepin Counties, respectively. Ochs Brick & Tile Co. also produced kaolin in Redwood County. Total clay sales decreased in both quantity and value. Most of the clay was used in face brick and concrete block manufacture, with lesser amounts used for structural concrete products and other aggregates.

**Lime.**—Lime production in Minnesota in 1975 increased markedly over that of 1974 owing to the opening of a new plant at Renville by American Crystal Sugar Co., the State's only lime producer. In addition to the Renville plant in Renville County, the company also operated plants at Moorhead in Clay County and at Crookston and East Grand Forks in Polk County. All of the output was used by the company in sugar refining. Total lime consumed in Minnesota was 222,100 tons, with out-of-State shipments coming primarily from Wisconsin.

**Perlite.**—There was no production of expanded perlite in Minnesota during 1975. W. R. Grace & Co., Zonolite Div., had discontinued production of expanded perlite at its Minneapolis plant during 1974, and the facility is now used as a redistribution site for material produced at the company's Milwaukee, Wis., plant.

**Sand and Gravel.**—Sand and gravel continued to be the principal nonmetallic mineral produced in Minnesota, representing 56% of the total value of nonmetallics produced during 1975. Although the tonnage sold declined 9%, to 33,398,000 tons, higher unit values increased the total value

of sales by 7% to \$45,214,000, a record high for the State. Production was reported from each of the State's 87 counties by 335 companies operating at 440 sites. Production in excess of 1 million tons was reported from five counties—Clay, Dakota, Hennepin, St. Louis, and Washington—which together accounted for 39% of the State output. The five counties are the locations of major metropolitan areas; namely, Minneapolis-St. Paul, Duluth, and Moorhead. Silica sand was produced in Le Sueur and Washington Counties by Unisil Corp. and Twin City Silica, Inc.

Table 10.—Minnesota: Sand and gravel sold or used by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ---	6,459	10,260	4,760	10,209
Highway and bridge construction -----	2,355	3,500	2,333	4,178
Other construction (dams, waterworks, air-ports, etc.) -----	376	608	94	242
Concrete products (cement blocks, bricks, pipe, etc.) -----	<sup>1</sup> 2,835	<sup>1</sup> 4,453	2,391	4,138
Bituminous paving (asphalt and tar paving) -----	7,559	7,701	5,920	7,435
Roadbase and subbase -----	9,091	8,987	10,561	11,967
Fill -----	1,319	1,579	1,068	1,455
Other uses -----	1,053	2,747	820	2,853
<b>Unprocessed:</b>				
Roadbase and subbase -----	2,181	848	1,994	984
Fill -----	3,492	1,687	3,047	1,624
Other uses -----	---	---	358	128
<b>Industrial sand</b> -----	---	---	W	W
<b>Total</b> <sup>2</sup> -----	36,720	42,370	33,398	45,214

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

<sup>1</sup> Excludes material for concrete products for publicly funded projects to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 11.—Minnesota: Sand and gravel sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Aitkin	2	19	7	4	513	673
Becker	3	203	218	7	410	578
Beltrami	4	286	300	5	289	321
Benton	2	63	50	3	W	W
Blue Earth	4	290	393	2	W	W
Brown	4	437	292	5	419	433
Carlton	10	728	533	5	278	193
Carver	3	396	430	3	326	485
Cass	6	238	387	4	94	194
Chippewa	6	342	226	5	470	395
Chisago	7	202	231	5	190	219
Clay	8	1,162	1,914	10	1,089	1,531
Clearwater	4	154	153	3	181	210
Cook	2	W	W	4	340	466
Cottonwood	3	W	W	4	112	132
Crow Wing	9	246	187	12	219	255
Dakota	17	2,820	3,477	16	2,554	3,020
Dodge	2	17	14	1	33	16
Douglas	2	W	W	3	88	142
Faribault	4	177	330	1	154	408
Fillmore	5	402	414	4	79	169
Freeborn	6	156	215	8	631	997
Goodhue	24	4,206	4,183	9	381	416
Hennepin	2	W	13	26	3,578	4,061
Houston	3	112	206	2	W	W
Hubbard	1	62	47	4	124	188
Isanti	5	633	1,278	1	28	76
Itasca	4	211	300	10	714	1,572
Jackson	3	67	55	3	118	127
Kanabec	6	552	572	2	W	W
Kandiyohi	3	124	102	6	649	689
Kittson	1	56	23	2	33	W
Koochiching	4	40	63	8	147	78
Lac qui Parle	2	W	W	2	84	W
Lake	1	W	W	3	79	105
Lake of the Woods	6	1,016	2,693	3	341	600
Le Sueur	4	251	190	4	641	2,526
McLeod	1	91	54	4	318	311
Mahnomen	4	347	264	1	68	43
Marshall	4	244	245	2	W	W
Martin	3	358	191	2	203	249
Meeker	5	255	283	4	205	302
Mille Lacs	4	491	1,310	4	171	153
Morrison	5	276	239	4	318	662
Mower	3	307	433	6	221	237
Nicollet	3	96	27	2	W	W
Norman	4	614	872	2	W	W
Olmsted	5	119	70	4	340	509
Otter Tail	2	W	W	5	59	55
Pennington	4	759	516	1	3	1
Pine	1	W	W	3	759	499
Pipestone	4	580	646	1	3	1
Polk	3	81	81	5	399	598
Pope	3	81	81	4	61	81
Red Lake	--	--	--	1	207	259
Redwood	6	143	139	4	156	112
Renville	7	782	668	5	613	634
Rice	2	W	W	8	273	518
Rock	3	220	357	3	284	672
Roseau	4	168	100	2	W	W
St. Louis	34	3,554	2,940	49	3,465	3,802
Scott	5	519	537	5	640	613
Sherburne	7	1,238	1,747	10	925	1,415
Stearns	9	782	975	11	688	792
Steele	5	286	515	7	707	996
Swift	2	W	W	3	262	179
Todd	4	564	422	5	742	705
Wabasha	3	146	205	3	138	253
Wadena	1	21	7	1	17	9
Waseca	1	19	11	3	W	W
Washington	21	2,852	3,330	20	2,501	4,511
Watsonwan	1	42	40	1	13	12
Wilkin	5	400	365	5	114	66

See footnotes at end of table.

Table 11.—Minnesota: Sand and gravel sold or used by producers, by county  
—Continued

(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Winona -----	3	421	603	4	321	622
Wright -----	10	728	928	11	448	741
Yellow Medicine -----	5	134	136	4	40	84
Undistributed <sup>1</sup> -----	27	3,415	3,619	22	2,333	3,247
Total <sup>2</sup> -----	402	36,720	42,370	440	33,398	45,214

<sup>1</sup> Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

<sup>2</sup> Includes Anoka, Big Stone, Grant, Lincoln, Lyon, Murray, Nobles, Ramsey, Sibley (1975), Stevens, and Traverse (1975) Counties and some sand and gravel that cannot be assigned to specific counties (1974).

<sup>3</sup> Data may not add to totals shown because of independent rounding.

**Stone.**—Although the total tonnage of stone sold in Minnesota in 1975 decreased 17%, the total value increased 6% and established a new record high, surpassing the previous high set in 1974. Types of stone produced included limestone and dolomite, granite, quartzite, and traprock.

Limestone (including dolomite) was produced in 16 counties, primarily in areas along the Mississippi and Minnesota Rivers in the southeastern and south-central parts of the State. Output of crushed and broken limestone decreased 23% in quantity and 11% in value. Sales of dimension limestone increased nearly 30%.

Granite was quarried in central Minnesota in Mille Lacs and Stearns Counties and the upper Minnesota River Valley in Big Stone, Lac qui Parle, Redwood, Renville, and Yellow Medicine Counties. Output of dimension granite, used chiefly for buildings and monuments, increased markedly, while sales of crushed material

declined slightly in quantity but increased 9% in value. Declines were reported also in the sales of crushed and broken quartzite, all from Nicollet County, and dimension quartzite, all from Rock County. Traprock production, from four St. Louis County quarries, increased sharply over that of 1974.

**Sulfur.**—Elemental sulfur was recovered as a byproduct of petroleum refining operations in Dakota and Washington Counties. Output increased over that of 1974.

**Vermiculite.**—Crude vermiculite mined in Western States was exfoliated by three companies at plants in Hennepin and Ramsey Counties. Sales declined 11% in quantity and 6% in value from those of 1974. The expanded material was used primarily for loose fill and block insulation, with smaller quantities used in plaster and concrete aggregate and for horticultural and miscellaneous purposes.

**Table 12.—Minnesota: Limestone and dolomite sold or used by producers, by use**  
(Thousand short tons and thousand dollars unless otherwise specified)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Dimension:</b>				
Rough architectural <sup>1</sup> -----thousand cubic feet--	25	107	50	215
Cut stone -----do-----	64	1,147	91	1,562
House stone veneer <sup>2</sup> -----do-----	84	481	83	468
Total (thousand short tons) -----	14	1,735	18	2,245
<b>Crushed and broken:</b>				
Bituminous aggregate -----	207	293	216	409
Concrete aggregate -----	740	1,304	356	788
Dense-graded roadbase stone -----	2,717	4,158	2,213	3,800
Surface treatment aggregate -----	919	1,550	756	1,455
Other construction aggregate and roadstone -----	958	1,546	496	989
Agricultural limestone -----	384	762	391	873
Riprap and jetty stone -----	55	88	60	133
Other uses <sup>3</sup> -----	542	1,021	516	1,102
Total <sup>4</sup> -----	6,472	10,721	5,003	9,549
Grand total -----	6,486	12,456	5,021	11,794

<sup>1</sup> Data include irregular shaped stone, rubble, and rough flagging.

<sup>2</sup> Data include sawed stone, dressed flagging, and monumental stone (1974).

<sup>3</sup> Data include stone used for macadam aggregate, railroad ballast, filter stone (1974), lime manufacture (1975), asphalt filler, bedding material (1974), fill (1975), and drainfields (1974).

<sup>4</sup> Data may not add to totals shown because of independent rounding.

**Table 13.—Minnesota: Crushed granite sold or used by producers, by use**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Aggregate and roadstone <sup>1</sup> -----	346	619	264	541
Railroad ballast -----	1,022	1,713	1,088	2,076
Other uses <sup>2</sup> -----	71	208	36	152
Total -----	1,439	<sup>3</sup> 2,539	1,388	2,769

<sup>1</sup> Includes bituminous aggregate, concrete aggregate, dense-graded roadbase stone, other construction aggregate and roadstone, riprap, and jetty stone (1974).

<sup>2</sup> Includes poultry grit, bedding material, and fill.

<sup>3</sup> Data do not add to total shown because of independent rounding.

**Table 14.—Minnesota: Crushed limestone sold or used by producers, by county**  
(Thousand short tons and thousand dollars)

County	Number of quarries	1974		1975	
		Quantity	Value	Quantity	Value
Clay -----	--	--	--	1	4
Fillmore -----	16	463	924	12	729
Goodhue -----	12	238	353	13	403
Hennepin -----	3	5	16	--	--
Houston -----	22	399	608	19	667
Olmsted -----	11	878	1,430	9	925
Ramsey -----	1	( <sup>1</sup> )	1	--	--
Scott -----	18	1,122	1,978	7	1,748
Steele -----	1	154	257	1	217
Washington -----	2	W	W	3	1,170
Undistributed <sup>2</sup> -----	28	3,213	5,154	27	3,684
Total <sup>3</sup> -----	114	6,472	10,721	92	9,549

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

<sup>1</sup> Less than 1/2 unit.

<sup>2</sup> Includes Blue Earth, Dakota, Dodge, Le Sueur, Mower, Rice, Wabasha, and Winona Counties.

<sup>3</sup> Data may not add to totals shown because of independent rounding.



### MINERAL FUELS

**Coke.**—Coke ovens were operated by American Steel & Wire Div., United States Steel Corp. at Duluth in St. Louis County, and by Koppers Co., Inc., at St. Paul in Ramsey County. Output decreased about 17% from that of 1974. All of the coke produced by the American Steel & Wire Div. was consumed by United States Steel Corp. blast furnaces in Illinois, while Koppers' production was primarily for foundry use with shipments to 14 Midwestern and Western States and to Canada. Primary sources of coking coal were Kentucky, Pennsylvania, Utah, and West Virginia, with lesser receipts from Alabama, Ohio, Oklahoma, Tennessee, and Virginia.

In August, the United States Steel Corp. announced plans to shut down its Duluth coke plant by July 1, 1977, because of economic factors and the facility's inability to meet rigid State pollution-control standards. The plant, which was built in 1914, employed about 250 workers in 1975. It was the only remaining activity of the company's once extensive iron and steel operation in Duluth that employed approximately 2,500 persons as recently as 1972.

**Peat.**—Moss and reed-sedge peat was produced by five companies from bogs in Aitkin, Carlton, Itasca, Pine, and St. Louis Counties. Sales totaled 13,000 tons, valued at \$230,000 with decreases of 34% and 51%, respectively, from those of 1974. The peat was sold for general soil improvement use in bulk and packaged form.

In July, Minnegasco applied to the DNR for a 25-year lease on 200,000 acres of State-owned land in Northwestern Minnesota. The tract covered by the lease is located in Koochiching, Beltrami, and Lake of the Woods Counties and represents less than 3% of the State's total peat acreage. In the hope of opening up a vast new source of energy, Minnegasco had begun conducting research studies in September 1974 on the feasibility of converting Minnesota peat into synthetic natural gas. Minnesota has more than 7 million acres of peat, but there has been little commercial use of peat, other than for horticultural purposes. If research indicates that peat gasification is commercially feasible, Minnegasco would build a demonstration

plant in the lease area, which would have a capacity of 80 million cubic feet of synthetic natural gas per day. If that plant proves feasible, a full-scale plant with a capacity of 250 million cubic feet per day, and employing up to 1,500 persons, would be constructed. The annual output from such a plant would equal one-fourth the amount of natural gas used in Minnesota in 1974. Preparation of an EIS and other required steps could delay the start of peat development at least 3 years—provided the State first approves the new venture.

The DNR received a grant of \$94,000 from the Upper Great Lakes Regional Commission for a preliminary technical and environmental assessment of peat use for fuel and other purposes. The DNR will administer the study, which will be done in large part by Midwest Research Institute with participation by the Pollution Control Agency, the State Energy Agency, and the University of Minnesota. The study is expected to take about 9 months.

The Minnesota Department of Iron Range Resources & Rehabilitation, working in conjunction with the Soil Science Department of the University of Minnesota, has developed a "peat-over-sand" filter system which may be the answer to part of the Nation's growing problem of sewage treatment. A relatively simple means to achieve proper sewage treatment, the peat-over-sand filter consists of an area of ground ranging from 70 to 90 feet wide with a 24- to 30-inch sand base covered with 8 to 12 inches of peat. Each system is equipped with an irrigating sprinkler that sprays the effluent over the filter medium. The relatively low cost of installation, operation, and maintenance, and the tremendous amount of peat that is available in Minnesota, make this new system particularly interesting—especially for small communities, resorts, and campgrounds.

**Petroleum Refineries.**—Minnesota's three crude oil refineries, which are about 90% dependent on Canadian crude oil imports for their feedstock, began studying possible alternate sources of supply as the Canadian Government began cutting its exports of crude to Minnesota and to refineries in other States. The Canadian Government began reducing its petroleum exports to

the United States in January on a schedule that will completely phase out oil sales to the United States by the early 1980's. Combined crude oil distillation operating capacity of the three refineries as of the

end of the year was 214,943 barrels per day. Production at the Wrenshall refinery of Continental Oil Co. was halted in mid-January by a labor strike that lasted for 3 weeks.

Table 15.—Principal producers

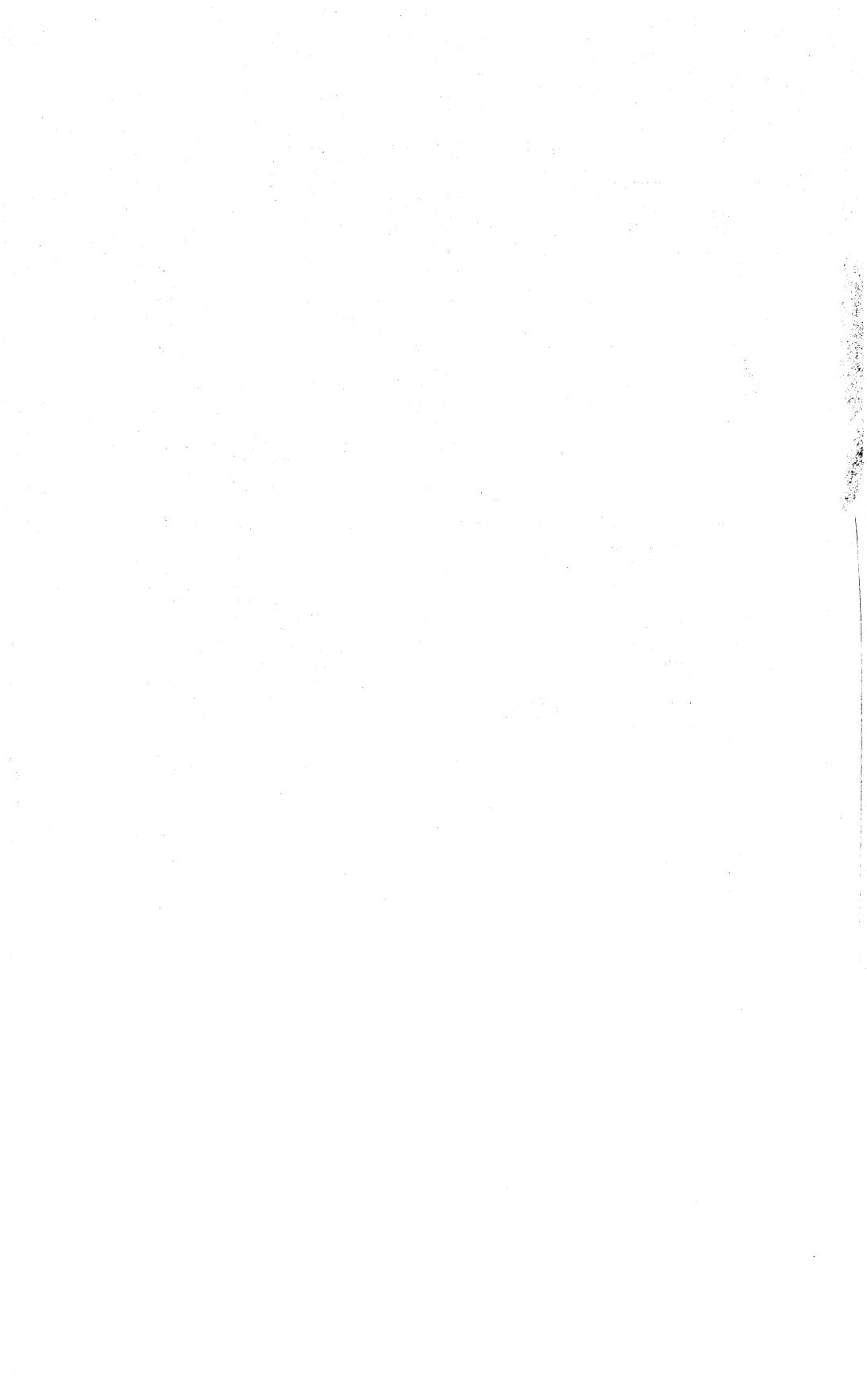
Commodity and company	Address	Type of activity	County
<b>Abrasive stone:</b>			
Jasper Stone Co -----	14575 Garden Rd. Golden, Colo. 80401	Quarry and station- ary plant.	Rock.
<b>Cement:</b>			
Universal Atlas Cement Div., United States Steel Corp.	U.S. Steel Building 600 Grant St. Pittsburgh, Pa. 15230	Portland and masonry, wet process.	St. Louis.
<b>Clays and shale:</b>			
North Central Lightweight Aggregate Co., Inc.	4901 West Medicine Lake Dr. Minneapolis, Minn. 55427	Pit and plant ----	Hennepin.
Ochs Brick & Tile Co ----	Box 106 Springfield, Minn. 56087	Pits and plant ---	Brown and Redwood.
<b>Coke:</b>			
Koppers Co., Inc -----	1000 North Hamline Ave. St. Paul, Minn. 55104	Coke ovens -----	Ramsey.
United States Steel Corp --	Morgan Park Duluth, Minn. 55800	----do -----	St. Louis.
<b>Iron ore:</b>			
Cleveland-Cliffs Iron Co.:	1460 Union Commerce Bldg. Cleveland, Ohio 44115		
Canisteo -----	-----	Mine and con- centrator.	Itasca.
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, Ohio 44114		
Butler Taconite Project	-----	Mine, concentrator, and agglomer- ator.	Do.
National Steel Pellet Project.	-----	----do -----	Itasca and St. Louis.
Pierce Group -----	-----	Mine and concen- trator.	St. Louis.
Whitney -----	-----	----do -----	Do.
Carmi -----	-----	Mine; ore treated at Pierce concen- trator.	Do.
Jones & Laughlin Steel Corp., Northwest Ore Div.:	Virginia, Minn. 55792 -----		
Hill Annex and Lind- Greenway.	-----	Mines and con- centrators.	Itasca.
McKinley -----	-----	Mine and concen- trator.	St. Louis.
Oglebay-Norton Co.:	1200 Hanna Bldg. Cleveland, Ohio 44115		
Thunderbird -----	-----	Mine -----	Do.
Fairlane plant -----	-----	Concentrator and agglomerator.	Do.
Pickands Mather & Co.:	1100 Superior Ave. Cleveland, Ohio 44114		
Erie Commercial -----	-----	Mine, concentrator, and agglomer- ator.	Do.
Pittsburgh Pacific Co.:	2521 First Ave. Hibbing, Minn. 55746		
Embarrass, Gilbert, Neville Reserve, Niles, Wyoming and others.	-----	Mines -----	Do.
Coons Pacific, Julia, Knox and Monroe plants.	-----	Concentrators -----	Do.
Reserve Mining Co.:	Silver Bay, Minn. 55614 ---		
Peter Mitchell -----	-----	Mine and primary crusher.	Do.
Silver Bay plant -----	-----	Concentrator and agglomerator.	Lake.
Rhude & Fryberger, Inc.:	Box 66 Hibbing, Minn. 55746		
Gross-Nelson, Hull- Rust, Leonidas, Rana, and Sharon- Culver.	-----	Mines and concen- trator.	St. Louis.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Iron ore—Continued			
United States Steel Corp., Minnesota Ore Operations:	Box 417 Mountain Iron, Minn. 55768		
Minntac -----	-----	Mine, concentrator, and agglomerator.	St. Louis.
Plummer group -----	-----	Mine and concentrator.	Itasca.
Sherman group -----	-----	do -----	St. Louis.
Stephens -----	-----	do -----	Do.
Iron and steel:			
North Star Steel Co -----	1678 Red Rock Rd. St. Paul, Minn. 55164	Electric steel furnace.	Ramsey.
Lead smelters (secondary):			
Gopher Smelting & Refining Co. -----	33855 South Highway 49 St. Paul, Minn. 55111	Processing plant --	Dakota.
NL Industries, Inc -----	3645 Hampshire Ave., South Minneapolis, Minn. 55426	do -----	Hennepin.
Lime:			
American Crystal Sugar Co. -----	101 North Third St. Moorhead, Minn. 56560	Quicklime; shaft kilns.	Clay, Polk, Renville.
Manganiferous ore:			
The Hanna Mining Co.: Lauretta -----	100 Erieview Plaza Cleveland, Ohio 44114	Stockpile ship- ments.	Crow Wing.
Pittsburgh Pacific Co.: Louise -----	2521 First Ave. Hibbing, Minn. 55746	do -----	Do.
Peat:			
Michigan Peat -----	P.O. Box 3006 Houston, Tex. 77001	Bog; processing plant.	Carlton.
Northern Peat Co -----	Box 416 Grand Rapids, Minn. 55744	do -----	Aitkin.
Power-O-Peat Co -----	Box 956 Gilbert, Minn. 55741	do -----	St. Louis.
Petroleum refineries:			
Continental Oil Co -----	P.O. Box 8 Wrenshall, Minn. 55797	Refinery -----	Carlton.
Koch Refining Co -----	P.O. Box 2302 Wichita, Kans. 67201	do -----	Dakota.
Northwestern Refining Co., a division of Ashland Oil, Inc. -----	P.O. Drawer 9 St. Paul Park, Minn. 55071	do -----	Washington.
Sand and gravel:			
Alexander Construction Co., Inc. -----	County Rd. 42 & Johnny Cake Ridge Rd. Apple Valley, Minn. 55068	Pits; portable plants.	Dakota, Hennepin, Washington.
Anderson Aggregate Co --	6008 Wayzata Blvd. Minneapolis, Minn. 55416	Pits; stationary and portable plants.	Hennepin.
Barton Contracting Co ---	10300 89th Ave., North Osseo, Minn. 55369	Pits; portable plants.	Carlton, Chisago, Dakota, Hennepin, Scott, Sherburne, Stearns, Washington, Wright.
Duinick Bros. & Gilchrist.	Olivia, Minn. 56277 -----	do -----	Kandiyohi, McLeod, Pine, Renville, Swift.
Fischer Sand & Aggregate, Inc. -----	County Rd. 42 Rosemount, Minn. 55068	Pits; stationary and portable plants.	Dakota.
Minnesota Valley Improvement Co. -----	Granite Falls, Minn. 56241 --	Pits; portable plants.	Aitkin, Benton, Big Stone, Chippewa, Clearwater, Cook, Goodhue, Grant, Jackson, Lake, Meeker, Polk, Rice, Rock, Stearns, Swift.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Sand and gravel—Continued</b>			
J. L. Shiely Co -----	1101 North Snelling Ave. St. Paul, Minn. 55108	Pit; stationary plant.	Washington.
Starry Construction -----	427 South Lake St. Long Prairie, Minn. 56347	Pits; portable plants.	Stearns and Todd.
Ulland Bros., Inc -----	P.O. Box 340 Cloquet, Minn. 55720	-----do -----	Carlton, Cook, Lake, St. Louis.
Do -----	Box 98 Austin, Minn. 55912	Pit; portable plant.	Mower.
Unisil Corp -----	Greenwich Office Park 4 Greenwich, Conn. 06830	Pit; stationary plant; industrial sand.	Le Sueur.
<b>Stone:</b>			
<b>Granite:</b>			
Cold Spring Granite Co.	Cold Spring, Minn. 56320	Quarries -----	Big Stone, Mille Lacs, Renville.
Do -----	-----	Quarries and sta- tionary plant.	Stearns.
The Green Co -----	200 14th Ave. Granite Falls, Minn. 56241	Quarry and sta- tionary plant.	Yellow Medicine.
Ortonville Stone Co --	P.O. Box 829 Sioux Falls, S. Dak. 57102	-----do -----	Big Stone.
J. L. Shiely Co -----	1101 North Snelling Ave. St. Paul, Minn. 55108	-----do -----	Stearns.
<b>Limestone and dolomite:</b>			
Biesanz Stone Co., Inc.	P.O. Box 768 Winona, Minn. 55987	-----do -----	Winona.
Bryan Rock Products, Inc.	Box 215 Shakopee, Minn. 55379	Quarries; station- ary and portable plants.	Scott and Washington.
Hector Construction Co., Inc.	Box 410 Caledonia, Minn. 55921	Quarries and portable plants.	Houston and Winona.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577	Quarry and sta- tionary plant.	Dakota.
Lundin Construction Co.	1905 Third Ave. Mankato, Minn. 56001	-----do -----	Blue Earth.
Mankato Aglime & Rock Co.	P.O. Box 254 Mankato, Minn. 56001	-----do -----	Do.
Mankato Stone Center, a division of the Babcock Co.	Box 3088 Mankato, Minn. 56001	Quarries and sta- tionary plants.	Blue Earth and Le Sueur.
Osmundson Bros -----	Adams, Minn. 55909	Quarries and portable plant.	Mower.
Quarve & Anderson Co.	Route 3, Box 27 Rochester, Minn. 55901	Quarries and portable plants.	Dodge, Fillmore, Olmsted, Wabasha, Winona.
River Warren Aggre- gates, Inc.	Lakeville, Minn. 55044	Quarry and sta- tionary plant.	Scott.
Roverud Construction, Inc.	159 West Main St. Spring Grove, Minn. 55974	Quarries and portable plants.	Fillmore and Houston.
J. L. Shiely Co -----	1101 North Snelling Ave. St. Paul, Minn. 55108	Quarries and sta- tionary plants.	Scott and Washington.
Vetter Stone Co -----	Route 5 Mankato, Minn. 56001	Quarries and sta- tionary plant.	Blue Earth and Le Sueur.
<b>Quartzite:</b>			
Jasper Stone Co -----	Jasper, Minn. 56144	Quarry and sta- tionary plant.	Rock.
New Ulm Quartzite Quarries, Inc.	Route 3, Box 75 New Ulm, Minn. 56073	-----do -----	Nicollet.
<b>Traprock (basalt):</b>			
Arrowhead Blacktop Co.	P.O. Box 6568 Duluth, Minn. 55806	-----do -----	St. Louis.
Ulland Bros., Inc -----	Box 340 Cloquet, Minn. 55720	Quarry and port- able plant.	Do.
<b>Sulfur, recovered elemental:</b>			
Koch Refining Co -----	Box 3596 St. Paul, Minn. 55101	Elemental sulfur recovered as a byproduct of oil refining.	Dakota.
Northwestern Refining Co., a division of Ashland Oil, Inc.	P.O. Drawer 9 St. Paul Park, Minn. 55071	-----do -----	Washington.
<b>Vermiculite, exfoliated:</b>			
Construction Products Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Processing plant	Hennepin.
Diversified Insulation, Inc.	P.O. Box 188 Hamel, Minn. 55340	-----do -----	Do.
MacArthur Co -----	936 Raymond Ave. St. Paul, Minn. 55114	-----do -----	Ramsey.



# 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 John L. Reuss<sup>1</sup> and Charles L. Reading<sup>2</sup>

Value of mineral production in Mississippi reached \$410.0 million in 1975, the highest value ever attained, and was 5% greater than the 1974 mineral production value of \$391.2 million. Petroleum (crude) and natural gas constituted 85% of the total value. Although production of both petroleum and natural gas was lower than in 1974, average unit values increased 9% for petroleum and 68% for natural gas. Value of all other mineral production, excluding petroleum and natural gas, increased \$4.6 million and was 8% higher than in 1974.

Because of the sustained demand for mineral fuels, drilling activity remained near the record highs established during 1974. At least 21 new oil and gas discoveries were confirmed during 1975. Natural gas reserves in Mississippi increased in 1975. Development drilling of the recently discovered Corrine field in Monroe, Clay, and Lowndes Counties indicated gas reserves of 200 to 500 billion cubic feet. Exploration drilling in the Lower Cretaceous trend of the Interior Salt Basin yielded two major gasfield discoveries during 1975.

Considerable interest in the lignite deposits of the Wilcox formation developed during 1975. Several energy-producing companies, including Phillips Petroleum Co., Tenneco Oil Co., and Consolidation Coal Co. leased approximately 250,000 acres of potential lignite resource lands in Lauderdale, Kemper, and Neshoba Counties. This activity was accelerating as the year came to a close, and Consolidation Coal estab-

lished a regional exploration office at Meridian.

Mississippi Power and Light Co. continued construction on the first of two 1,250,000-kilowatt nuclear generating units located in Claiborne County. Construction of the second unit has been delayed for 2 years because of financing difficulties. The first unit is scheduled to begin operations during 1980. Mississippi Power Co. also experienced financing difficulties and announced a 1-year delay in the construction of its two 500,000-kilowatt fossil-fuel-fired generating units in Jackson County. Scheduled completion dates for these two units are 1978 and 1980.

**Employment.**—Mississippi suffered substantial employment losses during 1975, and unemployment rose to the highest level since estimates were begun in 1960. According to the Mississippi Employment Security Commission, the nonagricultural labor force reported a decline of 4% from that of the previous year. Employment in the mining industry fell 2% in 1975 after recording a 5% rise during the previous year. A slowdown in the sand and gravel sector was primarily responsible for this slight decline.

**Legislation and Government Programs.**—A permit to install a 24-inch outfall line in Bay St. Louis, Miss., was issued to E. I. du Pont de Nemours & Co., Inc., by the Mobile District of the U.S. Army Corps of Engineers. The line will be installed to

<sup>1</sup> State Liaison Officer, Bureau of Mines, Jackson, Miss.

<sup>2</sup> Mineral specialist, Division of Interfuels Studies.

Table 1.—Mineral production in Mississippi<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ----- thousand short tons--	2,013	\$10,468	1,592	\$10,605
Lime ----- do-----	70	1,393	53	1,060
Natural gas ----- million cubic feet--	78,787	23,242	74,345	36,875
Petroleum (crude) ----- thousand 42-gallon barrels--	50,779	309,753	46,614	310,346
Sand and gravel ----- thousand short tons--	14,439	19,487	14,372	23,098
Stone ----- do-----	1,719	2,572	1,629	2,730
Value of items that cannot be disclosed:				
Cement, magnesium compounds, and natural gas liquids -----	XX	24,240	XX	25,295
Total -----	XX	391,155	XX	410,009
Total 1967 constant dollars -----	XX	184,938	XX	p 162,364

p Preliminary. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

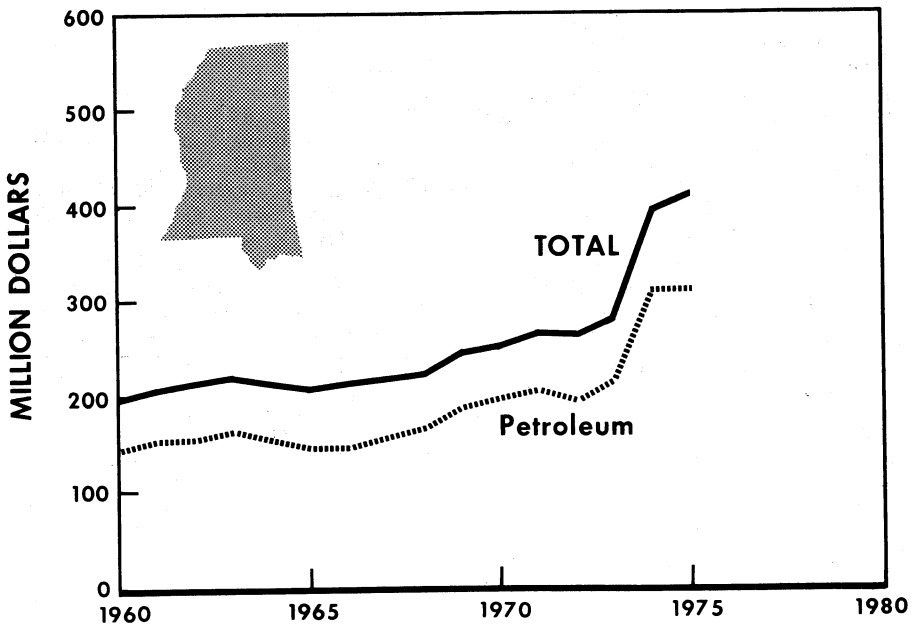


Figure 1.—Value of petroleum and total value of mineral production in Mississippi.

Table 2.—Value of mineral production in Mississippi, by county<sup>1,2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams	\$28,730	\$29,800	Petroleum, sand and gravel, natural gas, natural gas liquids.
Alcorn	W	W	Clays.
Amite	5,509	W	Petroleum, natural gas.
Benton	--	W	Clays.
Bolivar	W	W	Sand and gravel.
Calhoun	W	W	Natural gas.
Carroll	W	W	Sand and gravel, clays.
Chickasaw	W	W	Natural gas.
Clarke	64,921	W	Petroleum, natural gas, natural gas liquids.
Clay	837	794	Sand and gravel, natural gas, stone, petroleum.
Copiah	3,089	4,724	Sand and gravel.
Covington	650	1,229	Petroleum, natural gas.
De Soto	W	W	Sand and gravel.
Forrest	2,845	2,944	Sand and gravel, natural gas, petroleum, clays.
Franklin	9,937	W	Petroleum, natural gas.
George	W	125	Sand and gravel.
Greene	986	1,333	Petroleum, natural gas.
Grenada	W	W	Sand and gravel.
Hancock	289	384	Natural gas, petroleum.
Harrison	22	52	Sand and gravel.
Hinds	2,194	2,620	Petroleum, clays, natural gas.
Holmes	1,483	2,429	Sand and gravel, petroleum, natural gas.
Humphreys	87	220	Petroleum, natural gas.
Itawamba	893	W	Clays, natural gas, sand and gravel.
Jackson	W	W	Magnesium compounds, lime.
Jasper	62,077	61,553	Petroleum, natural gas, natural gas liquids.
Jefferson	1,103	1,046	Petroleum, natural gas.
Jefferson Davis	3,264	4,835	Natural gas, petroleum, sand and gravel.
Jones	13,764	15,823	Petroleum, natural gas, clays.
Kemper	W	W	Clays.
Lamar	46,804	45,873	Petroleum, natural gas.
Lauderdale	--	W	Clays.
Lee	W	W	Do.
Leflore	W	W	Petroleum.
Lincoln	7,607	7,682	Petroleum, natural gas, clays, sand and gravel.
Lowndes	W	14,106	Cement, sand and gravel, stone, clays.
Madison	2,091	2,455	Petroleum, natural gas.
Marion	4,741	6,422	Natural gas, petroleum, sand and gravel.
Marshall	413	W	Clays.
Monroe	4,782	6,272	Clays, sand and gravel, natural gas, petroleum.
Noxubee	W	744	Clays, stone.
Oktibbeha	W	W	Natural gas.
Panola	W	W	Clays.
Pearl River	340	264	Natural gas, petroleum.
Perry	413	517	Petroleum, sand and gravel, natural gas.
Pike	2,958	3,276	Do.
Prentiss	W	7	Clays.
Quitman	W	W	Do.
Rankin	11,457	15,262	Natural gas, cement, petroleum, stone.
Scott	581	431	Petroleum, natural gas.
Simpson	2,332	3,042	Do.
Smith	11,303	11,586	Petroleum, natural gas, natural gas liquids, clays.
Stone	W	W	Sand and gravel.
Sunflower	34	33	Clays.
Tate	75	W	Sand and gravel.
Tippah	W	W	Clays.
Tishomingo	W	W	Stone, sand and gravel.
Walthall	8,900	9,586	Natural gas, petroleum, sand and gravel.
Warren	W	W	Cement, sand and gravel, stone.
Washington	W	W	Sand and gravel.
Wayne	27,542	29,239	Petroleum, natural gas, stone.
Wilkinson	7,986	7,729	Petroleum, natural gas.
Winston	W	W	Clays.
Yalobusha	W	W	Sand and gravel.
Yazoo	16,663	18,462	Petroleum, sand and gravel, natural gas.
Undistributed <sup>3</sup>	31,452	97,124	
<b>Total<sup>4</sup></b>	<b>391,155</b>	<b>410,009</b>	

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

<sup>1</sup> The following counties were not listed because no production was reported: Attala, Choctaw, Claiborne, Coahoma, Issaquena, Lafayette, Lawrence, Leake, Montgomery, Neshoba, Newton, Pontotoc, Sharkey, Tallahatchie, Tunica, Union, and Webster.

<sup>2</sup> The value of petroleum and natural gas is based on an average price per barrel and cubic foot, respectively, for the State.

<sup>3</sup> Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.



Table 3.—Indicators of Mississippi business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands--	935.0	904.5	- 3.3
Unemployment -----do-----	38.8	64.6	+ 66.5
<b>Employment (nonagricultural):</b>			
Mining -----do-----	6.3	6.2	- 1.6
Manufacturing -----do-----	219.3	198.0	- 9.7
Contract construction -----do-----	44.6	36.1	- 19.1
Transportation and public utilities -----do-----	36.1	34.4	- 4.7
Wholesale and retail trade -----do-----	132.2	131.5	- 1.3
Finance, insurance, real estate -----do-----	27.1	27.5	+ 1.5
Services -----do-----	85.8	87.4	+ 1.9
Government -----do-----	142.7	146.2	+ 2.5
Total nonagricultural employment -----do-----	695.2	667.3	- 4.0
<b>Personal income:</b>			
Total -----millions--	\$8,955	\$9,504	+ 6.1
Per capita -----do-----	\$3,837	\$4,052	+ 5.6
<b>Construction activity:</b>			
Number of private and public residential units authorized--	7,179	5,235	- 27.1
Value of nonresidential construction -----millions--	\$83.9	\$73.5	- 12.4
Value of State road contract awards -----do-----	\$122.9	\$197.0	+ 60.3
Shipments of portland and masonry cement to and within Mississippi -----thousand short tons--	977	869	- 11.1
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$391.2	\$410.0	+ 4.8
Value per capita, resident population -----do-----	\$167.59	\$175.14	+ 4.5
Value per square mile -----do-----	\$8,197.56	\$8,592.69	+ 4.8

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Table 4.—Wage-and-salary workers in petroleum production, refining, and related industries

Year	Crude petroleum and natural gas production	Petroleum refining <sup>1</sup>	Pipeline transportation (except natural gas)	Gas utilities	Retail filling stations	Chemicals manufactured as byproducts of petroleum or used in refining of petroleum <sup>2</sup>
1971 -----	5,738	1,000	181	2,187	5,115	411
1972 -----	5,764	1,038	182	2,225	5,429	397
1973 -----	5,131	1,006	177	2,236	5,766	459
1974 -----	5,295	1,119	170	2,192	5,216	482
1975 -----	5,555	1,270	167	2,219	5,165	643

<sup>1</sup> Employment in petroleum refineries and petrochemicals manufactured in petroleum refineries.

<sup>2</sup> Employment in petrochemical manufacturing facilities located outside petroleum refineries.

Source: Mississippi Employment Security Commission.

carry waste water discharged from a proposed titanium dioxide manufacturing plant. All concerned Federal, State, and local agencies concurred in this issuance.

The Gulf Regional Planning Commission conducted public hearings on the collection, treatment, and disposal of sanitary wastes in compliance with the Federal Water Pollution Control Act of 1972 (Public Law 92-500). The Mississippi Marine Resources Council initiated a preliminary coastal resources management pro-

gram in accordance with the Coastal Zone Management Act of 1972.

The Mississippi Geological, Economic, and Topographical Survey published the second book in its series of comprehensive investigations of the environmental geology of individual geographic areas.<sup>3</sup>

<sup>3</sup> Green, J. W., and S. C. Childress. Environmental Geology of the Madison, Ridgeland, Jackson, and Jackson S.E. Quadrangles, Hinds, Madison, and Rankin Counties, Mississippi. Miss. Geol. Econ. Topographical Survey Bull. 1975, 64 pp.

**Transportation.**—For the second consecutive year, there were no new transmission pipelines installed in Mississippi and only 110 miles of utility gas mains were added to the State's pipeline distribution system.

According to the American Gas Association (AGA), there were 17,056 miles of gas distribution and transmission pipelines in

Mississippi at yearend 1975. Included in this total were 9,257 miles of transmission pipelines, 7,623 miles of distribution mains, and 176 miles of field and gathering pipelines. There were 3,389 miles of pipelines for crude oil and refined products in the State, according to the latest Bureau of Mines triennial report on pipelines carrying crude oil and refined products.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

The combined value of crude petroleum and natural gas production increased \$14 million and was 4% greater than the comparable 1974 value. The combined value of \$347 million was 85% of the State's total mineral production value.

Mississippi ranked 9th in crude oil production, 15th in natural gas production, and 20th in the production of natural gas liquids. Leading counties, in order of mineral fuel value, were Clarke, Jasper, Lamar, Adams, Wayne, and Yazoo.

Total drilling activity resulted in the completion of 451 wells: 83 were oil productive, 31 were gas productive, and 337 were dry holes. The number of holes drilled was 2% more than the number drilled during 1974. Of the 188 wells drilled in proved fields, there were 86 successes—60 oil and 26 gas producers. There were 23 successful oil and 5 successful gas ventures from a total of 263 exploratory wells drilled, a success ratio of 10.6%. Exploratory drilling accounted for 58.3% of all drilling activity in the State.

Exploratory and development drilling of oil and gas wells totaled 3,651,479 feet. The average depth of wells drilled in Mississippi during 1975 was 8,096 feet, slightly deeper than the average of 7,956 feet recorded in 1974. As of December 31, 1975, approximately 2,946 oil wells were producing an average of 42.5 barrels per day of crude oil, a decrease of 2.9 barrels per day from that reported for 1974.

According to the Mississippi State Oil and Gas Board, 8 gas pools and 17 oil pools were discovered during the year. Significant discoveries were reported from all five of the geologic intervals used to

classify the productive formations in Mississippi. Ten of the oil pool discoveries occurred in southwestern Mississippi in Tertiary (Eocene) sediments of the Wilcox formation, at depths ranging from 4,000 to 7,000 feet. Drilling in the Upper Cretaceous trend yielded only one new oil pool from the Lower Tuscaloosa formation at a depth of approximately 11,000 feet, in Lincoln County. Drilling in the Lower Cretaceous trend increased 66% over that of 1974, and four new gas pools were discovered. The two most significant gasfield discoveries were (Seminary field) from the Hosston formation in Covington County and (West Mount Olive field) from the Sligo formation in Smith County. Drilling in the Jurassic trend, principally the Smackover and Cotton Valley, yielded two oil pool discoveries, in Jones and Jasper Counties. Paleozoic drilling activity declined slightly from that in 1974; however, four new gas pools were located. The most significant Paleozoic development was in the Corrine field, located in Monroe, Clay, and Lowndes Counties.

According to the Mississippi State Oil and Gas Board, there were 463 oil pools and 87 gas pools producing from 465 fields in the State. Producing wells totaled 3,076, an increase of 1% from those at yearend 1974.

Considerable interest has developed in leasing the lignite deposits of the Wilcox formation located in Lauderdale, Kemper, and Neshoba Counties and was accelerating as the year came to a close. During 1975, an estimated 250,000 acres of potential lignite resource lands were leased by four major energy producers and Consolidation Coal had established a regional exploration office at Meridian.

Table 5.—Mississippi: Oil and gas well drilling completions, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Adams	23	--	42	10	--	59	134	816,817
Amite	4	--	3	--	--	13	20	210,986
Calhoun	--	--	--	--	--	1	1	6,503
Chickasaw	--	--	--	--	--	2	2	6,470
Clarke	8	--	2	--	--	6	16	169,243
Clay	--	4	--	--	--	2	6	35,671
Covington	1	1	1	--	1	3	7	108,782
Forrest	--	--	--	--	--	1	1	11,515
Franklin	10	--	10	4	--	34	58	375,165
George	--	--	--	--	--	2	2	39,059
Greene	--	--	1	--	--	2	3	36,979
Grenada	--	--	--	--	--	1	1	4,725
Hancock	--	1	--	--	--	1	2	26,998
Hinds	--	--	--	1	--	2	3	21,418
Holmes	--	--	--	--	--	1	1	11,705
Issaquena	--	--	--	--	--	1	1	8,972
Itawamba	--	--	2	--	--	1	1	7,951
Jasper	1	--	2	2	--	3	5	236,407
Jefferson	--	--	3	--	--	11	16	132,346
Jefferson Davis	--	2	1	--	1	17	20	67,182
Jones	3	1	--	--	1	2	7	90,379
Lafayette	--	--	--	--	--	1	1	5,000
Lamar	2	--	--	--	--	1	2	17,950
Lauderdale	--	--	--	--	--	1	1	10,200
Lawrence	--	--	--	--	--	1	1	19,460
Lee	--	--	--	--	--	1	1	2,286
Lincoln	1	--	8	1	--	3	13	140,209
Lowndes	--	--	--	--	--	1	1	5,646
Madison	--	--	--	--	--	1	1	11,996
Marion	--	--	--	--	--	3	3	37,255
Monroe	--	12	4	--	--	7	23	102,313
Noxubee	--	--	--	--	--	1	1	12,020
Perry	--	1	--	1	--	--	2	31,496
Pike	--	--	--	--	--	3	3	33,373
Pontotoc	--	--	--	--	--	1	1	2,349
Rankin	--	--	--	--	1	--	1	22,250
Scott	--	--	--	--	--	1	1	11,400
Sharkey	--	--	--	--	--	2	2	11,451
Simpson	--	1	--	--	--	--	1	13,820
Smith	--	--	--	--	--	3	3	55,623
Tippah	--	--	--	--	--	1	1	4,213
Walthall	--	3	3	--	1	5	12	152,603
Washington	--	--	--	--	--	1	1	8,518
Wayne	2	--	4	--	--	2	8	70,769
Wilkinson	3	--	16	4	--	30	53	401,624
Yazoo	2	--	--	--	--	2	4	42,382
Total	60	26	102	23	5	235	451	3,651,479

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

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

Commodity	Proved reserves Dec. 31, 1974	Changes in proved reserves due to extensions and discoveries in 1975	Proved reserves Dec. 31, 1975 (production deducted)	Changes from 1974 (percent)
Crude oil ----thousand barrels--	261,408	4,216	231,158	-11.6
Natural gas liquids thousand barrels--	12,593	3,143	15,170	+20.5
Natural gas--million cubic feet--	1,079,420	210,678	1,207,627	+11.9

Source: American Petroleum Institute and American Gas Association.

**Natural Gas.**—Natural gas production in Mississippi decreased slightly in 1975, continuing a sustained downward trend begun in 1964. Marketed natural gas volume was 74.3 billion cubic feet, a decrease of 6% from the 78.8 billion cubic feet recorded in 1974. Total value of marketed natural gas averaged 49.6 cents per thousand cubic feet (Mcf) in 1975, an increase of 68% from the 29.5 cents per Mcf established in 1974. Mississippi ranked 15th in the Nation in the marketed production of natural gas during 1975.

Of the 36 gas-producing counties, 8 counties supplied 79% of the natural gas produced in the State. In descending order of production, they were Rankin, Walthall, Marion, Jefferson Davis, Jasper, Clarke, Monroe, and Lamar. During the year, the number of gas-producing counties decreased by two with the deletion of Copiah and Leflore.

Contrary to the national downward trend, the natural gas reserves in Mississippi increased in 1975. According to AGA, estimated gas reserves were 1,207.6 billion cubic feet as of December 31, 1975, a 12% increase from yearend 1974. Because of this increase in reserves, the reserve-to-production ratio increased to 16.3:1 from the 13.7:1 reported in 1974.

Eight new gas pools were discovered during the year according to the Mississippi State Oil and Gas Board. Several significant wells were completed in Mississippian sandstone zones of the Paleozoic trend in the Black Warrior Basin in northern Mississippi. During 1975, the R. L. Burns Corp. and the Triad Oil and Gas Co. completed 13 gas wells in the Corrine field of Monroe, Clay, and Lowndes Counties. At yearend, this field had 14 gas wells in multiple Mississippian sandstones at depths of 5,100 to 5,700 feet with reserves estimated at 200 to 500 billion cubic feet.

Drilling in the Lower Cretaceous increased from 45 tests in 1974 to 75 tests in 1975. This increase was a result of the 1974 Florida Gas Exploration Co.'s discovery of the Bassfield field from the Hosston sandstone formation in Jefferson Davis County. The Bassfield discovery was the first significant gas reservoir reported from the Hosston formation, and has stimulated interest for other gas-bearing sandstone beds in the Sligo and Hosston formations throughout the Mississippi section of the Interior Salt Basin.

Florida Gas Exploration Co. continued its successful exploration program during 1975 with the discovery of the Seminary field in Covington County. This discovery well is a gas-condensate producer from the Hosston formation, at a depth of 14,480 feet. Another major Lower Cretaceous gas-field was discovered by the Pruet and Hughes Co. and the Aquitaine Co. from the Sligo formation at a depth of 13,660 feet in Smith County.

Underground storage of gas was at four locations: Amory field in Monroe County, Jackson Dome in Rankin and Hinds Counties, Eminence Dome in Covington County, and Muldon field in Monroe County. According to AGA, these four storage reservoirs contained 65,465 million cubic feet of gas on December 31, 1975.

**Natural Gas Liquids.**—Mississippi ranked 20th in the Nation during 1975 in natural gas liquids production. Reserves of natural gas liquids, as of December 31, 1975, increased 3.14 million barrels, or 21% from those at yearend 1974. According to AGA, Mississippi contained 0.24% of the Nation's reserves of natural gas liquids.

According to the Oil and Gas Journal annual survey of natural gas plants,<sup>4</sup> the eight plants operating in Mississippi during 1975 had a total capacity of 561.7 million cubic feet per day and processed an average of 229.5 million cubic feet per day. The production of natural gas liquids increased 13% over that in 1974, but the volume of gas processed increased 82%. This decrease in yield per unit volume of gas processed was the result of treating leaner gases.

Operators of the underground liquefied petroleum gas storage facilities in the Petal salt dome, Forrest County, indicated no significant change in the existing storage capacity of 6.75 million barrels of propane and 177,000 barrels of butane-propane mix reported at yearend 1974.

**Petroleum.**—Mississippi ranked ninth in crude petroleum production and accounted for approximately 2% of the U.S. output in 1975. State production of 46.6 million barrels of crude petroleum was valued at \$310 million, an average unit value of \$6.66 per barrel and an increase of 9% over the average unit value of \$6.10 per barrel established in 1974. Seven counties each pro-

<sup>4</sup> Oil and Gas Journal. 1976 Survey of Gas Processing Plants. V. 74, No. 27, July 5, 1976, p. 68.

duced more than 2 million barrels of crude petroleum, and they accounted for 81% of the total production. These counties, in descending order of production, were Jasper, Clarke, Lamar, Wayne, Adams, Yazoo, and Jones. Saltwater produced in association with crude petroleum production was 235 million barrels, an average of 5.1 barrels of water for each barrel of petroleum.

According to API estimates, proved crude oil reserves as of December 31, 1975, were 231,158 million barrels, 30 million barrels less than at yearend 1974. The crude oil reserve-to-production ratio was 5.00:1, ap-

proximately the same as reported during 1974.

According to the Oil and Gas Journal annual refining survey, crude oil refining capacity of the five State refineries was 329,500 barrels per calendar day.<sup>5</sup> This is an increase of 14% in the State's refining capacity from that reported at yearend 1974, and is the result of a 40,000-barrel-per-day two-stage crude distillation unit installed at the Standard Oil of Kentucky refinery at Pascagoula.

<sup>5</sup> Oil and Gas Journal, 1976 Annual Refining Survey, V. 74, No. 13, Mar. 29, 1976, p. 143.

Table 7.—Mississippi: Crude oil production, indicated demand, and stocks in 1975, by month  
(Thousand 42-gallon barrels)

Month	Production	Indicated demand <sup>1</sup>	End-of-month stocks originating in Mississippi
January	4,040	3,925	2,706
February	3,688	3,274	3,120
March	4,032	4,242	2,910
April	3,842	3,484	3,268
May	3,872	4,131	3,009
June	3,833	4,098	2,744
July	3,952	3,778	2,918
August	3,936	4,348	2,506
September	3,791	3,758	2,539
October	3,960	4,248	2,251
November	3,781	3,516	2,516
December	3,860	4,053	2,323
Total:			
1975	46,587	46,855	XX
1974	50,779	51,499	XX

XX Not applicable.

<sup>1</sup> Calculated from monthly production and changes in stocks.

Table 8.—Mississippi: Crude petroleum production, by field  
(Thousand 42-gallon barrels)

Field	1974	1975	Cumulative through Dec. 31, 1975
Baxterville	7,536	6,693	173,735
Bay Springs	1,537	1,322	27,474
Brookhaven	709	593	69,046
Bryan	660	554	23,418
Davis	1,534	1,349	8,097
East Euclutta	1,403	1,391	40,546
East Heidelberg	3,576	3,372	80,956
West Heidelberg	1,453	1,405	38,006
Lake Como	774	734	3,372
West Nancy	1,173	942	8,543
Pachuta Creek	3,651	3,036	27,274
Quitman Field	765	654	14,621
Quitman Bayou	1,376	1,359	15,518
Soso	891	743	53,841
Tinsley	2,549	2,548	198,510
Other fields	21,192	19,892	763,465
Total	50,779	46,587	1,546,422

Source: Mississippi State Oil and Gas Board.

**Petrochemicals.**—Mississippi Chemical Corp. was constructing a 1,150-ton-per-day ammonia plant and a 1,200-ton-per-day urea plant to expand its fertilizer-manufacturing facilities at Yazoo City. Mississippi Chemical has also entered into a joint exploration agreement with Amerada Hess to search for a captive source of natural gas for feedstock and energy requirements.

### NONMETALS

The combined production value of nonmetals and natural gas liquids was \$62.8 million and represented 15% of the State's mineral production. This value of nonmetals, including natural gas liquids production, represents an 8% increase over comparable 1974 values.

**Cement.**—Portland and masonry cements were produced at three plants using the wet process. Raw materials used in making cement were limestone, marl, oyster shells, and gypsum. Shipments of portland cement in 1975 were 1% less than in 1974, while shipments of masonry cement decreased 6% during the same period. The average unit value of portland and masonry cement increased approximately 12% during 1975.

**Clays.**—Total clays produced in Mississippi amounted to 1,592,298 tons, a 21% decrease from 1974 production. However, the average unit value increased 28%. Common clay production decreased 23% but accounted for 72% of the total clay output. The production of ball clay and fuller's earth decreased 6% from that of the previous year, and bentonite output decreased 21%.

Clays were mined from 32 pits in 22 counties. The leading producing counties, in descending order of output, were Noxubee, Hinds, Monroe, and Benton. Produc-

tion from these four counties accounted for 61% of the State total. Common clay, used primarily for brick, lightweight aggregates, flue lining, drain tile, and sewer pipe, was mined in 16 counties. Bentonite was mined in three counties. Fuller's earth was produced in Tippah County, and ball clay, in Panola and Quitman Counties.

**Lime.**—Corchem, Inc., produced quicklime at Pascagoula in Jackson County from dolomite quarried in Alabama. Production from this operation decreased approximately 10% from that in the comparable 1974 period.

**Magnesium Compounds.**—Production of magnesium compounds used in the manufacture of refractories decreased 36% from the 1974 level.

**Perlite.**—Johns-Manville Perlite Corp. continued to produce expanded perlite for roofing-insulation products at its Adams County facilities. Production in 1975 decreased approximately 31% from that of the previous year.

**Sand and Gravel.**—Production was reported from 61 individual operations located in 27 counties. Output was 14.37 million tons, essentially unchanged from that of the previous year; however, the average unit value increased 19% to \$1.61 per ton.

The leading producing counties, in descending order of output, were Copiah, Holmes, Monroe, Carroll, and Lowndes. These five counties accounted for 57% of the total State production.

The output of processed sand totaled 3,165,000 tons, and processed gravel totaled 7,276,000 tons. The production of unprocessed sand and gravel amounted to 3,931,000 tons. The amount of sand and gravel used for publicly funded projects increased 94% from that used in the previous year.

Table 9.—Mississippi: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Bentonite		Ball clay and fuller's earth		Common clay		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1971 -----	281	3,396	137	2,966	1,860	2,139	2,278	8,501
1972 -----	278	3,388	144	2,943	1,497	1,506	1,919	7,837
1973 -----	286	3,607	166	3,390	1,623	2,085	2,075	9,082
1974 -----	334	4,599	187	3,822	1,492	2,047	2,013	10,468
1975 -----	264	4,607	176	4,024	1,152	1,975	1,592	<sup>1</sup> 10,605

<sup>1</sup> Data do not add to total shown because of independent rounding.

Table 10.—Mississippi: Construction and industrial sand and gravel sold or used by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	3,721	4,832	3,165	4,775
Gravel -----	8,113	13,376	7,276	14,085
Unprocessed: Sand and gravel -----	2,605	1,251	3,931	2,740
Industrial:				
Sand -----	W	W	W	W
Gravel -----	--	--	--	--
Total -----	14,439	19,459	14,372	<sup>2</sup> 21,601

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

Table 11.—Mississippi: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction--	2,376	3,554	2,988	5,350
Highway and bridge construction -----	684	1,092	612	1,241
Other construction (dams, waterworks, airports, etc.) -----	80	132	W	W
Concrete products (cement blocks, brick, pipe, etc.) -----	1,504	2,433	455	814
Bituminous paving (asphalt and tar paving) ----	845	1,405	1,122	2,210
Road base and subbase -----	2,926	4,299	890	1,960
Fill -----	12	24	37	43
Other -----	263	400	--	--
Unprocessed:				
Road base and subbase -----	1,771	927	518	394
Fill -----	76	58	180	125
Other -----	--	--	W	W
Industrial sand and gravel -----	W	W	W	W
Total -----	10,537	14,324	6,802	12,137

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

Table 12.—Mississippi: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction--	34	87	83	159
Highway and bridge construction -----	710	1,213	1,622	3,663
Other construction (dams, waterworks, airports, etc.) -----	126	195	181	365
Concrete products (cement blocks, brick, pipe, etc.) -----	79	153	W	4
Bituminous paving (asphalt and tar paving) ---	1,376	1,954	1,265	2,427
Road base and subbase -----	819	1,294	1,217	2,035
Fill -----	W	W	W	W
Other -----				
<b>Unprocessed:</b>				
Road base and subbase -----	758	267	2,874	2,022
Fill -----	--	--	328	287
Total -----	3,902	5,163	7,570	110,961

W Withheld to avoid disclosing individual company confidential data; included with "Other construction (dams, waterworks, airports, etc.)."

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Stone.**—Crushed and broken limestone was produced in Lowndes, Rankin, Tishomingo, Warren, and Wayne Counties. Marl was produced in Clay, Rankin, Noxubee, and Warren Counties. Stone output from the State's eight quarries totaled 1,628,538 tons. This was a decrease of 5% from the 1974 total. Average unit value for all stone increased 12% to \$1.68 per ton. Principal

uses of stone produced in Mississippi were for cement manufacture and agriculture.

**Sulfur.**—Recovery of sulfur from refinery and natural gases was reported from Clarke, Jackson, Lamar, and Rankin Counties. Because of an increase in the volume of sour natural gas treated, the total production of recovered sulfur increased 44% from that of the previous year.

Table 13.—Principal producers

Commodity and company	Address	Type of activity or producing field	County
<b>Cement:</b>			
Marquette Cement Manufacturing Co.	20 North Wacker Dr. Chicago, Ill. 60606	Plant -----	Rankin.
United Cement Co -----	P. O. Box 185 Artesia, Miss. 39736	---do -----	Lowndes.
Valley Cement Industries, Inc.	Box 22491 Jackson, Miss. 39205	---do -----	Warren.
<b>Clays:</b>			
Atlas Brick Co -----	P. O. Box 67 Shuqualak, Miss. 39361	3 mines -----	Noxubee.
Delta-Macon Brick and Tile Co., Inc.	RFD 3, Box 2 Macon, Miss. 39341	Mine and plant --	Do.
Filtrol Corp -----	3250 East Washington Blvd. Los Angeles, Calif. 90023	---do -----	Itawamba and Smith.
Holly Springs Brick and Tile Co., Inc.	Box 310 Holly Springs, Miss. 38635	---do -----	Marshall.
International Minerals and Chemical Corp.	P. O. Box 346A Aberdeen, Miss. 39730	Mine -----	Monroe.
Jackson Ready Mix Concrete, division of Delta Industries, Inc.	P. O. Box 1292 Jackson, Miss. 39205	---do -----	Hinds.
Tri-State Brick and Tile Co., Inc.	Box 9787 Jackson, Miss. 39206	Mine and plant ---	Do.
<b>Lime:</b>			
Corchem, Inc -----	Box 1707 Pascagoula, Miss. 39567	Plant -----	Jackson.



Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity or producing field	County
<b>Magnesium compounds:</b>			
Corhort Refractories Co.	1600 West Lee St. Louisville, Ky. 40212	Plant -----	Jackson.
<b>Petroleum (crude) and natural gas:</b>			
Amoco Production Co.	Box 591 Tulsa, Okla. 74102	Clear Springs ----- Collins ----- Dollar Lake ----- Dry Bayou ----- North Freewoods ----- Knoxville ----- North Knoxville ----- Quitman Bayou ----- Stringer ----- Zeigler Creek ----- East Heidelberg -----	Franklin. Covington. Leflore. Franklin. Do. Do. Do. Adams. Jasper. Franklin. Jasper.
Atlantic Richfield Co.	Box 2819 Dallas, Tex. 75221	Brookhaven ----- South Center Ridge.	Lincoln. Smith.
Chevron Oil Co., Western Div.	Box 599 Denver, Colo. 80201	Cranfield ----- Hub ----- Hub East ----- Knoxo ----- East Mallalieu ----- West Mallalieu ----- Mize ----- Pisgah ----- Puckett ----- Raleigh ----- Reedy Creek ----- Hazlit Creek ----- North Mud Creek ----- Davis -----	Adams and Franklin. Marion. Do. Walthall. Lincoln. Do. Smith. Rankin. Rankin and Smith. Simpson. Jones. Wilkinson. Do. Clarke.
Cities Service Oil Co.	Box 12026 Jackson, Miss. 39211	Baxterville ----- Bryan ----- East Fairview ----- Gillsburg ----- Gwinville ----- Hub ----- Hub East ----- Knoxo ----- Pistol Ridge ----- Sandy Hook ----- East Yellow Creek ----- North Carthage Point.	Lamar and Marion. Jasper and Jones. Adams. Amite. Jefferson Davis. Marion. Do. Walthall. Pearl River. Marion. Wayne. Adams.
Continental Oil Co.	Box 2197 Houston, Tex. 77001	Clear Springs ----- Courtland ----- Dexter ----- East Nancy ----- West Nancy ----- Baxterville -----	Franklin. Adams. Walthall. Clarke. Do. Lamar and Marion.
Exxon Co. U.S.A.	Box 2180 Houston, Tex. 77001	Bolton ----- Gwinville ----- Heidelberg ----- East Heidelberg ----- West Heidelberg ----- Pistol Ridge ----- Soso ----- East Yellow Creek ----- Tinsley -----	Hinds. Jefferson Davis. Jasper. Do. Do. Forrest and Pearl River. Jasper, Jones, Smith. Wayne. Yazoo.
Getty Oil Co.	Box 1404 Houston, Tex. 77001	Nancy -----	Clarke.
Gulf Oil Corp.	Box 1166 Pittsburgh, Pa. 15230	Pachuta Creek ----- Goodwater ----- Bay Springs ----- Tallahala Creek ----- East Tallahala Creek.	Do. Do. Jasper. Smith. Do.
Pennzoil Producing Co.	900 Southwest Tower Houston, Tex. 77002		
Placid Oil Co.	1401 Elm St. Dallas, Tex. 75202		
Shell Oil Co.	Shell Building 921 Common New Orleans, La. 70112		

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity or producing field	County
<b>Petroleum (crude) and natural gas—Continued</b>			
Skelly Oil Co -----	Box 1650 Tulsa, Okla. 74101	Bay Springs -----	Jasper.
Sun Oil Co -----	1608 Walnut St. Philadelphia, Pa. 19103	Goodwater -----	Clarke.
		Baxterville -----	Lamar.
		Diamond -----	Wayne.
		West Eucutta -----	Do.
		East Franklin -----	Franklin.
		East Heidelberg ---	Jasper.
		Kokomo -----	Walthall.
		Mantua -----	Adams.
		McComb -----	Pike.
		Mercer -----	Adams.
		Pistol Ridge -----	Forrest and Pearl River.
		Sandy Hook -----	Marion.
		Smithdale -----	Amite.
		Tom Branch -----	Franklin.
		West Yellow Creek.	Wayne.
		Baxterville -----	Lamar.
		Pachuta Creek ----	Clarke.
Texaco, Inc -----	Box 60252 New Orleans, La. 70150		
<b>Petroleum refineries:</b>			
Amerada Hess Corp., Hess Oil & Chemical Div.	One Hess Plaza Woodbridge, N.J. 07095	Purvis refinery ----	Calhoun.
Southland Oil Co -----	P. O. Box 328 Yazoo City, Miss. 39194	Sandersville refinery.	Jones.
		Lumberton refinery.	Lamar.
		Crupp refinery ----	Jackson.
		Pascagoula refinery.	Jackson.
Standard Oil Co. (Kentucky)	Box 1300 Pascagoula, Miss. 39567		
<b>Sand and gravel:</b>			
American Sand & Gravel Co.	Box 272 Hattiesburg, Miss. 39401	Stationary -----	Forrest.
Bacco Materials, Inc ---	P. O. Box 1054 West Point, Miss. 39773	----do -----	Clay and Monroe.
Blaine Gravel Co -----	Box 268 Crystal Springs, Miss. 39059	----do -----	Copiah.
J. J. Ferguson Sand & Gravel.	Box 318 Greenwood, Miss. 38930	----do -----	Carroll.
Green Bros. Gravel Co., Inc.	Route 4, Box 17 Franklinton, La. 70433	----do -----	Copiah.
Memphis Stone & Gravel Co.	Box 38269 Germantown, Tenn. 38138	----do -----	De Soto.
Petermann Gravel Corp.-	P. O. Box 161 Yazoo City, Miss. 39194	----do -----	Yazoo.
W. J. Runyon & Son, Inc.	3312 Oak St. Vicksburg, Miss. 39180	----do -----	Warren.
Traxler Gravel Co., division of Delta Industries, Inc.	Box 1292 Jackson, Miss. 39205	Stationary and dredge.	Copiah.
<b>Stone:</b>			
Marquette Cement Manufacturing Co.	20 North Wacker Dr. Chicago, Ill. 60606	Quarry -----	Rankin.
State Department of Agriculture and Commerce.	P. O. Box 352 West Point, Miss. 39773	----do -----	Clay.
Valley Cement Industries, Inc.	Box 22491 Jackson, Miss. 39205	----do -----	Warren.



# The Mineral Industry of Missouri

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

By Waldemar M. Dressel<sup>1</sup> and James A. Martin<sup>2</sup>

In 1975, the value of Missouri's mineral output showed a slight increase over that of 1974. The total value of the State's mineral and metal products was the highest value ever recorded by the State even though actual production of a number of mineral commodities had declined. Higher prices for most mineral products compensated for the decrease in demand.

Principal minerals produced, in order of value, were lead, cement, stone, iron ore,

zinc, coal, lime, copper, sand and gravel, and clays.

The Governor called attention to the importance of the mining and mineral resources industry of Missouri by proclaiming March 3 as Missouri Mining Day.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Rolla, Mo.

<sup>2</sup> Geologist and Chief, Mineral Resources Section, Department of Natural Resources, Division of Geology and Land Survey, Rolla, Mo. (formerly Missouri Geological Survey).

Table 1.—Mineral production in Missouri<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite -----thousand short tons..	177	\$3,386	171	\$3,989
Cement:				
Masonry -----do.---	75	2,434	65	2,110
Portland -----do.---	4,229	106,985	3,962	116,260
Clays <sup>2</sup> -----do.---	2,565	13,151	2,168	13,214
Coal (bituminous) -----do.---	4,623	29,383	5,638	48,054
Copper (recoverable content of ores, etc.) short tons..	12,665	19,580	14,258	18,308
Iron ore (usable) thousand long tons, gross weight..	1,866	W	2,273	W
Lead (recoverable content of ores, etc.) short tons..	562,097	252,944	515,958	221,862
Lime -----thousand short tons..	1,901	36,369	1,606	40,630
Natural gas -----million cubic feet..	33	10	30	10
Petroleum (crude)-----thousand 42-gallon barrels..	56	W	57	W
Phosphate rock -----thousand short tons..	35	W	35	W
Sand and gravel -----do.---	10,933	19,462	9,752	18,216
Silver (recoverable content of ores, etc.) thousand troy ounces..	2,387	11,244	2,525	11,161
Stone -----thousand short tons..	50,626	90,204	46,988	95,535
Zinc (recoverable content of ores, etc.) short tons..	91,987	66,047	74,867	58,396
Value of items that cannot be disclosed:				
Asphalt (native), clays (bentonite (1974), kaolin, and fuller's earth) and values indicated by symbol W -----	XX	39,850	XX	74,983
Total -----	XX	691,049	XX	722,728
Total 1967 constant dollars -----	XX	326,728	XX	P 236,200

<sup>P</sup> Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes bentonite (1974), fuller's earth, and kaolin; included with "Value of items that cannot be disclosed."

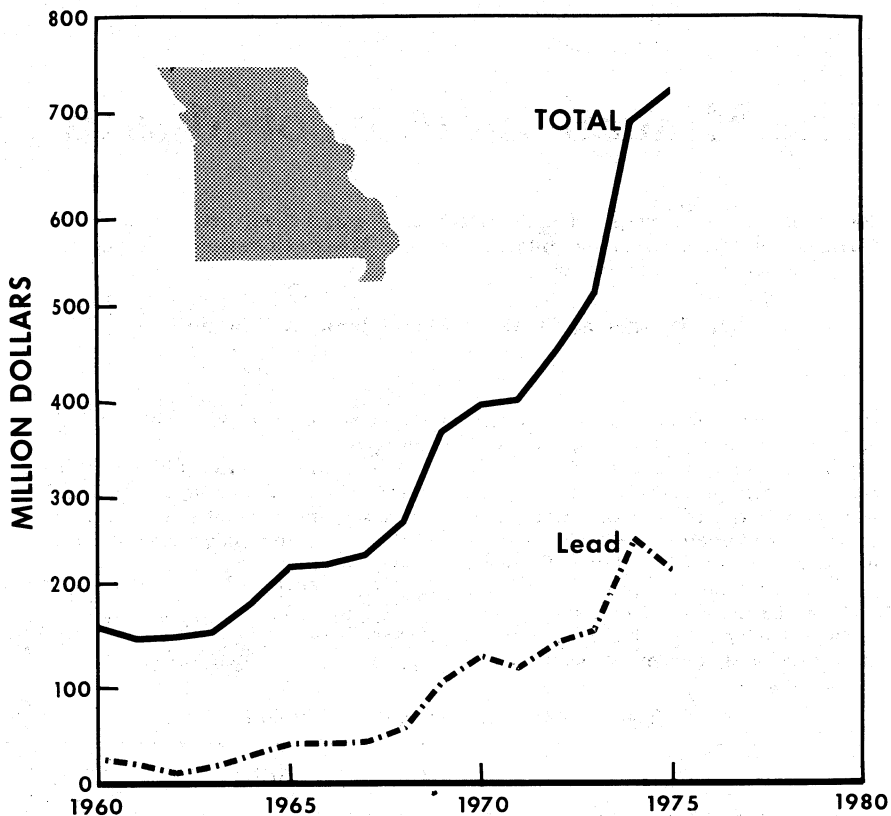


Figure 1.—Value of lead and total value of mineral production in Missouri.

Table 2.—Value of mineral production in Missouri, by county<sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adair -----	W	--	
Andrew -----	W	W	Stone.
Atchison -----	W	W	Petroleum.
Audrain -----	\$2,376	\$3,013	Clays.
Barry -----	W	W	Stone.
Barton -----	3,206	W	Coal, stone.
Bates -----	W	W	Do.
Benton -----	W	W	Stone.
Boone -----	2,426	W	Stone, sand and gravel, clays.
Buchanan -----	W	W	Stone.
Butler -----	W	W	Sand and gravel, stone, clays.
Caldwell -----	W	W	Stone, natural gas.
Callaway -----	3,421	W	Clays, stone, sand and gravel.
Camden -----	W	W	Stone, sand and gravel.
Cape Girardeau -----	W	10,669	Cement, stone, sand and gravel, clays.
Cass -----	1,369	W	Stone, petroleum.
Cedar -----	W	W	Stone.
Chariton -----	W	W	Stone, sand and gravel.
Christian -----	W	W	Stone.
Clark -----	W	W	Do.

See footnotes at end of table.

Table 2.—Value of mineral production in Missouri, by county <sup>1 2</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Clay	W	\$5,201	Stone, sand and gravel.
Clinton	\$634	W	Stone, natural gas.
Cole	W	W	Stone, sand and gravel.
Cooper	W	W	Do.
Crawford	6,576	W	Lead, copper, zinc, silver, clays, stone.
Dade	370	412	Stone.
Dallas	253	W	Stone, sand and gravel.
Daviess	W	1,765	Do.
De Kalb	233	274	Stone.
Douglas	415	W	Sand and gravel, stone.
Franklin	787	827	Stone, sand and gravel.
Gasconade	4,041	4,991	Clays, stone.
Gentry	W	475	Stone, sand and gravel.
Greene	7,128	W	Stone, lime.
Grundy	W	W	Stone, sand and gravel.
Harrison	1,700	W	Do.
Henry	W	W	Coal, stone.
Hickory	93	96	Stone.
Holt	W	W	Do.
Howard	W	W	Stone, coal, sand and gravel.
Howell	W	W	Stone, sand and gravel.
Iron	207,692	W	Lead, zinc, iron ore, copper, silver, stone, sand and gravel.
Jackson	20,824	W	Cement, stone, sand and gravel, petroleum.
Jasper	3,266	W	Stone, sand and gravel.
Jefferson	30,572	W	Cement, stone, sand and gravel, clays.
Johnson	W	564	Stone.
Knox	W	W	Do.
Laclede	W	253	Stone.
Lafayette	W	W	Sand and gravel, stone.
Lawrence	W	W	Stone.
Lewis	W	W	Sand and gravel, stone.
Lincoln	W	W	Stone, sand and gravel.
Livingston	W	W	Stone, clays, sand and gravel.
McDonald	--	W	Stone.
Macon	W	W	Coal.
Madison	W	W	Stone, sand and gravel.
Maries	W	W	Sand and gravel.
Marion	W	W	Stone.
Mercer	723	W	Do.
Miller	W	348	Stone, sand and gravel.
Moniteau	114	59	Stone.
Monroe	444	W	Clays.
Montgomery	2,316	W	Clays, stone, sand and gravel.
Newton	W	W	Stone.
Nodaway	966	W	Do.
Oregon	W	W	Sand and gravel, stone.
Osage	W	W	Stone, clays.
Ozark	--	W	Sand and gravel.
Pemiscot	108	242	Do.
Perry	W	W	Stone, sand and gravel.
Pettis	W	W	Stone.
Phelps	W	368	Stone, sand and gravel.
Pike	30,840	W	Cement, stone, clays, sand and gravel.
Platte	W	W	Stone, clays, sand and gravel.
Polk	275	342	Stone.
Pulaski	476	640	Sand and gravel, stone.
Putnam	697	W	Coal, stone.
Ralls	19,762	W	Cement, stone, clays.
Randolph	W	W	Coal, stone.
Ray	1,596	1,920	Stone.
Reynolds	118,067	W	Lead, zinc, copper, silver, sand and gravel.
Ripley	--	W	Sand and gravel.
St. Charles	2,814	3,204	Stone, sand and gravel, clays.
St. Clair	W	W	Stone.
St. Francois	W	W	Lime, stone.
Ste. Genevieve	38,892	W	Lime, stone, sand and gravel.
St. Louis	35,151	W	Cement, stone, sand and gravel, clays, petroleum.
Saline	1,609	2,574	Stone.
Scotland	W	W	Do.
Scott	W	W	Stone, clays, sand and gravel.
Shannon	W	W	Stone.
Shelby	W	W	Do.
Stoddard	765	750	Sand and gravel.
Stone	W	W	Stone.
Taney	W	W	Stone, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Missouri, by county<sup>1 2</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Texas -----	\$144	W	Stone.
Vernon -----	2,232	W	Coal, stone, native asphalt, petroleum.
Warren -----	W	W	Clays, stone.
Washington -----	59,157	\$80,060	Iron ore, lead, barite, zinc, copper, silver, phosphate rock, sand and gravel.
Wayne -----	749	W	Stone, sand and gravel.
Webster -----	176	181	Stone.
Worth -----	W	W	Do.
Wright -----	W	W	Do.
Undistributed <sup>3</sup> -----	75,562	603,495	
Total <sup>4</sup> -----	691,049	722,728	

<sup>1</sup> Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

<sup>2</sup> The following counties are not listed because no production was reported: Bollinger, Carroll, Carter, Dent, Dunklin, Linn, Mississippi, Morgan, New Madrid, Schuyler, and Sullivan.

<sup>3</sup> Value of petroleum is based on an average price per barrel for the State.

<sup>4</sup> Includes value of stone that cannot be assigned to specific counties, and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Missouri business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands--	2,057.0	2,071.0	+0.6
Unemployment ----- do-----	95.0	142.0	+49.5
<b>Employment (nonagricultural):</b>			
Mining ----- do-----	8.6	8.5	-1.2
Manufacturing ----- do-----	450.0	399.9	-11.1
Contract construction ----- do-----	72.8	67.4	-7.4
Transportation and public utilities ----- do-----	127.3	121.7	-4.4
Wholesale and retail trade ----- do-----	418.5	406.4	-2.9
Finance, insurance, and real estate ----- do-----	95.7	93.2	-2.6
Services ----- do-----	304.9	305.7	+2
Government ----- do-----	312.7	315.8	+1.0
Total nonagricultural employment ----- do-----	1,790.5	1,718.6	-4.0
<b>Personal income:</b>			
Total ----- millions--	\$24,169	\$26,244	+8.6
Per capita ----- do-----	\$5,065	\$5,510	+8.8
<b>Construction activity:</b>			
Number of private and public residential units authorized -----	15,181	16,135	+6.3
Value of nonresidential construction ----- millions--	\$426.7	\$412.3	-3.4
Value of State road contract awards ----- do-----	\$209.0	\$185.0	-11.5
Shipments of portland and masonry cement to and within Missouri ----- thousand short tons--	1,758	1,674	-4.8
<b>Mineral production value:</b>			
Total crude mineral value ----- millions--	\$691.0	\$722.7	+4.6
Value per capita, resident population ----- do-----	\$144.81	\$151.61	+4.7
Value per square mile ----- do-----	\$9,916.61	\$10,371.21	+4.6

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

St. Joe Minerals Corp. donated 8,500 acres of land in St. Francois County to the State of Missouri for use as a State park. The Governor said that "This is by far the largest land donation made to our State by private industry for park resources development." The property, which will be named St. Joe State Park, is in the Flat

River area of the Old Lead Belt on which St. Joe discontinued mining in 1970. The Governor called the donation an "enduring gesture which unites two of Missouri's finest assets—its State park system and the mineral industry—in a living memorial to be used and appreciated by present and future generations."

The annual "study tour" sponsored by the Missouri Chamber of Commerce and Central Missouri State University to teach instructors about free enterprise, gave instructors the opportunity to view several aspects of the mining industry. The Prairie Hill mine of Peabody Coal Co., the Dundee Cement Co. plant at Clarksville, and the A. P. Green Refractory Co. plant at Mexico were among the industries toured. The Mining Industry Council of Missouri and a Bureau of Mines representative also spoke to the group.

In October, a symposium on the Viburnum Trend—The Geology and Ore Deposits of Selected Mines—sponsored by the Missouri Department of Natural Resources, Division of Geology and Land Survey; the Society of Economic Geologists; AMAX, Inc.; Homestake Mining Co.; Cominco American, Inc.; Dresser Industries Inc.; Ozark Lead Co.; and St. Joe Minerals Corp. received national and international attention. More than 300 geologists, mining engineers, and students attended the symposium and toured four of the district's seven mines.

**Labor, Employment, and Safety.**—According to the Division of Employment Security, Missouri Department of Labor and Industrial Relations, the mining industry employed 8,512 workers in 1975, a decrease compared with 8,545 in 1974. Employment in the coal industry reached 1,385 in 1975 compared with 1,298 in the previous year. Employment in the metal mining industry decreased to 3,108 compared with 3,182 in the previous year, and the nonmetal industry employed 3,840 in 1975 compared with 3,885 in 1974.

Cominco American, Inc.'s Magmont mine and mill worked a combined 434,450 man-hours in 1975 with a zero frequency of lost-time accidents. St. Joe Minerals Corp.'s Viburnum mine 27 worked 72,505 man-hours with zero frequency of lost-time accidents. These mines were honored at the annual meeting of the Missouri Mining Industry Council. Also awarded trophies were the Peabody Coal Co. shop for zero frequency and the Pea Ridge iron mine of Meramec Mining Co. for most improvement in safety during the year.

Annual reports of the Mining Enforcement and Safety Administration (MESA) and the Missouri Division of Mine Inspection showed two fatal accidents in Missouri during 1975 in underground iron mines,

two in open pit coal operations, and two in limestone operations.

At its 31st annual meeting, the Missouri Limestone Producers Association (MLPA) presented safety certificates to 19 award winners for no lost-time accidents in their operations from October 1, 1974, through September 30, 1975. Award-winning companies included Raid Quarries; Big Spring Quarries; Trager Quarries; Galloway Limestone; Griesemer Stone Co. (Chesapeake plant and E. Kearney plant No. 1); Kelly Lime and Rock Co.; Kayser Construction Co.; Magruder Limestone Co.; Martin Marietta Aggregates (Dougan quarry); Midwest Minerals, Inc.; Rush Quarries; Farmers Stone Products Co.; Williams Rock Co. (Montrose, Clinton, and Snyder mines); Gilliam Rock Co., Inc.; Hall and Riley Quarries and Construction Co.; Jeff-Cole Quarries; Midwest Pre-Cote Co. (Randolph quarry); Callaway Rock Quarry; and Morgans Materials. A new program added to MLPA's safety program in 1975 was a contest to determine which superintendent was doing the most to promote safety in his company's operation. Approximately 40 superintendents participated in this contest.

**Legislation and Government Programs.**—The wilderness area issue was of concern to the mining industry in Missouri. Four areas within the Clark National Forest in southern Missouri, comprising approximately 50,000 acres, were under consideration for wilderness areas. Although a number of applications for exploration permits and mineral leases were submitted and pending from previous years, none were issued on any national forest lands in Missouri during the year.

A bill to include "tar sands" (native asphalt) in western Missouri under the Land Reclamation Law with coal and barite was under consideration by the State legislature. This bill was supported by the Missouri Mining Industry Council as well as by other land-use interest groups.

An agriculture liming materials act, supported by the Missouri Limestone Producers Association, provided for sampling and analysis of limestones used for liming soils. Under this bill, which was pending at yearend, sampling and analysis of limestones for agricultural purposes would be done by the University of Missouri. A levy of \$0.04 per ton of agricultural lime-



**Table 4.—Missouri: Summary of mining acreages permitted in 1974 and 1975 by commodity**

Commodity	Acreage	
	1974	1975
Barite -----	196	178
Clays -----	143	84
Coal -----	2,069	2,018
Limestone -----	376	358
Sand and gravel -----	55	48
Total -----	2,839	2,686

stone sold would be used to pay for this activity.

The Federal Trade Commission order requiring Kennecott Copper Corp. to divest itself of Peabody Coal Co. of St. Louis attracted attention from numerous potential buyers. Proposals to purchase were reportedly received from the Tennessee Valley Authority, Cities Service Co., International Carbon and Minerals Corp., Energy Resources Corp. (a group of 44 electric utility cooperatives), and Utilities Corp. (a consortium of 13 private and public electric utilities and Utah International).

Female miners became legalized on July 18 when the Governor signed into law House bill 40, which provides that women in Missouri are no longer barred from working in underground mines. A woman had been employed "illegally" in one of Missouri's underground lead mines for over a year prior to the signing of the law.

**Environment.**—A tailings pond dike failure near Potosi allowed tons of mud and silt to enter nearby streams. Fish kills were reported on Mill Creek and Big River. Prompted by this mishap, barite producers met with Federal and State groups to exchange views on dam safety. A MESA representative pointed out that MESA was the only agency that had any regulatory authority over tailings dams and impoundments. MESA has a list of 13 hydrologic and hydraulic considerations that it uses to guide its inspections and enforcement of standards. A short course on dams, construction and watershed hydrology, which developed as a result of the meeting, received wide interest and attendance of representatives of various phases of the Missouri mining industry.

Noise in the working environment received increased interest in 1975. MESA

held a noncoal noise control conference in St. Louis to exchange ideas and technical information on noise control problems and techniques for solving these problems.

An accurate survey of land areas disturbed by mining was promoted by the Missouri Department of Natural Resources. The State Geologist set up a preliminary meeting in December with members of the Division of Geology and Land Survey, Missouri Mining Industry Council, Missouri Limestone Producers Association, Missouri Conservation Commission, Missouri Conservation Federation, University of Missouri, U.S. Department of Agriculture (Soil Conservation Commission and Forest Service), and the Bureau of Mines to set this project in motion. The reaction to the proposal indicated that the survey was much needed and that cooperation from all the represented agencies would be forthcoming.

The Nation's first industrial waste exchange was set up by the Missouri Department of Natural Resources and the St. Louis Regional Commerce and Growth Association. The exchange is designed to help conserve materials and, at the same time, eliminate air and waste pollution problems by finding uses for waste products. The program tries to match an industry producing a certain type of waste with an industry having a need for that waste.

Participants in a 3-day symposium in Kansas City heard discussions of all aspects of the utilization of underground mined-out space. Kansas City leads the Nation in the utilization of underground limestone mines for such "secondary" uses as manufacturing, warehousing, sales, office space, and most recently, development of a huge foreign trade zone. This is the ultimate in mined land reclamation. Needed minerals are obtained by mining, and usable space is developed that conserves energy because of limited heat losses, conserves building materials, and conserves land otherwise required for building sites.

**Exploration, Geologic Studies, and Mapping.**—Homestake Mining Co. opened a Midwest exploration office in Rolla, and indicated that it opened there because it was near the area to be explored and because of the availability of files and research information of the Missouri Geological Survey, the University of Missouri, the

U.S. Geological Survey, and the Federal Bureau of Mines.

Exploration activity was sporadic during the year with drilling principally on the southeast and southern flank of the St. Francois Mountains and along the Missouri-Kansas line.

**Energy.**—The “energy crisis of 1974” continued to affect the mineral industry. The Second Annual University of Missouri/Missouri Energy Council Conference on Energy was held at the University of Missouri at Rolla to discuss identification of independence, the criteria for availability, and the technical methods and advancements involved in choosing a national energy strategy.

Possible natural gas shortages threaten the mineral industry. Some mineral processors operating on “interruptible” supplies of natural gas are expected to lose their supply in the years ahead. Coal gasification plants were being considered as a possible solution. The Missouri Mining Industry Council formed a standing committee to help prepare for the future shortages of fuel in the mining industry.

A Springfield, Mo., electric-generating plant and the Kansas City Power and Light Hawthorn plant received a Federal Energy Administration (FEA) notice of plans to order an early switch from oil and gas to coal as a source of fuel. In selecting plants for conversion to coal, FEA follows four steps: First, an Announcement of Intent to order the plant to convert to coal; second, a public hearing in the plant's area; third, a Fuel Conversion Order subject to Environmental Protection Agency (EPA) certification; and, fourth, the effective date of the Notice of Conversion Order.

A northeastern Missouri electric cooperative announced plans for a huge coal gasification, electric-generation, and fertilizer manufacturing project. Reportedly, the Northeast Missouri Electric Power Cooperative was well into the engineering and planning stage of a project that would consume up to 14,000 tons of coal per day to produce a medium-Btu gas for use in generating electric power and producing ammonia for fertilizer.

The Missouri Energy Agency was formed to consolidate and centralize State energy

programs. The agency operates within the Missouri Department of Natural Resources and utilizes the staff of the State Fuel Allocation Officer.

The licensing board of the Nuclear Regulatory Commission recommended approval of a request by Union Electric Co. of St. Louis (UE) to begin site preparation for a nuclear power-generating plant in Callaway County. Petitions were received from various consumer, student, and research groups, and hearings were held. Final decisions on this proposed plant were not in sight at yearend.

UE won an award from the Edison Electric Institute and the National Society of Professional Engineers for its development of a plant to burn refuse to generate electricity and for its cooperation with local and national agencies in finding economically sound and environmentally acceptable solutions to the problem of waste disposal. UE moved ahead on a \$70 million project to consume 2.5 million tons of trash per year. An integral part of this system includes setting up four collection and transfer stations in metropolitan St. Louis. Land-use conflicts and zoning restrictions, which had tied up selection of these sites, were not resolved at yearend.

While UE was burning trash, the University of Missouri at Rolla (UMR) was involved in a research project to study the feasibility of burning waste wood chips and barking wastes from the forest-product industry along with coal. The project was being carried out using a chain-grate stoker in the UMR powerplant and varying the burner feed from 12% to 66% wood by volume or 10% to 46% by weight. Additional research was scheduled to investigate the effect, if any, of the burning wood-coal mixtures on  $SO_2$ ,  $NO_x$ , and particulate matter in stack emissions, and on the properties of the resulting ash.

Both the UE and UMR developments show that combustible waste can be utilized as a source of energy; can be burned with and reduce the requirement for coal; and, since the wastes are low in sulfur, can help reduce the  $SO_2$  emissions from coal-burning operations. In addition, metal values can be removed and recovered from municipal wastes prior to burning the combustibles.

## REVIEW BY MINERAL COMMODITIES

In 1975, metals accounted for about 53% of the total value of the State's mineral output compared with 56% in 1974. Non-metal production was about 40%, and mineral fuels increased to 7%.

## METALS

**Aluminum.**—Noranda Aluminum, Inc., continued to produce primary aluminum metal near New Madrid in southeast Missouri. The plant produced the metal from alumina shipped from outside the State.

Alumax, Inc.'s (50% AMAX, Inc., 45% Mitsui & Co., Ltd., and 5% Nippon Steel Corp.) addition to its St. Louis aluminum foil mill was substantially complete at yearend. This facility is expected to result in doubling plant capacity and lowering overall operating costs.

**Copper.**—Copper production increased slightly during the year, although the tonnage of lead ore mined and lead produced declined. The increase was attributed to a slight increase in the average copper grade in the ore mined from 0.14% in 1974 to 0.18% in 1975. Copper is a coproduct of lead and zinc in Missouri Viburnum Trend mines.

**Iron Ore.**—Production increased during the year, and the market price of pellets increased substantially. The alkali-reduction system of Pilot Knob Pellet Co., which began operation in March 1974, included a regrind ball mill and a flotation circuit.

Meramec Mining Co. continued to divert a small portion of its total output into special products such as heavy-media products for use by the coal industry for the separation of coal from shale and pyrite.

Natural and manufactured iron oxide pigment production decreased 29% and 34%, respectively.

**Lead.**—Missouri mines accounted for 83% of the Nation's total mine output of lead in 1975. Output decreased from an alltime high of 562,097 tons in 1974 to

515,958 tons in 1975. This decrease resulted from a slackened demand for lead during the year.

The Herculaneum smelter and its individual departments were highlighted in the fall 1975 issue of St. Joe Headframe, published by the St. Joe Minerals Corp. Employee Relations Department. The spring issue of the same publication featured the story of the "Lead Belt Mineral Area Museum" located in Flat River, Mo., at the junction of Highway 8 and Business Route U.S. 67.

AMAX, Inc., reported that it underwent a scheduled shutdown of its mill and smelter for repairs and replacements. The mill was down for approximately 3 weeks, and the smelter was down 1 week. A new 3-year agreement between AMAX and the United Steel Workers was ratified in May, calling for wage increases of \$0.50 per hour the first year and \$0.20 per hour in each of the successive 2 years. A cost-of-living clause and other benefits were included.

Table 5.—Missouri: Tenor of lead ore milled and concentrates produced in 1975

Total material	short tons	8,467,794
Metal content of ore: <sup>1</sup>		
Copper	percent	0.18
Lead	do	6.33
Zinc	do	1.09
Concentrates produced and average content:		
Copper	short tons	8,573
Recovery ratio	percent	0.10
Average copper content	do	28.70
Copper-lead	short tons	18,428
Recovery ratio	percent	0.22
Average copper content	do	29.83
Average lead content	do	7.11
Lead	short tons	729,012
Recovery ratio	percent	8.61
Average lead content	do	72.91
Zinc	short tons	148,232
Recovery ratio	percent	1.75
Average zinc content	do	55.80

<sup>1</sup> Figures represent metal content of crude ore only as contained in the concentrate.

Table 6.—Total value of mineral production in Missouri and production and value of lead in Missouri and the United States

Year	Total value of Missouri mineral production (thousands)	Lead production					
		Missouri				United States	
		Quantity (short tons)	Value (thousands)	Percent of U.S. production	Percent of world production	Quantity (short tons)	Value (thousands)
1971	\$400,089	429,634	\$118,579	74.3	11.4	578,550	\$159,679
1972	451,817	489,397	147,113	79.1	12.8	618,915	186,046
1973	512,634	487,143	158,711	80.8	12.6	603,024	196,465
1974	691,049	562,097	252,944	84.7	14.6	663,870	298,742
1975	722,728	515,958	221,862	83.0	13.6	621,464	267,230

<sup>r</sup> Revised.

Table 7.—Missouri: Mine production (recoverable) of silver, copper, lead, and zinc

	1973	1974	1975
Mines producing: Lode	11	10	9
Material sold or treated: Lead ore	7,586	9,110	8,468
Production (recoverable):			
Quantity:			
Silver	2,057,732	2,387,250	2,525,042
Copper	10,273	12,665	14,258
Lead	487,143	562,097	515,958
Zinc	82,350	91,987	74,867
Value:			
Silver	\$5,264	\$11,244	\$11,161
Copper	12,224	19,580	13,308
Lead	158,711	262,944	221,862
Zinc	34,027	66,047	58,396
Total <sup>1</sup>	210,226	349,814	309,726

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Silver.**—Recovery of silver as a byproduct of lead-zinc operations increased again to reach another alltime high. Lower prices resulted in a slight decrease in total value of production. Missouri continued to be the sixth largest producer of silver with about 7% of the national total.

**Zinc.**—Mine production, which in 1974 was the highest since the Old Tri-State district was in full production, dropped 19% in 1975. Missouri slipped into third place in zinc mine production with Tennessee and New York taking first and second place, respectively.

Zinc concentrate, a coproduct of lead and copper in the Viburnum Trend, contains magnesium and cobalt, which detract from the marketability of Missouri concentrate for electrolytic zinc smelters. The AMAX smelter at Sauget uses a preleach treatment to remove dolomite from the concentrates. Ozark Lead Co. installed a regrind flotation

circuit where zinc concentrates are ground to about 50% 400 mesh to liberate dolomite particles so that they can be separated by refloating. Bureau of Mines research is underway to find methods of removing cobalt-nickel minerals from zinc concentrates.

#### NONMETALS

In 1975, nonmetal production accounted for 40% of the total value of mineral production. Output of barite, cement, clays, lime, and stone was down compared with 1974, but the value of these items was up because of increased prices.

**Barite.**—Output of barite was down slightly, but value increased approximately 18%. Over 50% of the barite produced in Missouri was used as weighting material in oil and gas well drilling muds. Various fillers, chemicals, paint, and glass accounted for the remainder.

**Cement.**—Seven cement plants operated by six companies produced nearly 4 million tons of cement in 1975. Approximately 75% of the cement was used in ready-mix concrete. Highway contractors and concrete product manufacturers each used about 10% of the production, with the remaining 4% to 5% being sold to building material dealers, government agencies, and other contractors or customers.

**Clays.**—Types of clay produced were common clay and shale, refractory or "fire"

clay, and absorbent clay. Common clay and shale accounted for approximately 56% of the tonnage; however, refractory clay accounted for 85% of the total value. Major uses, in order of tonnage consumed, were cement manufacturing, refractories, brick and tile, lightweight aggregate, and absorbents, such as floorsweep, cat litter, and insecticide-pesticide carriers.

**Lime.**—Two plants, Ash Grove Cement Co. and Mississippi Lime Co., produced high-calcium lime; the third, Valley Mineral Products Corp., produced dolomitic quicklime and refractory dolomite. Principal users were steel manufacturers and the chemical industry.

**Perlite.**—J. J. Broek & Co. operated a perlite-expanding plant in St. Louis. The perlite products were used as plaster aggregate, concrete aggregate, insulation, and in horticultural and other areas.

**Phosphate Rock.**—Meramec Mining Co. produced approximately 35,000 tons of an apatite concentrate as a byproduct of iron ore beneficiation. The product which contained approximately 33%  $P_2O_5$  was shipped out-of-State for processing into fertilizer.

**Sand and Gravel.**—Approximately 92% of the sand and gravel produced in the State was used by the construction industry, primarily in ready-mix concrete and paving. Industrial sand amounted to slightly over 800,000 tons, with glass manufacturing being the largest consuming industry. Of the State's total sand and gravel production, 70% was sand. Forty-five percent of the tonnage and over 50% of the value was produced in the St. Louis, Jefferson, and St. Charles Counties.

**Table 8.—Missouri: Portland cement salient statistics**  
(Short tons)

	1974	1975
Number of active plants	7	7
Production	4,297,528	3,919,181
Shipments from mills:		
Quantity	4,229,241	3,961,695
Value	\$106,984,842	\$116,259,872
Stocks at mills, Dec. 31	395,695	387,438

**Table 9.—Missouri: Masonry cement salient statistics**  
(Short tons)

	1974	1975
Number of active plants	4	4
Production	80,225	66,314
Shipments from mills:		
Quantity	74,940	64,678
Value	\$2,434,252	\$2,110,360
Stocks at mills, Dec. 31	11,801	13,436

**Table 10.—Missouri: Clays sold or used by producers, by kind**  
(Thousand short tons and thousand dollars)

Year	Fire clay		Common clay		Other clays		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value <sup>1</sup>
1971	872	4,896	1,440	2,558	<sup>2</sup> 42	W	2,354	7,454
1972	894	5,512	1,677	3,583	W	W	2,571	9,096
1973	829	7,563	1,565	2,371	<sup>2</sup> 157	<sup>2</sup> 1,692	2,551	11,626
1974	924	10,761	1,542	2,391	<sup>3</sup> 99	W	2,565	13,151
1975	854	11,285	1,209	1,928	<sup>3</sup> 105	W	2,168	13,214

W Withheld to avoid disclosing individual company confidential data; excluded from total.

<sup>1</sup> Data may not add to totals shown because of independent rounding.

<sup>2</sup> Bentonite.

<sup>3</sup> Kaolin.

Table 11.—Missouri: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mix concrete):				
Nonresidential and residential construction -----	3,468	4,820	3,336	5,160
Highway and bridge construction -----	467	741	359	594
Other construction (dams, waterworks, airports, etc.) -----	52	78	181	245
Concrete products (cement blocks, brick, pipe, etc.) -----	642	924	490	844
Bituminous paving (asphalt and tar paving) -----	994	1,629	845	1,575
Road base and subbase -----	1,426	1,739	1,352	1,653
Fill -----	202	321	554	864
Other -----	239	387	161	340
Unprocessed:				
Road base and subbase -----	210	97	306	348
Fill -----	116	93	133	149
Other -----	--	--	W	W
Industrial sand and gravel -----	1,390	5,991	824	4,456
Total -----	9,206	16,820	8,541	16,228

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

Table 12.—Missouri: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mix concrete):				
Nonresidential and residential construction -----	98	210	32	87
Highway and bridge construction -----	501	725	646	1,125
Other construction (dams, waterworks, airports, etc.) -----	84	136	17	27
Concrete products (cement blocks, bricks, pipe, etc.) -----	5	5	--	--
Bituminous paving (asphalt and tar paving) -----	372	547	285	495
Road base and subbase -----	527	800	96	142
Fill -----	109	187	W	W
Other -----	--	--	W	W
Unprocessed:				
Road base and subbase -----	31	34	101	73
Fill -----	--	--	4	2
Total <sup>1</sup> -----	1,727	2,648	1,211	1,988

W Withheld to avoid disclosing individual company confidential data; included in "Total."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Stone.**—Output of stone was down primarily because of reduction in highway construction, but value increased considerably. The Missouri Limestone Producers Association employed the University of Missouri to produce a 30-minute public relations film entitled "The Limestone Legacy—Nature's Gift to Mankind."

**Sulfur.**—Two lead smelters contributed significantly to the value of mineral production in the State in the form of sulfur

as sulfuric acid. St. Joe Minerals Corp. recovered sulfur as acid at its Herculaneum lead smelter. Amax Lead Co. of Missouri recovered sulfuric acid at its lead smelter near Boss. Although this acid was used for many purposes, the bulk of it was sent to plants manufacturing fertilizer from phosphate rock. A significant tonnage of sulfur was removed from oil refining operations at Sugar Creek by Amoco Oil Co.

Table 13.—Missouri: Stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Dimension stone -----	8	1,686	4	1,006
Crushed stone:				
Bituminous aggregate -----	2,882	5,707	3,148	7,159
Concrete aggregate -----	7,339	13,198	6,990	14,238
Dense-graded road base stone -----	6,176	11,949	6,483	14,867
Macadam aggregate -----	2,668	3,902	2,820	4,775
Surface treatment aggregate -----	3,854	8,232	2,951	7,140
Other construction aggregate and roadstone -----	5,671	10,605	5,490	11,250
Agricultural limestone <sup>1</sup> -----	4,619	9,700	4,385	10,029
Cement and lime manufacture -----	10,305	13,486	8,523	12,953
Manufactured fine aggregate (stone sand) -----	140	397	96	225
Mineral fillers, extenders, and whiting -----	551	2,314	129	543
Railroad ballast -----	34	55	732	1,563
Riprap and jetty stone -----	4,512	4,908	3,400	5,349
Sulfur dioxide removal -----	283	702	340	717
Other uses <sup>2</sup> -----	1,584	3,363	1,493	4,220
Total <sup>3</sup> -----	50,618	88,518	46,984	94,529
Grand total -----	50,626	90,204	46,988	95,535

<sup>1</sup> Data in 1974 include poultry grit and mineral food.

<sup>2</sup> Includes stone used for filter stone, terrazzo and exposed aggregate, flux stone, mine dusting, chemicals, glass, dead-burned dolomite, bedding material (1974), roofing aggregate chips and granules, and uses not specified.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

#### MINERAL FUELS

Mineral fuels comprised slightly more than 7% of the value of the State's mineral output.

Mineral fuel resources in Missouri included bituminous coal, oil, gas, and huge deposits of tar sands in the western part of the State. Coal was the only mineral fuel produced in significant quantities.

Coal.—Twelve strip mines and one auger mine operated within the State. Production increased about 1 million tons over that of 1974 to a total of 5.6 million tons. This approached the alltime high of 5.7 million tons set in 1917. The total value of \$48 million represented a record high. Peabody Coal Co. and Pittsburg & Midway Coal Mining Co. accounted for 90% of the State's coal production according to the 88th Annual Report of the Division of Labor Standards Mining Inspection Section.

Increased demand for coal was largely being satisfied by shipments from Illinois or from Western coalfields. Several new mines were being opened or planned, but these were not expected to increase production substantially. However, expansion at several existing mines could have a notable effect on future production.

Petroleum and Natural Gas.—Oil production in Missouri increased in 1975 to

a total of 57,000 barrels. Part of this increase was due to the revival of an oil pool in Cass County and part to an increase in production due to the unitization of the Florissant oilfield in St. Louis County. All of Missouri's oil wells were classed as stripper wells.

Natural gas production decreased to 30 million cubic feet.

Drilling activity in 1975 decreased slightly with 91 wells drilled. Of these, 7 were classified as oil development wells, 15

Table 14.—Missouri: Bituminous coal production from strip mines, by county, 1975

County	Number of mines	Production (thousand short tons)	Value (thousands)
Barton -----	1	563	W
Bates -----	1	W	W
Henry -----	2	W	W
Howard -----	1	3	\$48
Macon -----	1	W	W
Putnam -----	1	353	4,585
Randolph <sup>1</sup> -----	4	W	W
Vernon -----	2	242	W
Undistributed -----	--	4,477	43,421
Total -----	13	5,638	48,054

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

<sup>1</sup> Includes one auger mine to avoid disclosing company confidential data.

Table 15.—Missouri: Stripper well survey<sup>1</sup> for calendar year 1975

County	Field	Total annual crude oil production (barrels)	Number of stripper wells	Amount from secondary recovery (percent)	Acreage attributed to stripper wells	Number of wells abandoned
Cass -----	Various -----	19,689	35	80	300	10
St. Louis -----	Florissant -----	19,545	20	10	650	10
Atchison -----	Tarkio -----	9,166	3	---	160	---
Jackson -----	Various -----	7,657	60	10	300	---
Vernon -----	do -----	917	45	30	100	---

<sup>1</sup> As of January 1, 1976.

Sources: Interstate Oil Compact Commission and National Stripper Well Association.

as unsuccessful wildcat wells, and the remaining 69 were stratigraphic core tests. Two exploratory wells drilled at yearend were not included in the statistics, but may be completed in 1976 as discoveries.

Drilling in the Forest City basin accounted for all of the unsuccessful wildcat wells and 37 of the shallow stratigraphic test wells. The information obtained from this drilling provided considerable data for further evaluation of the basin.

Of the 69 shallow core tests drilled in the State, 32 were located in the heavy oil-tar sand deposit in Vernon County.

The Missouri Department of Natural Resources, Division of Geology and Land Survey, embarked on a program funded by a U.S. Geological Survey grant to inventory and evaluate heavy oil-tar sand deposits located in Barton, Bates, and Vernon Counties of western Missouri. The objective of this study was to improve es-

timates of the location, size, depth, and quality of this potential resource. The oil ranges from very viscous to solid in the natural state and has a gravity range of 25° API down to 8° API. This potential energy resource, which extends into Kansas and Oklahoma, was also being evaluated by geologists in those respective States.

With the increasing number of permits being requested, revisions of permitting procedures and spacing requirements were formulated by the State Oil and Gas Council. The revisions also provided for specific procedures in abandoning a hole in which logging tools containing a radioactive source has been irretrievably lost.

In anticipation of the development and mining of tar sands for an energy resource, the Land Reclamation Law of Missouri was being revised to include lands disturbed by tar sand mining as well as by coal and barite mining.

Table 16.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Asphalt, native:</b>			
Bar-Co-Roc Asphalt Co ---	P.O. Box 11 Iantha, Mo. 64753	Mine -----	Barton.
Silica Rock Asphalt Corp--	Sheldon, Mo. 64784	-----do -----	Vernon.
<b>Barite:</b>			
Milchem, Inc -----	P.O. Box 22111 Houston, Tex. 77001	Mine and mill ----	Washington.
NL Industries, Inc -----	P.O. Box 1675 Houston, Tex. 77001	-----do -----	Do.
Pfizer Inc -----	Box 47 Mineral Point, Mo. 63660	-----do -----	Do.
<b>Cement:</b>			
Alpha Portland Cement Co.	15 South Third St. Easton, Pa. 18043	Plant and quarry -	St. Louis.
Dundee Cement Co. <sup>1,2</sup> ---	P.O. Box 317 Dundee, Mich. 48131	-----do -----	Pike.
Marquette Cement Manufacturing Co. <sup>1,2</sup>	20 North Wacker Dr. Chicago, Ill. 60606	-----do -----	Cape Girardeau.
Missouri Portland Cement Co. <sup>1,2</sup>	7751 Carondelet Ave. St. Louis, Mo. 63105	-----do -----	Jackson and St. Louis.
River Cement Co -----	Festus, Mo. 63028	-----do -----	Jefferson.
United States Steel Corp. <sup>1,2</sup>	600 Grant St. Pittsburgh, Pa. 15230	-----do -----	Ralls.

See footnotes at end of table.



Table 16.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Clays:</b>			
Dresser Industries Inc ----	2 Gateway Center Pittsburgh, Pa. 15222	Mine and plant --	Callaway, Gasconade, Mont- gomery, Warren.
Kaiser Aluminum & Chemical Corp.	P.O. Box 499 Mexico, Mo. 65265	----do -----	Audrain, Callaway, Gasconade, Mont- gomery, Warren, Gasconade.
United States Gypsum Co.	Mexico, Mo. 65265 -----	----do -----	Gasconade.
<b>Coal:</b>			
Peabody Coal Co -----	301 North Memorial Dr. St. Louis, Mo. 63102	----do -----	Henry, Macon, Randolph.
Pittsburg & Midway Coal Mining Co.	1600 Tenmain Center Kansas City, Mo. 64105	----do -----	Barton and Bates.
<b>Iodine:</b>			
Hoffman-Taff, Inc -----	West Bennett Rd. Springfield, Mo. 65800	Plant -----	Greene.
Mallinckrodt Chemical Works.	3600 North Second St. St. Louis, Mo. 63147	----do -----	St. Louis.
West Agro-Chemical, Inc -	42-16 West St. Long Island City, N.Y. 11101	----do -----	Jackson.
<b>Iron Ore:</b>			
Meramec Mining Co -----	Route 4 Sullivan, Mo. 63080	Underground mine.	Washington.
Pilot Knob Pellet Co ----	Box 26 Ironton, Mo. 63650	----do -----	Iron.
<b>Lead:</b>			
Amax Lead Co. of Mo. <sup>3</sup> ---	Boss, Mo. 65440 -----	----do -----	Do.
Cominco American, Inc. <sup>3</sup> ---	Box 430 Salem, Mo. 65560	----do -----	Do.
Ozark Lead Co. <sup>3</sup> -----	Sweetwater, Mo. 63680	----do -----	Reynolds.
St. Joe Minerals Corp. <sup>3</sup> ---	Bonne Terre, Mo. 63628	----do -----	Crawford, Iron, Reynolds, Washington.
<b>Lime:</b>			
Ash Grove Cement Co ----	1000 Tenmain Center Kansas City, Mo. 64105	Plant -----	Greene.
Mississippi Lime Co. <sup>2</sup> ----	7 Alby St. Alton, Ill. 62002	----do -----	Ste. Genevieve.
Valley Mineral Products Corp.	915 Olive St. St. Louis, Mo. 63101	----do -----	St. Francois.
<b>Perlite, expanded:</b>			
J. J. Brouk & Co -----	1367 South Kingshighway Blvd. St. Louis, Mo. 63110	----do -----	St. Louis.
<b>Roofing granules:</b>			
GAF Corp -----	P.O. Box 278 Annapolis, Mo. 63620	----do -----	Iron.
<b>Sand and gravel:</b>			
Holliday Sand & Gravel Co.	6811 West 63d St. Overland Park, Kans. 66202	Dredge -----	Various.
Missouri Gravel Co -----	313 Sixteenth St. Moline, Ill. 61265	Pit and plant ---	Lewis.
Riverside Sand & Dredging.	5000 Bussen Rd. St. Louis, Mo. 63129	Dredge -----	St. Louis.
St. Charles Sand Co -----	Route 1, Box 253 Bridgeton, Mo. 63042	Plant -----	Do.
Winter Bros. Material Co.--	13098 Gravois Rd. St. Louis, Mo. 63127	----do -----	Do.
<b>Stone:</b>			
Ash Grove Cement Co ----	P.O. Box 70 Butler, Mo. 64730	Quarries -----	Bates, Greene, Jackson, Vernon.
Medusa Corp -----	Box 5668 Cleveland, Ohio 44101	----do -----	Boone, Daviess, Gentry, Harrison.
Fred Weber Inc -----	7929 Alabama Ave. St. Louis, Mo. 63111	----do -----	Jefferson, St. Charles, St. Louis.
West Lake Quarry & Material Co.	Route 1, Box 206 Taussig Rd. Bridgeton, Mo. 63042	----do -----	Cape Girardeau, St. Louis, Scott.
<b>Vermiculite, exfoliating:</b>			
W. R. Grace & Co -----	62 Whittemore Ave. Cambridge, Mass. 01109	Plant -----	St. Louis.

<sup>1</sup> Also clays.<sup>2</sup> Also stone.<sup>3</sup> Also silver, copper, and zinc.

# 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.

By George T. Krempasky<sup>1</sup> and Don C. Lawson<sup>2</sup>

In 1975, Montana's mineral production was valued at \$573 million, a decrease of less than 1% compared with the 1974 value. The 1975 value of copper decreased 44% compared with that of 1974. Other metals showing significant value decreases were gold, 38%, and silver, 30%.

Petroleum production decreased 5%; however, the value increased 12%. Natural gas production decreased 26%, but the value increased 27%. Coal continued its upward trend with an increase in production of 7.9 million tons, or 56%. The value of the coal produced increased 103%.

The value of output of nonmetallics increased. Nonmetallics showing value increases were phosphate rock, 34%; lime, 54%; cement, 8%; vermiculite, 45%; stone, 8%; and sand and gravel, 14%.

Three nonferrous metals, copper, lead, and zinc, and two precious metals, gold and silver, were mined in Montana. Based on value of commodity recovered, Montana ranked 4th in the United States in copper, 5th in silver, 7th in gold, 14th in lead, and 18th in zinc. The combined value of copper, lead, zinc, gold, and silver produced in Montana during 1975 declined 43% compared with the value in 1974. A 44% decrease in production from the Butte mines during the year is the prime reason for the decrease in value.

Montana's 1975 Legislative Session discussed 76 bills related to the mineral industry, and 38 bills were submitted to the Governor. Included in the legislation that became law was a revision of the method of taxing coal: As of July 1, 1975, coal

mined by surface mining methods in Montana with a Btu value in excess of 7,000 is taxed at a rate of 30% of its selling price. Lignite with a Btu value of less than 7,000 is taxed at 20%. A different schedule is applicable to extraction of the resource by underground methods. Other legislation included extending the statute of limitations on damage to real property caused by oil or gas operations to 2 years from discovery; increasing to \$1.50 an acre from \$1 the minimum annual rental for oil and gas leases on State-owned land; providing for assessment fees for the preparation of environmental impact statements; revision of Montana's Utility Siting Act of 1973; providing for the control of surface effects of underground mining operations and the reclamation of lands and waters affected by underground mining; taxing the production of natural gas and crude oil; distribution of funds generated by coal tax, 40% to the general fund, 10% to the school foundation program, 10% to the highway account, 4% to the counties in which the coal is mined, 27.5% to the local impact and education trust account, 1% to county land planning, 2.5% to renewable resource development, 2.5% to alternate energy research, and 2.5% to the recreation and parks fund; and amending the open-cut and hard-rock mining acts. Other pieces of legislation indirectly related to the mineral industry have also been enacted.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Helena, Mont.

<sup>2</sup> Field agent, Montana Bureau of Mines and Geology.

Table 1.—Mineral production in Montana<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony -----short tons--	W	W	273	\$813
Clays <sup>2</sup> -----thousand short tons--	298	\$2,189	223	1,878
Coal (bituminous) -----do--	14,106	54,961	22,054	111,579
Copper (recoverable content of ores, etc.) -----short tons--	181,131	202,728	87,959	112,940
Gem stones -----	NA	400	NA	400
Gold (recoverable content of ores, etc.) -troy ounces--	28,268	4,516	17,259	2,787
Iron ore (usable) -thousand long tons, gross weight--	30	W	18	W
Lead (recoverable content of ores, etc.) -short tons--	154	69	205	88
Lime -----thousand short tons--	226	3,364	221	5,188
Natural gas -----million cubic feet--	54,873	13,883	40,734	17,638
Peat -----thousand short tons--	W	W	1,105	51
Petroleum (crude) -----thousand 42-gallon barrels--	34,554	229,802	32,844	257,169
Sand and gravel -----thousand short tons--	4,242	6,126	4,127	6,963
Silver (recoverable content of ores, etc.) -----thousand troy ounces--	3,512	16,542	2,617	11,565
Stone <sup>3</sup> -----thousand short tons--	3,115	6,242	3,130	6,753
Zinc (recoverable content of ores, etc.) -short tons--	136	98	110	86
Value of items that cannot be disclosed:				
Cement, fire clay, fluorspar, gypsum, natural gas liquids, phosphate rock, stone (dimension), talc, tungsten, vermiculite, and values indicated by symbol W -----	XX	33,881	XX	37,252
Total -----	XX	574,801	XX	573,150
Total 1967 constant dollars -----	XX	271,766	XX	226,967

<sup>p</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes fire clay; included with "Value of items that cannot be disclosed."

<sup>3</sup> Excludes dimension stone; included with "Value of items that cannot be disclosed."

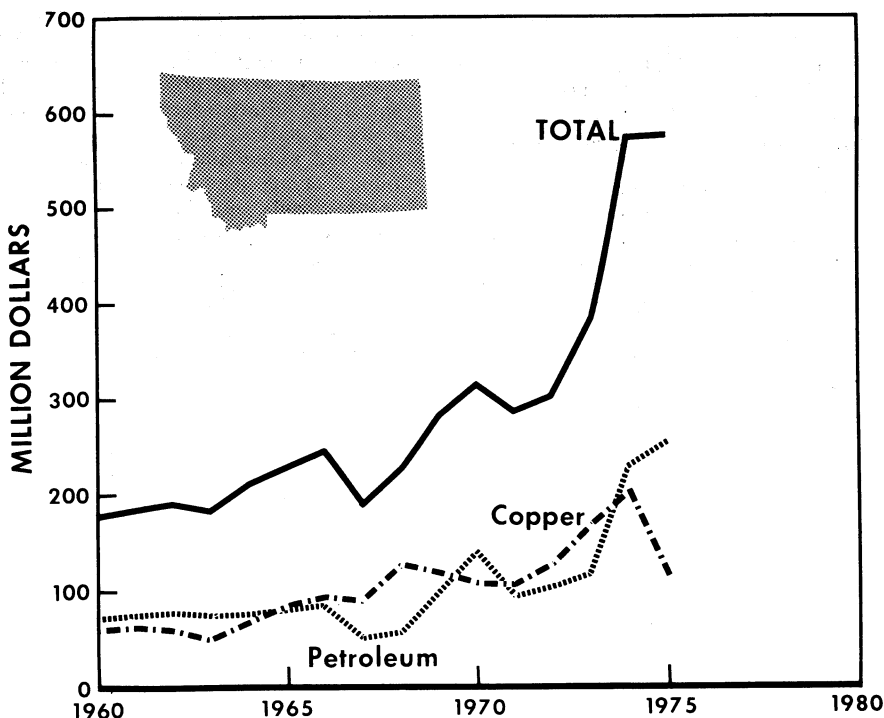


Figure 1.—Value of copper, petroleum, and total value of mineral production in Montana.

Table 2.—Value of mineral production in Montana, by county<sup>1</sup>

(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Beaverhead	\$414	\$354	Stone, sand and gravel, silver, tungsten, gold, copper, zinc, lead.
Big Horn	38,364	W	Coal, petroleum, stone, sand and gravel.
Blaine	W	W	Petroleum, clays.
Broadwater	W	W	Iron ore, gold, silver, zinc, copper.
Carbon	W	W	Petroleum, stone, clays, sand and gravel.
Carter	1,361	W	Clays, petroleum, stone.
Cascade	W	W	Sand and gravel, clays, stone.
Chouteau	70	88	Sand and gravel.
Custer	15	W	Sand and gravel, stone.
Daniels	W	12	Sand and gravel.
Dawson	W	9,739	Petroleum, sand and gravel, stone.
Deer Lodge	3,774	5,697	Lime, stone, sand and gravel, silver, clays, gold, copper, tungsten.
Fallon	34,628	W	Petroleum, natural gas liquids.
Fergus	W	W	Sand and gravel, gypsum, clays, gold, zinc, silver, copper, lead.
Flathead	1,202	1,088	Sand and gravel, silver, lead, stone, peat, gold, copper, zinc.
Gallatin	W	W	Cement, stone, sand and gravel, clays.
Garfield	W	W	Petroleum, stone.
Glacier	3,735	14,026	Petroleum, natural gas liquids.
Golden Valley	10	9	Sand and gravel.
Granite	1,097	1,925	Silver, stone, gold, copper, sand and gravel, lead, zinc.
Hill	W	105	Sand and gravel, stone.
Jefferson	8,810	10,634	Cement, stone, silver, sand and gravel, gold, zinc, lead, clays, copper.
Lake	W	W	Sand and gravel, peat, stone.
Lewis & Clark	286	W	Sand and gravel, silver, stone, gold, zinc, copper, lead.
Liberty	W	W	Petroleum.
Lincoln	W	W	Vermiculite, stone, sand and gravel, tungsten.
McCone	W	W	Petroleum, stone.
Madison	2,328	W	Talc, gold, silver, stone, zinc, sand and gravel, copper, lead.
Meagher	W	W	Iron ore, stone, gold, lead, silver, zinc.
Mineral	139	43	Sand and gravel, stone.
Missoula	W	509	Sand and gravel, stone, barite, gold, copper, silver, lead.
Musselshell	W	12,818	Petroleum, coal, sand and gravel, stone.
Park	191	W	Stone, sand and gravel.
Petroleum	6	W	Petroleum, sand and gravel.
Phillips	228	( <sup>2</sup> )	Stone.
Pondera	W	W	Petroleum, sand and gravel, stone.
Powder River	W	W	Petroleum, coal, sand and gravel.
Powell	W	W	Phosphate rock, sand and gravel, stone, gold, silver, lead, copper, zinc.
Prairie	41	W	Petroleum.
Ravalli	W	601	Fluorspar, sand and gravel, stone, silver, peat, lead, zinc.
Richland	14,932	15,553	Petroleum, coal, lime, natural gas liquids, sand and gravel, stone.
Roosevelt	W	W	Petroleum, natural gas liquids, sand and gravel.
Rosebud	26,843	W	Coal, petroleum, stone, sand and gravel, clays.
Sanders	602	903	Antimony, sand and gravel, silver, stone, copper.
Sheridan	W	W	Petroleum, sand and gravel.
Silver Bow	221,977	125,165	Copper, silver, gold, stone, lead, zinc, sand and gravel.
Stillwater	W	24	Stone.
Sweet Grass	2	4	Do.
Teton	W	W	Petroleum, sand and gravel, stone.
Toole	W	16,344	Petroleum, sand and gravel, gold, silver, stone.
Treasure	760	1,499	Clays, stone.
Valley	W	W	Sand and gravel, clays.
Wibaux	25	W	Petroleum, sand and gravel, stone.
Yellowstone	3,049	W	Sand and gravel, lime, petroleum, clays, stone.
Undistributed <sup>3</sup>	209,906	356,013	
Total <sup>4</sup>	574,801	573,150	

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

<sup>1</sup> Judith Basin and Wheatland Counties, and Yellowstone National Park are not listed because no production was reported.

<sup>2</sup> Less than ½ unit.

Includes natural gas production that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Montana business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	322.6	322.4	-0.1
Unemployment -----do-----	21.6	24.7	+14.4
<b>Employment (nonagricultural):</b>			
Mining -----do-----	7.5	6.7	-10.7
Manufacturing -----do-----	24.3	22.2	-8.6
Contract construction -----do-----	13.8	12.4	-10.1
Transportation and public utilities -----do-----	19.6	19.2	-2.0
Wholesale and retail trade -----do-----	59.1	59.5	+0.7
Finance, insurance, real estate -----do-----	10.0	10.2	+2.0
Services -----do-----	43.4	44.9	+3.5
Government -----do-----	58.2	64.9	+11.5
Total nonagricultural employment -----do-----	235.9	240.0	+1.7
<b>Personal income:</b>			
Total -----millions--	\$3,743	\$4,054	+8.3
Per capita -----do-----	\$5,079	\$5,422	+6.8
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----	2,566	3,066	+19.5
Value of nonresidential construction -----millions--	\$40.5	\$57.7	+42.5
Value of State road contract awards -----do-----	\$43.5	\$91.0	+109.2
Shipments of portland and masonry cement to and within Montana -----thousand short tons--	272	256	-5.9
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$574.8	\$573.2	-.3
Value per capita, resident population -----do-----	\$779.92	\$768.30	-1.5
Value per square mile -----do-----	\$3,906.54	\$3,895.32	-.3

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Exploration activities continued at a relative high rate especially for coal, oil, gas, potash, talc, geothermal, uranium, gold, silver, platinum, and base metals.

Exploration and development for precious and base metals are fairly extensive throughout southwestern Montana. In northwest Montana, exploration was extensive in Lincoln, Sanders, and Mineral Counties. Of most significance was the announcement by ASARCO Inc. of its intent to determine the feasibility of erecting an 8,500-ton mill. Ore reserves were reported to be 50 million tons of ore grading 0.7% copper and 1.5 ounces of silver per ton. In south-central Montana exploration was at a low key. However, Johns-Manville Corp. was continuing its work in the upper Stillwater area. Driving of an adit, cross-cutting, diamond drilling, assaying, bulk sampling, and metallurgical testing have been the major efforts. Assaying of samples taken from an area held by the company disclosed 0.46 troy ounce per ton of platinum-palladium with a ratio of platinum to palladium of about 1 to 3.5, and 0.15% copper-nickel. In north-central Montana, Exxon and Amax were active in the Neihart and Barker districts. In eastern Montana, exploration for precious and base metals

was limited to the Zortman and Landusky areas of the Little Rockies.

An exploration project to determine if mining of potash near Scobey is technically and economically feasible has been started. The company involved is attempting to secure a domestic source of potash. The potash-bearing zone is reportedly at a depth of 10,000 feet. Potash deposits at this depth would require solution mining.

Southwestern Montana talc deposits were receiving considerable exploration attention. The lack of asbestiform minerals in the deposits makes Montana talc desirable. Four active mines were producing in the area.

Faltering domestic copper demand resulted in changes in The Anaconda Company's operations in Montana. During the year, Anaconda closed its concentrator at Anaconda; closed the Arbiter plant, which went onstream in 1974 and was the first commercial application of a hydro-metallurgical process for the recovery of copper; mined out the Continental-East pit; changed the waste-ore removal ratio at the Berkeley pit from 3.6 to 2.6 tons of overburden to 1 ton of ore; and phased out all underground mining operations in Butte except pumping and maintenance opera-

tions and providing access to areas required for future underground exploration and development.

The sale of approximately 800,000 tons of chrome ore stockpiled near Nye to Metallurgy Inc. of New York was announced by the General Services Administration. It is anticipated that the removal of the chrome concentrates from Nye by truck and rail shipment will take about 5 years.

Coal was the mineral commodity of major discussion in Montana. Issues discussed during the year included but were not limited to exploration, powerplant siting, air pollution, coal slurry pipelines, social-economic impacts, pollution controls, hydrology of coal beds, taxation, reclamation,

and magnetohydrodynamics (MHD).

Research activities in MHD commenced at Montana State University in Bozeman and at Montana Tech at Butte. The primary objective of the research is to develop engineering information on MHD generators and systems.

Montana's Board of Health granted air variance extensions to June 30, 1976, to The Anaconda Company copper smelter, east of the city of Anaconda; to ASARCO's lead-zinc complex at East Helena; and to the primary aluminum reduction plant of Anaconda at Columbia Falls. In addition, the board granted Stauffer Chemical a 6-month variance extension to January 31, 1976, for its elemental phosphorous plant at Silver Bow.

## REVIEW BY MINERAL COMMODITIES

### METALS

**Aluminum.**—Production of primary aluminum decreased 25% during 1975. The value of production decreased 18%.

**Antimony.**—The U.S. Antimony Corp. continued to be the second largest antimony producer in the United States. The company mined about 14,000 tons of ore containing 419 short tons of antimony at the Sanders County operation. The ore concentrates contained 273 short tons of antimony, or approximately 30% of the U.S. production of antimony concentrates; value was about 38% of overall U.S. antimony value.

**Copper.**—Copper was mined from 40 mines in 12 Montana counties. Copper production declined 33% in 1975 compared with 1974 production, and value decreased 44%. Approximately 99% of the copper produced in Montana came from operations in Silver Bow County.

During 1975, The Anaconda Company ceased operations at the Continental-East pit in Butte, phased out all underground production at Butte, shut down the Arbiter plant at Anaconda, changed the waste-ore removal ratio from 3.6 to 2.6 tons of overburden to 1 ton of ore at the Berkeley pit in Butte, and closed its concentrator in Anaconda.

The main reason for the change was the faltering domestic demand for copper.

**Gold.**—Gold was produced principally as a byproduct of copper refining. During

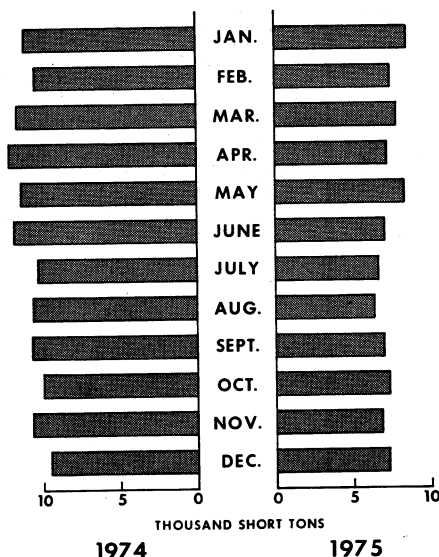


Figure 2.—Mine production of copper in Montana, by month, in terms of recoverable metal.

the year, gold output decreased to 17,259 troy ounces valued at \$2.787 million, a 38% decrease compared with the 1974 value. A total of 48 mines in 13 counties produced gold. Approximately 78% of the gold produced in Montana came from the Butte operations.

Exploration and evaluation of former gold-producing areas continued. However, efforts to date have not disclosed any de-

posits that can be considered economically feasible.

Table 4.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by class of ore or other source material

Source	Number of mines <sup>1</sup>	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
<b>Lode ore:</b>							
Gold -----	12	537	181	914	( <sup>2</sup> )	3	3
Gold-silver -----	14	21,448	2,967	97,911	16	68	90
Silver -----	21	71,633	546	357,576	14	110	11
Total -----	47	93,618	3,694	456,401	30	<sup>3</sup> 180	104
Copper -----	6	19,261,701	13,317	2,151,969	70,029	--	--
Lead -----	4	209	--	3,397	--	20	1
Lead-zinc -----	2	81	19	2,924	( <sup>2</sup> )	5	5
Total -----	12	19,261,991	13,336	2,158,290	70,029	25	6
<b>Other lode material:</b>							
Gold tailings, gold cleanup, and copper cleanup <sup>4</sup> -----	<sup>5</sup> 1	106	43	166	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )
Gold-silver tailings -----	1	500	40	1,750	--	( <sup>2</sup> )	--
Copper precipitates -----	2	24,211	--	--	17,900	--	--
Total -----	4	24,817	83	1,916	17,900	( <sup>2</sup> )	( <sup>2</sup> )
Total lode -----	61	19,380,426	17,113	2,616,607	87,959	205	110
Placer -----	2	--	145	19	--	--	--
Grand total -----	63	19,380,426	17,259	2,616,626	87,959	205	110

<sup>1</sup> Detail may not add to total because some mines produce more than one class of material.

<sup>2</sup> Less than ½ unit.

<sup>3</sup> Data do not add to total shown because of independent rounding.

<sup>4</sup> Combined to avoid disclosing individual company confidential data.

<sup>5</sup> Cleanup not counted as a mine.

Table 5.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing		Material sold or treated <sup>1</sup> (short tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1973, total	57	1	19,114,099	27,806	\$2,719,707	4,349,869	\$11,126,968
1974, total	96	2	23,231,295	28,268	4,515,529	3,512,161	16,542,278
1975:							
Beaverhead	3	--	1,094	19	3,068	12,584	55,621
Broadwater	2	--	508	48	7,752	1,782	7,876
Fergus	2	--	23	12	1,937	65	288
Granite	12	--	70,589	1,387	223,985	317,299	1,402,462
Jefferson	11	--	6,330	448	72,347	39,928	176,481
Lewis & Clark	3	1	191	142	22,932	6,464	28,570
Madison	8	--	6,801	1,507	243,365	29,744	131,469
Meagher	2	1	32	48	7,752	353	1,561
Powell	5	--	238	40	6,459	805	3,559
Sanders	1	--	22	--	--	1,889	6,139
Silver Bow	6	--	19,289,725	13,528	2,184,637	2,161,943	9,555,788
Undistributed <sup>2</sup>	6	--	4,873	80	12,919	44,270	195,672
Total	61	2	19,380,426	17,259	2,787,153	2,616,626	11,565,486
Copper Lead Zinc Total value							
	Short tons	Value	Short tons	Value	Short tons	Value	Total value
1973, total	132,466	\$157,634,461	176	\$57,200	73	\$30,127	\$171,568,463
1974, total	131,131	202,727,887	154	69,128	136	97,942	223,952,764
1975:							
Beaverhead	2	2,034	1	550	2	1,231	62,504
Broadwater	--	--	( <sup>3</sup> )	155	( <sup>3</sup> )	53	15,836
Fergus	( <sup>3</sup> )	137	1	393	1	870	3,625
Granite	12	15,019	1	227	( <sup>3</sup> )	128	1,641,821
Jefferson	4	5,049	64	27,379	83	64,930	346,186
Lewis & Clark	1	914	1	412	1	1,017	53,345
Madison	4	4,988	8	3,417	14	11,286	394,525
Meagher	--	--	10	4,353	( <sup>3</sup> )	254	13,920
Powell	( <sup>3</sup> )	617	2	967	1	399	12,001
Sanders	3	3,763	--	--	--	--	9,902
Silver Bow	87,927	112,898,344	12	5,347	4	3,227	124,647,343
Undistributed <sup>2</sup>	7	8,880	105	45,128	4	2,795	265,394
Total	4 87,959	112,939,745	205	88,328	110	86,190	127,466,902

<sup>1</sup> Does not include gravel washed.<sup>2</sup> Deer Lodge, Flathead, Missoula, Ravalli, and Toole Counties combined to avoid disclosing individual company confidential data.<sup>3</sup> Less than ½ unit.<sup>4</sup> Data do not add to total shown because of independent rounding.

Table 6.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Smelting of concentrates from ore	13,356	2,158,827	70,025	19	5
Direct smelting of—					
Ore	3,674	455,864	35	186	105
Precipitates	--	--	17,900	--	--
Tailings	44	1,790	( <sup>1</sup> )	( <sup>1</sup> )	--
Cleanup	39	126	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )
Total	3,757	457,780	17,935	186	105
Total lode	17,113	2,616,607	<sup>2</sup> 87,959	205	110
Placer	146	19	--	--	--
Grand total	17,259	2,616,626	87,959	205	110

<sup>1</sup> Less than ½ unit.<sup>2</sup> Data do not add to total shown because of independent rounding.



Table 7.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in Silver Bow County

Year	Mines producing	Material sold or treated (thousand short tons)	Gold (troy ounces)	Silver (thousand troy ounces)
1971	4	13,531	13,789	2,415
1972	5	17,208	22,535	3,159
1973	12	19,055	24,341	4,070
1974	8	23,188	24,609	3,259
1975	6	19,290	13,528	2,162
1882-1975	--	<sup>1</sup> 484,855	2,575,632	667,720
	Copper (short tons)	Lead (short tons)	Zinc (short tons)	Total value (thousands)
1971	88,503	--	--	\$96,344
1972	123,958	2	--	132,656
1973	132,282	--	--	170,208
1974	131,062	--	--	221,902
1975	87,927	12	4	124,647
1882-1975	9,086,085	415,439	2,406,822	5,081,647

<sup>1</sup>1882-1904; complete data not available.

**Iron.**—The R&S Iron Co. produced ore from two open pit mines. The direct-shipping ore was all used in cement manufacturing.

**Lead.**—Production of lead was reported from 31 mines in 12 counties. The output based on quantity increased 33%, compared with 1974 production. The value of production increased 28%. Silver values in the ore exceeded the value of lead.

**Silver.**—The principal source of silver, approximately 83% of the State total, was byproduct output from operations in the Butte area, Silver Bow County. Silver production declined about 34% in Silver Bow County, and State production declined 26%. Production of silver outside the Butte area was about 253,000 ounces in 1974. In 1975, the production of silver from 53 mines in 15 counties outside the Butte area was about 455,000 ounces, an increase of about 80%.

Interest in silver remained high in the areas outside Butte. In Lincoln County, the Troy project, a deposit reported to have reserves of 50 million tons of copper-silver mineralization assaying 0.7% copper and 1.5 ounces of silver per ton, was undergoing final evaluation. Other areas of interest were also being investigated.

**Tungsten.**—Tungsten was mined by three companies operating in three counties. The value of production decreased 60% and the quantity produced decreased 57% in 1975.

**Zinc.**—Output of zinc from 25 mines in 12 counties declined 19%, compared with

1974 production. In most cases, the value of silver in the ore was higher than the value of other commodities recovered.

#### NONMETALS

**Cement.**—Sales of portland cement declined 13%, but the value of the commodity rose 7%. Masonry cement sales remained about the same, but value of product sold increased 25%. Two plants operated in the State, one near Helena and the other at Trident. Due to potential loss of natural gas, both plants are evaluating conversion to coal-fired units.

**Clays.**—Output of all types of clays and shales came from 19 mines in 12 counties. Clays and shale mined in Montana were used for face brick, animal feed, drilling needs, iron pellets, portland cement, waterproofing and sealing, concrete block, and foundry sand. Twelve individuals and/or companies produced clay in Montana. The size of operations ranged from 800 short tons per year to about 130,000 tons per year. Output from all mines declined 25%, compared with 1974 production, and value declined 14%.

**Fluorspar.**—One mine in Ravalli County, operated by Roberts Mining Co., produced all of the fluorspar output in the State. Production declined 56% and the value of production decreased 45%. The product was sold mainly to the steel industry as a flux.

**Gypsum.**—United States Gypsum Co. mined gypsum in Fergus County; output

declined 16% and was 23% below the 1973 record. United States Gypsum also calcined gypsum in Fergus County; output declined 18% and was 42% below the 1973 record.

**Lime.**—The Anaconda Company, Holly Sugar Corp., and Great Western Sugar Co. used 221,420 tons of lime for metallurgical purposes, sewage treatment, and sugar refining. The value of material used increased 54%, while output from the mines declined 2%.

**Phosphate Rock.**—Increased demand for phosphate rock resulted in increased exploration activities. In 1975, production decreased 5% and value increased 34%.

**Sand and Gravel.**—Output declined 3% in 1975, but value increased 14%. Sand and gravel was produced from 68 operations in 40 of the 56 counties in the State.

**Stone.**—Stone production increased less than 1% in quantity; however, the value of production increased 8%. A total of 77 quarries operated in 40 counties with 61 quarries producing less than 25,000 tons. Nine quarries produced in excess of 100,000 tons and accounted for 82% of the State's production. Type of stone produced included traprock, limestone, granite, quartzite, and marble.

Trucks transported 85% of all the shipments of crushed and broken stone; the balance was moved by rail. The stone produced was used for macadam, dense road-base, riprap, railroad ballast, flux, surface trim, aggregate, cement and lime manufacturing, and fill.

**Sulfur.**—Sulfur was recovered as a by-product by two companies operating plants at Billings, Yellowstone County. A production increase of 19% was achieved as com-

pared with 1974 output, and value of production increased 22%.

**Talc.**—Three companies operating four mines in Madison County produced 52% less talc in 1975 than in 1974. Most of the talc was shipped out of Montana and was used in the manufacture of paper, paint, refractories, toilet preparations, rice polishing, ceramics, rubber, roofing materials, and insecticides.

**Vermiculite.**—W. R. Grace & Co. produced vermiculite at Libby, in Lincoln County, primarily for further treatment and sale outside Montana. Production increased about 1%, but the value of production increased 45%. W. R. Grace's new flotation mill, with a capacity of 1,000 tons per day, went onstream.

#### MINERAL FUELS

**Coal.**—Output of bituminous coal increased 56% over the 1974 production level. The value of coal produced increased 103% compared with the 1974 value. Production came from eight active surface mines, and the increase was due to expansion at existing mines. Based on production, the mine at Decker is now the largest coal producer in the United States.

The Montana Bureau of Mines and Geology continued to evaluate the coal deposits in Montana.

Burlington Northern continued to evaluate the feasibility of constructing a complex at Circle that would synthesize ammonia fertilizer, methanol methyl fuel, and synthetic diesel fuel from coal.

The Energy Research and Development Administration announced that Butte has

Table 8.—Montana: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand .....	910	1,710	819	1,521
Gravel .....	1,860	3,173	1,874	3,710
Unprocessed: Sand and gravel .....	1,472	1,168	1,434	1,185
Industrial sand .....	--	--	W	W
Total .....	4,242	6,051	4,127	6,416

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

been chosen as the site for a \$50 million MHD component and integration test facility. The facility will be used to develop, test, and demonstrate MHD components on a small-scale basis. In addition, the facility will be used to study interaction during operations of the MHD concept and subsystems (coal handling and coal preparation).

**Petroleum and Natural Gas.**—Crude petroleum recovery declined 5%, compared with the 1974 figure of 34.6 million barrels. The value of production in 1975 increased 12% to \$257.2 million. About 65% of the crude oil produced came from seven fields: The Bell Creek field (8.67 million barrels), Powder River County; the Pine field (2.56 million barrels), Dawson, Fallon, Prairie, and Wibaux Counties; the Cut Bank field (2.54 million barrels), Glacier and Toole Counties; the Pennel field (2.52 million barrels), Fallon County; the Cabin Creek field (2.01 million barrels), Fallon County; the Sumatra field (1.92 million barrels), Rosebud County; and the Elk Basin field (1.19 million barrels), Carbon County. During 1975, oil was produced in 23 of Montana's 56 counties.

The production decline, as reported by Montana's Board of Oil and Gas Conservation, was mainly due to normal production losses at the Bell Creek and Cut Bank fields.

Natural gas production in Montana during 1975 totaled 40,734 million cubic feet, a 26% decrease from that of 1974. The value of production in 1975 increased 27%.

Gas was recovered from 38 fields in 16 counties. The Tiger Ridge field with a production of about 15.7 billion cubic feet was the largest producing field in 1975.

Of the 30 producing gasfields in 1975, 11 had decreases and 1 had no reported production.

The Tiger Ridge field had a decline of production of about 19%, 15.7 billion cubic feet was produced in 1975, compared with 19.4 billion cubic feet during 1974. Nine gasfields from which no production was reported in 1974 produced approximately 780 million cubic feet in 1975; the fields were Bears Den, Liberty County; Browns Coulee, Hill County; Coal Coulee, Hill County; Middle Dry Creek, Carbon County; North Clark Fork, Carbon County; Pumpkin Creek, Custer County; South Clark Fork, Carbon County; Strawberry Creek, Toole County; and Timber Creek, Toole County.

Oil and gas well drilling during 1975 was reported to have been greater than in any of the previous 5 years. A total of 387 wells, 276 gas and 111 oil, were completed as oil and gas producers. In 1974, 265 wells, 200 gas and 65 oil, were completed as oil and gas producers.

Exploration activities continued at a relative high pitch, with major interest in the shallow gas-producing sands of northern Montana, the oil-bearing Tyler sands of central Montana, and the overthrust area along the western portion of Montana, owing to recent major discoveries south of the State boundary.

**Table 9.—Montana: Bituminous coal and lignite production, by type of mine and county**

(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines			Production (thousand short tons)			Value (thousand dollars)
	Under- ground	Strip	Total	Under- ground	Strip	Total	
<b>Bituminous coal:</b>							
Big Horn -----	--	2	2	--	W	W	W
Musselshell -----	--	2	2	--	W	W	W
Rosebud -----	--	2	2	--	W	W	W
<b>Total -----</b>	<b>--</b>	<b>6</b>	<b>6</b>	<b>--</b>	<b>21,752</b>	<b>21,752</b>	<b>W</b>
<b>Lignite coal:</b>							
Powder River -----	--	1	1	--	1	1	W
Richland -----	--	1	1	--	301	301	W
<b>Total -----</b>	<b>--</b>	<b>2</b>	<b>2</b>	<b>--</b>	<b>302</b>	<b>302</b>	<b>W</b>
<b>Grand total -----</b>	<b>--</b>	<b>8</b>	<b>8</b>	<b>--</b>	<b>22,054</b>	<b>22,054</b>	<b>111,579</b>

W Withheld to avoid disclosing individual company confidential data.

Table 10.—Montana: Oil and gas well drilling completions in 1975, by county

County	Proved field wells			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Beaverhead	--	--	--	--	--	1	1	13,909
Big Horn	3	1	1	--	--	7	12	35,987
Blaine	1	24	36	--	1	30	92	188,739
Carbon	--	4	5	--	--	6	15	80,206
Carter	1	--	--	--	--	7	8	16,152
Chouteau	--	2	9	--	--	2	13	15,877
Custer	--	1	--	--	--	2	3	6,658
Daniels	--	--	--	--	--	3	3	24,277
Dawson	1	--	1	--	--	6	8	71,245
Fallon	7	--	2	--	--	1	10	92,776
Fergus	--	6	10	--	--	11	27	57,378
Garfield	--	--	--	--	--	1	1	2,202
Glacier	12	3	7	--	--	3	25	73,736
Golden Valley	--	--	--	--	1	8	9	27,538
Granite	--	--	--	--	--	2	2	2,534
Hill	--	36	62	--	3	16	117	186,227
Liberty	8	24	14	--	2	4	52	134,481
McCone	3	--	2	1	--	4	10	66,264
Musselshell	9	--	11	1	--	14	35	128,369
Petroleum	1	--	--	--	--	10	11	34,290
Phillips	--	119	6	--	1	10	136	206,251
Pondera	7	9	6	--	2	2	26	48,381
Powder River	4	--	2	--	--	1	7	32,442
Richland	8	--	2	--	--	4	14	167,908
Roosevelt	7	--	--	1	--	7	15	125,380
Rosebud	11	--	14	2	--	16	43	206,022
Sheridan	2	--	1	--	--	7	10	82,625
Stillwater	--	13	8	--	--	3	24	45,368
Sweet Grass	--	--	--	--	1	5	6	23,265
Teton	7	--	3	--	--	10	20	49,081
Toole	12	19	15	--	4	16	66	137,993
Valley	--	--	4	--	--	10	14	47,194
Wibaux	--	--	1	1	--	1	3	20,440
Yellowstone	1	--	--	--	--	6	7	16,638
Total	105	261	222	6	15	236	845	2,467,833

Source: Montana Oil and Gas Conservation Division. Annual Review for the Year 1975.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Cement:</b>			
Ideal Cement Co -----	821 17th St. Denver, Colo. 80202	Plant -----	Gallatin.
Kaiser Cement & Gypsum Corp. <sup>1</sup>	300 Lakeside Dr. Oakland, Calif. 94604	----do -----	Jefferson.
<b>Clays:</b>			
Hallett Minerals Co -----	Box 491 Forsyth, Mont. 59327	----do -----	Phillips, Rosebud, Treasure, Valley.
International Minerals and Chemicals Corp.	Old Orchard Rd. Skokie, Ill. 60076	Pit -----	Carter.
NL Industries, Inc -----	Box 1675 Houston, Tex. 77001	Pit -----	Do.
<b>Coal:</b>			
Decker Coal Co -----	Box 12 Decker, Mont. 59025	Strip mines ---	Big Horn.
Knife River Coal Co -----	Box 37 Savage, Mont. 59262	----do -----	Richland.
Peabody Coal Co -----	Big Sky Mine Colstrip, Mont. 59323	----do -----	Rosebud.
Western Energy Co -----	40 East Broadway Butte, Mont. 59701	----do -----	Do.
Westmoreland Resources ----	823 West 3rd Hardin, Mont. 59034	----do -----	Big Horn.
Copper: The Anaconda Company <sup>2</sup>	Anaconda, Mont. 59711	Smelter, mine, plant.	Silver Bow.
Fluorspar: Roberts Mining Co --	Box 365 Darby, Mont. 59829	Mine and plant	Ravalli.
Gypsum: United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	Underground mine and plant.	Fergus.
Iron Ore: R&S Iron Co -----	Radersburg, Mont. 59644	Mine -----	Broadwater.
<b>Phosphate rock:</b>			
Cominco American, Inc ----	Garrison, Mont. 59731	Mine and plant	Powell.
Stauffer Chemical Co -----	299 Park Ave. New York, N.Y. 10017	Plant -----	Silver Bow.
<b>Sand and gravel:</b>			
Gallatin Sand and Gravel Co..	Box 248 Bozeman, Mont. 59715	Pit -----	Gallatin.
McElroy & Wilkin Inc -----	Box 35 Kalispell, Mont. 59901	Pit -----	Flathead.
Midland Materials Co -----	Box 2521 Billings, Mont. 59103	Pit -----	Yellowstone.
Barry O'Leary Co -----	Box 1102 Billings, Mont. 59103	Pit -----	Do.
M.S. Ready Mix -----	Box 1501 Missoula, Mont. 59801	Pit -----	Missoula.
Stone: Big Horn Calcium Co ---	Box 118 Frannie, Wyo. 82423	Quarry -----	Carbon and Granite.
<b>Talc:</b>			
Cyprus Industrial Minerals Co	555 South Flower St. Los Angeles, Calif. 90017	Open pit and plant.	Madison.
Pfizer Co., Inc -----	Box 1147 Dillon, Mont. 59725	----do -----	Do.
Vermiculite, crude: W.R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Plant -----	Lincoln.

<sup>1</sup> Also clays and stone.<sup>2</sup> Also aluminum, gold, lime, silver, and stone.

# 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 Conservation and Survey Division of the University of Nebraska, Nebraska Geological Survey, for collecting information on all minerals except fuels.

By George H. Johnson <sup>1</sup> and Raymond R. Burchett <sup>2</sup>

The value of mineral production in Nebraska in 1975 was \$111.9 million, an increase of \$13.3 million or 13.5% above the production value of 1974. The 1975 mineral production value in Nebraska was at an alltime high, exceeding the previous record value of \$108.4 million established in 1962.

Petroleum and natural gas accounted for 51% of the mineral production value in 1975, compared with 47% in 1974. Sand and gravel and stone together contributed 24% of the total, compared with 28% in 1974. The remaining 25% of the State's mineral production value in both 1974 and 1975 was accounted for by substantial production of cement, and relatively minor

production of clays, gem stones, lime, and natural gas liquids.

**Legislation and Government Programs.**—The Nebraska Geological Survey, in cooperation with the U.S. Geological Survey, published a geologic map of eastern Nebraska at a scale of 1:250,000, or approximately one-quarter inch to the mile.<sup>3</sup> Consolidated bedrock, bedrock exposures,

<sup>1</sup> State Liaison Officer, Bureau of Mines, Topeka, Kans. (now deceased).

<sup>2</sup> Research geologist, Nebraska Geological Survey.

<sup>3</sup> Burchett, R.R., V.H. Dreeszen, E.C. Reed, and G.E. Prichard. Bedrock Geologic Map Showing Thickness of Overlying Quaternary Deposits, Fremont Quadrangle and Part of Omaha Quadrangle, Nebraska. U.S. Geol. Survey Misc. Geol. Invest. Map I-905, 1975.

Table 1.—Mineral production in Nebraska <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays .....thousand short tons..	182	\$414	195	\$416
Gem stones .....	NA	W	NA	11
Lime .....thousand short tons..	36	591	W	W
Natural gas .....million cubic feet..	2,538	863	2,565	1,388
Petroleum (crude) .....thousand 42-gallon barrels..	6,611	45,167	6,120	55,133
Sand and gravel .....thousand short tons..	13,231	17,727	11,759	16,901
Stone .....do..	4,630	10,364	4,242	10,322
Value of items that cannot be disclosed:				
Cement, natural gas liquids, and values indicated by symbol W .....	XX	23,508	XX	27,734
Total .....	XX	98,634	XX	111,905
Total 1967 constant dollars .....	XX	46,634	XX	P 44,314

<sup>P</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

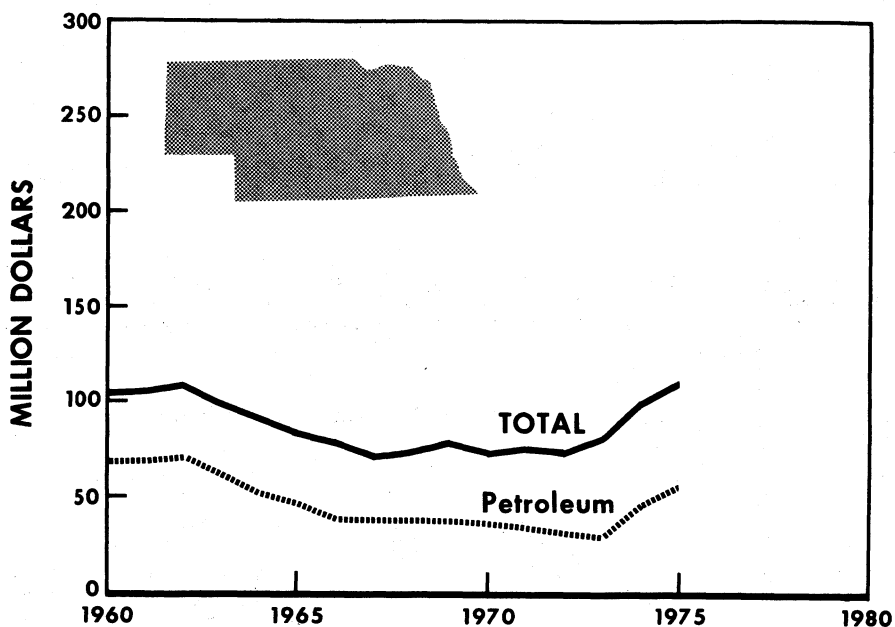


Figure 1.—Value of petroleum and total value of mineral production in Nebraska.

Table 2.—Value of mineral production in Nebraska, by county <sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams -----	W	W	Sand and gravel.
Antelope -----	\$111	\$118	Do.
Banner -----	W	7,246	Petroleum, sand and gravel, natural gas.
Boone -----	--	W	Sand and gravel.
Boyd -----	61	59	Do.
Brown -----	W	W	Do.
Buffalo -----	431	451	Do.
Burt -----	6	2	Do.
Butler -----	346	253	Do.
Cass -----	22,045	W	Cement, stone, sand and gravel, clays.
Cedar -----	232	78	Sand and gravel.
Chase -----	W	55	Do.
Cherry -----	W	W	Do.
Cheyenne -----	12,777	14,377	Petroleum, natural gas, natural gas liquids, sand and gravel.
Clay -----	W	W	Sand and gravel.
Colfax -----	152	174	Do.
Cuming -----	749	692	Do.
Custer -----	263	194	Do.
Dawes -----	W	W	Do.
Dawson -----	644	529	Do.
Deuel -----	W	W	Natural gas, sand and gravel.
Dixon -----	W	W	Sand and gravel, stone.
Dodge -----	714	838	Sand and gravel.
Douglas -----	W	W	Sand and gravel, clays.
Dundy -----	W	W	Petroleum.
Fillmore -----	177	170	Sand and gravel.
Franklin -----	149	177	Do.
Frontier -----	339	429	Petroleum, sand and gravel, natural gas.
Furnas -----	W	W	Sand and gravel, petroleum.
Gage -----	W	W	Sand and gravel, stone.
Garden -----	W	W	Petroleum, sand and gravel.
Garfield -----	W	W	Sand and gravel.
Grant -----	6	3	Do.
Greeley -----	W	W	Do.
Hall -----	574	488	Do.

See footnotes at end of table.

Table 2.—Value of mineral production in Nebraska, by county <sup>1 2</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Hamilton -----	W	W	Sand and gravel.
Harlan -----	W	W	Petroleum.
Hayes -----	W	W	Sand and gravel.
Hitchcock -----	W	W	Petroleum, sand and gravel.
Holt -----	\$218	\$149	Sand and gravel.
Hooker -----	9	--	
Howard -----	W	35	Sand and gravel.
Jefferson -----	W	W	Sand and gravel, clays.
Kearney -----	124	24	Sand and gravel.
Keith -----	178	193	Do.
Keya Paha -----	7	--	
Kimball -----	9,252	11,720	Petroleum, natural gas liquids, natural gas, sand and gravel.
Knox -----	155	171	Sand and gravel.
Lancaster -----	276	364	Stone, clays, sand and gravel.
Lincoln -----	W	W	Sand and gravel, petroleum.
Loup -----	W	--	
Madison -----	W	168	Sand and gravel.
Merrick -----	W	253	Do.
Morrill -----	2,834	3,080	Petroleum, lime, sand and gravel, natural gas.
Nance -----	W	W	Sand and gravel.
Nemaha -----	W	W	Stone.
Nuckolls -----	W	W	Cement, sand and gravel, stone.
Otoe -----	W	W	Clays, stone.
Pawnee -----	W	W	Stone.
Perkins -----	W	W	Sand and gravel.
Phelps -----	W	W	Do.
Pierce -----	107	103	Do.
Platte -----	992	908	Do.
Polk -----	122	167	Do.
Red Willow -----	W	W	Petroleum, sand and gravel.
Richardson -----	534	W	Petroleum, stone, sand and gravel.
Rock -----	W	W	Sand and gravel.
Saline -----	W	W	Do.
Sarpy -----	W	W	Stone, sand and gravel, clays.
Saunders -----	W	W	Sand and gravel, stone.
Scotts Bluff -----	2,567	3,208	Petroleum, lime, sand and gravel, natural gas.
Seward -----	W	W	Stone.
Sheridan -----	W	W	Sand and gravel.
Stanton -----	W	W	Do.
Thayer -----	345	294	Do.
Thomas -----	W	136	Do.
Valley -----	W	10	Do.
Washington -----	W	W	Stone.
Webster -----	165	W	Sand and gravel.
Wheeler -----	W	--	
York -----	111	--	
Undistributed <sup>3</sup> -----	40,864	64,586	
Total <sup>4</sup> -----	98,684	111,905	

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

<sup>1</sup> The following counties are not listed because no production was reported: Arthur, Blaine, Box Butte, Dakota, Gosper, Johnson, Logan, McPherson, Sherman, Sioux, Thurston, and Wayne.

<sup>2</sup> Values of petroleum and natural gas are based on the average price per barrel and cubic foot, respectively, for the State.

<sup>3</sup> Includes gem stones, and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.



Table 3.—Indicators of Nebraska business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands---	708.0	706.0	-0.3
Unemployment -----do-----	27.1	42.8	+57.9
<b>Employment (nonagricultural):</b>			
Mining -----do-----	1.7	1.5	-11.8
Manufacturing -----do-----	93.2	85.4	-8.4
Contract construction -----do-----	29.8	27.3	-8.4
Transportation and public utilities -----do-----	40.7	39.5	-2.9
Wholesale and retail trade -----do-----	142.3	141.9	-.3
Finance, insurance, and real estate -----do-----	33.5	33.9	+1.2
Services -----do-----	99.0	100.0	+1.0
Government -----do-----	121.4	124.5	+2.6
Total nonagricultural employment -----do-----	561.6	554.0	-1.4
<b>Personal income:</b>			
Total -----millions---	\$8,270	\$9,384	+13.5
Per capita -----do-----	\$5,379	\$6,087	+13.2
<b>Construction activity:</b>			
Number of private and public residential units authorized	7,019	7,927	+12.9
Value of nonresidential construction -----millions---	\$156.0	\$85.8	-45.0
Value of State road contract awards -----do-----	\$79.0	\$83.0	+5.1
Shipments of portland and masonry cement to and within Nebraska -----thousand short tons---	1,130	913	-19.2
<b>Mineral production value:</b>			
Total crude mineral value -----millions---	\$98.6	\$111.9	+13.5
Value per capita, resident population -----do-----	\$64.01	\$72.48	+13.2
Value per square mile -----do-----	\$1,277.20	\$1,449.04	+13.5

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

and the thickness of unconsolidated mantle rock are shown through the use of a combination of patterns and colors. Field mapping continued on the Sioux City, McCook, North Platte, and Scotts Bluff quadrangles.

The Nebraska Geological Survey also continued a mineral resource inventory program in cooperation with the U.S. Soil Conservation Service and the Nebraska Department of Roads to obtain information on active and abandoned quarries, pits, and mines. Remote sensing by aircraft and satellite imagery continued to be used in

locating the various mineral resource operations.

An open file report<sup>4</sup> showed that 666 active mining operations including limestone, sand and gravel, siltstone, clay and shale, and sandstone pits disturbed 820 acres; of this acreage, 83 were restored during the year.

Evaluation continued on the Elk Creek anomaly near the Johnson-Pawnee county line because of the rare earth elements associated with this anomaly. Field mapping also continued on the outcropping coals in southeastern Nebraska.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Cement manufacturing contributed significantly to Nebraska's mineral production in 1975. The output in 1975 was about the same as that in 1974. The production value increased 18.2% owing in part to a modest price increase. Cement was produced by Ash Grove Cement Co. in Cass County and by Ideal Basic Industries, Inc. in Nuckolls County. The chief raw materials used were limestone, common clay and shale, and gypsum. Disposi-

tion of output was 68.4% to ready-mix companies, 15.5% to highway contractors, 10% to concrete product manufacturers, 3.6% to building material dealers, and 2.5% to other contractors. Distribution of shipments was 60.9% by truck and 39.1% by railroad.

**Clays.**—Five firms produced clay in 1975. Clay production was 194,975 tons, an increase of 7% from the 182,000 tons

<sup>4</sup> Burchett, R.R., and G.R. Svoboda. Nebraska Mineral Operations Review. Nebr. Geol. Survey open file report, 1975.

produced in 1974. The 1975 value of clay production was \$416,386, compared with \$414,000 in 1974.

Ash Grove Cement Co. produced clay for cement manufacture near Louisville, Cass County. Omaha Brick Works produced clay for face and common brick near Ralston in Douglas County and in Sarpy County. Endicott Clay Products Co. produced clay to make face brick at Endicott in Jefferson County. Yankee Hill Brick Manufacturing Co., near Lincoln in Lancaster County, produced clay for common and face brick. Western Brick & Aggregate Co., in Otoe County east of Nebraska City, produced clay for making building brick and lightweight aggregate.

**Fertilizer Materials.**—Producers of ammonia, urea, and ammonium nitrate included Allied Chemical Co. at La Platte in Sarpy County, CF Industries Inc. in Dodge County, and Phillips Chemical Co. in Gage County. Farmland Industries, Inc. produced ammonia in Adams County. In addition, Cominco-American, Inc., produced ammonium nitrate in Gage County.

**Lime.**—Great Western Sugar Co. produced lime from limestone shipped from its quarry in Wyoming. Limekilns were located at Scotts Bluff, Gering, and Mitchell in Scotts Bluff County, and at Bayard in Morrill County. Quantity and value of production increased over those of 1974. The lime was used mainly for sugar refining.

**Perlite.**—The Zonolite Division of W.R. Grace & Co. was the sole manufacturer of expanded perlite. At its plant near Omaha

in Douglas County, crude perlite from other States was expanded and sold as aggregate for plaster and concrete, horticultural purposes, and filler material.

**Sand and Gravel.**—Nebraska produced 11.1% less sand and gravel in 1975 than in 1974. Production was 11.8 million tons with a value of \$16.9 million, compared with 13.2 million tons valued at \$17.7 million in 1974. The average value of sand and gravel in 1975 was \$1.44 per ton, compared with \$1.34 in 1974.

Sand and gravel was produced in 69 counties by 178 companies at 197 commercial operations, and by 22 government organizations at 28 operations. Twenty-eight large operations with individual output of more than 100,000 tons accounted for 74% of the State's total sand and gravel production by quantity and 77% by value. The leading producers were Lyman-Richey Sand & Gravel Corp. in Cass, Dodge, Douglas, Morrill, Platte, and Saunders Counties; Western Sand & Gravel Co. in Cass, Dodge, and Saunders Counties; Hartford Sand & Gravel Co. in Dodge, Douglas, and Sarpy Counties; and Central Sand & Gravel Corp. in Butler and Platte Counties. Leading in production were Douglas and Saunders Counties.

Commercial uses of sand and gravel accounted for 49.7% of the output by quantity and 49.9% of the production value. Government and contractor operations produced the remainder. About 57% of the sand and gravel produced commercially was used in building operations.

**Table 4.—Nebraska: Sand and gravel sold or used by producers, by county**  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Adams -----	1	W	W	1	W	W
Antelope -----	3	86	111	3	80	118
Banner -----	2	47	W	2	W	W
Boone -----	--	--	--	1	W	W
Boyd -----	1	42	61	1	37	59
Brown -----	2	W	W	3	W	W
Buffalo -----	8	556	431	8	518	451
Burt -----	1	11	6	1	7	2
Butler -----	4	234	346	4	167	253
Cass -----	4	496	667	4	756	1,233
Cedar -----	5	164	232	3	68	78
Chase -----	2	W	W	4	77	55
Cherry -----	2	30	W	1	W	W
Cheyenne -----	3	192	273	4	110	160
Clay -----	3	W	W	3	W	W

See footnotes at end of table.

Table 4.—Nebraska: Sand and gravel sold or used by producers, by county—Continued  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Colfax	4	95	152	4	93	174
Cuming	4	530	749	4	446	692
Custer	4	134	263	4	119	194
Dawes	1	W	W	1	W	W
Dawson	7	549	644	7	442	529
Deuel	2	W	W	2	W	31
Dixon	2	W	W	1	W	W
Dodge	4	505	714	4	471	838
Douglas	7	2,118	3,224	6	1,524	2,696
Dundy	1	W	W	--	--	--
Fillmore	1	W	177	1	W	170
Franklin	3	113	149	3	120	177
Frontier	1	W	W	1	19	14
Furnas	4	82	123	2	W	W
Gage	8	179	402	7	129	322
Garden	2	W	W	2	W	W
Garfield	1	W	W	2	W	W
Grant	1	1	6	1	12	3
Greeley	1	W	W	1	W	W
Hall	9	585	574	6	448	488
Hamilton	3	W	W	3	W	W
Hayes	2	W	W	2	W	W
Hitchcock	4	41	42	2	15	27
Holt	11	204	203	9	153	149
Hooker	1	2	9	--	--	--
Howard	1	W	W	1	W	35
Jefferson	4	W	W	3	120	234
Kearney	1	W	124	1	46	24
Keith	5	249	178	5	233	193
Keya Paha	1	W	7	--	--	--
Kimball	5	W	W	2	4	1
Knox	7	132	155	6	120	171
Lancaster	1	W	W	1	W	W
Lincoln	9	309	246	11	546	469
Madison	4	W	W	1	108	168
Merrick	3	W	W	6	218	253
Morrill	4	209	259	5	83	94
Nance	2	W	W	2	W	W
Nuckolls	1	W	W	2	W	W
Perkins	2	W	W	2	W	W
Phelps	2	W	W	2	W	W
Pierce	3	61	107	3	54	103
Platte	8	609	992	7	471	908
Polk	4	108	122	4	117	167
Red Willow	7	143	236	7	181	288
Richardson	2	W	W	3	4	4
Rock	1	W	W	1	W	W
Saline	3	101	W	3	W	W
Sarpy	4	219	245	3	105	131
Saunders	3	1,323	1,806	4	1,134	1,818
Scotts Bluff	6	338	327	9	561	575
Sheridan	2	W	W	2	W	W
Stanton	1	W	W	1	W	W
Thayer	5	224	345	5	163	294
Thomas	1	W	W	1	W	136
Valley	1	W	W	1	8	10
Webster	3	144	165	3	W	W
York	1	44	111	--	--	--
Undistributed <sup>1</sup>	3	2,026	2,749	--	1,672	1,910
Total <sup>2</sup>	239	13,231	17,727	225	11,759	16,901

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

<sup>1</sup> Includes Harlan, Loup, and Wheeler Counties for 1974, some sand and gravel that cannot be assigned to specific counties, and counties indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 5.—Nebraska: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand .....	4,979	5,769	3,761	4,554
Gravel .....	7,677	11,136	7,105	10,341
Unprocessed: Sand and gravel .....	525	521	846	660
Industrial:				
Sand .....	50	266	47	270
Gravel .....	--	--	--	--
Total .....	13,231	17,692	11,759	<sup>2</sup> 15,826

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

Table 6.—Nebraska: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ---	1,735	2,034	1,728	2,369
Highway and bridge construction .....	894	1,356	575	876
Other construction (dams, waterworks, airports, etc.) .....	242	276	335	398
Concrete products (cement blocks, brick, pipe, etc.) .....	1,358	1,750	1,289	1,788
Bituminous paving (asphalt and tar paving) .....	717	1,109	333	552
Roadbase and subbase .....	1,141	1,925	808	1,416
Fill .....	543	556	383	445
Other .....	134	178	65	69
Unprocessed:				
Roadbase and subbase .....	9	9	132	123
Fill .....	238	371	143	123
Other .....	--	--	W	W
Industrial sand and gravel .....	50	266	47	270
Total .....	7,061	9,830	<sup>1</sup> 5,839	8,439

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

<sup>1</sup> Data do not add to total shown because of independent rounding.

Table 7.—Nebraska: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	100	142	50	92
Highway and bridge construction -----	2,795	3,682	2,188	3,505
Other construction (dams, waterworks, airports, etc.) -----	53	52	129	123
Concrete products (cement blocks, brick, pipe, etc.) -----	W	W	17	22
Bituminous paving (asphalt and tar paving) -----	1,149	1,431	1,328	1,880
Roadbase and subbase -----	1,693	2,367	1,579	2,305
Fill -----	96	71	20	21
Other -----	6	11	39	71
<b>Unprocessed:</b>				
Roadbase and subbase -----	278	141	497	401
Fill -----	W	W	37	22
Other -----	--	--	38	19
<b>Total</b> <sup>1</sup> -----	<b>6,170</b>	<b>7,897</b>	<b>5,921</b>	<b>8,462</b>

W Withheld to avoid disclosing individual company confidential data; "concrete products" included with "bituminous paving"; "unprocessed fill" included with "unprocessed roadbase."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Stone.**—Stone accounted for 9% of the State's mineral production by value. Stone production decreased 8% in quantity compared with that of 1974; value remained about the same. Unit value increased from \$2.24 per ton in 1974 to \$2.43 per ton in 1975. Production was entirely in the form of crushed and broken limestone. It was produced in 13 counties by 16 commercial producers with 27 quarries. Three large quarries with individual outputs of more than 400,000 tons accounted for 62% of the State's total stone production by quantity. In Cass County, eight companies with nine quarries pro-

duced 69% of the stone by quantity and 66% by value. The leading stone producers by quantity were Hopper Brothers Quarries, Ash Grove Cement Co., Kerford Limestone Co., and Fort Calhoun Stone Co. Together, their 14 operations accounted for 85% of the stone production by quantity and 74% by value.

Crushed and broken stone was used for concrete and concrete aggregate, bituminous aggregate, surface treatment aggregate, roadbase, riprap, and agricultural purposes. Transportation was 85% by truck, 14% by railroad, and 1% by waterway.

Table 8.—Nebraska: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	W	W	410	896
Concrete aggregate -----	W	W	1,394	3,177
Dense-graded roadbase stone -----	353	737	286	594
Surface treatment aggregate -----	W	W	669	1,686
Other construction aggregate and roadstone -----	126	289	92	339
Agricultural limestone <sup>1</sup> -----	311	1,799	169	361
Riprap and jetty stone -----	283	831	104	350
Other uses <sup>2</sup> -----	3,558	6,708	1,119	2,918
<b>Total</b> <sup>3</sup> -----	<b>4,630</b>	<b>10,364</b>	<b>4,242</b>	<b>10,322</b>

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

<sup>1</sup> 1974 data include poultry grit and mineral food.

<sup>2</sup> Includes stone used in railroad ballast, cement manufacture, asphalt fillers, minor amount of whitening (1974), soil conditioners, poultry grit and mineral food (1975), waste material (1975), and uses indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

**Talc.**—Cyprus Mines Corp's United Sierra Division plant near Grand Island in Hall County was the only producer of ground talc in Nebraska. The crude talc was obtained from outside the State. The product was used in paper, ceramics, rubber, paint, insecticides, textiles, and toilet articles.

**Vermiculite.**—The only producer of exfoliated vermiculite was W.R. Grace & Co., Construction Products Division, near Omaha in Douglas County. Montana was the source of the crude vermiculite. The expanded product was used principally for insulation, concrete aggregate, and fireproofing.

#### MINERAL FUELS

The Nebraska Oil and Gas Conservation Commission issued 377 permits to drill for oil and gas in 1975. Of these, 212 were for exploration wells, 160 were for development wells, 2 for water disposal wells, and 3 were for stratigraphic testing. Drilling permits for exploratory and development wells were issued largely for Kimball (83), Cheyenne (70), Hitchcock (54), and Banner (37) Counties.

There were 338 oil and gas well completions in Nebraska in 1975 with a total footage drilled of 1,707,170 feet, compared with 230 completions in 1974 with a footage drilled of 1,189,152 feet. Of the

total wells completed in 1975, 75 were productive and 263 were dry. Completions were reported in 21 counties; Kimball, Cheyenne, and Hitchcock Counties accounted for 195 of the total completions. At yearend 1975, there were 1,209 active oil and gas wells in Nebraska and 450 capped wells. Of the total active oil wells, 1,010 were in Red Willow, Kimball, Cheyenne, and Banner Counties.

**Natural Gas.**—The marketed production of natural gas in 1975 increased 1.1% in quantity above that of 1974; the value of the output increased 61%. The average unit sales price for marketed natural gas increased from 34 cents per thousand cubic feet in 1974 to 54 cents per thousand cubic feet in 1975. Production of dry and casinghead gas was reported in seven counties; Cheyenne County was the major producer.

**Natural Gas Liquids.**—Two natural gas processing plants are located in Nebraska. One, south of Kimball in Kimball County, is operated by Cities Service Oil Co. The other, west of Sidney in Cheyenne County, is operated by Marathon Oil Co. Production from these two plants includes natural gasoline, cycle products, liquid petroleum gases, and ethane. The output of the products declined 26.3%, and the value of production declined 32.4%, compared with the 1974 figures.

Table 9.—Nebraska: Oil and gas well drilling completions, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Banner	2	--	6	2	--	21	31	190,069
Box Butte	--	--	--	--	--	1	1	3,470
Buffalo	--	--	--	--	--	1	1	3,283
Cherry	--	--	--	--	--	1	1	4,205
Cheyenne	9	--	23	2	--	34	68	342,141
Dawes	--	--	--	--	--	1	1	1,913
Deuel	--	--	--	--	--	5	5	19,008
Dundy	2	--	1	2	--	8	13	62,095
Frontier	--	--	--	--	--	2	2	5,159
Furnas	1	--	--	--	--	3	4	13,901
Hayes	--	--	--	--	--	2	2	9,166
Hitchcock	5	--	13	7	--	21	46	197,642
Keith	--	--	--	--	--	1	1	4,994
Kimball	13	--	21	4	1	42	81	529,573
Lincoln	--	--	--	--	--	2	2	9,171
Morrill	2	--	7	--	--	15	24	107,996
Red Willow	21	--	5	--	--	8	34	116,952
Richardson	--	--	1	--	--	5	6	16,166
Scotts Bluff	2	--	2	--	--	6	10	52,469
Sheridan	--	--	--	--	--	2	2	3,676
Sioux	--	--	--	--	--	3	3	14,121
<b>Total</b>	<b>57</b>	<b>--</b>	<b>79</b>	<b>17</b>	<b>1</b>	<b>184</b>	<b>338</b>	<b>1,707,170</b>

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 10.—Nebraska: Number of active and capped oil and dry gas wells at yearend 1975, by county

County	Oil wells		Dry gas wells	
	Active	Capped	Active	Capped
Banner .....	169	70	--	--
Cheyenne .....	239	39	17	3
Deuel .....	--	--	1	10
Dundy .....	8	--	--	--
Frontier .....	8	2	--	--
Furnas .....	1	2	--	--
Garden .....	2	--	--	--
Harlan .....	8	--	--	--
Hitchcock .....	49	21	--	--
Kimball .....	289	142	1	--
Lincoln .....	--	1	--	--
Morrill .....	55	21	--	--
Red Willow .....	313	113	--	--
Richardson .....	17	21	--	--
Scotts Bluff .....	32	5	--	--
Total .....	1,190	437	19	13

Source: Nebraska Oil and Gas Conservation Commission.

**Petroleum.**—A total of 6.1 million barrels of petroleum was produced in 1975, compared with 6.6 million barrels in 1974, a 7.4% decline. The number of active wells increased from 1,127 to 1,190, and the number of capped wells decreased from 467 to 437. The reported unit value of crude petroleum increased 31.9%, from \$6.83 per barrel in 1974 to \$9.01 per barrel in 1975.

Production was reported in 14 counties; Red Willow, Cheyenne, Kimball, and

Banner Counties accounted for 84.4% of the total output. The State's largest producing field, Sleepy Hollow field in Red Willow County, produced 18% of the total.

#### METALS

The ASARCO, Inc. refinery in Omaha recovered lead, gold, silver, antimony, and bismuth from lead bullion and other smelter products shipped from ASARCO plants outside Nebraska.

Table 11.—Nebraska: Crude petroleum production, by county (Thousand 42-gallon barrels)

County	1974	1975	Principal fields
Banner .....	854	791	Singleton, Stage Hill, <sup>1</sup> Johnson.
Cheyenne .....	1,547	1,352	Jormar, Margate, Southwest Sidney, West Engelland, Filon.
Dundy .....	12	47	East Indian Creek, Rock Canyon.
Frontier .....	45	46	Bed Canyon. <sup>2</sup>
Furnas .....	2	2	Southwest Wilsonville.
Garden .....	7	6	Richard and McCord.
Harlan .....	22	20	South Alma.
Hitchcock .....	218	279	Reiher.
Kimball .....	1,258	1,247	Sloss, Enders, Axial, Bertramson.
Lincoln .....	2	1	Red Willow Creek.
Morrill .....	362	314	Bridgeport.
Red Willow .....	1,985	1,775	Sleepy Hollow, Ackman, Danbury, Bed Canyon. <sup>2</sup>
Richardson .....	42	36	Dawson, Fall City, Barada.
Scotts Bluff .....	254	204	Cedar Valley, Stage Hill, <sup>1</sup> Minatare.
Total .....	<sup>3</sup> 6,611	6,120	

<sup>1</sup> Partly in Banner and Scotts Bluff Counties.

<sup>2</sup> Partly in Frontier and Red Willow Counties.

<sup>3</sup> Data may not add to total shown because of independent rounding.

Source: Nebraska Oil and Gas Conservation Commission.

Table 12.—Nebraska: Crude oil production in the 25 largest fields in 1975  
(42-gallon barrels)

Field	County	Annual output	Average daily output
Sleepy Hollow	Red Willow	1,103,403	3,023
Ackman	do	192,533	527
Silver Creek	do	184,069	504
Jormar	Cheyenne	139,743	383
Bush Creek	Hitchcock	114,549	314
Singleton	Banner	95,199	261
Joyce	do	93,411	256
Danbury	Red Willow	91,382	250
Southwest Sidney	Cheyenne	88,718	243
Bridgeport	Morrill	87,374	241
Midway	Red Willow	87,691	240
Stage Hill	Banner and Scotts Bluff	84,788	232
Owasco	Kimball	81,860	224
Middle Creek	Cheyenne and Morrill	79,601	218
Cedar Valley	Scotts Bluff	77,610	213
Margate	Cheyenne	75,577	207
Pecos	do	59,376	163
Reiher	Hitchcock	59,330	163
Johnson	Banner	58,317	160
Bed Canyon	Frontier and Red Willow	55,857	153
Enders	Kimball	55,388	152
Houtby	do	52,230	143
West Engelland	Cheyenne	51,854	142
Doran	do	50,967	140
Sloss	Kimball	49,555	136

Source: Nebraska Oil and Gas Conservation Commission.



Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Cement:</b>			
Ash Grove Cement Co. <sup>1</sup> -----	1000 Tenmain Center Kansas City, Mo. 64105	Plants -----	Cass.
Ideal Basic Industries, Inc. <sup>2</sup> ---	420 Ideal Cement Bldg. Denver, Co. 80202	----do -----	Nuckolls.
<b>Clays:</b>			
Endicott Clay Products Co ----	Endicott, Nebr. 68350	Open pit mine and plant.	Jefferson.
Western Brick & Aggregate Co	Box 1141 Nebraska City, Nebr. 68410	----do -----	Otoe.
Yankee Hill Brick Manu- facturing Co.	Route 1 Lincoln, Nebr. 68502	----do -----	Lancaster.
<b>Natural gas and petroleum:<sup>3</sup></b>			
<b>Sand and gravel:</b>			
Behrens Construction Co -----	Box 118 Beatrice, Nebr. 68310	Pits and plants	Gage and Saline.
Central Sand & Gravel Corp --	Box 626 Columbus, Nebr. 68601	Dredging -----	Butler and Platte.
Hartford Sand & Gravel Co --	Box 571 Valley, Nebr. 68064	Dredging and pits.	Dodge, Douglas, Sarpy.
Lyman-Richey Sand & Gravel Corp.	4315 Cuming St. Omaha, Nebr. 68131	Pits and plants	Cass, Dodge, Douglas, Morrill, Platte, Saunders.
Western Sand & Gravel Co ---	Lincoln, Nebr. 68501	Dredging -----	Cass, Dodge, Saunders.
<b>Stone:</b>			
City Wide Rock & Excavation Co.	38th and Mason Sts. Omaha, Nebr. 68105	Quarries and plants.	Sarpy.
Fort Calhoun Stone Co -----	1255 South St. Blair, Nebr. 68008	----do -----	Washington.
Hopper Bros. Quarries -----	Weeping Water, Nebr. 68463	----do -----	Cass, Nemaha, Pawnee, Saunders.
Kerford Limestone Co -----	Box 434 Weeping Water, Nebr. 68463	Quarry and plant.	Cass.
United Rock Construction, Inc -	1117 Woodman of the World Bldg. Omaha, Nebr. 68102	----do -----	Do.

<sup>1</sup> Also stone and clays.<sup>2</sup> Also stone.<sup>3</sup> Most of the major oil and gas companies and many smaller companies operate in Nebraska, and several commercial directories contain lists of them.

# The Mineral Industry of Nevada

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

By Paul V. Fillo<sup>1</sup>

The value of Nevada's mineral output reached \$258.4 million in 1975, compared with \$257.9 million in 1974. Production value of metals as a group decreased 8%, nonmetals increased 21%, and mineral fuels (petroleum) decreased 2%.

Gold production continued to increase, and in 1975 Nevada was the leading gold producer in the United States. Copper production dropped 3% and its portion of the total value of the State's mineral production slipped from 50% in 1974 to 40% in 1975.

Of the 16 nonmetallic materials, 7 showed an increase in production and 9 showed a decrease. Substantial percentage gains continued to be made by barite and lithium minerals, while lime, gypsum, diatomite, and sand and gravel showed declines.

**Trends and Developments.**—In February, Kennecott Copper Corp.'s Nevada Mines Div. reduced its operating level from 7 days per week to 5. The buildup in copper inventories required that production be reduced until a better balance between supply and demand in the industry was restored. A layoff of approximately 200 workers occurred to bring about the change. In July, the firm began an 8-week shutdown which resulted in a layoff of 750 of the 1,280 employees. Production of copper at its concentrating and smelting operations was also brought to a temporary halt.

The Anaconda Company's development work at the Victoria open pit mine continued as scheduled. The 1,000-ton concentrator continued to produce copper con-

centrates which were shipped to Anaconda, Mont.

Minerals Engineering Co. (MECO) began exploratory drilling on one site at Gold Hill and another at Silver City to determine the potential wealth of mines located on 1,850 acres of land which includes 95% of the Comstock Lode. Tenabo Gold Placers conducted drilling on its property in the Bullion mining district in Lander County. Cyprus Mines Corp. was conducting an exploratory drilling operation on the Northumberland gold property.

Mt. Hope Mining Co. was building a flotation plant for the Mt. Hope zinc-lead mine 25 miles north of Eureka, Nev. Combined Enterprises, Inc. disclosed a new discovery of a silver deposit in the Atlanta mining district which would constitute an open pit mine. Summa Corp. signed a 50-year lease agreement in April on the Mary mine in the Silver Peak mining district. Cliffs Copper Co. shut down its mining and leaching program at the Rio Tinto mine near Mountain City.

The Standard Slag Co. operated the Atlanta mine and mill located between Pioche and Ely. A crushing plant was under construction and the 300-ton-per-day cyanide plant was being renovated. The company poured its first gold bullion bar from the operation in late spring. Silver King Mines, Inc. announced an aggressive program of exploration and development for gold in the Taylor mining district southeast of Ely. The company plans to construct a

<sup>1</sup> State Liaison Officer, Bureau of Mines, Carson City, Nev.

1,000-ton-per-day plant. The Smoky Valley Mining Co., a subsidiary of Copper Range Co., awarded a contract for design and construction of gold-processing facilities at its Round Mountain, Nev. mine. Reactivation is expected to result in production of about 82,000 ounces of gold annually for at least 5 years.

Work began late in 1975 on Idaho Mining Co.'s new refinery building at its site in Windfall Canyon near Eureka. The plant will be put into operation removing gold from the activated carbon obtained through the leaching process. Polaris Resources leased a gold property near Yerington in Lyon County and was sampling existing cuts and shafts on the lease.

IMCO Services and All Minerals, Inc., two barite producers, were both working 6-day weeks, producing between 600 to 800 tons per day. IMCO's new barite mill near Battle Mountain services all of the western United States and Alaska with bagged barite used primarily as a well drilling fluid in deep wells. Standard Slag Co.'s Old Soldier Mine in northern Nye County conducted an extensive drilling operation as

part of its proposed program to produce paint-grade barite.

Union Carbide Corp., Mining and Metals Div., opened a temporary office at Alamo, Nev. The company was making preparations to construct a 1,000-ton tungsten mill at the Lincoln mine in the Tempiute mining district.

After a 3-year dispute, the Environmental Protection Agency (EPA) and Kennecott Copper Corp. have come to an understanding. EPA has adopted substitute regulations for control of sulfur dioxide air pollutant emissions from Kennecott's smelter at McGill on a temporary basis. The company must eventually achieve reduction in emissions on a permanent basis.

Sierra Pacific Power Co. started test drilling near Valmy in Humboldt County to gather geological information on the proposed site of a \$150 million coal-fired powerplant.

The Duval Corp. mine, an open pit copper mine at Battle Mountain in Lander County, has been designated the safest Duval mine in the country. The mine was approaching 2 million man-hours with no lost time accidents.

Table 1.—Mineral production in Nevada<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite -----thousand short tons--	761	\$8,115	916	\$11,006
Clays -----do-----	39	218	5	136
Copper (recoverable content of ores, etc.) -----short tons--	84,101	130,021	81,210	104,274
Gem stones -----	NA	400	NA	2,814
Gold (recoverable content of ores, etc.) -----troy ounces--	298,754	47,723	332,814	53,746
Gypsum -----thousand short tons--	843	2,959	558	2,375
Iron ore (usable) -----thousand long tons, gross weight--	139	W	109	1,017
Lead (recoverable content of ores, etc.) -----short tons--	1,785	803	2,976	1,280
Petroleum (crude) --thousand 42-gallon barrels--	129	W	115	W
Sand and gravel -----thousand short tons--	8,736	14,515	8,056	16,848
Silver (recoverable content of ores, etc.) -----thousand troy ounces--	872	4,108	1,609	7,111
Stone -----thousand short tons--	2,186	4,203	3 4,829	3 4,524
Tungsten (W content) -----thousand pounds--	132	537	33	152
Zinc (recoverable content of ores, etc.) -----short tons--	3,405	2,445	5,496	4,287
Value of items that cannot be disclosed:				
Antimony, cement, clays (common and shale), diatomite, fluorspar, lime, lithium minerals, magnesite, mercury, molybdenum, perlite, pumice, salt, stone (dimension), talc, and values indicated by symbol W	XX	41,829	XX	48,820
Total -----	XX	257,876	XX	258,390
Total 1967 constant dollars -----	XX	121,924	XX	P 102,322

<sup>P</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes common clay and shale.

<sup>3</sup> Excludes dimension stone.

Table 2.—Value of mineral production in Nevada, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Carson City -----	W	\$284	Sand and gravel, pumice, stone, gold.
Churchill -----	\$1,014	876	Diatomite, sand and gravel, tungsten, gold, salt, pumice, silver, stone, copper, lead.
Clark -----	22,778	21,070	Sand and gravel, lime, stone, gypsum, gold, silver, zinc, clays, lead, copper.
Douglas -----	W	383	Sand and gravel, silver, stone, gold, copper, lead, zinc.
Elko -----	4,415	W	Copper, sand and gravel, gold, barite, silver, tungsten, stone, zinc.
Esmeralda -----	W	13,412	Lithium, diatomite, sand and gravel, talc, clays, silver, lead, zinc, gold, copper.
Eureka -----	24,681	W	Gold, iron ore, stone, mercury, silver, lead.
Humboldt -----	741	1,553	Mercury, lead, stone, copper, silver, sand and gravel.
Lander -----	46,595	43,011	Copper, gold, barite, silver, sand and gravel, lead, zinc.
Lincoln -----	W	9,368	Zinc, silver, lead, gold, clays, sand and gravel, perlite, copper.
Lyon -----	65,084	59,276	Copper, cement, stone, sand and gravel, diatomite, gypsum.
Mineral -----	W	W	Tungsten, sand and gravel.
Nye -----	4,592	7,126	Barite, magnesite, petroleum, gold, fluor spar, sand and gravel, pumice, iron ore, tungsten, clays, silver, lead, zinc.
Pershing -----	8,817	8,245	Diatomite, gypsum, iron ore, sand and gravel, gold, mercury, clays, silver, perlite, tungsten, lead, zinc, copper.
Storey -----	W	W	Diatomite, pumice.
Washoe -----	4,343	W	Sand and gravel, pumice, clays, stone.
White Pine -----	W	39,742	Copper, gold, silver, lime, sand and gravel, stone, molybdenum, tungsten.
Undistributed <sup>1</sup> -----	74,810	54,040	
Total <sup>2</sup> -----	257,876	258,390	

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

<sup>1</sup> Includes some mercury and sand and gravel that cannot be assigned to specific counties; gem stones, barite, and values indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Nevada business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands..	279.6	285.0	+1.9
Unemployment ----- do..	21.4	26.5	+23.8
<b>Employment (nonagricultural):</b>			
Mining ----- do..	4.3	4.4	+2.3
Manufacturing ----- do..	12.1	12.2	+.8
Contract construction ----- do..	15.4	12.1	-21.4
Transportation and public utilities ----- do..	16.7	17.1	+2.4
Wholesale and retail trade ----- do..	49.9	51.4	+3.0
Finance, insurance, and real estate ----- do..	10.8	10.6	-1.9
Services ----- do..	103.7	110.3	+6.4
Government ----- do..	43.0	45.6	+6.0
Total nonagricultural employment ----- do..	255.9	263.7	+3.0
<b>Personal income:</b>			
Total ----- millions..	\$3,537	\$3,935	+11.3
Per capita ----- do..	\$6,161	\$6,647	+7.9
<b>Construction activity:</b>			
Number of private and public residential units authorized ----- do..	5,760	7,187	+24.8
Value of nonresidential construction ----- millions..	\$115.1	\$132.7	+15.3
Value of State road contract awards ----- do..	\$20.0	\$25.0	+25.0
Shipments of portland and masonry cement to and within Nevada ----- thousand short tons..	369	366	-0.8
<b>Mineral production value:</b>			
Total crude mineral value ----- millions..	\$257.9	\$258.4	+0.2
Value per capita, resident population ----- do..	\$449.26	\$437.95	-2.5
Value per square mile ----- do..	\$2,332.87	\$2,337.52	+0.2

<sup>p</sup> Preliminary.

Source: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

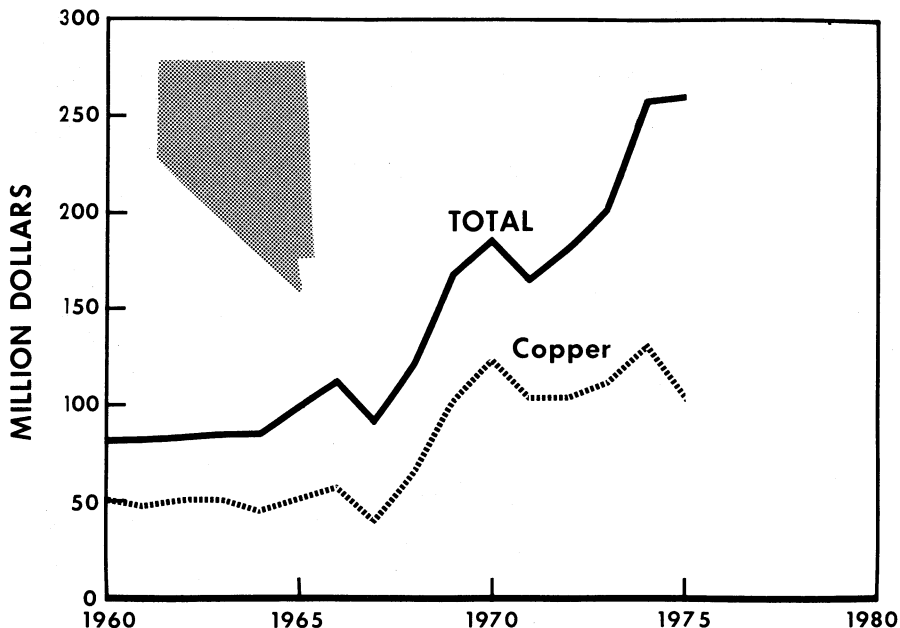


Figure 1.—Value of copper and total value of production in Nevada.

**Legislation and Government Programs.**—The Federal Government owns 60,832,171 acres of Nevada's 70,745,600 acres. Between 7,902,536 and 8,402,536 acres of Federal land are withdrawn or segregated from mining and/or mineral leasing. In addition, there is pending legislation to withdraw an additional 179,926 acres.

The Charles Sheldon Antelope Range, covering 578,000 acres of northern Nevada and southern Oregon, was officially closed to any further mining locations by the Bureau of Land Management (BLM). The Federal withdrawal prevents any further mining claims from being filed on a total of 468,000 acres of the range. This will remain in effect until the Geological Survey and the Bureau of Mines can complete a study of the mineral values there. Public hearings were held in the State on withdrawal of the Sheldon Antelope Range from mineral leasing.

BLM reopened 9,200 acres of national resource lands in Lander County to mining and geothermal leasing. The lands have been closed since late 1973 when the former Atomic Energy Commission filed an application to temporarily withdraw 86,000 acres at three sites in Pershing and Lander

Counties for geothermal exploration. The State of Nevada received \$950,000 as its share of revenues from the Federal lands administered in the State by BLM. The sum represents Nevada's share of all Federal revenues from mineral leasing, such as bonuses, royalties, and rentals.

A new Government agency consolidating energy research activities began operations in January. The Energy Research and Development Administration (ERDA) combined the efforts of the old Atomic Energy Commission, the Department of the Interior, the Environmental Protection Agency, and the National Science Foundation. The State of Nevada is the site of ERDA's only underground nuclear testing facility.

A package of bills to boost the State Tax Commission's power over mines and to ease certain taxpayer penalties was proposed in the State Assembly. The eight-bill package would require mine operators to keep detailed records of all income and expenses, with a strict penalty to be imposed for failure to file the report.

The two Nevada Senators introduced legislation in Congress designed to assist small miners and prospectors in mineral

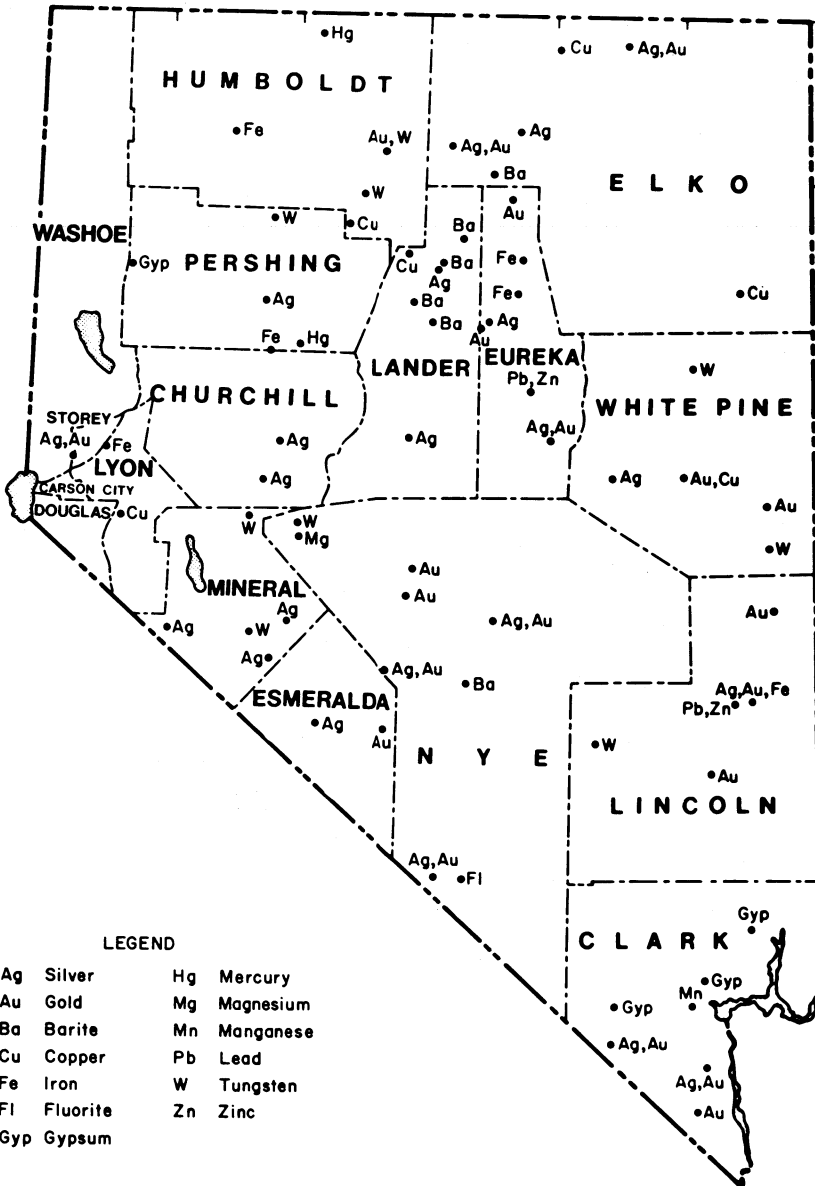


Figure 2.—Generalized map of selected mineral industries in Nevada.

exploration and development of mining claims.

A bill outlining qualifications for a new Nevada mines inspector, and setting up safety regulations and qualifications for deputy mines inspectors, was introduced

and passed in the State Assembly. The guidelines were drawn up in accordance with the Federal Mines Safety Act.

Nevada's controversial mining claim map law was declared legal by the State Supreme Court. The law had been enacted

by the 1971 legislature but was later overturned in Mineral County district court on the grounds it was "drafted by incompetents."

The U.S. Army Corps of Engineers' program to construct three upstream storage dams on the Humboldt River near Elko ran into opposition from the Pershing County Water Conservation District and various other groups. Concern was voiced over effects the project would have on long established water rights on the river and resulting problems to agricultural interests involved.

The Department of the Interior awarded three grants to the University of Nevada in Reno during the year. Mackay School of Mines will get a \$16,906 grant for research on silver-bearing ores and another for \$15,009 for sulfuric acid research. The third grant of \$15,663 goes to the chemistry department for a research project in the vibrational spectroscopy laboratory.

The Bureau of Mines awarded a \$23,000 contract to the Desert Research Institute, University of Nevada System, Las Vegas, for the development and testing of an environmental monitoring program in Boulder City. Kennecott Copper Corp. of McGill received a \$59,000 grant from the Bureau of Mines to be used for research services for a slope stability program on Kennecott property in McGill.

The Bureau of Mines Reno (Nev.) Metallurgy Research Center performed field tests at several active gold mills in the State in a trailer-mounted mobile test unit. The mobile project is part of a Bureau of Mines program to develop lower cost-processing methods which will stimulate the production of gold and silver from marginal ore deposits.

Heap leaching amenability tests were conducted by the Reno Metallurgy Research Center on gold ores from Death Valley National Park, at the request of the National Park Service, as part of an evaluation for a mining permit in the park. The tests showed that the gold-quartz ore was amenable to heap leaching with dilute cyanide solution.

Rare Earth Metals Co. of America (Remcoa) successfully completed operation of a pilot electrolytic cell to produce rare-earth metals and has begun construction of a 20,000-ampere demonstration cell which will give Remcoa an entry into the mischmetal market with a target production of about 250,000 pounds per year. The process was developed in a 1,000-ampere cell at the Reno Center.

Bureau-developed techniques of utilizing  $\text{FeCl}_6(\text{g})$  to enhance chloride volatilization of gold at low temperature has been extended to the vapor transport of base metal chlorides in recent research at the Colorado School of Mines. Several new volatile species have been identified by transpiration mass spectrometric analysis. Previously the Colorado School of Mines, under a Bureau grant, assisted the Reno Metallurgy Research Center in identifying the volatile species  $\text{AuFeCl}_6(\text{g})$  and  $\text{AuAlCl}_6(\text{g})$ .

Preliminary agreements were completed between the Bureau of Mines and Kennecott Copper Corp.'s Nevada Mines Div. to conduct cooperative studies on the electrooxidation of off-grade molybdenite concentrates at Kennecott's concentrator at McGill. Plans call for 24-hour-per-day operation of the electrooxidation-separation-precipitation process to produce marketable molybdenum and rhenium compounds.

## REVIEW BY MINERAL COMMODITIES

### METALS

**Copper.**—Copper output decreased 3% below that of 1974, making the State the Nation's fifth largest copper producer. Most of the output came from operations of The Anaconda Company, Lyon County; Kennecott Copper Corp., White Pine County; the Victoria mine owned by The Anaconda Company in Elko County; and Duval Corp., Lander County.

The decrease in copper output was attributed to two companies that terminated operations; Ranchers Exploration & Development Corp. which operated the Big Mike mine near Winnemucca in Humboldt County, and Cliffs Copper Corp. that ended its operations at the Rio Tinto mine near Mountain City in Elko County.

A negligible quantity of copper was recovered as a byproduct from silver ores.

Table 4.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing		Material sold or treated <sup>1</sup> (short tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1973, total	13	5	24,596,246	260,437	\$25,473,344	623,660	\$1,595,324
1974, total	30	--	23,110,295	298,754	47,722,964	872,243	4,108,266
1975:							
Carson City	--	1	--	13	2,099	--	--
Elko	4	--	342,933	10,269	1,658,341	65,691	290,354
Eureka	4	--	804,981	203,226	32,818,967	467	2,064
Lander	6	--	4,142,760	94,677	15,289,388	740,596	3,273,434
Lyon	1	--	10,654,791	--	--	--	--
Pershing	4	1	200,574	411	66,372	6,578	29,075
White Pine	2	--	4,891,107	14,861	2,399,903	111,547	493,038
Undistributed <sup>2</sup>	11	--	675,258	9,357	1,511,062	683,856	3,022,644
Total	32	2	21,712,404	332,814	53,746,132	1,608,785	7,110,609
Copper							
Lead							
Zinc							
	Short tons	Value	Short tons	Value	Short tons	Value	Total value
1973, total	93,702	\$111,504,886	--	--	--	--	\$138,573,554
1974, total	84,101	130,020,651	1,785	\$803,091	3,405	\$2,445,034	185,100,006
1975:							
Carson City	--	--	--	--	--	--	2,099
Elko	4,734	6,078,467	--	--	( <sup>3</sup> )	75	8,027,237
Eureka	--	--	( <sup>3</sup> )	36	--	--	32,321,067
Lander	13,740	17,642,282	( <sup>3</sup> )	36	( <sup>3</sup> )	118	36,205,258
Lyon	34,243	43,967,378	--	--	--	--	43,967,378
Pershing	( <sup>3</sup> )	335	7	2,851	4	3,156	101,789
White Pine	28,357	36,410,614	--	--	--	--	39,303,555
Undistributed <sup>2</sup>	136	174,413	2,970	1,276,933	5,492	4,283,801	10,263,853
Total	81,210	104,273,989	*2,976	1,279,856	5,496	4,287,150	170,697,736

<sup>1</sup> Does not include gravel washed.<sup>2</sup> Includes Churchill, Clark, Douglas, Esmeralda, Humboldt, Lincoln, and Nye Counties combined to avoid disclosing individual company confidential data.<sup>3</sup> Less than ½ unit.<sup>4</sup> Data do not add to total shown because of independent rounding.



Table 5.—Nevada: Mine production of gold, silver, copper, lead, and zinc in 1975, by class of ore or other source material, in terms of recoverable metal

Source	Number of mines <sup>1</sup>	Material sold or treated <sup>2</sup> (thousand short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
<b>Lode ore:</b>							
Gold <sup>3</sup> .....	12	3,768	296,917	9,401	1	( <sup>4</sup> )	( <sup>4</sup> )
Gold-silver .....	5	50	2,155	215,779	199	( <sup>4</sup> )	( <sup>4</sup> )
Silver .....	8	1	24	13,147	( <sup>4</sup> )	7	4
Copper <sup>3</sup> .....	4	17,476	33,288	701,940	72,517	--	--
Copper-lead .....	1	13	131	12,508	108	355	49
Lead .....	1	( <sup>4</sup> )	1	1,006	( <sup>4</sup> )	5	1
Lead-zinc .....	1	390	91	649,988	26	2,604	5,428
Zinc .....	1	1	138	3,726	1	5	14
Total <sup>5</sup> .....	32	21,700	332,745	1,607,495	72,853	2,976	5,496
<b>Other lode material:</b>							
Gold-silver cleanup .....	--	( <sup>4</sup> )	46	1,240	--	( <sup>4</sup> )	( <sup>4</sup> )
Copper precipitates .....	3	12	--	--	8,358	--	--
Total .....	3	12	46	1,240	8,358	( <sup>4</sup> )	( <sup>4</sup> )
Total lode material <sup>5</sup> .....	33	21,712	332,791	1,608,735	81,210	2,976	5,496
Placer .....	2	--	23	--	--	--	--
Grand total .....	35	21,712	332,814	1,608,735	81,210	2,976	5,496

<sup>1</sup> Detail will not necessarily add to totals shown because some mines produce more than one class of material.

<sup>2</sup> Does not include gravel washed.

<sup>3</sup> Includes material that was leached.

<sup>4</sup> Less than ½ unit.

<sup>5</sup> Data may not add to totals shown because of independent rounding.

Table 6.—Nevada: Mine production of gold, silver, copper, lead, and zinc in 1975, by type of material processed and method of recovery, in terms of recoverable metal

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
<b>Lode:</b>					
Amalgamation .....	427	65	--	--	--
Cyanidation .....	298,099	218,432	--	--	--
Smelting of concentrates .....	33,689	1,380,914	58,687	2,975	5,494
Leaching .....	( <sup>1</sup> )	( <sup>1</sup> )	13,966	--	--
Direct smelting of—					
Ore .....	530	8,084	200	1	2
Copper precipitates .....	--	--	8,358	--	--
Gold-silver cleanup .....	46	1,240	--	( <sup>2</sup> )	( <sup>2</sup> )
Total lode material .....	332,791	1,608,735	<sup>3</sup> 81,210	2,976	5,496
Placer .....	23	--	--	--	--
Grand total .....	332,814	1,608,735	81,210	2,976	5,496

<sup>1</sup> Included in cyanidation.

<sup>2</sup> Less than ½ unit.

<sup>3</sup> Data do not add to total shown because of independent rounding.

**Gold.**—Nevada was the Nation's leading gold producer in 1975 with 32% of the total U.S. output. Gold output increased 11% compared with that of 1974, but value increased 13%. Two lode gold mines, the Carlin Gold Mining Co. and the Cortez Gold Mines Co., provided most of the total production. The balance was produced pri-

marily as byproduct gold from copper ores, which accounted for 10% of the lode gold recovered. A total of 28 mines were involved in the production of gold. Placer gold recovery was insignificant by comparison. Only one property in Pershing County and one in Carson City yielded more than a few ounces.

**Iron Ore.**—Production and shipments of usable iron ore dropped 22% from those of 1974. Only three mines were active during the year and the direct shipping grade of ores was produced and shipped by Nevada-Barth Corp., Eureka County, and by Cooney Brothers and Nevada Iron Ore Co., Inc., both in Douglas County. Standard Slag Co., Douglas County, produced iron ore concentrate for export at its Wabuska plant in Lyon County.

**Lead.**—Although 12 lode mines contributed to the total lead output in 1975, only 5, the Silver Hawk Mining Co., Clark County; Western Minerals Products Co., Humboldt County; Sylvania Mining Co., Esmeralda County; Toulon Metals and Ores, Inc., Pershing County; and Pan American lead-zinc mine, Lincoln County, yielded significant quantities of recoverable lead. Pan American dominated the lead industry in Nevada with 87% of the total output. Production for the State increased 67% from that of 1974.

**Mercury.**—Production of mercury increased over 1,500% from that of 1974. Nevada was the leading mercury mining State in 1975, producing 84% of the total national quantity of the mineral. The largest producer in the State was the new McDermit Mine in Humboldt County, operated as a joint venture between Mineral Exploration and Placer Amex. The mine had its formal opening June 2. It reportedly will produce 20,000 flasks of mercury per year, which represents almost 50% of domestic primary demand. Other producers in the State were the Carlin Gold Mining Co. which continued to produce mercury as a byproduct from its gold mine in Eureka County, and Crofoot Tungsten Co., producing from its Red Bird mine in Pershing County.

**Molybdenum.**—Kennecott Copper Corp. was the only company to recover molybdenum as a byproduct in treating copper ore at its McGill concentrator, White Pine County. Production was practically nil compared with 1974 production.

**Silver.**—Recoverable silver production rose 84% above the 1974 output. The number of lode silver mines increased to 28 from 8 in the previous year. As in 1974, the Pan American lead-zinc mine in Lincoln County was the State's leading producer of recoverable silver. Lead-zinc ores yielded 40% of the total lode silver, copper ores yielded 44%, byproduct from gold ores

equaled 14%, and all other ores equaled 2%.

**Tungsten.**—The number of producing tungsten properties increased from 11 to 16 in 1975, but tungsten production decreased significantly from that of 1974. The decrease was attributed to Nevada Scheelite terminating its mining operation. Most of the State's output was shipped to Kennemetal's tungsten carbide plant in Churchill County. A small amount was shipped to Union Carbide Corp.'s ammonium paratungstate plant at Pine Creek near Bishop, Calif.

**Zinc.**—Zinc output and value were up 61% and 75%, respectively, from 1974 figures. Eight lode mines accounted for the total zinc production. Over 99% of the recoverable zinc came from lead-zinc, zinc, and lead ores. Pan American lead-zinc mine in Lincoln County dominated Nevada's zinc industry.

#### NONMETALS

**Barite.**—The quantity of primary barite sold or used by Nevada producers increased 20% above that of 1974. Sales of ground barite, including tonnages used by producers, increased 29% in 1975. The number of active operations decreased from 16 in 1974 to 15 in 1975. NL Industries, Inc. and Dresser Minerals ground barite in their respective plants at Dunphy, Eureka County, and Battle Mountain, Lander County. Ground barite was also produced by Milchem, Inc. in its Bateman plant near Battle Mountain. Nearly all of the ground and crushed barite was sold for use in well drilling. Crude ore from the Lander County mine of FMC Corp. was shipped to a company plant in Modesto, Calif., for use in manufacturing barite chemicals.

**Cement.**—Portland cement was produced by Nevada Cement Co. in a dry-process plant at Fernley in Lyon County. Shipments decreased 2%, but the value increased 47% from that of 1974. Most of the cement was used by ready-mix concrete and concrete products manufacturers, building materials dealers, and highway contractors.

**Clays.**—Clays sold or used decreased in quantity compared with the 1974 total. The clays were produced from seven operations. Common clay was obtained from a deposit near Flanigan in Washoe County, by Nevada Cement Co., for use at the

company cement plant located in Lyon County. Moore Paint Co., Inc. mined kaolin near Lovelock in Pershing County. Western Talc Co. mined bentonite from pits in three counties; the Toddy mine in Clark County, the Blanco mine in Esmeralda County, and the New Discovery mine near Beatty in Nye County. The material from the three deposits of Western Talc Co. was processed and prepared for use in cosmetics and pharmaceuticals. Soil conditioner was produced by the Good Earth Corp. near Panaca in Lincoln County.

**Diatomite.**—Sales of prepared diatomite decreased 8% in quantity and increased 8% in value compared with those figures in 1974. Five deposits were mined, one each in Churchill, Esmeralda, Lyon, Pershing, and Storey Counties. Eagle-Picher Industries, Inc. remained the largest Nevada producer from its Celatom mine in Pershing County, and its Tunnel Hill mine in Storey County. Cyprus Mines Corp., the second largest producer, supplied diatomite from its mine in Churchill County to its plant at Fernley in Lyon County. Product sales were mainly for filtration, filler, and light-weight aggregate.

**Fluorspar.**—Fluorspar was mined and shipped from two Nye County mines; metallurgical grade from the Crowell mine was shipped to west coast steel plants, and lower grade material from the Mary mine deposit was shipped to cement plants in California. Production was down 10% from that of 1974.

**Gem Stones.**—During 1975, 12 mine operators produced turquoise in 4 Nevada counties; Esmeralda, Churchill, Lander, and Mineral. Several thousand tons of material was mined at a value of over \$1 million.

**Gypsum.**—A depressed home building market was chiefly responsible for a crude gypsum output that was 34% lower than in 1974, and 52% below the 1973 record. The Flintkote Co., Johns-Manville Corp., and United States Gypsum Co. calcined 319,000 tons of gypsum in Clark and Pershing Counties. Output declined 17% and was 41% below the 1973 record.

**Lime.**—The Flintkote Co. and Morrison & Weatherly Chemical Products Co. produced lime in Clark and White Pine Counties for open-hearth steel furnaces, finishing lime, copper ore concentration, and other uses. Output of lime was 34% lower in quantity than in 1974.

**Lithium.**—The output of lithium carbonate from the Silver Peak facility of Foote Mineral Co. in Esmeralda County increased 14% over that of 1974. The use of lithium carbonate as a cell additive in aluminum potlines has clearly become the major market.

**Magnesite.**—Mine production of magnesite from open pit operations of Basic, Inc. near Gabbs in Nye County increased over that of 1974. The company upgraded the ore in nearby plants, and most of the ore was consumed in the manufacture of special products and refractory materials. Some magnesite was sold to out-of-State customers. Combined consumption and shipments of all materials were higher than in 1974.

**Perlite.**—Crude perlite sales in 1975 declined from those of the previous year. All of the crude perlite was produced by two companies. United States Gypsum Co. operated the Pearl Hill quarry in Pershing County where the crude ore was expanded and used in the company wallboard plant in Washoe County. The Delamore Perlite Co. worked the Mackie claims in Lincoln County and shipped the crude material to out-of-State customers.

**Pumice (Volcanic Cinder).**—Output of pumice, pumicite, and volcanic cinder was up 34% from 1974 production. The material was used for concrete admixture, aggregate, landscaping, and roofing. Cind-R-Lite Block Co. mined volcanic cinder from the Cinder Cove deposit southeast of Beatty, Nye County, for landscaping and concrete aggregate use. Volcanic cinder from the property of Savage Construction Co., Inc., Carson City, was prepared for use in concrete aggregates, road construction, landscaping, and roofing. Pumicite from the Rilite Aggregate Co., Washoe County, was prepared for use in concrete aggregate.

**Salt.**—Production of salt increased significantly over that of 1974. The only salt producer in the State was Huck Salt Co. which operated a solar evaporation plant in Churchill County. All of the production was used in Nevada. Most of the output was sold for use in ice control on roads by State, county, and local agencies. The remainder was used in the meatpacking, tanning, casing, and dairy industries, in feed mixes and weedkillers, and by waterconditioning service companies.

**Sand and Gravel.**—Nevada had 82 active sand and gravel operations in 1975, 2 less than in 1974. The production of sand and gravel was down 8%, but the production value increased 16%.

**Stone.**—About 1.8 million tons of stone was quarried from 11 established locations, compared with 2.2 million tons in 1974, and 86 smaller sales were transacted by the

Bureau of Land Management in the State during the year. The unit value of material produced in 1975 increased over the unit value of last year, even though production was down.

Limestone quarried in Clark County represented a substantial part of the total stone production in Nevada, with uses in sugar refining, metallurgical flux, and other

**Table 7.—Nevada: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	1,626	2,942	2,058	6,235
Gravel -----	6,046	9,692	5,178	9,306
Unprocessed:				
Sand and gravel -----	767	452	820	464
Industrial:				
Gravel -----	297	1,381	W	W
Total -----	8,736	14,467	8,056	16,005

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

**Table 8.—Nevada: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction--	1,959	3,678	2,571	7,623
Highway and bridge construction -----	65	103	53	105
Other uses (dams, waterworks, airports, etc.) -----	30	60	72	144
Concrete products (cement blocks, bricks, pipes, etc.) -----	88	147	155	279
Bituminous paving (asphalt and tar paving) -----	829	1,186	535	795
Road base and subbase -----	835	1,204	661	871
Fill -----	286	307	189	285
Other -----	40	60	W	W
Unprocessed:				
Road base and subbase -----	113	46	W	W
Fill -----	341	306	461	247
Other -----	297	1,381	W	W
Industrial sand and gravel -----	297	1,381	W	W
Total -----	4,883	8,478	4,697	10,349

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

Table 9.—Nevada: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	56	145	160	349
Highway and bridge construction -----	1,160	2,028	261	814
Other uses (dams, waterworks, airports, etc.) -----	W	W	W	W
Concrete products (cement blocks, bricks, pipes, etc.) -----	--	--	--	--
Bituminous paving (asphalt and tar paving) -----	778	1,511	947	2,290
Road base and subbase -----	1,441	1,941	1,662	2,864
Fill -----	105	312	W	29
Other -----	--	--	W	W
<b>Unprocessed:</b>				
Road base and subbase -----	303	87	294	127
Fill -----	10	13	20	23
Other -----	--	--	15	W
Total -----	3,853	6,037	3,359	<sup>1</sup> 6,499

W Withheld to avoid disclosing individual company confidential data; included with "Highway and bridge construction."

<sup>1</sup> Data do not add to total shown because of independent rounding.

chemical and industrial uses. Most of the granite and quartzite was used in road construction. A large tonnage of marble for terrazzo was quarried in Mineral County.

Public work crews and contractors produced limestone, granite, and quartzite in several counties for use as riprap, roadbase, and concrete aggregate.

**Talc.**—Talc and soapstone production came from one deposit in Esmeralda County. Talc was mined from the Oasis mine approximately 20 miles south of Lida. All shipments went to out-of-State grinding mills.

#### MINERAL FUELS

**Petroleum.**—The Eagle Springs oilfield continued to be the only producing area in the State. The production was 114,654 barrels compared with 129,413 barrels in 1974, a decrease of 11%. The field has yielded a total of 2,968,009 barrels of oil through December 1975. The Nevada Oil and Gas Conservation Commission issued five well drilling permits in 1975, five less than in 1974. Of the five permits issued, four were plugged and abandoned, and one was never drilled.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Barite:</b>			
Dresser Minerals -----	P.O. Box 375 Battle Mountain, Nev. 89820	Surface mine ----	Lander.
FMC Corp -----	P.O. Box 3808 Modesto, Calif. 95352	----do -----	Do.
Milchem, Inc -----	P.O. Box 22111 Houston, Tex. 77027	----do -----	Do.
NL Industries, Inc -----	P.O. Box 1675 Houston, Tex. 77001	----do -----	Elko.
<b>Cement:</b>			
Nevada Cement Co. <sup>1</sup> -----	Fernley, Nev. 89408 -----	Plant -----	Lyon.
<b>Clays:</b>			
Kelly-Moore Paint Co -----	1015 Commercial St. San Carlos, Calif. 94070	Pit -----	Pershing.
Western Talc Co -----	P.O. Box 398 Beatty, Nev. 89003	Pit -----	Clark, Esmeralda, Nye.
<b>Copper:</b>			
The Anaconda Company <sup>2</sup> --	P.O. Box 1000 Weed Heights, Nev. 89443	Surface mine ----	Lyon.
	Box 65 Wendover, Utah 84083	Open pit -----	Elko.
Duval Corp. <sup>3</sup> -----	P.O. Box 451 Battle Mountain, Nev. 89820	Surface mine ----	Lander.
Kennecott Copper Corp. <sup>4</sup> --	McGill, Nev. 89318 -----	----do -----	White Pine.
<b>Diatomite:</b>			
Cyprus Mines Corp -----	P.O. Box 1201 Trenton, N.J. 08606	----do -----	Churchill.
Eagle-Picher Industries, Inc.	P.O. Box 1869 Reno, Nev. 89505	----do -----	Pershing and Storey.
<b>Fluorspar:</b>			
J. Irving Crowell, Jr -----	P.O. Box 96 Beatty, Nev. 89003	Underground mine--	Nye.
<b>Gold:</b>			
Atlanta Gold Mine, Div. of Standard Slag Co.	P.O. Box 538 Pioche, Nev. 89043	Surface mine ----	Lincoln.
Carlín Gold Mining Co. <sup>5</sup> --	P.O. Box 979 Carlín, Nev. 89822	----do -----	Elko and Eureka.
Cortez Gold Mines Co ----	Cortez, Nev. 89821 -----	----do -----	Lander.
<b>Gypsum:</b>			
The Flintkote Co. <sup>6</sup> -----	P.O. Box 127 Henderson, Nev. 89015	----do -----	Clark.
Johns-Manville Products Corp.	P.O. Box 14186 Las Vegas, Nev. 89114	----do -----	Do.
United States Gypsum Co. <sup>7</sup> ..	101 S. Wacker Dr. Chicago, Ill. 60606	----do -----	Pershing.
<b>Iron ore:</b>			
Cooney Bros -----	Box 568 Lovelock, Nev. 89419	----do -----	Douglas.
Nevada-Barth Corp -----	P.O. Box 1057 Winnemucca, Nev. 89445	----do -----	Eureka.
Standard Slag Co -----	P.O. Box 4400 Reno, Nev. 89505	----do -----	Lyon.
<b>Lead:</b>			
Pan American Mine, Kerr-McGee Corp. <sup>8</sup>	P.O. Box 276 Pioche, Nev. 89043	----do -----	Lincoln.
Silver Hawk Mining Co ---	818 East Fremont Las Vegas, Nev. 89101	----do -----	Clark.
Sylvania Mining Co -----	Fish Lake Valley Dyer, Nev. 89010	----do -----	Esmeralda.
Toulon Metals and Ores, Inc.	P.O. Box 524 Lovelock, Nev. 89419	----do -----	Pershing.
Western Minerals Products Co.	5120 So. Cottonwood Salt Lake City, Utah 84117	----do -----	Humboldt.
<b>Lime:</b>			
Morrison & Weatherly Chemical Products Co. <sup>9</sup>	East Ely, Nev. 89315 -----	Rotary kilns ----	White Pine.
Lithium: Foote Mineral Co ---	Silverpeak, Nev. 89047	Dry lake brines ---	Esmeralda.
Magnesite: Basic, Inc. <sup>10</sup> -----	Box 4 Gabbs, Nev. 89409	Surface mine ----	Nye.
<b>Mercury:</b>			
Crofoot Tungsten Co -----	P.O. Box 797 Lovelock, Nev. 89419	Underground mine--	Pershing.
McDermitt Mine -----	P.O. Box 101 McDermitt, Nev. 89421	Open pit -----	Humboldt.
Perlite: Delamore Perlite Co --	Pioche, Nev. 89043 -----	Underground mine--	Lincoln.

See footnotes at end of table.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Petroleum:</b>			
Ely Crude Oil -----	Via Tonopah Stage Ely, Nev. 89301	Wells -----	Nye.
Toiyabe Oil Inc -----	P.O. Box 549 Tonopah, Nev. 89049	-----do -----	Do.
Western Oil Lands, Inc ---	380 Linden St. Reno, Nev. 89502	-----do -----	Do.
<b>Pumice:</b>			
Cind-R-Lite Block Co ----	3333 Cinder Lane Las Vegas, Nev. 89103	Open pit -----	Do.
Rillite Aggregate Co -----	P.O. Box 5665 Reno, Nev. 89503	Surface mine ----	Washoe.
Savage Construction Co ---	P.O. Box 970 Carson City, Nev. 89701	Open pit -----	Carson City.
<b>Salt: Huck Salt Co -----</b>	Rt. 2, Box 33 Fallon, Nev. 89406	Solar evaporation plant.	Churchill.
<b>Sand and gravel:</b>			
Robert L. Helms Construc- tion & Development.	P.O. Drawer 608 Sparks, Nev. 89431	Pit -----	Washoe.
Nevada Aggregates and Asphalt.	P.O. Box 7424 Reno, Nev. 89502	Pit -----	Do.
Nevada Rock & Sand Co --	P.O. Box 2775 Huntridge Station Las Vegas, Nev. 89101	Pit -----	Clark.
Stewart Brothers Co -----	-----do -----	Pit -----	Nye.
W.M.K. Transit Mix, Inc --	1606 Industrial Rd. Las Vegas, Nev. 89102	Pit -----	Do.
Wells-Cargo, Inc. <sup>11</sup> -----	P.O. Box 14037 Las Vegas, Nev. 89114	Pit -----	Do.
<b>Tungsten: Rawhide Mining Co -</b>	P.O. Box 378 Fallon, Nev. 89406	Underground mine.	Mineral.

<sup>1</sup> Also clay and stone.<sup>2</sup> Also gold and silver.<sup>3</sup> Also gold, silver, and lead.<sup>4</sup> Also gold, silver, and molybdenum.<sup>5</sup> Also mercury.<sup>6</sup> Also lime and stone.<sup>7</sup> Also perlite.<sup>8</sup> Also silver and zinc.<sup>9</sup> Also crude petroleum.<sup>10</sup> Sole magnesite producer in the United States.<sup>11</sup> Also stone.

# 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 R. Barton <sup>1</sup> and Glenn W. Stewart <sup>2</sup>

The value of minerals produced in New Hampshire in 1975 was \$17.1 million compared with \$13.7 million in 1974. The 25% increase in value was a reflection of generally sustained construction activity throughout the year. Sand and gravel, and stone, which are used mostly for construction, represented 99% of the mineral wealth produced by New Hampshire miners in 1975; common clay and gem stones represented the balance. As would be expected with a mineral industry based on construction raw materials, mineral production was greatest in the more populous counties in the southern part of the State.

In January, Gov. Meldrim Thomson, Jr., created the New Hampshire Mineral and Energy Resource Council to explore the potential of New Hampshire's mineral resources. Bureau of Mines research assistance to determine the potential for multi-mineral extraction from the Conway granite was obtained. In addition, the coun-

cil chairman received a \$165,000 grant from the Energy Research and Development Administration to core-drill a 3,000-foot hole in the Conway granite to determine its geothermal heat potential. The hole was drilled under contract by Longyear, Inc., and studies were underway at yearend to determine geothermal gradient, heat flow and other properties of the rock.

In May, the Department of Resources and Economic Development issued a booklet on the impact of offshore oil on the State.<sup>3</sup> Also, as part of a continuing effort to introduce comprehensive statewide land planning in New Hampshire, numerous land-use bills were introduced before the legislature, but none became law.

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<sup>2</sup> State Geologist, Department of Resources and Economic Development, Durham, N.H.

<sup>3</sup> Gilman, G., and C. Allen. *The Impact of Offshore Oil, New Hampshire and the North Sea Experience*. New Hampshire Department of Resources and Economic Development, 1975, 97 pp.



Table 1.—Mineral production in New Hampshire <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays -----thousand short tons--	34	\$55	W	W
Gem stones -----	NA	42	NA	W
Sand and gravel -----thousand short tons--	6,126	8,223	5,150	\$9,077
Stone -----do-----	590	5,371	1,519	7,938
Value of items that cannot be disclosed:				
Items indicated by symbol W -----	XX	XX	XX	92
Total -----	XX	13,691	XX	17,107
Total 1967 constant dollars -----	XX	6,473	XX	<sup>P</sup> 6,774

<sup>P</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in New Hampshire, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Belknap -----	\$654	W	Sand and gravel, stone.
Carroll -----	1,157	\$1,831	Do.
Cheshire -----	894	489	Do.
Coos -----	451	487	Do.
Grafton -----	655	W	Do.
Hillsborough -----	W	7,086	Stone, sand and gravel.
Merrimack -----	W	2,606	Sand and gravel, stone.
Rockingham -----	W	1,772	Stone, sand and gravel, clays.
Strafford -----	W	W	Sand and gravel, clays.
Sullivan -----	373	170	Sand and gravel, stone.
Undistributed <sup>1</sup> -----	9,506	2,667	
Total <sup>2</sup> -----	13,691	17,107	

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

<sup>1</sup> Includes gem stones, and values indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New Hampshire business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	367.1	358.1	-2.5
Unemployment -----do-----	13.2	23.2	+75.8
<b>Employment (nonagricultural):</b>			
Mining -----do-----	.4	.4	--
Manufacturing -----do-----	94.5	84.9	-10.2
Contract construction -----do-----	15.4	12.9	-16.2
Transportation and public utilities -----do-----	12.8	12.1	-5.5
Wholesale and retail trade -----do-----	63.4	64.3	+1.4
Finance, insurance, real estate -----do-----	14.2	14.0	-1.4
Services -----do-----	55.6	56.9	+2.3
Government -----do-----	45.7	47.7	+4.4
Total nonagricultural employment -----do-----	302.0	293.2	-2.9
<b>Personal income:</b>			
Total -----millions--	\$4,030	\$4,346	+7.8
Per capita -----do-----	\$4,986	\$5,315	+6.6
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----	5,130	3,631	-29.2
Value of nonresidential construction -----millions--	\$39.2	\$28.0	-28.6
Value of State road contract awards -----do-----	\$35.0	\$52.0	+48.6
Shipments of portland and masonry cement to and within New Hampshire -----thousand short tons--	253	220	-13.0
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$13.7	\$17.1	+24.8
Value per capita, resident population -----do-----	\$16.94	\$21.07	+24.4
Value per square mile -----do-----	\$1,471.84	\$1,838.67	+24.9

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce; U.S. Department of Labor; Highway and Heavy Construction Magazine; and U.S. Bureau of Mines.

Table 4.—Worktime and injury experience in the New Hampshire mineral industry in 1975 <sup>1</sup>

	Men	Man-hours	Disabling injuries		Nondisabling injuries	
			Number	Frequency rate	Number	Frequency rate
<b>Sand and gravel:</b>						
Surface -----	252	400,376	7	17.48	2	5.00
Office -----	43	57,646	--	--	--	--
Total -----	295	458,022	7	15.28	2	4.37
<b>Stone:</b>						
Surface -----	91	169,575	8	23.59	1	5.90
Mill -----	147	239,558	8	33.39	--	--
Office -----	42	68,939	--	--	--	--
Total -----	280	478,072	16	25.10	1	2.09
<b>Clay:</b>						
Surface -----	4	4,391	--	--	--	--
Mill -----	20	23,227	--	--	--	--
Office -----	1	2,448	--	--	--	--
Total -----	25	30,066	--	--	--	--
<b>Gypsum:</b>						
Mill -----	13	45,789	--	--	--	--
Office -----	1	416	--	--	--	--
Total -----	14	46,205	--	--	--	--
<b>State total:</b>						
Surface -----	347	574,342	15	19.15	3	5.22
Mill -----	180	303,574	8	25.93	--	--
Office -----	87	129,449	--	--	--	--
Grand total -----	614	1,012,365	23	18.77	3	2.96

<sup>1</sup> All data are preliminary. No fatal accidents were reported for 1975; therefore, data shown are for nonfatal injuries.

Source: Mining Enforcement and Safety Administration.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—There are no cement plants in New Hampshire. In 1975, domestic producers reported shipping 209,000 tons of finished portland cement and 11,000 tons of prepared masonry cement into the State; 1974 figures were 242,000 tons and 11,000 tons, respectively.

**Clays.**—W. S. Goodrich, Inc. and Kane-Gonic Brick Corp. mined common clay to manufacture common and face brick. Output decreased compared with that of 1974. The clay was mined and manufactured into brick in Rockingham and Strafford Counties.

**Diatomite.**—Interest continued in the State-owned deposit of diatomaceous earth beneath Lake Umbagog. The last attempt to obtain a mining permit in 1970–72 was denied because of pressure from environmentalist groups.

**Gem Stones.**—The value of gem stones and mineral specimens collected in 1975 was substantial. The old Ruggles mine, in a pegmatite near Grafton, was operated as a commercial tourist attraction. It was a center for mineral collectors as well as for those just wishing to tour the mine. Collecting bright green fluorite at the old Will Wise mine in Westmoreland was also popular, along with searching for amazonite, topaz, and smoky quartz in Conway granite areas.

**Gypsum.**—National Gypsum Co. calcined gypsum from Canada at its Portsmouth plant in Rockingham County. Output declined 19%. The plant was one of the only two gypsum plants active in New England. (The other was United States Gypsum Co. at Charlestown, Mass.)

**Lime.**—There are no lime plants in New Hampshire. Consumption of lime, as measured by shipments of domestic lime into the State, was 7,724 tons in 1975. Agricultural liming was done in the form of ground limestone, but is not reflected in the lime consumption total.

**Mica.**—Mica was not produced in New Hampshire in 1975, and none of the mica mines in the State have been active for many years.

Two firms, the Macallen Co., Inc. (a division of Essex International, Inc.) at Newmarket and Concord Mica Corp., Pena-

cook, fabricated mica purchased elsewhere.

**Perlite.**—National Gypsum Co. expanded perlite for plaster aggregate at Portsmouth, Rockingham County. The crude perlite was shipped into New Hampshire from Western States.

**Sand and Gravel.**—Production of sand and gravel decreased 16% in tonnage and increased 10% in value compared with 1974 production. A total of 45 pits were operated in the 10 counties by 44 operators. The three counties recording the highest production in 1975—Hillsborough, Carroll, and Merrimack—accounted for 56% of the total sand and gravel output. The leading commercial producers were Manchester Sand, Gravel & Cement Co.; Ossipee Aggregates Corp.; J. J. Cronin Co.; and Tilton Sand & Gravel, Inc. These firms accounted for 35% of production. The New Hampshire Department of Public Works and Highways was another important producer, operating nine pits.

The firm, Arthur Whitcomb, Inc., of Keene and its 12 subsidiary companies were described.<sup>4</sup> In New Hampshire, the firm operates seven sand and gravel pits, four ready-mix paving plants, one crushed stone quarry, and one concrete plant.

**Stone.**—Stone production increased 157% in tonnage and 48% in value in 1975. Dimension granite was quarried in Hillsborough and Merrimack Counties for dressed architectural, construction, and monumental stone, and curbing. Fabrication plants were also operated in both counties.

Under the provisions of the Trade Act of 1974, the John Swenson Granite Co., Inc., received a loan of \$250,000 for new stonecutting and fabrication equipment and for improving the Concord quarry. The money permitted the firm to protect the jobs of 46 workers and rehire 5 others. The loan was part of a U.S. Commerce Department program to assist companies adversely affected by foreign competition as a result of U.S. trade regulations.

The Bureau of Mines at Tuscaloosa, Ala., conducted research on silicon carbide-bearing sludge from a Milford, N.H., granite-finishing plant. The researchers turned the

<sup>4</sup> Rock Products. Keene Sand & Gravel Supplies All Firm's Concrete Needs. V. 78, No. 6, June 1975, pp. 54–58.

Table 5.—New Hampshire: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	1,734	1,968	1,700	2,677
Gravel -----	3,040	5,291	2,150	4,614
Unprocessed: Sand and gravel -----	1,352	839	1,301	848
Industrial:				
Sand -----	W	W	W	W
Total <sup>2</sup> -----	6,126	8,098	5,150	8,140

W Withheld to avoid disclosing individual company confidential data; included with construction sand.

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 6.—New Hampshire: Construction aggregate (blended sand and gravel) and industrial sand sold or used commercially by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	1,100	2,166	1,441	3,148
Highway and bridge construction -----	291	480	69	145
Other construction (dams, waterworks, airports, etc.) -----	88	165	48	111
Concrete products (cement blocks, brick, pipe, etc.) -----	254	447	210	444
Bituminous paving (asphalt and tar paving) -----	770	1,219	755	1,588
Roadbase and subbase -----	392	652	168	312
Fill -----	148	137	69	109
Other -----	509	949	454	1,160
Unprocessed:				
Roadbase and subbase -----	429	203	246	232
Fill -----	923	636	458	315
Other -----	--	--	135	151
Industrial sand -----	W	W	W	W
Total -----	4,904	7,054	<sup>1</sup> 4,052	7,715

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Table 7.—New Hampshire: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	58	96	68	126
Highway and bridge construction -----	115	193	126	259
Other construction (dams, waterworks, airports, etc.) -----	W	W	W	W
Concrete products (cement blocks, brick, pipe, etc.) -----	2	W	2	3
Bituminous paving (asphalt and tar paving) -----	225	409	225	382
Roadbase and subbase -----	693	262	114	157
Fill -----	14	27	19	37
Other -----	115	182	83	121
<b>Unprocessed:</b>				
Roadbase and subbase -----	--	--	389	250
Fill -----	--	--	68	24
Other -----	--	--	5	1
<b>Total</b> -----	<b>1,222</b>	<b>1,169</b>	<b>1,099</b>	<b>1,861</b>

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

<sup>1</sup> Data do not add to total shown because of independent rounding.

waste into reuseable silicon carbide grit and also made bonded silicon carbide inserts for grinding equipment.<sup>5</sup>

Crushed traprock was produced by Lebanon Crushed Stone, Inc., in Grafton County and crushed metavolcanics, by Iafolla Industries, Inc., in Rockingham County. North Country Aggregates, Inc., crushed quartz in Hillsborough County for exposed concrete aggregate. Manchester Sand, Gravel & Cement Co. produced crushed granite in Hillsborough County. The New Hampshire Department of Public Works and Highways crushed stone in several counties for road aggregate.

Total stone production was 1.5 million tons valued at \$7.9 million in 1975 compared with production of 590,000 tons valued at \$5.4 million in 1974.

#### MINERAL FUELS

Statistics on New Hampshire fuel consumption are published annually by the New England Fuel Institute in the March issue of *Yankee Oilman*. Data for 1973 were published in March 1975.

**Natural Gas.**—Sea-3, Inc. (Division of Gaz-Ocean, S.A.), placed in operation a 400,000-barrel terminal and storage tank for liquid petroleum gas (LPG) at Newington. The new facility will handle about one-third of New England's current demand for LPG.

**Petroleum.**—At least two firms were considering Rochester, N.H., as a potential refinery site. As a service to local governments, the State of New Hampshire started a program of evaluating localities to determine their suitability as refinery sites.

#### METALS

**Base Metals.**—Considerable prospecting occurred in old copper and zinc mining districts of New Hampshire. Several firms were active around West Milan, Benton, Warren, Gardner Mountain, Milan, north of Gorham, and in Pittsburg.

**Gold.**—The September issue of *New Hampshire Profiles* featured an article on panning gold from streams in the old Ammonoosuc goldfields.<sup>6</sup> The hard-rock mining rush in the fields lasted from 1864 to 1880. Renewed commercial interest in the area is mostly for copper, with gold only as a possible byproduct. However, some local residents guide tourists to favorite panning sites on streams, and some of the old mines are open to mineral collectors and tourists.

**Iron.**—Franconia was designated a "Bicentennial Community" for its commemorative project to restore the old ironworks and blast furnace. The furnace used local

<sup>5</sup> Llewellyn, T. O., J. V. Sullivan, and E. Martin. Recovery of Silicon Carbide From Granite Sludge. Bu. Mines RI 8074, 1975, 8 pp.

<sup>6</sup> Rounds, Mike. Gold Panning the Ammonoosuc. *New Hampshire Profiles*, v. 24, No. 9, September 1975, pp. 40-43.

magnetite ore from what was once New England's largest magnetite mine.

**Uranium and Thorium.**—There was renewed interest in the State's potential as a source of uranium and thorium as a result of work by the Federal Bureau of Mines on the Conway granite. Several firms began conducting reconnaissance prospecting in the State, the Energy Research and Development Administration was having airborne radiometric surveys conducted over

part of the State, and the Geological Survey was interested in the potential of uranium mineralization in a road-cut on Interstate 89 near New London.

**Zirconium.**—Ionarc, Inc. (a division of Ionarc Smelters, Ltd.), produced zirconium and zirconium dioxide in a plant at Bow. The zircon raw material was imported principally from Australia and converted by the Ionarc process.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Clays:</b>			
W. S. Goodrich, Inc -----	Epping, N.H. 03042 -----	Pit -----	Rockingham.
Kane-Gonic Brick Corp -----	Gonic, N.H. 03867 -----	Pit -----	Strafford.
<b>Gypsum (calcined):</b>			
National Gypsum Co. <sup>1</sup> -----	325 Delaware Ave. Buffalo, N.Y. 14202	Plant -----	Rockingham.
<b>Sand and gravel:</b>			
R. S. Audley, Inc -----	Route 3A, Bow, N.H. 03302 --	Pit -----	Merrimack.
Alvin J. Coleman & Son, Inc	Route 16, Conway, N.H. 03818	Pit -----	Carroll.
J. J. Cronin Co -----	Box 176 North Reading, Mass. 01864	Pit -----	Hillsborough.
Iafolla Industries, Inc. <sup>2</sup> ----	Peverly Hill Rd. Portsmouth, N.H. 03801	Pit -----	Rockingham and Strafford.
Keene Sand & Gravel, Inc --	725 Main St. Keene, N.H. 03431	Pit -----	Cheshire.
Manchester Sand, Gravel & Cement Co. <sup>3</sup>	Box 415 Hookset, N.H. 03106	Pit -----	Merrimack.
Ossipee Aggregates Corp ---	Ossipee, N.H. 03864 -----	Pit -----	Carroll.
Tilton Sand & Gravel, Inc --	Tilton, N.H. 03276 -----	Pit -----	Belknap.
<b>Stone:</b>			
<b>Granite, dimension:</b>			
Kitledge Granite Corp --	Armory Rd. Milford, N.H. 03055	Quarry -----	Hillsborough.
Maine-New Hampshire Granite Co.	P.O. Box 1122 Lowell, Mass. 01852	----do -----	Do.
John Swenson Granite Co., Inc.	North State St. Concord, N.H. 03301	----do -----	Merrimack.
Quartz, crushed:			
North Country Aggregates, Inc.	South Lyndeboro, N.H. 03082	----do -----	Hillsborough.
<b>Traprock:</b>			
Lebanon Crushed Stone, Inc.	Plainfield Rd. West Lebanon, N.H. 03784	----do -----	Grafton.

<sup>1</sup> Also expanded perlite.

<sup>2</sup> Also traprock.

<sup>3</sup> 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 Natural Resources, Bureau of Geology and Topography, for collecting information on all minerals except fuels.

By William Kebblish <sup>1</sup>

The value of New Jersey's mineral production totaled \$123.7 million, 12.1% less than that of 1974. Sand and gravel, one of the State's two major mineral products, decreased 16% in value. Stone, the other leading commodity, decreased 19%. Zinc, which ranks a distant third, remained little changed in output value. Sussex was the leading mineral-producing county and was followed, in descending order of value, by Somerset, Cumberland, Ocean, Morris, and Passaic. Mineral production was reported for all counties except Salem.

The total true value of all taxable land and buildings in New Jersey as computed

by the Division of Taxation amounted to \$94.5 billion, an increase of 9.2% over 1974. New Jersey remained the third richest State in terms of per capita income, led the Nation in research with more scientists and engineers per 1,000 population, and was near the top in the number of inventions patented annually. Seventy thousand engineers, scientists, and technicians are engaged in more than \$3 billion worth of research and development activities in New Jersey. The largest chemical

<sup>1</sup> State Liaison Officer—New Jersey, Bureau of Mines, Harrisburg, Pa.

Table 1.—Mineral production in New Jersey <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ----- thousand short tons--	104	\$524	67	\$372
Gem stones -----	NA	16	NA	16
Peat ----- thousand short tons--	31	603	29	686
Sand and gravel ----- do	17,924	47,292	13,012	39,640
Stone <sup>2</sup> ----- do	15,749	52,456	11,821	42,381
Zinc (recoverable content of ores, etc.)--short tons--	32,848	23,585	31,105	24,262
Value of items that cannot be disclosed:				
Magnesium compounds, manganese residuum, greensand marl, stone (dimension), and titanium concentrate (ilmenite) -----	XX	16,272	XX	16,345
Total -----	XX	140,748	XX	123,702
Total 1967 constant dollars -----	XX	66,546	XX	<sup>p</sup> 48,986

<sup>p</sup> Preliminary. NA Not available. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes dimension stone; included with "Value of items that cannot be disclosed."



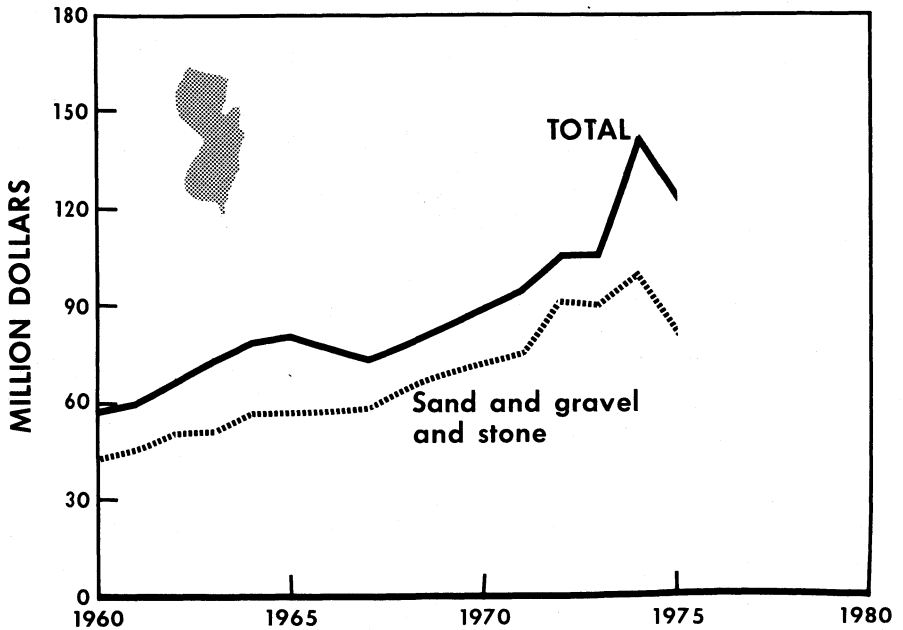


Figure 1.—Value of sand and gravel and stone, and total value of mineral production in New Jersey.

Table 2.—Value of mineral production in New Jersey, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Atlantic -----	\$588	W	Sand and gravel.
Bergen -----	W	W	Do.
Burlington -----	9,889	\$5,944	Do.
Camden -----	1,889	1,876	Do.
Cape May -----	W	W	Magnesium compounds, sand and gravel.
Cumberland -----	W	W	Sand and gravel, clays.
Essex -----	W	W	Stone.
Gloucester -----	W	W	Greensand marl, sand and gravel.
Hudson -----	W	W	Stone.
Hunterdon -----	5,168	4,337	Do.
Mercer -----	W	W	Do.
Middlesex -----	W	W	Sand and gravel, clays.
Monmouth -----	1,323	842	Sand and gravel.
Morris -----	W	8,066	Sand and gravel, stone.
Ocean -----	W	W	Ilmenite, sand and gravel.
Passaic -----	7,667	6,680	Stone, sand and gravel.
Somerset -----	25,289	19,582	Stone, clays.
Sussex -----	33,834	W	Zinc, stone, sand and gravel, peat, manganiferous residuum.
Union -----	W	W	Stone.
Warren -----	W	W	Sand and gravel, stone, peat.
Undistributed <sup>2</sup> -----	55,152	76,374	
Total <sup>3</sup> -----	140,748	128,702	

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

<sup>1</sup> Salem County is not listed because no production was reported.

<sup>2</sup> Includes gem stones and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New Jersey business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	3,210.0	3,242.0	+1.0
Unemployment -----do-----	203.0	332.0	+63.5
<b>Employment (nonagricultural):</b>			
Mining -----do-----	3.1	2.8	-9.7
Manufacturing -----do-----	824.1	735.9	-10.7
Contract construction -----do-----	117.2	90.9	-22.4
Transportation and public utilities -----do-----	185.7	176.3	-5.1
Wholesale and retail trade -----do-----	602.4	589.1	-2.2
Finance, insurance, and real estate -----do-----	137.1	135.1	-1.5
Services -----do-----	474.8	469.0	-1.2
Government -----do-----	439.9	468.8	+6.6
Total nonagricultural employment -----do-----	2,784.3	2,667.9	-4.2
<b>Personal income:</b>			
Total -----millions--	\$45,708	\$49,181	+7.6
Per capita -----do-----	\$6,242	\$6,722	+7.7
<b>Construction activity:</b>			
Number of private and public residential units authorized.	25,917	23,440	-9.6
Value of nonresidential construction -----millions--	\$524.1	\$380.1	-27.5
Value of State road contract awards -----do-----	\$45.0	\$54.0	+20.0
Shipments of portland and masonry cement to and within New Jersey -----thousand short tons--	1,994	1,494	-25.1
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$140.7	\$123.7	-12.1
Value per capita, resident population -----do-----	\$19.22	\$16.87	-12.2
Value per square mile -----do-----	\$17,961.72	\$15,786.37	-12.1

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce; U.S. Department of Labor, Highway and Heavy Construction Magazine; and U.S. Bureau of Mines.

and the third largest petroleum corporate complexes are situated in New Jersey.

New Jersey has the potential of becoming the energy center of the Nation. Princeton University is pioneering fusion and combustion research; Princeton's Center for Environmental Studies is conducting research on a variety of energy issues such as conservation, Outer Continental Shelf (OCS) development, and onshore impacts; and Rutgers University, Stevens Institute of Technology, New Jersey Institute of Technology, Seton Hall University, and Fairleigh Dickinson University are all involved in energy and conservation programs. Princeton received \$250 million to test the Nation's first fusion reaction, a process by which the sun produces energy.

The world's first offshore floating nuclear plants will be sited less than 3 miles off the New Jersey shore. Nuclear power parks are planned for south and central New Jersey.

Hydrocarbon Research has been awarded the largest synthetic fuel contract to date—\$100 million for the development of a plant to convert coal into liquid fuels. Hydrocarbon Research also is pursuing another \$100 million venture involving gasification.

Public Service Electric & Gas Co. (PSE&G), the Nation's third largest combined utility, has built the Nation's first synthetic gasplant using naphtha as the basic raw material.

PSE&G and Exxon Research and Engineering Co., are developing new forms of hydrocarbon fuels as byproducts of nuclear generation, as well as new chemical batteries for electrical generation and motor vehicle use.<sup>2</sup>

Jersey Central Power and Light Co. of Morris Township and the Energy Systems Division of Wheelabrator Frye Inc. of Basking Ridge plan to erect in central New Jersey a 110,000-kilowatt plant fueled with shredded garbage. Recycling processes will recover an estimated 230 tons of metals daily.<sup>3</sup>

Jersey Central Power and Light Co. has applied to the Federal Power Commission for permission to build the Nation's first underground powerplant beneath Mt. Hope Lake in Rockaway Township. The \$290 million plant would be located 3,000 feet below the 220-acre lake and would be a hydroelectric pump storage generating station producing 1 million kilowatts of

<sup>2</sup> Constructioner. Sept. 15, 1975, p. 40.

<sup>3</sup> Constructioner. June 9, 1975, p. 18.

electricity every hour. Construction is planned to begin in 1982.<sup>4</sup>

In early June the Public Utilities Commission (PUC) granted Jersey Central Power and Light Co. a \$23.7 million rate increase which will raise the monthly electric bills of 630,000 customers an average of 12% and in late September the company filed another rate increase with the PUC which would increase electric bills by 33%. Meanwhile, PSE&G was granted

a \$99 million interim rate increase by the PUC in June. PSE&G is the largest electric and gas utility in the State serving 1.8 million customers in 297 municipalities. In late December, PSE&G requested and filed another rate increase with the PUC totaling \$350 million. The utilities blamed the inflationary spiral of the economy in asking for the rate increases.

<sup>4</sup> *Constructioneer*, May 26, 1975, pp. 17-18.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Shipments of portland cement into New Jersey totaled 1,442,540 tons, 25% less than in 1974. Masonry shipments into New Jersey were 50,681 tons, 23% less than in 1974. Most of the portland and masonry cement was manufactured in eastern Pennsylvania and eastern New York. Cement was distributed from five terminals, two in Jersey City, and one each in Bayonne, Elizabethport, and Newark.

**Clays.**—The quantity of clays produced decreased 36% compared with that of

1974. Total value was 29% lower, reflecting a slight increase in the average unit value. Common clay and shale accounted for 75% of the total tonnage and 67% of the value, and fire clay accounted for the remaining tonnage and value. Common clay and shale were used for face brick and sewer pipe, whereas fire clay was used for fire brick and block, refractory mortar, and sealing. Common clay and shale were produced in Somerset County. Fire clay was mined in Cumberland and Middlesex Counties. The leading clay producer was New Jersey Shale Brick & Tile Corp.

Table 4.—New Jersey: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind	1974		1975	
	Quantity	Value	Quantity	Value
Fire clay -----	37	232	17	122
Common clay and shale -----	67	292	50	250
Total -----	104	524	67	372

**Gem Stones.**—Collectors and dealers collected mineral specimens from several localities, refuse areas, and abandoned quarries located principally in the northern part of the State. The value of the material collected was estimated to be \$16,000, the same as 1974.

**Gypsum.**—National Gypsum Co., the Celotex Corp., The Flintkote Co., and Kaiser Gypsum Co., Inc., calcined gypsum in Bergen, Burlington, and Camden Counties. Output declined 21% to 433,000 tons valued at \$5.25 million; production was 26% below the 1973 record. During the year Kaiser closed its plant at Delanco in Burlington County. Calcined gypsum is

used mainly for prefabricated products such as regular wallboard, Type X wallboard, and lath. The leading sales regions in the United States for prefabricated products were the south central and the east north-central regions. Reduction of activity in the housing industry contributed to the decline in prefabricated products sales during 1975.

**Iodine.**—Consumption of organic and inorganic iodine by chemical and pharmaceutical companies in the State totaled 516,028 pounds compared with 1,012,991 pounds in 1974. The iodine was used for medicines, sanitation products, and other chemicals.

**Lime.**—Consumption of lime in New Jersey declined 5% from 119,200 tons in 1974, to 113,313 tons in 1975. There was no production of lime in New Jersey in 1975.

**Magnesium Compounds.**—Production of magnesium compounds decreased 32% compared with 1974 with a 31% increase in average unit value. Refractory magnesia was produced in Cape May County from dolomite and domestic seawater.

**Marl, Greensand.**—Greensand, which is widely distributed in the eastern United States, was produced in 1975 only by the Inversand Co., a subsidiary of Hungerford and Terry Inc., near Clayton. Raw greensand produced was sold to Zook and Tanck, of Gap, Pa., for agricultural use as a soil conditioner. Processed greensand was used by manufacturers as filter media in equipment for the removal of manganese, iron, and other elements from water.

**Perlite.**—Crude perlite mined in Colorado, Nevada, and New Mexico was expanded at two plants in Middlesex County and used in roof insulation, plaster and concrete aggregate, masonry and cavity filler, and as a soil conditioner.

**Sand and Gravel.**—The total output of

sand and gravel decreased 27% in quantity and 16% in value from that of 1974. Production of sand and gravel for construction declined 30% in quantity and 27% in value compared with 1974. Average value per ton was \$2.04 in 1975. Of the 10.3 million tons of sand and gravel used for construction, 57% was processed sand, 28% was processed gravel, and 15% was unprocessed sand and gravel. Output of industrial sand decreased 16% in quantity and 5% in value with an average unit value of \$5.98 per ton. Industrial sand accounted for 21% of the tonnage and 41% of the value of all sand and gravel produced in the State. The primary uses of industrial sand were for glass, molding, and foundry purposes. Most of the industrial sand was produced in Cumberland County. Dredging operations were the principal method for recovery of the sand. The number of sand and gravel operations dropped by 16 to 73. Production came from 14 of the State's 21 counties. The leading producing counties, ranked by tonnage, were Cumberland, Burlington, Ocean, Morris, and Middlesex. Cumberland County ranked first in value.

**Table 5.—New Jersey: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
<b>Construction:</b>				
<b>Processed:</b>				
Sand -----	8,309	15,588	5,901	11,840
Gravel -----	4,122	11,226	2,847	7,786
<b>Unprocessed:</b>				
Sand and gravel -----	2,246	1,843	1,535	1,345
<b>Industrial:</b>				
Sand -----	3,247	17,272	2,730	16,321
Gravel -----	--	--	W	W
<b>Total<sup>2</sup></b> -----	<b>17,924</b>	<b>45,929</b>	<b>13,012</b>	<b>37,293</b>

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

**Table 6.—New Jersey: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	3,772	7,564	2,329	6,070
Highway and bridge construction -----	908	2,026	710	1,686
Other construction (dams, waterworks, airports, etc.) -----	392	881	219	373
Concrete products (cement blocks, brick, pipe, etc.) -----	4,137	10,881	3,228	8,153
Bituminous paving (asphalt and tar paving) -----	1,183	2,626	968	2,546
Roadbase and subbase -----	521	1,281	179	440
Fill -----	217	328	201	350
Other -----	45	101	103	263
<b>Unprocessed:</b>				
Roadbase and subbase -----	308	321	184	254
Fill -----	1,938	1,522	1,153	1,137
Other -----	--	--	--	--
Industrial sand and gravel -----	3,247	17,272	2,730	16,321
<b>Total</b> <sup>1</sup> -----	<b>16,668</b>	<b>44,803</b>	<b>12,003</b>	<b>37,594</b>

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 7.—New Jersey: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	W	W	76	166
Highway and bridge construction -----	394	835	35	101
Other construction (dams, waterworks, airports, etc.) -----	W	W	44	127
Concrete products (cement blocks, brick, pipe, etc.) -----	51	127	59	153
Bituminous paving (asphalt and tar paving) -----	540	987	443	929
Roadbase and subbase -----	229	470	82	211
Fill -----	--	--	36	73
Other -----	42	69	37	96
<b>Unprocessed:</b>				
Roadbase and subbase -----	--	--	117	126
Fill -----	--	--	81	64
Other -----	--	--	--	--
<b>Total</b> <sup>1</sup> -----	<b>1,256</b>	<b>2,488</b>	<b>1,009</b>	<b>2,047</b>

W Withheld to avoid disclosing individual company confidential data; included with "Highway and bridge construction."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 8.—New Jersey: Sand and gravel sold or used by county, in 1975**  
(Thousand short tons and thousand dollars)

County	Number		Quantity	Value
	Mines	Companies		
Atlantic -----	2	2	W	W
Bergen -----	1	1	W	W
Burlington -----	3	3	2,072	5,944
Camden -----	6	4	585	1,876
Cape May -----	5	4	584	1,072
Cumberland -----	11	9	2,649	15,299
Gloucester -----	6	5	175	295
Middlesex -----	4	4	760	1,578
Monmouth -----	4	4	393	842
Morris -----	6	5	1,934	4,667
Ocean -----	8	7	2,001	3,316
Passaic -----	6	6	491	1,864
Sussex -----	8	8	656	1,065
Warren -----	3	3	429	1,021
<b>Total -----</b>	<b>73</b>	<b>65</b>	<b>13,012</b>	<b>39,640</b>

W Withheld to avoid disclosing individual company confidential data; included in "Total."

**Stone.**—Crushed and broken stone production decreased 25% in quantity and 19% in value compared with 1974. Basalt (traprock), granite, and limestone, in decreasing order of tonnage, were the primary types of stone quarried in 1975. Basalt accounted for 72% and 70% of the State's total crushed and broken stone production and value, respectively. Average value per ton for traprock was \$3.51, \$0.08 less than the State average for all crushed and broken stone. Total production of crushed and broken basalt was 8.5 million tons. Somerset and Passaic Counties were the leading basalt producers. Producers were also located in Essex, Hudson, Hunterdon, Mercer, Morris, and Union Counties. Most of the output was used as aggregate for highway and building construction. Crushed granite production decreased from 3.33 million tons in 1974. The average unit value was \$2.81 in 1975, up \$0.39 from 1974. Granite was produced from 10 quarries in Hunterdon, Morris,

Passaic, Sussex, and Warren Counties in 1975. The principal uses of granite were dense-graded roadbase, bituminous aggregate, and concrete aggregate.

Crushed limestone was produced at two quarries in Sussex County. The limestone was used principally for roadbase, agricultural limestone filler, flux stone, and unspecified aggregate. Somerset County with eight quarries had the largest reported production of stone, followed by Hunterdon with seven quarries, Passaic with six quarries, and Sussex with five quarries. Other producing counties were Essex, Hudson, Mercer, Morris, Union, and Warren with a total of nine quarries. There were two quarries with production of over 900,000 tons, six quarries produced between 500,000 and 900,000 tons, 16 quarries produced between 100,000 and 500,000 tons, and 11 produced less than 100,000 tons. Most of the stone (97%) was transported by truck and the remaining 3% was transported by rail.

Table 9.—New Jersey: Crushed stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	2,459	10,015	1,899	8,004
Concrete aggregate (coarse) -----	944	2,155	593	1,623
Dense-graded roadbase stone -----	4,614	13,473	3,796	11,942
Surface treatment aggregate -----	300	759	247	693
Other construction aggregate and road stone -----	5,679	18,889	4,025	13,917
Riprap and jetty stone -----	W	W	112	390
Railroad ballast -----	W	W	56	159
Other uses <sup>1</sup> -----	1,754	7,166	1,093	5,652
Total <sup>2</sup> -----	15,749	52,456	11,821	42,381

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

<sup>1</sup> Includes agricultural limestone, macadam aggregate, filter stone, flux stone, asphalt and other fillers, acid neutralization, roofing aggregates, uses not specified, and uses indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

**Sulfur.**—Shipments of byproduct sulfur increased 17% to 82,568 long tons. The total value was 64% higher with the average price per long ton increasing to \$44.92 from \$31.85 in 1974. Elemental sulfur was recovered as a byproduct of petroleum refining in Gloucester, Middlesex, and Union Counties.

**Vermiculite.**—Exfoliated vermiculite was produced at one plant each in Mercer and Middlesex Counties from crude vermiculite mined in other States. The exfoliated vermiculite was used mainly for agricultural purposes, loose-fill insulation, fireproofing, and lightweight concrete aggregate.

#### METALS

**Ferroalloys.**—Shieldalloy Corp., Newfield, Gloucester County, produced ferroalloys of vanadium, titanium, boron, chromium, columbium, and columbium-nickel.

**Iron Ore.**—Halecrest Co. acquired in late 1972 the Mt. Hope iron mine located in Rockaway Township, Morris County. This mine has a listing of continuous production from 1722 until 1959, when increased labor and material handling costs forced it to close. Currently a feasibility study is underway which could result in the mine being reopened.

**Pigments.**—Metal-base pigments, used primarily in the manufacture of paint, were produced at a number of plants in New Jersey. Iron oxide pigments were produced by Pigments and Specialties Div., Cities Service Co. in Mercer and Middlesex Counties, and by E. I. du Pont de Nemours & Co., Inc., in Essex County. Titanium dioxide was produced by The

New Jersey Zinc Co., Gloucester City; and NL Industries, Inc., near Sayreville. The latter firm also manufactured lead pigments. Zinc oxide pigments were produced by Royce Chemical Co., Carlton Hill. The quantity of manufactured pigments in New Jersey declined about 60% and the value about 52% compared with 1974. The primary reason was due to declines in the housing and automotive industries. Compared with 1974 production, manufactured black magnetic pigments declined 43%, brown iron oxide 65%, pure and red iron oxides 46%, and yellow iron oxide 75%. These pigments are primarily used in the manufacture of paint, varnish, lacquer, and in the manufacture of materials for magnetic applications.

**Selenium.**—Selenium was produced as a byproduct from two copper refineries in 1975. AMAX Copper, Inc., Carteret, and The Anaconda Company, Perth Amboy, produced selenium for such end uses as electronic components, glass, and chemical pigments.

**Tellurium.**—Tellurium is commercially recovered principally from the precious metal-rich anode slimes obtained from the electrolytic refining of copper. Tellurium, when added to low carbon steels and high strength alloy steels, improves machinability with no deleterious effects on mechanical properties. It is also used as a mold dressing for cast iron products. Tellurium was produced by AMAX Inc., Carteret, and The Anaconda Company, Perth Amboy.

**Titanium.**—Although the quantity of ilmenite decreased 13%, the value increased 11% compared with 1974. Glid-

den-Durkee Div. of SCM Corp. recovered ilmenite from a sand deposit about 3 miles north of Lakehurst, Ocean County. The material was concentrated and shipped to a company-owned plant at Baltimore, Md., for conversion to titanium dioxide pigment. Since early 1973, ASARCO, Inc., began shipping ilmenite from its new suction dredging system near Lakehurst. The ilmenite is recovered from a sand deposit and then upgraded to a 63% titanium dioxide concentrate in two successive concentrating stages. Proven ore reserves of over 100 million tons indicate a life of over 20 years at the current mining rate of 20,000 tons per day.<sup>5</sup> Currently all of the concentrate is sold to E.I. du Pont de Nemours & Co. for manufacture of white pigments used in plastics, paints, and paper.

**Zinc.**—The quantity of zinc mined at Sterling Hill, Sussex County, decreased 5%, but increased 3% in value compared with 1974. The ore was crushed and shipped directly to a company-owned smelter at Palmerton, Pa., where zinc and manganiferous residuum were recovered. New Jersey ranked sixth behind Tennessee, New York, Missouri, Colorado, and Idaho in production of zinc ore.

#### MINERAL FUELS

**Natural Gas.**—During the summer months it was predicted that a natural gas shortage would occur in New Jersey resulting in the loss of numerous jobs throughout the State. However, Transcontinental Pipeline Co., the main supplier for south New Jersey, indicated sufficient reserves were available to meet the area's needs. South Jersey Gas Co. meanwhile planned to accumulate and store natural gas to meet the winter demand, but cancelled prior arrangements when a tentative agreement with Con Space to store 2 billion cubic feet of natural gas was abandoned. In late July it was determined that enough natural gas would be available if temperatures remained normal, but customers in the southern part of the State would be required to pay higher gas prices amounting to 10% to 15% to cover higher company costs of purchasing synthetic natural gas which costs up to \$5 per 1,000 cubic feet compared with pipeline costs of 51¢ for the same quantity of gas.

**Peat.**—Production of peat decreased 8% in quantity while increasing 14% in value compared with 1974. Peat was recovered from bogs near Newton and Stanhope in Sussex County, and Great Meadows in Warren County. Most of the output was used for general soil improvement, but a small quantity was used for packing flowers, mushroom beds, and ingredients for potting soil.

**Petroleum.**—There were four petroleum refineries in New Jersey with a combined daily capacity of over one-half million barrels. The refineries were located in Perth Amboy, Linden, Paulsboro, and Westville. All of the crude oil came from outside the State. In late October, the U.S. Geological Survey announced plans for drilling deep test wells off the United States east coast to provide geological information to participating companies and to the Federal Government as an aid in evaluating tracts to be offered in the mid-Atlantic OCS lease sale Nos. 40 and 42 tentatively scheduled for late 1976. These wells will assist in making resource evaluations and are not drilled for the purpose of finding oil or gas. The stratigraphic testing program is aimed at obtaining scientific data about the geology of the continental margin and its potential resources. The first test hole to be drilled will be in the Baltimore Canyon located at latitude 39°22'31" north and longitude 72°44'9" west, or about 80 miles seaward from the New Jersey shoreline in about 290 feet of water.<sup>6</sup>

Oil spills reported in New Jersey occurred in late November when the 30-inch-diameter pipeline erupted in the Crosswicks section of Hamilton Township sending thousands of gallons of kerosene into storm sewers. In early December a train derailment near Frenchtown, Kingwood Township resulted in an oil spill into the Delaware River.

An \$862,322 contract was awarded to the Mobil Oil Corp. in late January to perform development studies on the conversion of methanol and related oxygenates to gasoline. The work under this contract will be performed at Paulsboro, and the Mobil Technical Center at Princeton.<sup>7</sup>

<sup>5</sup> Mining Magazine. V. 130, No. 1, January 1974, p. 7.

<sup>6</sup> U.S. Department of the Interior News Release, Oct. 31, 1975.

<sup>7</sup> U.S. Department of the Interior News Release, Jan. 29, 1975.



Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Clays:</b>			
<b>Fire:</b>			
Almasi Clay Co -----	Metuchen Ave. Woodbridge, N.J. 07095	Plant -----	Middlesex.
Crossman Co -----	P.O. Box 35 South Amboy, N.J. 08879	-----do -----	Do.
J. S. Morie & Son, Inc --	P.O. Box 35 Mauricetown, N.J. 08329	Pit -----	Cumberland.
<b>Miscellaneous:</b>			
New Jersey Shale Brick & Tile Corp.	P.O. Box 490 Somerville, N.J. 08876	Plant -----	Somerset.
<b>Gypsum, calcined:</b>			
Celotex Corp -----	North 1 River Rd. Edgewater, N.J. 07020	-----do -----	Bergen.
The Flintkote Co -----	480 Central Ave. East Rutherford, N.J. 07073	-----do -----	Camden.
Kaiser Gypsum Co., Inc ----	300 Lakeside Drive Oakland, Calif. 94612	-----do -----	Burlington.
National Gypsum Co -----	325 Delaware Ave. Buffalo, N.Y. 14202	-----do -----	Do.
<b>Ilmenite:</b>			
ASARCO, Inc -----	Route 70, Mile 41 Lakehurst, N.J. 08733	-----do -----	Ocean.
Glidden-Durkee Division of SCM Corp.	P.O. Box 5 Lakehurst, N.J. 08733	-----do -----	Do.
<b>Iron oxide pigments (manufactured):</b>			
Cities Service Co -----	380 Madison Ave. New York, N.Y. 10017	-----do -----	Mercer and Middlesex.
Combustion Engineering C. E. Minerals Div.	901 E. 8th Ave. King of Prussia, Pa. 19406	-----do -----	Camden.
E.I. du Pont de Nemours & Co., Inc.	Du Pont Building, D 10034 Wilmington, Del. 19898	-----do -----	Essex.
<b>Magnesium compounds:</b>			
Harbison-Walker Refractories, Div. of Dresser Industries.	2 Gateway Center Pittsburgh, Pa. 15222	-----do -----	Cape May.
Marl, greensand: Inversand Co --	226 Atlantic Ave. Clayton, N.J. 08312	Pit -----	Gloucester.
<b>Peat:</b>			
Hyper-Humus Co -----	Lafayette Rd. P.O. Box 267 Newton, N.J. 07860	Bog -----	Sussex.
Kelsey Humus and Partac Co	Kelsey Park Great Meadows, N.J. 07838	Bog -----	Warren.
Mt. Bethel Humus Co. Inc --	315 W. 57th St. New York, N.Y. 10019	Bog -----	Sussex.
Netcong Natural Products ---	738 Rt. 10 Randolph, N.J. 07801	Bog -----	Do.
<b>Perlite (expanded):</b>			
Grefco, Inc -----	3450 Wilshire Blvd. Los Angeles, Calif. 90010	Plant -----	Middlesex.
The Schundler Co -----	P.O. Box 251 Metuchen, N.J. 08840	-----do -----	Do.
<b>Sand and gravel:</b>			
S. Braen & Co. -----	Brookside Wyckoff, N.J. 07481	2 Pits -----	Sussex.
Brick-Wall Corp -----	Route 70 Lakehurst, N.J. 08733	Pit -----	Ocean.
Fisher Bros. Sand & Gravel Co.	115 Hickory Lane Bayville, N.J. 08721	Pit -----	Do.
Houdaille Construction Materials, Inc.	10 Park Pl. Morristown, N.J. 07960	Pits -----	Morris, Ocean, Warren.
J. S. Morie & Son, Inc -----	P.O. Box 35 Mauricetown, N.J. 08329	2 pits and 2 dredges.	Cumberland.
Pennsylvania Glass Sand Corp.	Berkeley Springs, W. Va. 25411	Pit -----	Do.
Saxon Falls Sand & Gravel Co. Inc.	R.D. 3 Stanhope, N.J. 07874	Pit -----	Morris.
N. J. Silica Sand Co -----	Millville, N.J. 08332	Dredge -----	Cumberland.
Tuckahoe Sand & Gravel ---	P.O. Box 101 Tuckahoe, N.J. 08250	Pit -----	Cape May.
Whitehead Brothers Co -----	60 Hanover Rd. Florham Park, N.J. 07932	Pit and dredge.	Cumberland.
<b>Stone:</b>			
<b>Granite, crushed and broken:</b>			
Anthony Ferrante & Sons, Inc.	Route 202, Mine Brook Rd. Bernardsville, N.J. 07924	Quarry -----	Somerset and Hunterdon.
Hamburg Quarry, Inc --	Route 23 Hamburg, N.J. 07419	-----do -----	Sussex.

Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Granite, crushed and broken—Continued			
Passaic Crushed Stone Co., Inc.	P.O. Box 348 Pompton Lakes, N.J. 07442	Quarry	Passaic.
Tri County Asphalt Corp.	Route 15 Hopatcong, N.J. 07843	do	Sussex.
Limestone, crushed:			
Limestone Products Corp. of America.	122 Main St. Newton, N.J. 07860	do	Do.
Traprock (basalt), crushed and broken:			
Samuel Braen's Sons	P.O. Box 188 Wyckoff, N.J. 07481	do	Passaic.
Dock Watch Quarry Pit, Inc.	Box 245 Martinsville, N.J. 08836	do	Somerset.
Fanwood Crushed Stone Co.	141 Central Ave. Westfield, N.J. 07090	do	Do.
Anthony Ferrante & Sons, Inc.	Route 202, Mine Brook Rd. Bernardsville, N.J. 07924	do	Do.
Houdaille Construction Materials, Inc.	10 Park Pl. Morristown, N.J. 07960	do	Hunterdon, Passaic, Somerset, Union.
M. L. Kernan Quarry	500 Tilton Rd. South Orange, N.J. 07979	do	Essex.
Orange Quarry Co	318 Eagle Rock Ave. West Orange, N.J. 07050	do	Do.
Trap Rock Industries, Inc.	Laurel Ave. Kingston, N.J. 08528	do	Hunterdon, Mercer, Somerset.
The Union Building & Construction Corp.	111 Clifton Ave. Clifton, N.J. 07013	do	Passaic.
Sulfur (recovered):			
Chevron Oil Co	1200 State St. Perth Amboy, N.J. 08861	Plant	Middlesex.
Exxon Company U.S.A	Box 23 Linden, N.J. 07036	do	Union.
Mobil Oil Corp	Paulsboro, N.J. 08066	do	Gloucester.
Texaco Inc	Eagle Point, P.O. Box 52332 Houston, Tex. 77052	do	Do.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, Mass. 02140	do	Mercer.
The Schundler Co	P.O. Box 251 Metuchen, N.J. 08840	do	Middlesex.



# The Mineral Industry of New Mexico

By Herman W. Sheffer <sup>1</sup>

Mineral production in New Mexico continued to rise to a new record high in 1975, reaching a total value of over \$2,091 million, an increase of 7.7% over that of 1974. However, as in 1974 the high increase in value of minerals produced reflected increased prices since quantity of production decreased for most mineral commodities produced in the State. In 1975, New Mexico ranked eighth in the Nation in mineral production value. It

continued to produce a broad variety of minerals including fuels, metals, and non-metals and the industry comprised a major sector of the State's economy. The State also continued to be the leading producer of perlite, potassium salts, and uranium in the United States. It was also among the leaders in output of copper, molybdenum, natural gas, natural gas

<sup>1</sup> State Liaison Officer, Bureau of Mines, Santa Fe, N. Mex.

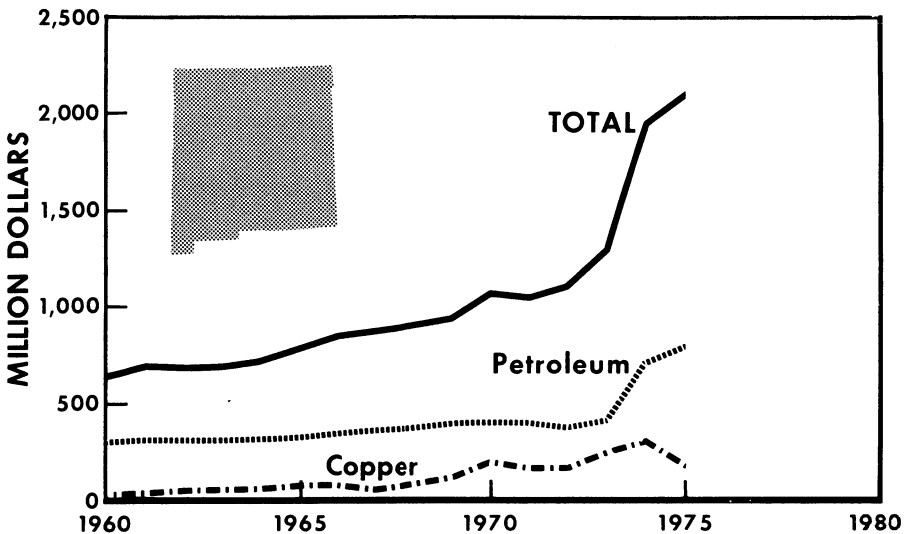


Figure 1.—Value of copper, petroleum, and total value of mineral production in New Mexico.

Table 1.—Mineral production in New Mexico<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Carbon dioxide (natural) thousand cubic feet...	W	W	569,352	\$60
Clays <sup>2</sup> ..... thousand short tons...	55	\$317	44	61
Coal (bituminous) ..... do.....	9,392	W	8,785	W
Copper (recoverable content of ores, etc.) short tons...	196,585	303,920	146,263	187,802
Gem stones ..... do.....	NA	200	NA	200
Gold (recoverable content of ores, etc.) troy ounces...	15,427	2,464	15,049	2,430
Gypsum ..... thousand short tons...	157	532	W	W
Iron ore (usable) thousand long tons, gross weight...	6	135	W	W
Lead (recoverable content of ores, etc.) short tons...	2,364	1,064	1,931	830
Lime ..... thousand short tons...	58	1,679	W	W
Manganiferous ore (5% to 35% Mn) short tons...	47,348	W	49,976	W
Mica, scrap ..... thousand short tons...	12	60	W	W
Natural gas ..... million cubic feet...	1,244,779	390,861	1,217,430	493,059
Natural gas liquids: Natural gasoline and cycle products thousand 42-gallon barrels...	9,713	53,545	9,194	45,292
LP gases ..... do.....	30,271	120,781	30,214	122,065
Peat ..... thousand short tons...	4	111	--	--
Perlite ..... do.....	480	6,306	429	6,400
Petroleum (crude) thousand 42-gallon barrels...	98,695	712,578	95,063	788,073
Potassium salts ..... thousand short tons...	2,102	128,588	2,081	179,924
Pumice ..... do.....	471	1,466	397	1,280
Salt ..... do.....	167	W	147	1,048
Sand and gravel ..... do.....	7,413	10,605	6,220	13,798
Silver (recoverable content of ores, etc.) thousand troy ounces...	1,195	5,628	792	3,501
Stone ..... thousand short tons...	<sup>3</sup> 3,531	8,359	2,197	4,683
Uranium (recoverable content U <sub>3</sub> O <sub>8</sub> ) thousand pounds...	9,971	104,693	10,393	127,829
Zinc (recoverable content of ores, etc.) short tons...	13,784	9,897	11,015	8,592
Value of items that cannot be disclosed: Cement, clay (fire), fluorspar, helium (high purity) (1975), molybdenum, tin, vanadium and values indicated by symbol W ..... Total ..... Total 1967 constant dollars .....	XX XX XX	77,755 1,941,544 917,962	XX XX XX	104,614 2,091,541 P 828,502

<sup>1</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>2</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>3</sup> Excludes fire clay; included with "Value of items that cannot be disclosed."

<sup>4</sup> Excludes dimension stone.

liquids, pumice, and crude petroleum. Fuels continued to rank first in value of production totaling \$1,509.5 million, followed by metals totaling \$360.1 million, and nonmetals totaling \$221.7 million. Of the 30 mineral commodities reportedly produced in New Mexico, 6 accounted for 93% of the total mineral production. These minerals ranked by value, with percentage showing individual share of the total were as follows: Petroleum (37.7%); natural gas (23.6%); copper (9.0%); potassium salts (8.6%); natural gas liquids (8.0%); and uranium (6.1%).

Mining operations were located throughout the State; however, most of the petroleum and natural gas was produced in the southeastern and northwestern parts. Copper was produced principally in the southwestern corner of the State; uranium was mined and processed in the west-central part of the State; potash was mined and processed in the southeastern part; and most of the molybdenum and perlite was produced in the north-central part of New Mexico. Coal was mined and used to generate electricity in the northwestern part of the State; additional coal for use

Table 2.—Value of mineral production in New Mexico, by county<sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975, in order of value
Bernalillo -----	\$16,400	W	Cement, sand and gravel, stone, clays.
Catron -----	W	W	Stone, salt, tin, sand and gravel.
Chaves -----	16,573	\$17,468	Petroleum, natural gas, sand and gravel, stone.
Colfax -----	W	W	Coal, sand and gravel.
De Baca -----	W	W	Sand and gravel.
Dona Ana -----	1,017	W	Sand and gravel, stone, pumice, clays.
Eddy -----	368,127	490,899	Petroleum, potassium salts, natural gas, natural gas liquids, salt, sand and gravel, stone.
Grant -----	315,558	205,539	Copper, zinc, silver, lime, gold, lead, molybdenum, manganese ore, sand and gravel, stone, helium.
Guadalupe -----	W	--	Natural carbon dioxide.
Harding -----	W	60	Sand and gravel, copper, stone, silver, gold, clays.
Hidalgo -----	4,342	717	Petroleum, natural gas, natural gas liquids, sand and gravel, potassium salts, stone.
Lea -----	716,791	785,136	Iron ore, sand and gravel, stone.
Lincoln -----	458	W	Sand and gravel, fluorspar, clays, stone.
Luna -----	W	W	Uranium, natural gas liquids, petroleum, coal, natural gas, stone, sand and gravel, vanadium, molybdenum.
McKinley -----	119,873	138,527	Sand and gravel, stone.
Mora -----	20	53	Stone, sand and gravel.
Otero -----	943	W	Natural gas, petroleum, natural gas liquids, stone, sand and gravel, pumice.
Quay -----	W	--	Petroleum, stone, natural gas, natural gas, stone.
Rio Arriba -----	72,236	87,921	Petroleum, stone, natural gas, gypsum, sand and gravel, pumice.
Roosevelt -----	14,981	14,679	Petroleum, stone, natural gas, natural gas, stone.
Sandoval -----	11,005	3,677	Petroleum, stone, natural gas, gypsum, sand and gravel, pumice.
San Juan -----	186,988	212,313	Natural gas, petroleum, coal, natural gas liquids, sand and gravel, stone, pumice, clays.
San Miguel -----	122	304	Sand and gravel.
Santa Fe -----	1,238	2,878	Sand and gravel, gold, copper, stone, pumice, silver.
Sierra -----	W	25	Sand and gravel.
Socorro -----	542	W	Sand and gravel, stone.
Taos -----	28,663	33,724	Molybdenum, perlite, sand and gravel, mica, stone, pumice.
Torrance -----	178	W	Sand and gravel, iron ore.
Union -----	W	W	Pumice, sand and gravel.
Valencia -----	44,521	44,699	Uranium, sand and gravel, gold, perlite, silver.
Undistributed <sup>3</sup> -----	20,968	52,923	
Total -----	1,941,544	4 2,091,541	

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

<sup>1</sup> Curry and Los Alamos Counties are not listed because no production was reported.

<sup>2</sup> The value of petroleum is based on an average price per barrel for the State.

<sup>3</sup> Includes gem stones which cannot be assigned to specific counties and values indicated by symbol W.

<sup>4</sup> Data do not add to total shown because of independent rounding.

Table 3.—Indicators of New Mexico business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	428.5	431.1	+0.6
Unemployment -----do-----	26.9	31.2	+16.0
<b>Employment (nonagricultural):</b>			
Mining -----do-----	18.7	20.1	+7.5
Manufacturing -----do-----	29.3	27.2	-7.2
Contract construction -----do-----	25.3	23.8	-5.9
Transportation and public utilities -----do-----	23.3	22.8	-2.1
Wholesale and retail trade -----do-----	79.9	81.3	+1.8
Finance, insurance, real estate -----do-----	16.3	16.6	+1.8
Services -----do-----	65.0	68.0	+4.6
Government -----do-----	102.5	105.0	+2.4
Total nonagricultural employment -----do-----	360.3	364.8	+1.2
<b>Personal income:</b>			
Total -----millions--	\$4,810	\$5,476	+13.8
Per capita -----do-----	\$4,299	\$4,776	+11.1
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----			
Value of nonresidential construction -----millions--	6,598	6,904	+4.7
Value of State road contract awards -----do-----	\$101.6	\$123.3	+21.4
Shipments of portland and masonry cement to and within New Mexico -----thousand short tons--	\$48.7	\$62.0	+27.3
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	601	555	-7.7
Value per capita, resident population -----do-----	\$1,941.5	\$2,091.5	+7.7
Value per square mile -----do-----	\$1,735.07	\$1,828.27	+5.4
Value per square mile -----do-----	\$15,957.98	\$17,190.84	+7.7

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

in steelmaking was mined in the north-eastern part of the State.

New Mexico was a significant supplier of raw materials to other States since most of the mineral industry's products were consumed outside the State.

Principal events in the mining industry of New Mexico during 1975 included the following: Near completion of the \$240 million Phelps Dodge Corp. copper smelter in Hidalgo County; beginning of a partnership agreement between Molycorp, Inc., and Kennecott Copper Corp. to explore the possibility of further development of Molycorp's Questa molybdenum property; retention by New Mexico of leadership in U.S. uranium production; continued exploration for and development of new uranium properties and startup of new mines in the Grants Uranium Belt; dedication of a new perlite mine and plant near Socorro by Grefco, Inc.; start of potash production by Mississippi Chemical Corp. east of Carlsbad; and notable decreases in the production of clays, copper, lead, perlite, pumice, salt, sand and gravel, silver, stone, and zinc.

**Legislation and Government Programs.**—Environment and energy continued to be

the focal points of government activities related to the mineral industry of New Mexico during 1975. In January the New Mexico State Legislature, in Chapter 289 of the Laws of 1975, created the Energy Resources Board, the Office of the State Petroleum Engineer, and the Office of the State Geologist. Chapter 289 also reconstituted the makeup of the Oil and Gas Conservation Commission to consist of three members: The State Land Commissioner to serve as chairman, the State Petroleum Engineer, and the State Geologist.

Chapter 289 designated the seven members of the Energy Resources Board as follows: Director of the Energy Resources Board to serve as administrator and member, the State Geologist, the State Land Commissioner, the State Petroleum Engineer, the Director of the New Mexico Bureau of Mines and Mineral Resources, a nongovernment member having expertise in an energy related field, and a nongovernment member to represent energy consumers.

The Coal Surfacemining Commission continued to administer the State mining reclamation law. Examinations of reclama-

tion progress at all coal strip mines were made three times during the year.

Reports relating to the mineral industry of New Mexico were published by the Federal Bureau of Mines,<sup>2</sup> the U.S. Geological Survey,<sup>3</sup> and the New Mexico State Bureau of Mines and Mineral Resources (a division of the New Mexico Institute of Mining and Technology).<sup>4</sup>

The number of mining and oil and gas leases on Federal lands in New Mexico increased slightly to 15,432 leases, totaling 13,850,013 acres,<sup>5</sup> nearly 53% of the federally owned acreage in the State and nearly 18% of the total area in the State. Mining leases on Federal land increased from 629 in 1974 to 653 in 1975. Most of the mining leases were for potash and coal.

Acreage of mining leases increased nearly 30% from 702,460 acres to 912,065 acres in 1975. The number of oil and gas leases increased slightly from 14,452 to 14,779; acreage of oil and gas leases increased from 10,931,954 to 12,937,948.

**Employment and Safety.**—The New Mexico mining industry employed a total of 18,526 people, exclusive of clerical personnel, indicating that nearly 6,000 people were employed in exploration, administration, and sales in addition to those listed below in production categories. The 1975 Annual Report of the State Inspector of Mines listed employment in the mining industry, by category of activity, as follows:

	Coal	Metals	Non-metals	Sand and gravel	Other	Total
Surface -----	726	2,227	707	644	--	4,304
Underground -----	256	2,829	1,760	--	--	4,845
Mill or plant -----	( <sup>1</sup> )	434	672	413	713	2,232
Other -----	( <sup>1</sup> )	481	347	116	230	1,174
<b>Total -----</b>	<b>982</b>	<b>5,971</b>	<b>3,486</b>	<b>1,173</b>	<b>943</b>	<b>12,555</b>

<sup>1</sup> Included in surface category.

More than 19,000 men and women were employed in the petroleum industry in New Mexico during 1975, of which over 8,700 were employed in the production of crude oil and natural gas. Approximately

900 people were employed at the State's eight petroleum refineries.

During 1975 the metal and nonmetal mining industry experienced an accident frequency rate of 18.96 per million man-

<sup>2</sup> Hamilton, P. A., D. H. White, Jr., and T. K. Matson. The Reserve Base of U.S. Coals by Sulfur Content (In Two Parts). 2. The Western States. BuMines IC 8693, 1975, 322 pp.

<sup>3</sup> Santos, E. S. Lithology and Uranium Potential of Jurassic Formations in the San Ysidro-Cuba and Majors Ranch Areas, Northwestern New Mexico. U.S. Geol. Survey Bull. 1329, 1975, 22 pp.

Santos, E. S., R. B. Hall, and R. C. Weisner. Mineral Resources of the San Pedro Parks Wilderness and Vicinity, Rio Arriba and Sandoval Counties, New Mexico. U.S. Geol. Survey Bull. 1385-C, 1975, pp. C1-C29.

West, S. W., and W. L. Broadhurst. Summary Appraisals of the Nation's Ground-Water Resources—Rio Grande Region. U.S. Geol. Survey Prof. Paper 813-D, 1975, pp. D1-D39.

<sup>4</sup> Garrity, T. A., Jr., and E. T. Nitzschke, Jr. Water Law Atlas—A Water Law Primer, 1975. N. Mex. BuMines and Miner. Res. Circ. 95, 1975, 24 pp.

Hiss, W. L. Chloride-Ion Concentration in Ground Water in Permian Guadalupian Rocks, Southeast New Mexico and West Texas, N. Mex. BuMines and Miner. Res., Resource Map 4, 1975.

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Kelley, V. C., and S. A. Northrop. Geology of Sandia Mountains and Vicinity, New Mexico. N. Mex. BuMines and Miner. Res. Memoir 29, 1975, 136 pp.

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Sutherland, P. K., and A. Montgomery. Trail Guide to Geology of the Upper Pecos. Scenic Trips to the Geologic Past. N. Mex. BuMines and Miner. Res. No. 6, 1975, 116 pp.

Zeller, R. A., Jr. Structural Geology of Big Hatchet Peak Quadrangle, Hidalgo County, New Mexico. N. Mex. BuMines and Miner. Res. Circ. 146, 1975, 23 pp.

<sup>5</sup> U.S. Geol. Survey, Conservation Div. Federal and Indian Lands, Oil & Gas Production, Royalty Income & Related Statistics. June 1976.



hours worked as compared with 27.69 in 1974. The severity rate per million man-hours worked for the same periods was 1,465 and 2,879, respectively. The mining industry as a whole experienced 357 lost-time accidents, 3 of which were fatal. Coal mining experienced 34 lost-time accidents and 1 fatal accident.

During 1975 active central mine rescue stations were located in Carlsbad, Grants, Lordsburg, and the Silver City-Vanadium area.

The State Inspector of Mines and his

deputies performed 1,063 mine safety inspections during the year. Federal Mining Enforcement and Safety Administration (MESA) personnel monitored and assisted the State Inspector of Mines making numerous joint inspections. MESA personnel also investigated and wrote reports on two fatal and two nonfatal accidents and investigated three natural deaths that occurred on mining property. As of the end of 1975, 313 metal and nonmetal mines and 5 coal mines were active in New Mexico.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

New Mexico remained a major producer of mineral fuels and was a significant supplier of energy to other States during 1975. Mineral fuels comprised 72.2% of the State's mineral output in terms of

value and amounted to \$1.5 billion. Although most mineral fuels increased in value during 1975 and represented a significant part of the State's total mineral production value, as shown in the tabulation below, the quantity of each mineral fuel produced decreased from that of 1974.

	1975 value (thousands)	Percent of mineral fuels value	Percent of total minerals value
Coal -----	<sup>1</sup> \$61,030	4.0	2.9
Crude petroleum -----	788,073	52.2	37.7
Natural gas liquids -----	167,357	11.1	8.0
Natural gas -----	493,059	32.7	23.6
Total -----	1,509,519	100.0	72.2

<sup>1</sup> Value obtained from State Mine Inspector's Annual Report, 1975.

The petroleum industry continued to be the greatest single source of tax revenue for the State and oil and gas production in 1975 generated nearly \$149 million in direct revenues. Of the 77.7 million acres in the State, 36.7% have been proved productive of oil and/or gas, or are leased for possible future exploration.

During 1975, a total of 1,213 wells were drilled, including 485 oil wells, 564 gas wells, and 164 dry holes. Drilling and completing these wells cost approximately \$195 million. Of 205 "wildcat" wells drilled during the year, 84 were dry holes. Total footage drilled by an average of 71 rotary rigs was more than 6.9 million feet.

**Coal.**—Coal production decreased by nearly 607,000 tons from that of 1974 due chiefly to a decrease in demand for steam coal. The Four Corners powerplant of Arizona Public Service Co. experienced mechanical difficulties in operating the

production units at levels whereby volume of emissions would meet stringent air quality regulations. Coal was produced at one strip mine and one underground mine in Colfax County, at one strip mine in McKinley County, and at two strip mines in San Juan County.

Principal coal production was by Utah International, Inc., at its Navajo mine in San Juan County. The low-sulfur, high-ash coal was used at the Four Corners powerplant. The company also contract-mined coal for Western Coal Co. for use at the San Juan powerplant. According to Utah International's annual report, coal sales in 1975 were 6.2 million tons compared with 7.1 million tons in 1974. The present Navajo mine configuration has a capacity to produce approximately 8 million tons of steam coal annually. Of the 1.1 billion tons of coal reserves at the Navajo mine recoverable by strip mining,

**Table 4.—New Mexico: Coal (bituminous) production, by type of mine and county, 1975**

(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines			Production (thousand short tons)		
	Under-ground	Strip	Total	Under-ground	Strip	Total
Colfax -----	1	1	2	764	253	1,017
McKinley -----	--	1	1	--	468	468
San Juan -----	--	2	2	--	7,301	7,301
Total -----	1	4	5	764	8,022	1 8,785

<sup>1</sup> Data do not add to total shown because of independent rounding.

less than one-third is committed to the Four Corners powerplant. Conditional commitment of the balance of the reserves to two utility companies would be used to produce pipeline quality gas from the coal. Reclamation practices at the Navajo mine by company environmental engineers included the seeding of approximately 540 acres of land using approximately 60,000 pounds of native plant seed.

Operations at the McKinley mine of the Pittsburg and Midway Coal Mining Co. began again on May 5 when miners returned to work following a 14-week strike concerning renewal of their United Mine Workers of America contract. Coal shipments to the Public Service Co. powerplant in Joseph City, Ariz. were started. In an effort to increase annual capacity from the current 500,000 to 5 million tons by 1979, expansion of the mining operation continued on schedule. During 1976, two of three new draglines will be built at the mine. Reclamation continued at the mine and requirements of the State-enforced reclamation law were met during the year.

Kaiser Steel Corp. continued to operate its underground York Canyon mine and its nearby West York strip mine. Longwall mining continued in cooperation with the Federal Bureau of Mines. During September about 300 workers were laid off at the York Canyon mine due to declining steel demand and a subsequent decrease in coal demand at the company's steel plant in California. Reclamation requirements at the strip mine were met in accordance with State law.

The Sundance mine of Sundance Coal Co. was closed on December 4, 1974, as a result of a strike by workers. Sundance Coal Co. began negotiations with Amcoal,

Inc., in February 1975 to subcontract the entire operation of the Sundance mine. The mine was sold in October to Amcoal, Inc., a subsidiary of Amcord, Inc., of Riverside, Calif. Because of the continuing strike, however, the mine remained closed during 1975.

The Santa Fe Railway announced during July that a \$50 million, 70-mile stretch of new rail line would be built from Star Lake in the San Juan Basin to Santa Fe's main line near Prewitt about 16 miles west of Grants. Coal will be mined by Peabody Coal Co. from a strip mine located near Star Lake and will feed an electric generating plant near St. John's, Ariz. The mine is estimated to be a \$65 million investment employing 200 people. Approximately 125 acres per year will be mined. Each unit of the powerplant will require 4,000 tons of coal per day. Coal requirements for the first two units of the powerplant are approximately 86 million tons and the mine will supply the powerplant for its entire 35-year life.

Inspections of reclamation at each of the four operating strip mines in New Mexico were made during April, July, and October by contracted officials for the New Mexico Coal Surfacing Commission to insure each company's conforming to requirements of the State reclamation law.

**Natural Gas.**—Production of natural gas decreased a little more than 2% in 1975 from the banner year of 1974. Value of production, however, increased 26% as the average price of natural gas rose to \$0.405 per thousand cubic feet. New Mexico ranked fourth among the 50 States in the production of natural gas. During 1975, 564 new gas wells were drilled and the approximate average cost for drilling

and equipping the wells was \$34.50 per foot. The total average cost per well was \$202,000. Production of over 1.2 trillion cubic feet of natural gas in 1975 came from a total of 10,352 producing wells. As of December 31, 1975, proved natural gas reserves amounted to 11.8 trillion cubic feet, a slight decrease of 1.5% from the year before.<sup>6</sup> Production of natural gas came from State-owned land, 21%; from Federal lands, 56%; from Indian trust lands, 4%; and from private lands, 19%. Direct revenues to the State from natural gas production increased 36.6% over that of 1974 and totaled \$48.5 million.<sup>7</sup> State royalties amounted to \$13.4 million; ad valorem production tax, \$5.6 million; conservation tax, \$0.7 million; severance tax, \$17.1 million; and school tax, \$11.7 million. Of the 1.2 trillion cubic feet of natural gas produced in the State, only 0.3 trillion cubic feet or 24% was consumed in New Mexico.

In July the K. B. Kennedy Engineering Co. announced plans to construct a \$4.7 million plant at Hobbs to extract natural gas, nitrogen, and gas liquids from previously unmarketable nitrogen impregnated gas. The plant, expected to be in operation by March 1976, will process 50 million cubic feet per day of the unmarketable gas and produce 20 million cubic feet per day of marketable gas.

**Natural Gas Liquids.**—Production of natural gas liquids decreased 1.4% to 39.4 million barrels and decreased in value 4% to \$167.4 million. A total of over 980 billion cubic feet of gas was processed in 36 plants producing 47 million barrels of butane, propane, natural gasoline, and other products.

Estimates by American Gas Association (AGA)<sup>8</sup> as of December 31, 1975, indicated proved reserves of approximately 369 million barrels of natural gas liquids, a decline of 28 million barrels or about 7% from the 1974 estimate.

**Petroleum.**—Although production of petroleum in the State declined for the sixth consecutive year (3.7% less than 1974), crude petroleum remained the largest single source of mineral value in New

Mexico. Value of petroleum output increased 10.6% over that of 1974. The petroleum industry was the State's principal source of tax revenue and the largest nongovernmental employer.

Output of crude petroleum totaled 95,063,000 barrels valued at \$788.1 million, setting an alltime high value for this commodity in the State. New Mexico ranked sixth among crude petroleum-producing States in the Nation. According to the New Mexico Oil Conservation Commission, 17,115 oil wells in 777 reservoirs were in production during the year, a decrease of 120 wells but an increase of 13 reservoirs. There were 3,147 injection wells in secondary recovery or pressure maintenance projects, an increase of 77 wells over those of 1974. The Permian Basin in southeast New Mexico remained the principal oil-producing area, accounting for almost 92% of the total production. Direct revenue to the State from petroleum production in 1975 totaled \$110.5 million, an increase of 16% over that of 1974.<sup>9</sup> State royalties amounted to \$46.3 million; ad valorem production tax, \$8.3 million; conservation tax, \$1.1 million; severance tax, \$26.6 million; and school tax, \$18.1 million.

Proved reserves of crude oil as of December 31, 1975, reported by American Petroleum Institute (API)<sup>10</sup> were 588 million barrels, down from 37 million barrels in 1974, a decrease of 5.9%.

Secondary recovery techniques produced 33.5 million barrels or 35% of the State total oil production, and 11.2 million barrels (11%) was from stripper wells. The average production of crude oil per well at the end of 1975 was 19 barrels per day. A total of 199 depleted oil wells were abandoned during 1975.

Eight refineries, listed in the tabulation below, were capable of processing approximately 114,000 barrels of oil per day.

<sup>6</sup> American Gas Association. Gas Facts: A Statistical Record of the Gas Utility Industry, 1975, pp. 6-7.

<sup>7</sup> New Mexico Oil and Gas Accounting Commission.

<sup>8</sup> Table 3, page 9, of work cited in footnote 6.

<sup>9</sup> Work cited in footnote 7.

<sup>10</sup> Table 7, page 14 of work cited in footnote 6.

Name	Location	Capacity (barrels per day)
Navajo Refining Co	Artesia	29,930
Famariss Oil and Refining Co	Monument	5,000
Shell Oil Co.—Ciniza	Gallup	18,000
Famariss Oil and Refining Co	Lovington	37,000
Plateau, Inc	Bloomfield	8,400
Caribou Four Corners Oil Co	Kirtland	2,300
Thriftway Oil Co	Bloomfield	7,500
Giant	do	6,200
Total		114,330

Forty-seven percent of the oil produced came from State-owned land, 32% from Federal land, 2% from Indian trust land, and 19% from private land.

An average cost of approximately \$28.75 per foot was spent for drilling and equipping oil wells. Total average cost per well approximated \$141,000. Dry holes averaged \$27.50 per foot for drilling and equipping and total costs averaged \$152,000.

Holly Corp., the parent organization of Navajo Refining Co. in Artesia,

planned and evaluated a \$0.6 million expansion project at the refining plant. The expansion would increase by 50% the refinery's gasoline production capabilities.

Of the 95.1 million barrels of crude oil produced in the State, only 28.6 million barrels or 30% were processed in New Mexico refineries. Most New Mexico crude oil (69%) was shipped to PAD District II and III for refining. Refineries in Illinois and Texas processed 56% and 17%, respectively, of the total crude oil shipped from New Mexico.

Table 5.—New Mexico: Production of crude oil and condensate, and natural gas, by county

County	Crude oil and condensate (thousand 42-gallon barrels)		Natural gas (million cubic feet)	
	1974	1975	1974	1975
<b>Southeast New Mexico:</b>				
Chaves	1,788	1,522	10,294	10,755
Eddy	21,505	23,650	229,214	263,070
Lea	66,028	62,153	436,930	416,129
Roosevelt	1,373	1,240	5,842	4,607
Total <sup>1</sup>	90,694	88,565	682,281	684,561
<b>Northwest New Mexico:</b>				
McKinley	1,263	985	2,668	1,741
Rio Arriba	1,476	1,308	174,870	170,748
Sandoval	264	270	1,289	1,026
San Juan	4,998	3,934	368,566	345,031
Total <sup>1</sup>	8,001	6,497	547,392	518,546
Grand total <sup>1</sup>	98,695	95,063	<sup>2</sup> 1,229,673	<sup>2</sup> 1,203,107

<sup>1</sup> Data may not add to totals shown because of independent rounding.

<sup>2</sup> Totals for natural gas differ from same totals in table 1. U.S. Bureau of Mines and the State of New Mexico use different pressure basis for natural gas statistics.

Source: New Mexico Oil Conservation Commission. 1975 Oil and Gas Statistics.

Table 6.—New Mexico: Oilfield and gasfield statistics

	Southeast area	Northwest area	Total
<b>Wells completed:</b>			
Oil -----	422	63	485
Gas -----	224	340	564
Dry -----	133	31	164
Total -----	779	434	1,213
Service -----	15	2	17
<b>Depleted wells abandoned:</b>			
Oil -----	178	21	199
Gas -----	29	24	53
Service -----	57	8	65
Total -----	264	53	317
<b>Number of pools:</b>			
Oil -----	699	78	777
Gas -----	271	66	337
Total -----	970	144	1,114
<b>Number of active wells:</b>			
Oil -----	15,484	1,631	17,115
Gas -----	1,815	8,951	10,766
Injection -----	2,871	276	3,147
Total -----	20,170	10,858	31,028
<b>Production from natural gas-processing plants:</b>			
Natural gasoline ----- barrels---	14,060,830	3,373,701	17,434,531
Butane ----- do-----	4,263,958	4,027,708	8,291,666
Propane ----- do-----	5,128,957	4,585,225	9,714,182
Composite liquids ----- do-----	2,408,139	9,272,089	11,680,228
Total liquids ----- do-----	25,861,884	21,258,723	47,120,607
Sulfur ----- long tons---	21,831	--	21,831
<b>Gas processed in plants, thousand cubic feet:</b>			
Intake -----	581,307,454	399,836,594	981,144,048
Plant use -----	31,703,761	12,693,451	44,397,212
Shrinkage -----	44,737,394	18,136,220	62,873,614

Source: 1975 Report of New Mexico Oil Conservation Commission.

Table 7.—New Mexico: Oil and gas well drilling completions, by county

	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Chaves -----	33	12	21	4	2	11	83	353,977
Colfax -----	--	--	--	--	--	3	3	5,672
Curry -----	--	--	--	--	--	1	1	7,048
De Baca -----	--	--	--	--	1	--	1	7,030
Eddy -----	97	87	43	8	19	24	278	2,054,466
Guadalupe -----	--	--	--	--	--	1	1	712
Harding -----	--	--	--	--	2	2	4	8,606
Hidalgo -----	--	--	--	--	2	2	2	10,367
Lea -----	213	25	52	7	5	17	319	2,168,098
Luna -----	14	1	10	3	--	5	33	59,013
McKinley -----	--	6	1	--	--	1	2	4,479
Otero -----	--	--	--	--	--	2	2	10,953
Quay -----	5	150	5	--	1	2	163	828,555
Rio Arriba -----	4	--	1	--	1	2	8	63,904
Roosevelt -----	5	5	--	1	2	12	25	122,080
Sandoval -----	40	195	18	3	3	12	271	1,140,783
Santa Fe -----	--	--	--	--	--	2	2	11,175
Sierra -----	--	--	--	--	--	1	1	3,400
Torrance -----	--	--	--	--	--	5	5	12,806
Union -----	--	--	--	--	--	3	3	33,061
Total -----	411	481	151	26	36	108	1,213	6,906,190

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 8.—New Mexico: Principal oil and gas discoveries in 1975

County and field	Well	Operator	Location			Producing formation	Total depth (feet)	Initial production	
			Section	Township	Range			Barrels of oil per day	Thousand cubic feet of gas per day
Eddy: Unnamed -----	1-Stonewall, EP State Com.	Yates Petroleum Co.	30	20 S	28 E	Morrow	11,478	--	17,600
Do -----	1-Ives A, Com.	Cities Service Oil Co.	30	21 S	27 E	-----do-----	11,571	--	36,207
Lea: Salt Lake -----	Hanson State, No. 1.	Flag-Redfern Oil Co.	13	20 S	32 E	Bone Springs	10,267	319	--
McKinley: Unnamed -----	Marcelina, No. 1.	Northern Minerals Inc.	24	16 N	10 W	Dakota	1,750	70	--
Mora: Unnamed -----	Clyde, Berlier, No. 1-A.	Brooks Exploration, Inc.	14	21 N	21 E	-----do-----	434	--	456
Roosevelt: Peterson -----	Swearingen(c), No. 1.	Amco Discovery Co.	18	5 S	33 E	Susselman	8,335	342	--
Sandoval: Unnamed -----	Jicarilla 428, No. 1.	Merrion & Bayless---	32	23 N	4 W	Pictured Cliffs	2,280	--	2,200
San Juan: Unnamed -----	Stover Navajo, No. 1.	Consolidated Oil & Gas, Inc.	34	27 N	18 W	Mississippian	6,816	--	3,349
Do -----	Navajo 1-5, No. 1.	Petroleum Energy --	5	26 N	19 W	-----do-----	6,040	110	--
Do -----	Federal G, No. 1.	Bco, Inc -----	2	22 N	8 W	Gallup	4,950	120	--

**Other Fuels.**—Carbon dioxide and high-purity helium were also produced in New Mexico during 1975. Carbon dioxide was produced by S.E.C. Corp. of El Paso, Tex., at two plants in Harding County—one at Solano and one at Bueyeros. The company recovered carbon dioxide from wells in the form of a gas and piped the gas to the processing plants. The gas as recovered from the wells was better than 99% CO<sub>2</sub>. The gas was converted to a liquid in the plants and was sold either as a liquid or as a solid (dry ice). S.E.C. Corp. employed 50 people at its plants and was the largest single industry in Harding County. Western Helium Co. operated a helium extraction plant. High-purity helium was recovered from a feed stock mixture of nitrogen and helium obtained from the Tocito field.

### METALS

The value of metal production decreased to \$360.1 million, 20% less than the \$451.1 million in 1974. Principal cause of the decrease was a drastic reduction in the production of copper attended by a drop in the price of copper from \$0.77 to \$0.64 per pound. Demand for copper remained depressed and worldwide copper inventories continued to climb to record levels. Uranium production and value increased and prevented an even larger decrease in total metal production value. Copper, however, remained the principal metal produced, accounting for 52% of the total metal value in the State. Uranium value was nearly 36% of the total metal value. Other metals produced in New Mexico in 1975 were gold, iron ore, lead, manganese ore, molybdenum, silver, tin, vanadium, and zinc.

**Table 9.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by class of ore or other source material**

Source	Number of mines <sup>1</sup>	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore: Total -----	10	19,553,193	15,049	792,050	121,249	1,931	11,015
Other lode material:							
Copper precipitates ---	3	32,957	--	--	25,014	--	--
Grand total -----	10	19,586,150	15,049	792,050	146,263	1,931	11,015

<sup>1</sup> Detail may not add to total because some mines produce more than one class of material.

Table 10.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing <sup>1</sup> (lode)	Material sold or treated (short tons)	Gold		Silver			
			Troy ounces	Value	Troy ounces	Value		
1973, total	13	26,577,749	13,864	\$1,356,038	1,111,269	\$2,842,627		
1974, total	16	26,557,948	15,427	2,464,310	1,194,800	5,627,508		
1975:								
Grant	7	19,529,164	10,268	1,658,180	778,452	3,440,759		
Hidalgo	1	3,868	72	11,627	2,967	13,114		
Undistributed <sup>2</sup>	2	53,118	4,709	760,456	10,631	46,989		
Total	10	19,586,150	15,049	2,430,263	792,050	3,500,862		
		Copper		Lead		Zinc		Total value
		Short tons	Value	Short tons	Value	Short tons	Value	
1973, total		204,742	\$243,642,811	2,556	\$832,884	12,327	\$5,093,603	\$253,767,963
1974, total		196,585	303,920,197	2,364	1,063,806	13,784	9,896,672	322,972,493
1975:								
Grant		145,802	187,209,503	1,931	830,492	11,015	8,591,884	201,730,818
Hidalgo		165	211,653	--	--	--	--	236,394
Undistributed <sup>2</sup>		296	380,654	--	--	--	--	1,187,999
Total		146,263	187,801,710	1,931	830,492	11,015	8,591,884	203,155,211

<sup>1</sup> Operations at plants leaching runoff water not counted as producing mines.

<sup>2</sup> Includes Santa Fe and Valencia Counties, combined to avoid disclosing individual company confidential data.

Table 11.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Cyanidation and smelting of concentrates <sup>1</sup>	14,444	772,297	121,221	1,925	11,014
Direct smelting of—					
Ore	605	19,753	28	6	1
Precipitates	--	--	25,014	--	--
Total	605	19,753	25,042	6	1
Grand total	15,049	792,050	146,263	1,931	11,015

<sup>1</sup> Combined to avoid disclosing individual company confidential data.

**Copper.**—Total copper production in 1975 declined by 50,322 tons in quantity and \$116.1 million in value from that of 1974. The State, however, continued to rank third in total copper production, behind Arizona and Utah. Three mines in Grant County and one each in Hidalgo County and Santa Fe County produced copper as the primary metal. Several other companies in Grant County produced copper as a byproduct from other metal mining and by leaching. The Chino mine

of Kennecott Copper Corp. near Santa Rita and the Tyrone mine of Phelps Dodge Corp. near Tyrone, both in Grant County, were the leading copper-producing facilities in the State.

The Nacimiento mine of Earth Resources Co. was closed in February as a result of depressed copper prices. Remaining ore reserves will be held in anticipation of higher copper prices. Federal Resources Corp. suspended all operations at the 85 mine and at the Bonney mine in January



and both mines were placed on a standby basis until such time as the copper price trend could be evaluated.

The weak copper market during 1975 forced Kennecott Copper Corp. to reduce operations at its Chino open pit mine near Santa Rita and at its copper smelter at Hurley. The company shut down on June 27 for 4 weeks for obligatory vacations and laid off 250 employees and reduced the work week from 7 to 5 days. During the year the company rebuilt the reverberatory furnace in the smelter to increase furnace efficiency and life. A supplementary control system for regulating SO<sub>2</sub> emissions was installed and began operating in August. Curtailment of smelter operations during the last 5 months of the year in order to meet ambient air quality standards resulted in an average loss of 2 days of smelting operations per month. Production costs were higher due to reduced operating rates. According to the company's annual report, over 106 million pounds of copper was produced at the Chino Mines Div. during 1975.

Occidental Minerals Corp. (OXYMIN) continued exploratory drilling at a porphyry copper deposit, located approximately 6 miles north of Cerrillos, for a possible in situ leaching operation.

Construction of the Phelps Dodge Corp.'s \$240 million copper smelter in Hidalgo County neared completion at yearend. The flash smelting process in the new smelter will produce furnace gas streams with higher concentrations of SO<sub>2</sub> than gas streams from reverberatory furnaces, thereby making it possible to remove sulfur either as elemental sulfur or as sulfuric acid. The smelter is expected to process copper concentrates from the company's Tyrone operation in mid-1976. Anode production at the smelter will be shipped to the company refinery at El Paso, Tex. During 1975, the company expended nearly \$2.5 million for capital improvements at the Tyrone mine and concentrator. The copper mine at Tyrone produced only 150.8 million pounds of copper in 1975 compared with 194.1 million pounds in 1974. Average grade of ore mined in 1975 was 0.81% copper compared with 0.83% in 1974. Work schedules at Tyrone were cut from 5½ to 4 days for 4 months allowing production cutbacks with no layoffs. The company shut down 3

weeks for vacation in the summer and resumed operation on July 13.

UV Industries, Inc., due to a 3-month strike at its Continental mine, milled less tons in 1975 than in 1974 and copper concentrate production was down 28% and copper in concentrate was down from 24,167 to 17,614 tons or 27% less. At the concentrator, the No. 1 mill processed 647,204 tons of ore, averaging 1.647% copper, and the No. 2 mill processed 996,806 tons of ore, averaging 0.853% copper. Copper concentrate from the No. 1 mill totaled 37,853 tons averaging 26.36% copper, and the No. 2 mill production totaled 28,112 tons averaging 27.16% copper. The company completed its conversion to trackless mining in the area of the underground copper operations during 1975.

**Gold.**—Production of gold came from seven mines operated by six companies in Grant County and from one mine each in Hidalgo, Santa Fe, and Valencia Counties. Most of the production came from Grant County and was a result of byproduct recovery from copper mining. The quantity of gold produced in 1975 was 378 troy ounces, \$412,000 less than in 1974. The average price of gold in 1975 was \$161.47 per ounce compared with \$159.72 in 1974.

**Iron Ore.**—UV Industries, Inc., produced magnetite as a byproduct at its Continental copper mine in Grant County. H. N. LaRue & Sons produced hematitic iron ore from the Smokey mine in Lincoln County and from the Iron King mine in Torrance County.

**Lead and Zinc.**—The Ground Hog mine operated by ASARCO Incorporated in Grant County was the leading producer of lead and zinc in New Mexico during 1975. Two other companies produced lead and zinc, also in Grant County. Lead and zinc were not reported produced in any other county of the State.

Production of lead decreased 433 tons (18%) in quantity and \$234,000 (22%) in value from that of 1974. The average price of lead produced in New Mexico during the year was \$0.215 per pound.

Zinc production decreased by 2,769 tons (20%) in quantity and \$1.3 million (13%) in value from that of 1974. The average price of zinc produced in New Mexico during the year was \$0.39 per pound.

Principal cause of the drop in production of lead and zinc was a 5-week strike by Local 8244, United Steel Workers of America against ASARCO Incorporated at the Ground Hog mine.

**Molybdenum.**—Principal production of molybdenum came from the Questa mine of Molycorp, Inc. Similar molybdenum concentrates were produced by Kennecott Copper Corp. as a byproduct at its Hurley copper concentrator. Kerr-McGee Corp. also produced a molybdenum byproduct during uranium concentration at its Ambrosia Lake milling operation.

According to the company's 1975 annual report, Molycorp produced 11.1 million pounds of molybdenum disulfide concentrates during the year, approximately the same as in 1974. In July, Molycorp entered into a partnership agreement with Kennecott Copper Corp. for the further development of the Questa molybdenum property. Kennecott is required to contribute a minimum of \$5 million to the partnership prior to July 1977 for drilling and other evaluation work within a 33-square-mile block held by Molycorp at Questa.

**Silver.**—Production of silver came chiefly as a byproduct of copper and zinc mining and processing. Major producers in order of rank were Phelps-Dodge Corp., UV Industries, Inc., and ASARCO Incorporated, all in Grant County. Other producers in Grant County were Kennecott Copper Corp., Grant County Mining Co., and C. F. Hanson. Silver was also produced by one company each in Hidalgo, Santa Fe, and Valencia Counties. Silver production decreased 403,000 troy ounces (34%) in quantity and \$2.1 million (38%) in value from that of 1974.

**Uranium.**—New Mexico retained its position as the leading producer of uranium in the United States, accounting for 45% of the U.S. total. Total production of uranium oxide ( $U_3O_8$ ) amounted to 10,393,000 pounds, recovered from 2,975,755 tons of ore.

Reported production came from 22 mines in McKinley County and 4 mines in Valencia County. The ore was mined by six companies and processed in three uranium processing mills having a nominal capacity of 13,000 tons of ore per day. The mills, all located in the Ambrosia Lake district in McKinley County were

operated by Kerr-McGee Corp., United Nuclear-Homestake Partners and The Anaconda Company. Most of the ore was processed at the Kerr-McGee mill. The average price of the  $U_3O_8$  (yellow cake) produced during the year was \$12.30 per pound.

During 1975, The Anaconda Company began a gradual phasing out, until the year 1979, of the open pit mining operations at the Jackpile and Paguate mines located on the Laguna Indian Reservation. Limited underground production began early in 1975 at the new P-10 mine. Problems were encountered early in 1975 in the milling of ore by Anaconda, thereby causing an approximate one-third reduction in production capability. Gulf Energy and Minerals Co. made good progress during 1975 in development work at its Mt. Taylor underground uranium mine. The service shaft had reached a depth of approximately 700 feet at yearend, and work on the main shaft began in December and is expected to be completed in mid-1978. Underground development would commence in 1978; commercial production could begin by 1981.

A mining plan was filed by Gulf Energy and Minerals Co. with the U.S. Department of the Interior to develop smaller and shallower uranium reserves at Mariano. The company continued exploration drilling on other properties in New Mexico along the Grants Uranium belt in the same area as the Mt. Taylor and Mariano projects.

Uranium production at Kerr-McGee's principal mining operations in the Ambrosia Lake area increased over that of 1974. Initial production began near the end of 1975 at the Section 19 mine at Ambrosia Lake and the Church Rock No. 1 mine, northeast of Gallup. The mines became the 9th and 10th underground mines operated by Kerr-McGee in New Mexico. Ore from these mines will be processed at the 7,000-ton-per-day company mill near Grants.

Phillips Petroleum Co. stated during December that it had made a significant uranium discovery in the San Juan Basin near the Seven Lakes Region located about 48 air-miles northeast of Gallup and about 12 miles northeast of Crownpoint. Drilling indicated the presence of 25 million pounds of uranium oxide in an area

of about 1,900 acres within 43,000 acres of the company's full interest, options, and claims in McKinley County. The discovery is said to be contained in about 7 million tons of mineralized material at depths of 3,000 feet to 3,500 feet.

Ranchers Exploration & Development Corp. continued development of its Johnny M mine throughout the year, but progress was slower than expected and production will therefore begin in 1976. Severe adverse effects on development costs and anticipated operating costs were brought about by inflation, competition for labor, and other unforeseeable occurrences and conditions. Ranchers also obtained options on two small Grants mineral belt properties and explored them with a view toward immediate production. Reserves to date on the two properties total about 550,000 pounds of  $U_3O_8$ . Exploration drilling costs in the explored area averaged about \$2.25 to \$2.75 per foot for 2,000-foot deep holes and \$3.25 to \$3.75 per foot for 3,000-foot deep holes.

Sohio Petroleum Co. was 50% owner and operating manager for uranium properties located on the L-Bar Ranch about 50 miles west of Albuquerque. An underground mine and uranium processing mill was scheduled for completion in 1976. The mine will produce about 25,000 tons of ore per month and the mill will have a nominal capacity of 1,660 tons per day. The ore body was estimated to contain 5.3 million tons averaging 0.19%  $U_3O_8$  and occurs at depths of 250 to 650 feet. Ore from nearby mines as well as the Sohio-operated mine will be processed at the mill. About 2 million pounds of uranium concentrates is the expected output of the mill, 70% of which will be from the company-owned mine.

Uranium was produced by United Nuclear Corp. from its own mines and from mines operated by United Nuclear-Homestake Partners. Including United Nuclear's share of the partnership production, total uranium production for the year was 1.5 million pounds of  $U_3O_8$ , or 7% greater than in 1974. United Nuclear operated the Section 27 and Sandstone mines by conventional mining methods and the Ann Lee mine by solution mining. At the Church Rock mine, development proceeded with some ore production at the 1,000-foot level and sublevel development at the

1,700-foot level. United Nuclear's production was limited in 1975 by mining low-grade ore in certain mines in the Ambrosia Lake area coupled with the continued development activity of the Church Rock mine. Significant increases in mining and milling costs as a result of production of low-grade ores, coupled with continued  $U_3O_8$  deliveries on low-priced contracts resulted in an operating loss for the year. Tons of ore mined in 1975 totaled 227,333 and 634,885 pounds of  $U_3O_8$  were distributed to United Nuclear. Exploration efforts by United Nuclear were concentrated on various Navajo Indian Reservation tracts north and northeast of the company's Church Rock mine. At least 5 million pounds of  $U_3O_8$  are believed to represent minable reserves.

Mining operations continued during the year at United Nuclear-Homestake Partners's four underground mines and leaching operations and at Homestake's F-33 mine. Ore reserves at the F-33 mine are expected to be exhausted during 1976. Metallurgical recoveries were higher than those achieved during 1974. Although milling operations were limited by mine output, a plan was designed to increase production from partnership mines in view of more favorable market conditions.

With a 45% interest in a joint venture, Western Nuclear, Inc., a 100% owned subsidiary of Phelps Dodge Corp., began development of the underground Ruby No. 1 uranium mine near Grants. Production expected to begin in the second half of 1976 is to attain the rate of 500,000 to 600,000 pounds of  $U_3O_8$  annually. More than \$3 million of an estimated total capital cost was expended by the end of 1975. The company drilled several other uranium prospects in the area near Grants during the year.

**Other Metals.**—Manganiferous ore, tin, and vanadium were also produced in New Mexico during 1975. Manganiferous ore production increased by 2,628 tons (5.6%) but decreased 3.6% in value. Tin production and value tripled from the previous year. Vanadium production and value decreased slightly from that of 1974.

#### NONMETALS

Value of nonmetals production increased 30% to \$221.7 million and represented

10.6% of the State's total mineral production value. The most valuable nonmetallic mineral produced in New Mexico continued to be potash (potassium salts) as its share in value of the total nonmetals output was 81%. Other nonmetallic minerals produced in descending order of value were sand and gravel, cement, perlite, stone, lime, pumice, salt, gypsum, gem stones, mica, clays, and fluorspar.

**Cement.**—Ideal Cement Co., a division of Ideal Basic Industries, Inc., was the State's only cement producer at its plant located at Tijeras, east of Albuquerque in Bernalillo County.

**Clays.**—Six operations produced clay and shale during 1975. Two mines were operated in Bernalillo County and one mine each was operated in Dona Ana, Hidalgo, Luna, and San Juan Counties. Production and value of clay decreased substantially from those of 1974. The Federal Bureau of Mines ran extrusion tests on several clay samples submitted by the New Mexico Bureau of Mines and Mineral Resources.

**Fluorspar.**—Foseco Minsep, Inc., was the only reported producer of fluorspar in New Mexico during 1975. The company operated the Green Leaf mine located north of Deming in Luna County.

**Gypsum.**—White Mesa Gypsum Co. and Duke City Gravel Products Co. mined gypsum in Sandoval County. Output declined substantially. American Gypsum Co. calcined gypsum at Albuquerque in Bernalillo County; output declined 51% from that of 1974 and was 70% below the 1973 record.

**Lime.**—Mathis Mining & Exploration Co. and Kennecott Copper Corp. produced lime in Grant County during the year.

**Mica.**—Only one mica mine was active in the State during 1975, that of the Mineral Industries Commodities of America, Inc., located in Taos County.

**Perlite.**—New Mexico continued to lead the Nation with 84% of total crude perlite production, although 1975 production decreased by 51,000 tons. Value increased by nearly \$100,000. Grefco, Inc., with the El Grande mine, and Johns-Manville Perlite Corp., with the Seven Hill mine, both in Taos County, were the two largest producers in the State. Additional production came from Silbrico Corp. in Taos County

and United States Gypsum Co. in Valencia County.

No production was reported by Grefco, Inc., from its mine and plant near Socorro in Socorro County. Dedication ceremonies for this new operation were held during December. The perlite deposit is estimated to be in excess of 10 million tons.

**Potash.**—New Mexico remained the leading producer of potash in the Nation, contributing 83% of total U.S. output in 1975. Seven companies were engaged in potash production in Eddy County and one company produced potash in Lea County. Total production in New Mexico decreased slightly by 21,000 tons. Value of production, however, increased by nearly 40%, to \$180 million, with the average price of potash rising from \$61.17 per ton in 1974 to \$86.46 per ton in 1975.

AMAX Chemical Corp. initiated a program in September to develop additional low-grade reserves. The importance of these reserves increased as a result of developments in the Province of Saskatchewan, Canada. Duval Corp. anticipated that muriate of potash production would increase from 185,000 to 350,000 tons per year as the result of the commencement of production at a new mine costing approximately \$2.2 million. The company has a capacity for washed-langbeinite in New Mexico of 325,000 tons per year. Reserves estimated by Duval,<sup>11</sup> as proved recoverable as of December 31, 1975, were as follows:

	Tons (thousands)	Average grade (percent K <sub>2</sub> O)
Sylvite ore -----	1 19,684	17.3
Langbeinite ore ----	2 38,639	8.4

<sup>1</sup> Sufficient to produce 4,373,000 tons of muriate of potash, 60% K<sub>2</sub>O.

<sup>2</sup> Sufficient to produce 13,278,000 tons of washed langbeinite, 22% K<sub>2</sub>O.

International Minerals & Chemical Corp. terminated in 1975 the planned expansion begun at its operation in 1974. Kerr-McGee Chemical Corp.'s facility was named 1975 operator of the year by the New Mexico Mining Association for achieving the best safety record among New Mexico mining facilities with large underground operations. Kerr-McGee es-

<sup>11</sup> Pennzoil Co. Annual Report, 1975, p. 46.

established an accident frequency rate of only 3.5 lost-time injuries per million man-hours worked from July 1, 1974, to June 30, 1975. The work force comprised 434 persons. Mississippi Chemical Corp. began potash production in January and topped 52,000 tons by the end of June. Projected production at the Carlsbad facility will supply one-third of Mississippi Chemical's anticipated annual requirements.

National Potash Co. produced and sold less potash in 1975 than in 1974; however, higher prices made up for the decline in tonnage. The company began shifting mining operations from its nearly depleted Eddy County mine to its original mine in Lea County, which had been shut down in 1968 in order to utilize the higher grade Eddy County ore. A reduction of overall output in 1976 is expected as a result of the shift to the use of lower grade Lea County ore. Potash production at Potash Co. of America (PCA) was at the same level as in 1974 although somewhat reduced late in 1975 to control inventories. The company completed exploratory drilling on certain New Mexico lands indicating the existence of an ore body of commercial size. Extensive process research studies are underway to handle the complex ore mineralization in the ore body. On June 1, a 3-year contract with PCA was ratified by members of the International Association of Machinists and Aerospace Workers Lodge 1265.

**Pumice.**—In terms of tonnage, New Mexico ranked third in the Nation in the

production of pumice,<sup>12</sup> although both production and value declined from those of 1974. During 1975, 11 operations in 7 counties included 11 mines and 7 processing plants. The largest producers in the State were Twin Mountain Rock Co. in Union County, General Pumice Corp. in Rio Arriba County, and Morton Bros. in Dona Ana County.

**Salt.**—Salt was produced in various forms and continued to be a major by-product of the potash industry. A total of five active operations reported production for 1975; four operations were in Eddy County and the fifth operation was in Catron County. Salt production decreased 20,000 tons from that of 1974.

**Sand and Gravel.**—Production of sand and gravel remained the most widespread mining activity in the State. Sand and gravel was mined by 113 companies at 127 separate operations in 26 counties of the State. No production was reported for Curry, Guadalupe, Harding, Los Alamos, Quay, and Roosevelt Counties. Although production of sand and gravel decreased nearly 1.2 million tons, value of production increased 30% over that of 1974 to \$13.8 million. The average unit value of sand and gravel produced in New Mexico during 1975 was \$2.22 per ton. Commercial operations accounted for 3.8 million tons, 61% of the total State output; government operations accounted for the re-

<sup>12</sup> Statistics designated "pumice" include such volcanic materials as scoria and volcanic cinders.

Table 12.—New Mexico: Production and sales of potassium salts  
(Thousand short tons and thousand dollars)

Period	Crude salts <sup>1</sup> (mine production)		Marketable potassium salts					
	Gross weight	K <sub>2</sub> O equivalent	Production			Sold or used		
			Gross weight	K <sub>2</sub> O equivalent	Value <sup>2</sup>	Gross weight	K <sub>2</sub> O equivalent	Value
1974:								
January-June	8,442	1,305	1,958	1,042	56,029	2,022	1,075	57,827
July-December	8,764	1,361	1,991	1,060	72,559	1,863	986	68,196
Total	17,206	2,666	3,949	2,102	128,588	3,885	2,061	126,023
1975:								
January-June	9,156	1,402	2,037	1,079	93,661	1,603	846	73,987
July-December	8,653	1,298	1,817	1,002	86,263	1,618	903	76,634
Total	17,809	2,700	3,854	2,081	179,924	3,221	1,749	<sup>3</sup> 150,622

<sup>1</sup> Sylvite and langbeinite.

<sup>2</sup> Derived from reported value of "Sold or used."

<sup>3</sup> Data do not add to total shown because of independent rounding.

mainder. Most of the sand and gravel produced was used for road construction. More than 91% of all the sand and gravel produced was processed before use.

**Stone.**—Stone production decreased 38% in quantity and 44% in value from that of 1974. In 1975, a total of 45 stone quarries were operated in the State by 28 producers. Compared to 1974 production, 21 fewer quarries were in operation during the year. The average price per ton of stone dropped from \$2.37 in 1974 to \$2.13 in 1975.

**Other Nonmetals.**—Gem stones and sulfur were also produced in New Mexico during 1975. Raw turquoise was purchased out-of-State and sold either as raw or polished turquoise within New Mexico. Elemental sulfur was recovered as a by-product of natural gas processing at plants located in Eddy, Lea, and Roosevelt Counties. In 1975, six companies produced a total of 27,686 long tons, sold or used 26,920 long tons having a total value of \$973,621 or an average value of \$36.17 per long ton.

**Table 13.—New Mexico: Construction sand and gravel sold or used by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand .....	1,880	3,270	1,811	4,136
Gravel .....	4,713	6,857	3,860	8,046
Unprocessed:				
Sand and gravel .....	820	454	548	411
Total .....	7,413	10,581	<sup>2</sup> 6,220	12,593

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

**Table 14.—New Mexico: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction .....	99	191	80	223
Highway and bridge construction .....	59	93	208	549
Other construction (dams, waterworks, airports, etc.) .....	20	31	76	309
Concrete products (cement blocks, brick, pipe, etc.) .....	W	W	22	63
Bituminous paving (asphalt and tar paving) .....	1,481	1,901	894	2,073
Roadbase and subbase .....	1,314	1,083	736	1,302
Fill .....	94	57	33	50
Other .....	62	107	60	105
Unprocessed:				
Roadbase and subbase .....	327	148	300	198
Fill .....	134	81	31	19
Total <sup>1</sup> .....	3,590	3,692	2,439	4,892

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 15.—New Mexico: Construction aggregate (blended sand and gravel) sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	1,903	3,775	2,073	5,010
Highway and bridge construction -----	83	209	112	320
Other construction (dams, waterworks, airports, etc.) -----	45	116	163	452
Concrete products (cement blocks, brick, pipe, etc.) -----	399	1,094	445	1,532
Bituminous paving (asphalt and tar paving) -----	351	522	167	385
Roadbase and subbase -----	497	712	287	461
Fill -----	180	232	185	284
Other -----	7	28	130	268
<b>Unprocessed:</b>				
Roadbase and subbase -----	285	128	91	74
Fill -----	73	97	126	121
<b>Total</b> <sup>1</sup> -----	<b>3,823</b>	<b>6,913</b>	<b>3,781</b>	<b>8,906</b>

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 16.—New Mexico: Construction aggregate (blended sand and gravel) sold or used by producers, by county**  
(Thousand short tons and thousand dollars)

County	1974				1975			
	Number of mines	Quantity	Value	Number of companies	Number of mines	Quantity	Value	Number of companies
Bernalillo -----	8	2,213	3,551	7	8	1,458	2,825	8
Catron -----	--	--	--	--	1	10	49	1
Chaves -----	6	277	347	5	4	170	433	4
Colfax -----	4	206	210	4	5	63	115	5
De Baca -----	2	W	W	2	2	W	W	2
Dona Ana -----	12	435	303	9	11	572	622	10
Eddy -----	2	W	W	2	2	W	W	2
Grant -----	2	W	W	2	4	87	288	4
Guadalupe -----	2	W	W	2	--	--	--	--
Hidalgo -----	2	W	397	2	1	W	W	1
Lea -----	4	229	389	4	5	232	590	5
Lincoln -----	7	167	304	6	4	108	255	4
Luna -----	3	44	74	3	5	167	395	5
McKinley -----	2	W	252	2	3	58	113	3
Mora -----	2	29	20	2	3	38	43	2
Otero -----	8	474	466	8	5	178	275	5
Quay -----	2	W	W	2	--	--	--	--
Rio Arriba -----	6	163	146	5	6	90	211	3
Sandoval -----	3	46	36	3	2	W	W	2
San Juan -----	11	531	966	10	12	1,030	2,460	10
San Miguel -----	4	87	122	4	5	152	304	5
Santa Fe -----	10	984	850	9	16	673	1,575	10
Sierra -----	2	W	W	2	3	21	25	3
Socorro -----	3	W	W	2	3	43	73	3
Taos -----	5	W	W	5	3	154	277	3
Torrance -----	3	63	43	3	3	93	133	3
Union -----	2	W	W	2	4	95	165	4
Valencia -----	4	87	169	4	7	159	447	6
Undistributed -----	--	1,424	1,959	--	--	573	2,124	--
<b>Total</b> <sup>1</sup> -----	<b>121</b>	<b>7,413</b>	<b>10,605</b>	<b>111</b>	<b>127</b>	<b>6,220</b>	<b>13,798</b>	<b>113</b>

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 17.—New Mexico: Crushed limestone <sup>1</sup> sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Chaves -----	2	35	85	1	8	10
De Baca -----	1	139	457	--	--	--
Dona Ana -----	6	W	396	2	W	W
Eddy -----	4	220	641	1	34	92
Grant -----	2	101	W	4	137	256
Hidalgo -----	8	449	844	--	--	--
Lea -----	4	332	1,170	1	25	55
Lincoln -----	4	50	154	2	32	102
McKinley -----	7	399	784	4	102	169
Mora -----	--	--	--	1	9	10
Otero -----	7	190	477	1	W	W
Río Arriba -----	3	14	37	3	80	149
Roosevelt -----	--	--	--	2	31	43
Sandoval -----	2	497	941	--	--	--
San Juan -----	1	W	W	1	W	12
Taos -----	3	30	62	--	--	--
Valencia -----	3	146	332	--	--	--
Undistributed <sup>2</sup> -----	9	930	1,978	4	1,077	2,250
Total <sup>3</sup> -----	66	3,531	8,359	27	1,534	3,147

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

<sup>1</sup> 1974 data represent total stone.

<sup>2</sup> Includes Bernalillo, Luna (1974), Santa Fe (1975), and Socorro (1974) Counties, and counties indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.



Table 18.—Principal producers

Commodity and company	Address	Type of activity	County
Carbon dioxide (natural): S.E.C. Corp -----	Box 9737 El Paso, Tex. 79987	Well and extraction plant.	Harding.
Cement: Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Dry process, 2 rotary kiln plant.	Bernalillo.
Clays: El Paso Brick Co -----	Box 12336 El Paso, Tex. 79912	Open pit mine ---	Dona Ana.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	----do -----	Bernalillo.
Kinney Brick Co., Inc ----	Box 1804 Albuquerque, N. Mex. 87102	----do -----	Do.
Coal: Kaiser Steel Corp -----	Box 58 Oakland, Calif. 90604	Underground mine, strip mine, crushing plant, dense media-froth flotation cleaning plant.	Colfax.
The Pittsburgh & Midway Coal Mining Co.	1600 Tenmain Center Kansas City, Mo. 64106	Strip mine, crushing plant, chemical and water treatment plant.	McKinley.
Utah International, Inc --	550 California St. San Francisco, Calif. 94104	Strip mine, crushing plant, dust suppression detergent treatment plant.	San Juan.
Western Coal Co -----	Box 1026 Albuquerque, N. Mex 87103	Strip mine -----	Do.
Copper: Kennecott Copper Corp., Chino Mines Div. <sup>1</sup>	Hurley, N. Mex. 88043 ----	Open pit mine, flotation mill, precipitation plant, smelter.	Grant.
Phelps Dodge Corp., Tyrone Branch. <sup>1</sup>	Drawer B Tyrone, N. Mex. 88065	Open pit mine and mill.	Do.
UV Industries, Inc. <sup>2</sup> -----	136 East South Temple St. Salt Lake City, Utah 84111	Underground mine, open pit mine, flotation mill.	Do.
Gypsum: Duke City Gravel Products Co.	Gun Club Rd., SW. Albuquerque, N. Mex. 87105	----do -----	Sandoval.
White Mesa Gypsum Co --	124 Jackson, NE. Albuquerque, N. Mex. 87108	Open pit mine ---	Do.
Iron ore: H. N. LaRue & Sons.	Box 1224 Socorro, N. Mex. 87801	Mine and concentrator.	Lincoln and Torrance.
Lead: ASARCO, Inc -----	Box 186 Vanadium, N. Mex. 88773	Underground mine and shaft.	Grant.
Lime: Kennecott Copper Corp., Chino Mines Div.	Hurley, N. Mex. 88043 ----	Rotary-kiln plant.	Do.
Mathis Mining & Exploration Co.	1101 Santa Rita Silver City, N. Mex. 88061	Quarry and open pit mine.	Do.
Mica: Mineral Industries Commodities of America, Inc.	Box 2408 Santa Fe, N. Mex. 87501	Open pit mine ---	Taos.
Molybdenum: Molycorp, Inc., Questa Div.	280 Park Ave. New York, N.Y. 10017	Open pit mine and flotation mill.	Do.
Natural gas and petroleum: <sup>3</sup> Perlite: Grefco, Inc., Dicalite Div -	333 North Michigan Ave. Chicago, Ill. 60601	Open pit mine; crushing, screening, air separation.	Do.
Johns-Manville Perlite Corp.	2500 Miguelito Rd. Lompoc, Calif. 93436	----do -----	Do.
Potash: AMAX Chemical Corp ----	Box 279 Carlsbad, N. Mex. 88220	Underground mine and refinery.	Eddy.
Duval, Corp., Potash Div -	Box 511 Carlsbad, N. Mex. 88220	2 underground mines and refinery.	Do.
International Minerals & Chemical Corp.	Box 71 Carlsbad, N. Mex. 88220	Underground mine	Do.
Kerr-McGee Corp -----	Kerr-McGee Bldg. Oklahoma City, Okla. 73102	----do -----	Do.

See footnotes at end of table.

Table 18.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Potash—Continued			
Mississippi Chemical Co --	Box 101 Carlsbad, N. Mex. 88220	1 underground mine.	Eddy.
National Potash Co -----	Box 731 Carlsbad, N. Mex. 88220	-----do -----	Do.
Potash Co. of America, a division of Ideal Basic Industries, Inc.	Box 31 Carlsbad, N. Mex. 88220	-----do -----	Do.
Pumice:			
General Pumice Corp -----	Box 449 Santa Fe, N. Mex. 87501	Open pit mine and crushing and screening plant.	Rio Arriba.
Morton Bros -----	Box 2000 Las Cruces, N. Mex. 88001	-----do -----	Dona Ana.
Twin Mountain Rock Co --	Box 1009 Sheridan, Wyo. 82801	-----do -----	Union.
Salt:			
Mississippi Chemical Corp-	Box 101 Carlsbad, N. Mex. 88220	Solar evaporation-	Eddy.
Potash Co. of America, a division of Ideal Basic Industries, Inc.	Box 31 Carlsbad, N. Mex. 88220	Tailings salt ----	Do.
Sand and gravel (commercial):			
Albuquerque Gravel Products Co.	Box 829 Albuquerque, N. Mex. 87103	Stationary plant --	Bernalillo.
Alcora Materials Co -----	Box 2439 Farmington, N. Mex. 87401	Portable plants --	San Juan.
Jones Construction Co ---	Box 803-A Albuquerque, N. Mex. 87103	-----do -----	Sandoval and Santa Fe.
Rose Gravel -----	1400 San Jose Blvd. Carlsbad, N. Mex. 88220	1 stationary and 2 portable plants.	Eddy.
San Juan Concrete -----	507 South Behrend Ave. Farmington, N. Mex. 87401	Portable plant and crushing pit.	San Juan.
Springer Corp -----	Box 572 Albuquerque, N. Mex. 87103	Pit and stationary crushing and screening plant.	Bernalillo.
Stone:			
G. F. Atkinson Co -----	Box W Albuquerque, N. Mex. 87103	Quarry -----	Sandoval.
Ideal Cement Co., a divi- sion of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, Colo. 80202	Quarry and plant-	Bernalillo.
New Pueblo Constructors, Inc.	Box 430 Tijeras, N. Mex. 87059	Quarry -----	Do.
Wylie Brothers Contracting Co.	Box 8526 Albuquerque, N. Mex. 87108	Open pit -----	Otero.
Uranium:			
The Anaconda Company, New Mexico Operations.	Box 638 Grants, N. Mex. 87020	Open pit mine and acid-leach proc- ess mill.	Valencia.
Kerr-McGee Corp -----	Box 218 Grants, N. Mex. 87020	Underground mines and acid-leach processed mill.	McKinley.
United Nuclear-Homestake Partners.	Box 98 Grants, N. Mex. 87020	Underground mines and alkaline- leach process mill.	Do.

<sup>1</sup> Also gold, molybdenum, and silver.<sup>2</sup> Also gold and silver.<sup>3</sup> Most of the major oil and gas companies operate in New Mexico and several commercial directories contain complete lists of them.



# The Mineral Industry of New York

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

By L. F. Heising <sup>1</sup>

The total value of New York's mineral production was \$397.7 million in 1975, compared with \$440.6 million in 1974. The State ranked second nationally in the production of zinc; was first in the production of synthetic calcium chloride, emery, ilmenite, and abrasive-grade aluminum

oxide; and continued to be a major producer of cement, garnet, salt, talc, sand and gravel, and stone. New York was the sole producer of wollastonite and manufactured abrasive aluminum-zirconium oxide in 1975.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Albany, N.Y.

Table 1.—Mineral production in New York <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays <sup>2</sup> -----thousand short tons--	1,451	\$2,348	817	\$1,561
Gem stones -----	NA	16	NA	16
Gypsum -----thousand short tons--	364	2,942	W	W
Lead (recoverable content of ores, etc.) --short tons--	3,076	1,384	3,027	1,302
Natural gas -----million cubic feet--	4,990	2,745	7,628	5,645
Peat -----thousand short tons--	18	181	22	377
Petroleum (crude) -----thousand 42-gallon barrels--	896	9,538	875	10,693
Salt -----thousand short tons--	6,464	57,705	5,978	57,344
Sand and gravel -----do-----	30,614	46,652	22,158	44,064
Silver (recoverable content of ores, etc.) -----thousand troy ounces--	64	304	56	248
Stone -----thousand short tons--	38,207	87,724	31,713	80,929
Zinc (recoverable content of ores, etc.) --short tons--	93,077	66,829	76,612	59,757
Value of items that cannot be disclosed:				
Cement, clay (ball), emery, garnet (abrasive), iron ore, lime, mercury, talc, titanium concen- trate, wollastonite, and values indicated by symbol W -----	XX	162,205	XX	135,792
Total -----	XX	440,573	XX	397,72 <sup>2</sup>
Total 1967 constant dollars -----	XX	208,303	XX	<sup>P</sup> 157,500

<sup>P</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes ball clay; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in New York, by county<sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Albany	\$41,090	W	Cement, stone, clays, sand and gravel.
Allegany	4,044	W	Petroleum, sand and gravel, natural gas.
Broome	W	\$956	Sand and gravel, clays, peat, stone.
Cattaraugus	10,579	10,767	Petroleum, sand and gravel, natural gas, peat.
Cayuga	W	W	Sand and gravel, natural gas.
Chautauqua	1,460	4,192	Natural gas, sand and gravel, petroleum.
Chemung	370	W	Sand and gravel.
Chenango	483	602	Do.
Clinton	W	W	Stone, sand and gravel.
Columbia	W	12,868	Cement, stone, sand and gravel, clays.
Cortland	662	706	Sand and gravel.
Delaware	1,959	W	Stone, sand and gravel.
Dutchess	W	15,979	Stone, sand and gravel, peat.
Erie	15,175	13,368	Stone, lime, sand and gravel, natural gas, gypsum, clays.
Essex	9,866	12,289	Titanium concentrates, iron ore, wollastonite, stone, sand and gravel.
Franklin	W	W	Sand and gravel, stone.
Fulton	110	W	Do.
Genesee	4,002	W	Stone, sand and gravel, gypsum, natural gas.
Greene	32,582	W	Cement, stone, sand and gravel.
Herkimer	W	W	Stone, sand and gravel.
Jefferson	W	1,406	Do.
Lewis	W	517	Do.
Livingston	W	W	Salt, sand and gravel, stone, natural gas.
Madison	W	W	Stone, natural gas, sand and gravel.
Monroe	W	W	Stone, sand and gravel, natural gas.
Montgomery	1,631	W	Stone, sand and gravel.
Nassau	W	W	Sand and gravel, clays.
Niagara	W	4,536	Stone.
Oneida	W	W	Stone, sand and gravel.
Onondaga	28,673	29,587	Lime, stone, cement, salt, sand and gravel, clays.
Ontario	2,716	W	Sand and gravel, stone, natural gas.
Orange	W	W	Sand and gravel, stone, peat.
Orleans	W	W	Stone, sand and gravel.
Oswego	1,081	709	Sand and gravel.
Otsego	379	W	Do.
Putnam	W	W	Stone, sand and gravel.
Rensselaer	W	W	Do.
Richmond	W	W	Sand and gravel.
Rockland	W	5,268	Stone, sand and gravel.
St. Lawrence	91,380	81,186	Zinc, iron ore, stone, talc, lead, sand and gravel, silver, mercury.
Saratoga	1,888	2,372	Stone, sand and gravel.
Schenectady	W	728	Sand and gravel.
Schoharie	6,783	W	Cement, stone, clays, sand and gravel.
Schuyler	W	W	Salt, sand and gravel.
Seneca	W	W	Stone, natural gas, sand and gravel, peat.
Steuben	3,335	3,930	Natural gas, sand and gravel, stone, petroleum.
Suffolk	6,749	4,179	Sand and gravel.
Sullivan	W	W	Stone, sand and gravel.
Tioga	1,310	1,932	Sand and gravel.
Tompkins	8,067	W	Salt, stone, sand and gravel.
Ulster	26,112	W	Cement, stone, clays, sand and gravel.
Warren	10,683	9,178	Cement, garnet, stone, sand and gravel.
Washington	1,248	1,254	Stone, sand and gravel.
Wayne	W	W	Do.
Westchester	126	388	Emery, stone, peat, sand and gravel.
Wyoming	W	W	Salt, natural gas.
Yates	W	W	Salt, sand and gravel.
Undistributed <sup>3</sup>	126,029	178,830	
Total <sup>4</sup>	440,573	397,728	

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

<sup>1</sup> Bronx, Hamilton, Kings, New York, and Queens Counties are not listed because no production was reported.

<sup>2</sup> Value of petroleum and natural gas is based on an average price per barrel and cubic foot, respectively, for the State.

<sup>3</sup> Includes gem stones, sand and gravel (1974) that cannot be assigned to specific counties, and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New York business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	7,547.0	7,668.0	+1.6
Unemployment -----do-----	482.0	730.0	+51.5
<b>Employment (nonagricultural):</b>			
Mining -----do-----	7.5	7.4	-1.3
Manufacturing -----do-----	1,573.9	1,407.1	-10.6
Contract construction -----do-----	257.6	202.4	-21.4
Transportation and public utilities -----do-----	456.9	432.5	-5.3
Wholesale and retail trade -----do-----	1,441.7	1,395.8	-3.2
Finance, insurance, real estate -----do-----	584.5	580.0	-.8
Services -----do-----	1,449.6	1,439.6	-.7
Government -----do-----	1,298.6	1,326.2	+2.1
Total nonagricultural employment -----do-----	7,070.2	6,791.1	-3.9
<b>Personal income:</b>			
Total -----millions--	\$110,784	\$118,958	+7.4
Per capita -----do-----	\$6,120	\$6,564	+7.3
<b>Construction activity:</b>			
Number of private and public residential units authorized -	48,729	30,761	-36.9
Value of nonresidential construction -----millions--	\$746.6	\$626.4	-16.1
Value of State road contract awards -----do-----	\$320.0	\$201.0	-37.2
Shipments of portland and masonry cement to and within New York -----thousand short tons--	3,595	2,663	-25.9
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$440.6	\$397.7	-9.7
Value per capita, resident population -----do-----	\$24.34	\$22.00	-9.6
Value per square mile -----do-----	\$8,886.82	\$8,022.59	-9.7

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

**Employment and Injuries.**—Total employment in New York State in December 1975 was 6,820,600. The unemployment rate was 10.3%. A comparison of total nonagricultural employment in the State, in thousands, by various sectors follows:

	1975	
	Janu- ary	Decem- ber
<b>Manufacturing</b> -----	1,426.4	1,387.8
Durable goods -----	732.4	692.1
Stone, clay and glass -	38.7	36.4
Primary metals -----	66.4	58.6
Other durables -----	627.3	597.1
Nondurable goods -----	694.0	695.7
Chemicals -----	74.8	73.4
Rubber and plastic products -----	23.9	24.1
Other nondurables -----	595.3	598.2
<b>Nonmanufacturing</b> -----	5,365.9	5,372.7
Mining -----	7.0	7.2
Other industries and services -----	5,359.0	5,365.6
<b>Total employment</b> -----	6,792.3	6,760.5

Source: New York State Department of Labor.

**Legislation and Government Programs.**—The State legislature delayed, for 1 year, implementation of a law requiring operators of strip and open pit mines, mining 1,000 tons or more in 12 successive months, to obtain a permit from the Department of Environmental Conservation. In applying for the permit, the company must submit a mining and reclamation plan outlining the mining sequence and the method proposed to restore the land to a reasonably attractive and useful site when mining is terminated. Administrative problems, both in industry and the State, resulted in requests to the legislature for a delay in implementation.

The State Power Authority's first nuclear power facility began commercial operation in July. Studies financed by the State and Federal Government emphasized the benefits to be obtained by utilizing garbage as a source of energy in New York.

## REVIEW BY MINERAL COMMODITIES

## NONMETALS

**Abrasives, Manufactured.**—Metal abrasives consisting of steel shot and grit, and cut wire shot, were produced by Cleveland Metal Abrasive Co., div. of Fanner Manufacturing Co., and Pellets, Inc., in Erie County.

The General Abrasive Co., div. of U.S. Industries, Inc., in Niagara County operated electric furnaces for producing fused aluminum oxide and silicon carbide. The finished product was used in abrasives and in refractories and other nonabrasives.

**Calcium Chloride.**—Allied Chemical Corp. produced calcium chloride at Onondaga as a byproduct of the manufacture of soda ash. Output decreased 1% from that of 1974, and was 12% below the 1968 record.

**Cement.**—Shipments of all types of cement decreased about 24% in quantity and 23% in value from those of 1974. Cement continued to rank first in value among the State's mineral industries. Portland cement accounted for 98% of the cement value. The average price of portland and masonry cement was \$26 and \$28 per ton, respectively.

Nine companies were in operation, of which eight were in eastern and one in western New York. Five plants produced both portland and masonry cement, and four plants produced portland cement exclusively. Cement production was from seven counties; in quantity, Albany County ranked first, followed by Ulster, Greene, Columbia, Schoharie, Warren, and Onondaga Counties.

**Clays.**—Total production of common and shale clays in 1975 was 817,000 short tons valued at \$1.6 million. Common clay was mined in Albany, Broome, Columbia, Erie, Nassau, Onondaga, Schoharie, and Ulster Counties. Clay was used in the manufacture of portland cement, lightweight aggregate, common brick, and pottery, and for abrasive bonding.

**Emery.**—Production was from two open pits, De Luca Emery Mine, Inc., and Emeri Crete, Inc., Westchester County. Uses of emery were mainly as aggregate for heavy-duty nonslip floors and pavements and for general abrasive purposes.

**Garnet.**—Output of abrasive garnet decreased in both quantity and value from

that of 1974. Garnet from the open pit mine operated by Barton Mines Corp. in Warren County was sold for precision uses in coated abrasives, glass grinding and polishing, and metal lapping. Garnet recovered as a byproduct of wollastonite mining by Interpace Corp. in Essex County was sold for use in sandblasting and for general abrasive purposes. New York State ranked second in the production of garnet in 1975.

**Gem Stones.**—The collecting of gem stones and mineral specimens was principally by amateurs. The value of gem stone production was estimated to be \$16,000.

**Graphite, Manufactured.**—Graphite manufactured from petroleum coke and other materials was produced by Great Lakes Carbon Corp., Airco Speer Electronics, Carborundum Metals Co., and Union Carbide Corp. The principal uses were for shapes: Anodes, electrodes, electric motor brushes, crucibles, and other refractories. Synthetic graphite powder was used in steelmaking, as an additive in nonferrous metallurgy, for foundry facings, and in lubricants.

**Gypsum.**—United States Gypsum Co. and National Gypsum Co. mined gypsum in Erie and Genesee Counties. Output declined considerably. During the year, National Gypsum closed its Clarence Center mine. United States Gypsum Co., National Gypsum Co., and Georgia-Pacific Corp. calcined 716,000 tons of gypsum in Bronx, Erie, Genesee, Richmond, Rockland, and Westchester Counties. Output declined 25% and was 42% below the 1973 record. United States Gypsum's Stony Point plant was the third largest calcining plant in the country. Among the States, New York ranked fourth in output of calcined gypsum.

**Lime.**—Two companies, Allied Chemical Corp. and Bethlehem Steel Corp., produced quicklime in Onondaga and Erie Counties for use in alkalies and steel furnaces. Output decreased 9% in quantity but increased 4% in value from that of 1974.

**Mullite, Synthetic.**—The Carborundum Co. produced fused, synthetic mullite at its plant in Niagara County.

**Perlite.**—Crude perlite mined in Western States was expanded at plants of four companies in New York. National Gypsum Co. operated plants in Bronx and Erie Counties; Georgia-Pacific Corp. and Buffalo

**Table 4.—New York: Crude gypsum production**  
(Thousand short tons and thousand dollars)

Year	Active mines	Quantity	Value
1969	4	492	2,945
1970	3	425	2,737
1971	3	415	2,376
1972	3	486	3,079
1973	3	525	3,369
1974	3	364	2,942
1975	2	W	W

W Withheld to avoid disclosing individual company confidential data.

Perlite Corp., in Erie County; and United States Gypsum Co., in Genesee, Richmond, and Rockland Counties. The most important use was in the manufacture of acoustical building plaster. Other uses included loose fill insulation, soil conditioning, lightweight concrete aggregate, and filtration.

**Salt.**—The output of salt decreased 8% in quantity and 1% in value from that of 1974. The overall value per ton increased 7%. Rock salt was produced from one mine each in Livingston, Tompkins, and Yates Counties. Brine was produced in one operation each in Onondaga and Schuyler Counties. Evaporated salt was produced from two operations in Schuyler County and from one operation in Wyoming County.

By tonnage, most evaporated salt was used in food processing and seasoning; another large use was for manufacturing chlorine and other chemicals. The principal use for rock salt was for ice control on highways in the Northeastern States; other important uses were in the chemical and food industries. Brine was used for the

manufacture of soda ash, chlorine, and other chemicals. Salt for chemical manufacture was consumed mainly within the State.

**Table 5.—New York: Salt sold or used by producers**

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1971	5,303	43,601
1972	5,604	43,866
1973	5,202	42,364
1974	6,464	57,705
1975	5,978	57,344

**Sand and Gravel.**—Production of sand and gravel in the State in 1975 was 22.2 million short tons valued at almost \$44.1 million. There were 222 commercial sand and gravel mining operations and many other locations operated by construction companies and governmental operators working on various Federal, State, county and local government contracts. More than 1 million tons each were reported from the following counties: Cattaraugus, Dutchess, Nassau, and Suffolk.

**Table 6.—New York: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand	13,714	21,454	9,210	19,434
Gravel	8,972	18,897	7,128	17,538
Unprocessed:				
Sand and gravel	7,804	5,681	5,685	4,781
Industrial:				
Sand	124	517	124	699
Gravel	W	27	11	33
Total	30,614	46,576	22,158	42,485

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.



**Table 7.—New York: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	10,136	17,960	5,857	15,537
Highway and bridge construction -----	1,246	2,442	782	1,645
Other construction (dams, waterworks, airports, etc.) -----	475	975	241	652
Concrete products (cement blocks, brick, pipe, etc.) -----	2,205	4,268	1,689	3,759
Bituminous paving (asphalt and tar paving) -----	2,222	4,503	1,453	3,644
Road base and subbase -----	1,340	2,018	602	1,307
Fill -----	543	607	507	682
Other -----	406	809	128	267
<b>Unprocessed:</b>				
Road base and subbase -----	1,460	1,477	1,289	1,279
Fill -----	5,403	3,861	2,031	1,906
Other -----	--	--	155	190
<b>Industrial sand and gravel -----</b>	<b>124</b>	<b>544</b>	<b>135</b>	<b>732</b>
<b>Total -----</b>	<b>25,560</b>	<b>39,464</b>	<b>14,869</b>	<b>1 31,598</b>

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Table 8.—New York: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	515	920	329	834
Highway and bridge construction -----	915	1,729	1,860	4,585
Other construction (dams, waterworks, airports, etc.) -----	349	416	142	269
Concrete products (cement blocks, brick, pipe, etc.) -----	255	446	235	505
Bituminous paving (asphalt and tar paving) -----	857	1,642	1,009	2,357
Road base and subbase -----	712	1,066	996	1,585
Fill -----	58	21	140	184
Other -----	451	604	369	657
<b>Unprocessed:</b>				
Road base and subbase -----	659	195	971	603
Fill -----	283	149	1,141	809
Other -----	--	--	97	79
<b>Total -----</b>	<b>5,054</b>	<b>7,188</b>	<b>7,289</b>	<b>12,467</b>

**Stone.**—Stone was the second most valuable mineral commodity produced in the State. Crushed limestone and dolomite, considered together as carbonate rock, were predominate, accounting for 92% of the tonnage and 87% of the value of all stone produced.

The chief uses for crushed limestone were as an aggregate in concrete, macadam, and bituminous materials and for the manufacture of cement and lime. Other uses

were agricultural stone, railroad ballast, asphalt filler, and fluxing stone.

Basalt (traprock) ranked second in quantity of stone production within the State. The chief uses were for road metal and concrete aggregate.

Sandstone, which included quartzite, was quarried as dimension stone and as crushed stone. The chief uses of dimension sandstone were for flagging, curbing, and architectural applications. Crushed

Table 9.—New York: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate .....	8,016	20,338	6,189	17,059
Concrete aggregate .....	4,399	9,586	2,530	6,013
Dense-graded road base stone .....	6,585	14,355	5,564	12,715
Macadam aggregate .....	583	1,316	457	1,126
Surface treatment aggregate .....	1,111	2,986	1,463	3,964
Other construction aggregate and roadstone .....	4,063	9,381	4,549	11,061
Agricultural limestone .....	317	1,490	306	1,491
Cement manufacture <sup>1</sup> .....	7,513	10,093	5,409	8,944
Railroad ballast .....	177	375	175	397
Riprap and jetty stone .....	448	1,034	682	1,870
Other <sup>2</sup> .....	2,015	5,877	1,704	5,618
<b>Total<sup>3</sup> .....</b>	<b>35,229</b>	<b>76,829</b>	<b>29,029</b>	<b>70,258</b>

<sup>1</sup> 1974 data include lime manufacture.

<sup>2</sup> Includes stone used for flux, filter, chemical stone, abrasives, bedding material, drain fields, fill, manufactured fine aggregate, mineral fillers, extenders and whitening, lime manufacture (1975), and uses not specified.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

sandstone was used for concrete aggregate and roadstone. Granite was quarried and dressed mostly for building stone. Crushed granite was used for concrete aggregate, railroad ballast, and road metal.

**Sulfur.**—Ashland Oil, Inc., recovered sulfur at its Buffalo refinery in Erie County in 1975.

**Talc.**—The 1975 output of talc decreased in quantity and in value. Talc was mined at two underground operations and at one open pit by Gouverneur Talc Co., Inc., a subsidiary of the R. T. Vanderbilt Co., Inc., in St. Lawrence County. Crude talc was ground in company-owned mills and used mainly in ceramics and as a mineral filler in paints. Smaller quantities were used as a mineral filler in floor tile, rubber, paper, and other miscellaneous products.

**Vermiculite.**—Crude vermiculite mined in other States was exfoliated at the Construction Products Div. plant of W. R. Grace & Co., Weedsport, Cayuga County. The expanded vermiculite was used for loose fill insulation, soil conditioning, ultralightweight concrete aggregate, and building plaster aggregate.

**Wollastonite.**—The entire U.S. production of crude wollastonite was mined and beneficiated at the Willsboro mine in Essex County, operated by Interpace Corp. Production in 1975 of refined wollastonite decreased 14% in quantity, and value increased 2% above the 1974 level. The refined product was used as an ingredient in ceramic products and as a filler in plastics and paints.

## METALS

**Aluminum.**—Production of primary aluminum from the Massena plants, in St. Lawrence County, of Aluminum Company of America (Alcoa) and Reynolds Metals Co. increased 10% in value with a 14% decrease in output from that of 1974. Upon completion of Alcoa's \$60 million expansion program in mid-1976, the capacity at its Massena facility will be increased to 190,000 short tons of primary aluminum metal.

**Iron Ore.**—Shipments of usable ore to consumers decreased 15% in quantity and 9% in value from those of 1974. The entire production was from two open pit operations, Jones & Laughlin Steel Corp. in St. Lawrence County and NL Industries, Inc., in Essex County, as a coproduct of ilmenite production. All of the ore was beneficiated, and most of the concentrates were agglomerated before shipment. Principal uses for the shipments were in the manufacture of pig iron and steel, and some was used in manufacturing cement, for heavy-media separation and for ballast.

**Lead.**—Lead was recovered as a by-product of zinc mining at the Balmat and Edwards mines of St. Joe Minerals Corp., in St. Lawrence County. Lead recovery varies from year to year, depending on the proportion of ore coming from the section of the mine where the vein has a higher lead content. The lead concentrates are shipped to the company lead smelter at Herculeum, Mo.

Table 10.—New York: Mine production (recoverable) of silver, lead, and zinc

	1973	1974	1975
Mines producing: Lode -----	2	2	2
Material sold or treated: Zinc ore -----thousand short tons--	1,094	1,232	1,247
Production (recoverable):			
Quantity:			
Silver -----troy ounces--	54,345	64,463	56,047
Lead -----short tons--	2,304	3,076	3,027
Zinc -----do-----	81,455	93,077	76,612
Value:			
Silver -----thousands--	\$139	\$304	\$248
Lead -----do-----	751	1,384	1,302
Zinc -----do-----	33,657	66,829	59,757
Total -----do-----	34,547	68,517	1 61,306

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Mercury.**—Mercury, a byproduct at the Balmat and Edwards zinc mines of St. Joe Minerals Corp., was recovered in the company smelter in Monaca, Pa.

**Silver.**—The quantity of silver recovered from lead concentrate from the Balmat and Edwards mines of St. Joe Minerals Corp. was 13% less than that of 1974, and the value decreased 18%. Silver recovery usually reflects the demands for silver-free lead, rather than the silver content of the concentrate.

**Titanium Concentrate (Ilmenite).**—Ilmenite concentrate was produced by NL Industries, Inc., in Essex County, as a co-product from the Tahawus titaniferous magnetite deposit. Shipments and value were, respectively, 2% and 31% above 1974 levels. The output was used principally in the manufacture of titanium dioxide pigments.

**Zinc.**—New York ranked second to Tennessee as a zinc producer in both quantity and value. The entire production in the State was from the Balmat and Edwards mines of the St. Joe Minerals Corp. in St. Lawrence County. The Balmat and Edwards complex is the largest single zinc mining operation in the United States.

#### MINERAL FUELS

**Natural Gas.**—The production of natural gas in 1975 increased 53% over that of 1974. The quantity and value of natural gas produced in the State for 1971–75 follow:

Year	Quantity <sup>1</sup> (million cubic feet)	Value (thousand dollars)
1971 -----	2,202	661
1972 -----	3,679	1,199
1973 -----	4,539	1,590
1974 -----	4,990	2,745
1975 -----	7,628	5,645

<sup>1</sup> Marketed production of natural gas represents gross withdrawals less gas used for repressuring and quantities vented and flared.

An increase in drilling for the account of industrial users was noted during the year when utility supplies were reduced. Proved new wells were nearly three times the number developed in 1974. A total of 227 new gas wells were proved, versus only 79 in 1974.

**Peat.**—Sales of peat in 1975 totaled 22,000 short tons, valued at \$377,000. Peat was used mainly for horticultural use. Orange County was the leading producing area, followed by Westchester, Cattaraugus, and Seneca Counties.

**Petroleum.**—Crude oil production in the State was 875,000 barrels, compared with 896,000 barrels in 1974. The value of crude oil produced was \$10.7 million, compared with \$9.5 million in 1974. The number of oil wells proved in 1975 was 12 less than in 1974. Cattaraugus was the leading oil producing county, followed by Allegany, Chautauqua, and Steuben Counties.

At yearend, there were 4,975 producing wells, compared with 5,475 wells at the end of 1974.

Table 11.—New York: Oil and gas well drilling in 1975, by county

County	Proved field wells <sup>1</sup>			Exploratory			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Allegany -----	60	--	--	--	1	--	61	74,543
Cattaraugus -----	43	4	1	1	2	2	53	97,986
Cayuga -----	--	7	--	--	--	--	7	14,617
Chautauqua -----	31	194	3	--	3	1	232	622,665
Erie -----	--	12	1	--	2	--	15	29,857
Genesee -----	--	8	--	--	1	--	9	12,187
Livingston -----	--	--	--	--	--	1	1	3,150
Ontario -----	--	--	--	--	--	1	1	2,120
Steuben -----	7	--	--	--	--	4	11	23,760
Wyoming -----	--	2	--	--	--	2	4	13,190
Total -----	141	227	5	1	9	11	394	894,075

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Abrasives:</b>			
The Carborundum Co -----	Box 423 Niagara Falls, N.Y. 14302	Plant -----	Niagara.
Cleveland Metal Abrasives Co. div. of Fanner Manufacturing Co. -----	Brookside Park Cleveland, Ohio 44109	----do -----	Erie.
General Abrasives Co., div. of U.S. Industries Inc. -----	2100 College Ave. Niagara Falls, N.Y. 14302	----do -----	Niagara.
Pellets, Inc -----	531 South Niagara St. Tonawanda, N.Y. 14150	----do -----	Erie.
<b>Aluminum, smelters:</b>			
Aluminum Company of America (Alcoa). -----	1210 Alcoa Bldg. Pittsburgh, Pa. 15222	----do -----	St. Lawrence.
Reynolds Metals Co -----	Box 27003-2A Richmond, Va. 23215	----do -----	Do.
<b>Cement:</b>			
Alpha Portland Cement Co. <sup>1</sup> -----	15 South 3d St. Easton, Pa. 18043	----do -----	Greene.
Flintkote Co. <sup>2</sup> -----	400 Westchester Ave. White Plains, N.Y. 10604	----do -----	Warren.
Lehigh Portland Cement Co. <sup>2</sup> -----	718 Hamilton St. Allentown, Pa. 18105	----do -----	Greene.
Marquette Cement Manufac- turing Co. <sup>1,2</sup> -----	20 North Wacker Dr. Chicago, Ill. 60606	----do -----	Do.
Newmont Mining Corp. <sup>1,2</sup> -----	Box 30 Stamford, Conn. 06904	----do -----	Albany.
United States Steel Corp. <sup>1,2</sup> -----	600 Grant St. Pittsburgh, Pa. 15230	----do -----	Columbia.
<b>Clays:</b>			
Lone Star Industries, Inc. <sup>1</sup> -----	1 Greenwich Plaza Greenwich, Conn. 06830	Pits -----	Ulster.
Nassau Brick Co., Inc -----	635 Round Swamp Rd. Long Island, N.Y. 11804	----do -----	Nassau.
Norlite Corp -----	628 South Saratoga St. Cohoes, N.Y. 12047	----do -----	Albany.
Emery: De Luca Emery Mine, Inc. -----	926 Constant Ave. Peekskill, N.Y. 10566	Pit -----	Westchester.
Garnet: Barton Mines Corp -----	North Creek, N.Y. 12853	Pit -----	Warren.
<b>Gypsum:</b>			
Georgia-Pacific Corp. <sup>3</sup> -----	Box 311 Portland, Ore. 97207	Underground mine and plant.	Erie and Westchester.
National Gypsum Co. <sup>3,4</sup> -----	325 Delaware Ave. Buffalo, N.Y. 14202	----do -----	Bronx and Erie.
United States Gypsum Co. <sup>3</sup> -----	101 South Wacker Dr. Chicago, Ill. 60606	----do -----	Genesee, Richmond, Rockland.
<b>Iron ore:</b>			
Jones & Laughlin Steel Corp -----	Star Lake, N.Y. 13690	Pit -----	St. Lawrence.
NL Industries, Inc. <sup>5</sup> -----	Tahawus, N.Y. 12879	Pit -----	Essex.
<b>Lime:</b>			
Allied Chemical Corp. <sup>1,6</sup> -----	Box 70 Morristown, N.J. 07960	Plant -----	Onondaga.
Bethlehem Steel Corp -----	701 East 3d St. Bethlehem, Pa. 18016	----do -----	Erie.

See footnotes at end of table.

Table 12.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Peat:</b>			
Anderson Peat Co., Inc -----	Pleasant Hill Rd. Wingdale, N.Y. 12594	Bog -----	Dutchess.
Sterling Forest Peat Co., Inc --	Box 608 Tuxedo, N.Y. 10987	Bog -----	Orange.
<b>Petroleum:</b>			
Ashland Oil & Refining Co. <sup>1</sup> --	Tonawanda, N.Y. 14150 --	Refineries -----	Erie.
Mobil Oil Corp -----	Buffalo, N.Y. 14221 -----	do -----	Do.
<b>Salt:</b>			
Cargill, Inc -----	1620 Northstar Center Minneapolis, Minn. 55402	Underground mine.	Tompkins.
International Salt Co -----	Clarks Summit, Pa. 18411	do -----	Livingston.
Morton Salt Co -----	110 North Wacker Dr. Chicago, Ill. 60606	Well -----	Wyoming.
Watkins Salt Co., Inc -----	Box 150 Watkins Glen, N.Y. 14891	do -----	Schuyler.
<b>Sand and gravel:</b>			
Albany Gravel Co -----	North Pearl St. & Loudonville Albany, N.Y. 12201	Pit -----	Albany and Rensselaer.
Buffalo Slag Co -----	111 Great Arrow Ave. Buffalo, N.Y. 14216	Plants -----	Allegany, Cattaraugus, Steuben.
Colonial Sand & Stone Co., Inc. <sup>1 2 4 7</sup>	1740 Broadway New York, N.Y. 10019	Pit -----	Dutchess and Nassau.
General Crushed Stone Co ----	712 Drake Bldg. Easton, Pa. 18042	Pit -----	Cattaraugus and Chemung.
Keyway Mason Supply Corp --	25 Montclair Ave. St. James, N.Y. 11780	Pit -----	Suffolk.
Roanoke Marbro Sand & Gravel Corp.	Box 172 Riverhead, Long Island, N.Y. 11901	Pit -----	Do.
<b>Stone:</b>			
The Callanan Road Improve- ment Co.	South Bethlehem, N.Y. 12161	Quarry -----	Albany and Ulster.
Dolomite Products Co. <sup>8</sup> -----	1150 Penfield Rd. Rochester, N.Y. 14625	do -----	Monroe.
General Crushed Stone Co ----	712 Drake Bldg. Easton, Pa. 18042	do -----	Genesee, Herkimer, Jefferson, Livingston, Onondaga, Ontario, Wayne.
Martin-Marietta Corp. <sup>4</sup> -----	Box 120 Mercersburg, Pa. 17236	do -----	Rockland.
Talc: Gouverneur Talc Co., Inc --	Gouverneur, N.Y. 13642 --	Underground ---	St. Lawrence.
Wollastonite: Interpace Corp. <sup>9</sup> ----	Willsboro, N.Y. 12996 ----	do -----	Essex.
Zinc: St. Joe Minerals Corp. <sup>10</sup> ----	250 Park Ave. New York, N.Y. 10017	Mine -----	St. Lawrence.

<sup>1</sup> Also stone.<sup>2</sup> Also clays.<sup>3</sup> Also expanded perlite.<sup>4</sup> Also lime.<sup>5</sup> Also titanium concentrates (ilmenite).<sup>6</sup> Also salt.<sup>7</sup> Also cement.<sup>8</sup> Also sand and gravel.<sup>9</sup> Also garnet.<sup>10</sup> Also silver and lead.

# 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 Division of Resource Planning and Evaluation, North Carolina Department of Natural and Economic Resources, for collecting information on all minerals except fuels.

By Lawrence E. Shirley<sup>1</sup> and Eldon P. Allen<sup>2</sup>

North Carolina led the Nation in the production of feldspar, lithium minerals, mica, and olivine. The State also continued to lead the Nation in brick production, as it has since 1962.

The economy of the State, as well as the Southeast and the entire Nation, was generally downward during the first half of 1975. Decreases in building and construction activity caused a reduced demand for mineral products, particularly those bulk commodities such as crushed stone, cement, sand and gravel, clays, and other commodities closely associated with the construction industry. However, in the last half of the year the economy began to show signs of recovery.

Total mineral production value in North Carolina in 1975 was \$152.9 million, a decrease of 2% below that of 1974, a record year. The year 1975 showed the first value decrease in mineral production since 1963.

Stone was the leading mineral commodity produced, accounting for 45% of the total mineral production value, followed by phosphate rock and lithium minerals, sand and gravel, and cement. These five commodities accounted for 87% of the total mineral production value.

Leading mineral producing companies based on value of mineral production and listed alphabetically were Ideal Basic Industries, Inc. (cement), Martin Marietta Corp., Southeast Division (crushed stone), Nello L. Teer Co. (crushed stone), Texas-

gulf, Inc. (phosphate rock), and Vulcan Materials Co., Mideast Division (crushed stone).

**Legislation and Government Programs.**—The Division of Resource Planning and Evaluation, Department of Natural and Economic Resources, through its Mineral Resources Section continued an active program of geologic and mineral resources investigations throughout the State. The Mineral Resources Section published the results of several important studies including a guide for regional mineral resource development and land use planning,<sup>3</sup> a bibliography of North Carolina geology,<sup>4</sup> and a bibliography of North Carolina's coastal plain, coastal zone, and Continental Shelf.<sup>5</sup>

<sup>1</sup> State Liaison Officer, Bureau of Mines, Raleigh, N.C.

<sup>2</sup> Chief, Mineral Resources Section, Division of Resource Planning and Evaluation, North Carolina Department of Natural and Economic Resources.

<sup>3</sup> Wilson, W. F., and P. A. Carpenter. *Region J Geology: A Guide for North Carolina Mineral Resource Development and Land Use Planning*. N.C. Dept. of Nat. and Econ. Res., Div. of Res. Planning and Evaluation, Min. Res. Sec., Reg. Ge. Ser. 1, 1975, 76 pp.

<sup>4</sup> Wilson, W. F. *Bibliography of North Carolina Geology, 1910-1960*. N.C. Dept. of Nat. and Econ. Res., Div. of Res. Planning and Evaluation, Min. Res. Sec., Bull. 82, 1975, 87 pp.

<sup>5</sup> Riggs, S. R., and M. P. O'Connor. *Geological Bibliography of North Carolina's Coastal Plain, Coastal Zone, and Continental Shelf*. Univ. of N.C. Sea Grant Pub. UNC-SG-75-13, N.C. Dept. of Nat. and Econ. Res., Div. of Res. Planning and Evaluation, Min. Res. Sec., Bull. 83, June 1975, 141 pp.

Table 1.—Mineral production in North Carolina <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays <sup>2</sup> -----thousand short tons--	3,422	\$4,648	2,582	\$4,094
Feldspar -----short tons--	650,684	11,147	483,401	8,070
Gem stones -----	NA	50	NA	50
Mica, scrap -----thousand short tons--	76	3,679	75	3,265
Mica, sheet -----pounds--	W	W	5,000	2
Sand and gravel -----thousand short tons--	12,784	20,844	8,169	15,610
Stone -----do--	34,762	75,142	28,308	69,327
Talc and pyrophyllite -----short tons--	110,978	993	58,514	985
Value of items that cannot be disclosed:				
Asbestos, cement, clay (kaolin), iron ore (1974), lithium minerals, olivine, and phosphate rock, and values indicated by symbol				
W -----	XX	<sup>r</sup> 39,358	XX	51,477
Total -----	XX	<sup>r</sup> 155,861	XX	152,880
Total 1967 constant dollars -----	XX	73,691	XX	<sup>p</sup> 60,540

<sup>p</sup> Preliminary. <sup>r</sup> 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.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes kaolin; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in North Carolina, by county <sup>1</sup>

(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Alamance -----	W	W	Stone, clays, sand and gravel, talc.
Anson -----	W	W	Sand and gravel, stone.
Ashe -----	W	W	Stone.
Avery -----	\$2,400	\$3,052	Mica, olivine, clays, stone, sand and gravel.
Beaufort -----	W	W	Phosphate rock, sand and gravel.
Bertie -----	221	164	Sand and gravel.
Bladen -----	W	W	Do.
Brunswick -----	W	W	Stone.
Buncombe -----	3,153	W	Stone, sand and gravel, clays.
Burke -----	W	W	Stone, sand and gravel.
Cabarrus -----	861	W	Stone, sand and gravel, clays.
Caldwell -----	752	W	Stone, sand and gravel.
Camden -----	7	W	Sand and gravel.
Caswell -----	W	W	Stone.
Catawba -----	W	W	Stone, sand and gravel.
Chatham -----	W	W	Clays, stone.
Cherokee -----	W	W	Talc, stone.
Chowan -----	1	1	Sand and gravel.
Cleveland -----	10,946	12,501	Lithium minerals, stone, feldspar, mica, sand and gravel, clays.
Craven -----	3,317	W	Stone, sand and gravel.
Cumberland -----	937	696	Sand and gravel, clays.
Currituck -----	--	W	Sand and gravel.
Davidson -----	W	W	Stone, clays, sand and gravel.
Davie -----	W	W	Stone, sand and gravel.
Duplin -----	W	W	Do.
Durham -----	W	W	Stone, clays.
Edgecombe -----	412	W	Stone, sand and gravel.
Forsyth -----	W	W	Stone.
Franklin -----	117	126	Sand and gravel.
Gaston -----	6,629	11,340	Lithium minerals, stone, feldspar, sand and gravel.
Granville -----	W	W	Talc.
Greene -----	W	W	Sand and gravel.
Guilford -----	W	4,991	Stone, clays, sand and gravel.
Halifax -----	W	W	Clays.
Harnett -----	W	W	Sand and gravel, clays.
Haywood -----	W	W	Stone.
Henderson -----	W	W	Stone, clays.
Hertford -----	W	W	Sand and gravel.
Hyde -----	3	2	Do.

See footnotes at end of table.

Table 2.—Value of mineral production in North Carolina, by county <sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Iredell	W	W	Stone, clays.
Jackson	W	W	Stone, sand and gravel.
Johnston	W	W	Do.
Jones	\$708	\$317	Do.
Lee	W	W	Stone, clays, sand and gravel.
Lenoir	W	W	Sand and gravel.
McDowell	672	524	Do.
Macon	W	W	Stone, sand and gravel.
Madison	W	--	
Martin	2	8	Sand and gravel.
Mecklenburg	W	W	Stone.
Mitchell	8,216	6,592	Feldspar, mica, stone, clays.
Montgomery	W	283	Stone, sand and gravel, clays.
Moore	W	W	Sand and gravel, talc, clays.
Nash	W	W	Stone.
New Hanover	18,810	14,179	Cement, stone, clays, sand and gravel.
Northampton	73	37	Sand and gravel.
Onslow	1,141	W	Stone, sand and gravel.
Orange	W	W	Stone, talc, sand and gravel, mica.
Pasquotank	25	41	Sand and gravel.
Pitt	W	W	Stone, sand and gravel.
Polk	--	W	Stone.
Randolph	W	W	Do.
Richmond	W	W	Stone, sand and gravel.
Robeson	185	18	Sand and gravel.
Rockingham	W	W	Stone, clays, sand and gravel.
Rowan	2,171	W	Do.
Rutherford	W	W	Stone, sand and gravel.
Sampson	W	W	Sand and gravel, clays.
Scotland	W	W	Sand and gravel.
Stanly	536	373	Clays.
Stokes	93	W	Stone, clays.
Surry	4,332	W	Stone, sand and gravel.
Swain	W	W	Do.
Transylvania	W	W	Do.
Tyrrell	1	--	
Union	W	W	Stone, clays.
Vance	W	W	Stone.
Wake	W	4,278	Stone, sand and gravel.
Washington	9	13	Sand and gravel.
Watauga	W	523	Stone.
Wayne	335	222	Sand and gravel.
Wilkes	W	W	Stone, sand and gravel.
Wilson	W	W	Do.
Yadkin	W	W	Sand and gravel, stone.
Yancey	1,845	1,963	Olivine, mica, sand and gravel, asbestos.
Undistributed <sup>2</sup>	r 87,460	90,635	
Total <sup>3</sup>	r 155,861	152,880	

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

<sup>1</sup> The following counties are not listed because no production was reported: Alexander, Alleghany, Carteret, Clay, Columbus, Dare, Gates, Graham, Hoke, Lincoln, Pamlico, Pender, Perquimans, Person, and Warren.

<sup>2</sup> Includes gem stones and mica that cannot be assigned to specific counties, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.



Table 3.—Indicators of North Carolina business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	2,453.0	2,511.0	+2.4
Unemployment -----do-----	111.0	217.0	+95.5
<b>Employment (nonagricultural):</b>			
Mining -----do-----	4.2	3.9	-7.1
Manufacturing -----do-----	795.2	736.5	-7.4
Contract construction -----do-----	121.5	116.4	-4.2
Transportation and public utilities -----do-----	104.1	99.8	-4.1
Wholesale and retail trade -----do-----	376.1	373.4	-7
Finance, insurance, and real estate -----do-----	86.6	86.4	-.2
Services -----do-----	260.9	265.6	+1.8
Government -----do-----	298.8	314.3	+5.2
Total nonagricultural employment -----do-----	2,047.4	1,996.3	-2.5
<b>Personal income:</b>			
Total -----millions--	\$24,990	\$26,995	+8.0
Per capita -----do-----	\$4,649	\$4,952	+6.5
<b>Construction activity:</b>			
Number of private and public residential units authorized	22,172	20,893	-5.8
Value of nonresidential construction -----millions--	\$341.7	\$238.6	-30.2
Value of State road contract awards -----do-----	\$179.0	\$275.0	+53.6
Shipments of portland and masonry cement to and within North Carolina -----thousand short tons--	1,955	1,551	-20.7
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$155.9	\$152.9	-1.9
Value per capita, resident population -----do-----	\$29.00	\$28.10	-3.1
Value per square mile -----do-----	\$2,964.08	\$2,907.24	-1.9

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

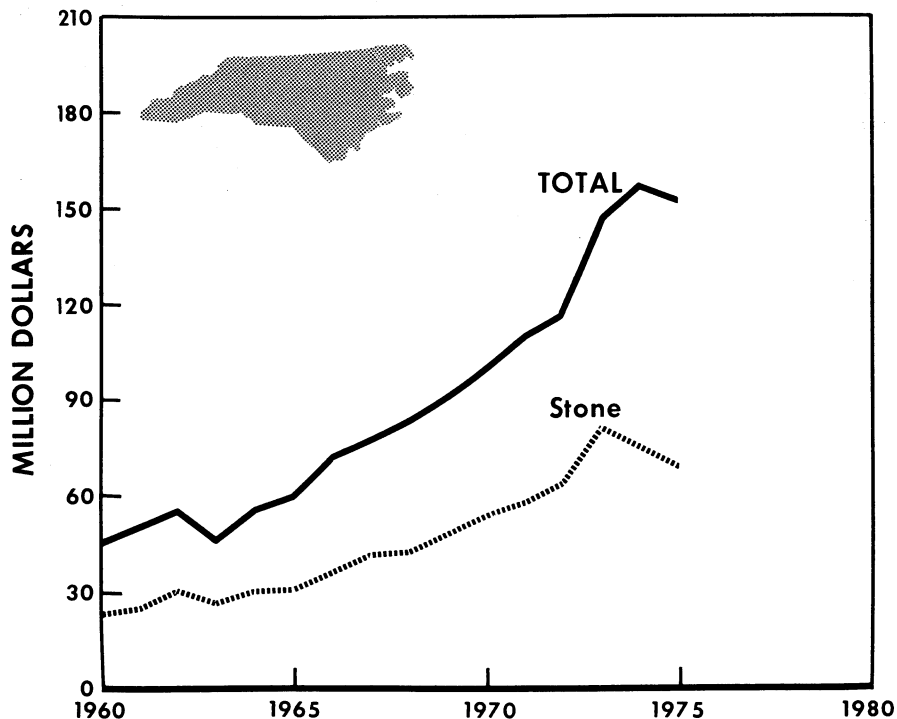


Figure 1.—Value of stone and total value of mineral production in North Carolina.

A list of publications describing reports by the Mineral Resources Section during 1975 was released.<sup>6</sup> A report describing the topography, geology, and mineral resources of North Carolina was published.<sup>7</sup> An addition to the geologic map series was also completed.<sup>8</sup>

A map locating North Carolina's exploratory oil wells accompanied by a list of available information was also published.<sup>9</sup>

The program by the Division of Resource Planning and Evaluation to provide detailed uniform-scale maps for all of North Carolina was significantly advanced during 1975 in both 7½-minute topographic and orthophotoquad coverage. At the present production rate of approximately 5% newly published topographic mapping each year, completion of coverage is scheduled for 1984. In view of the critical

and immediate need for interim base maps for plotting the resource data essential for wise land use planning, particularly in the coastal areas of eastern North Carolina, orthophotoquad mapping was authorized. Over 440 of the 955 quadrangles proposed under the program had been completed by yearend.

The Land Quality Section of the North Carolina Division of Environmental Management at the end of its fiscal year had conducted 800 mine inspections, had 452 mining operations under permit, and had total bonded acreage of 10,753 acres. Total acres disturbed during the year were 879 and total acres reclaimed at active mines were 475. A breakdown of the number of mines, annual acres affected, and acres reclaimed follows:

Commodity	Number of mines	Annual acres affected	Acres reclaimed
Sand and gravel -----	231	521	288
Crushed stone -----	100	155	83
Industrial minerals -----	38	108	49
Clay and shale -----	44	74	44
Dimension stone -----	19	6	1
Gem stones -----	20	15	10

In 1975, the North Carolina General Assembly enacted the Mine Safety and Health Act of North Carolina to become effective on January 1, 1976. This Act provided the necessary basis for the North Carolina Department of Labor to participate in a State Plan Agreement with the Mining Enforcement and Safety Administration (MESA), an agency of the U.S. Department of the Interior. At yearend a formal application for an agreement had been filed with MESA and was under review. Under the agreements, the States are given authority to issue notices of violations and withdrawal orders, or otherwise enforce health and safety standards. The States are required, under the agreements, to inspect all underground mines at least four times, and each underground gassy mine a minimum of five times annually. All active surface mines must be inspected at least once a year.

Minerals research in North Carolina was conducted in cooperation with the State's mineral industry by the Asheville Minerals Research Laboratory of North Carolina State University at Asheville. During the year the Asheville Laboratory conducted sponsored research or regular projects on

mica, phosphate, glass sand, kyanite, feldspar, spodumene, soapstone, olivine, and pyrophyllite. Studies were also made on mineral fillers for plastics, heavy minerals from phosphate tailings, and disposal of sand and gravel plant slimes. One of the reports published by the Asheville Laboratory concerned the flotation of spodumene from North Carolina ores.<sup>10</sup> The ball milling process resulting from this research was adopted by one North Carolina spodumene producer.

<sup>6</sup> North Carolina Division of Resource Planning and Evaluation. List of Publications of the Mineral Resources Section. Jan. 1, 1976, 8 pp.

<sup>7</sup> Allen, E. P. (rev. by). An Introduction to the Topography, Geology and Mineral Resources of North Carolina. N.C. Dept. of Nat. and Econ. Res., Div. of Res. Planning and Evaluation, Min. Res. Sec., Educational ser. 2, 1975, 20 pp.

<sup>8</sup> Wilson, W. F. Geology of the Winstead Quadrangle, North Carolina. N.C. Dept. of Nat. and Econ. Res., Div. of Res. Planning and Evaluation, Min. Res. Sec., Geologic map, ser. 2, 1975.

<sup>9</sup> North Carolina Division of Resource Planning and Evaluation, Mineral Resources Section. Map of North Carolina Exploratory Oil Wells, With List of Available Information—1975. 26 pp.

<sup>10</sup> Redeker, I. H. Flotation of Fine Ball Mill Ground Spodumene From North Carolina Ores. N.C. State Univ., School of Eng., Miner. Res. Lab., Rept. MRL-5, March 1975, 38 pp.

The Federal Bureau of Mines maintains a Liaison Office in Raleigh. The Office works closely with State Government and industry to supply mineral resource data and facilitate coordination and exchange of information at the local level.

**Trends and Developments.**—Industrial development in North Carolina in 1975 followed the national economic trend which was generally downward compared with recent years. During the first 4 months of 1975, the recession came to an end and after that period industrial production began a steady climb upward. According to the Economic Development Division of the North Carolina Department of Natural and Economic Resources, total capital investments in new and expanded industry in the State in 1975 amounted to \$701.3 million. This total came from 116 new plants and 219 expansions of existing plants. New industrial jobs created during 1975 totaled 18,590. The total investment figure for 1975 amounted to approximately 82% of the total for the State during 1974; investments during 1974 had been the highest on record for a calendar year. Foreign investments in North Carolina during 1975 contributed to industrial development in the State. While most of the new industry decisions were by American firms, the State was chosen for location by several foreign companies. The number of new foreign industrial prospects added measurably to active plant location investigations that took place in the State during the year.

The rise in the number of overseas firms looking at North Carolina can be traced to several occurrences in 1975, notably the opening of the Düsseldorf, West Germany, office of the North Carolina Economic Development Division in September. This outpost in Europe, with the contacts being made with the European business community, was quite effective in directing expanding industry in several nations to investigate North Carolina in their site searching in the United States.

North Carolina's two ports at Wilmington and Morehead City are a barometer of the region's economy. The growth of the two public port terminals since their construction 25 years ago parallels the industrial growth of the Southeast. During 1975 more than 600 ships called at the two ports and some 27 million tons of cargo moved through the ports requiring nearly

49,000 trucks and 10,000 railcars to transport the cargo to and from the ports. The State terminal at Wilmington consists of a 6,040-foot general cargo pier that can handle up to nine cargo ships and one tanker berth and has four mobile gantry cranes, the largest of which can handle 225 tons. In addition, there are several private petroleum company docks along the Cape Fear River at Wilmington and several industries also have private terminals.

The Morehead City State Port has 5,300 feet of dock that can handle eight ships and has two 125-ton capacity gantry cranes. According to the North Carolina State Ports Authority nearly 112,000 tons of phosphate rock and over 82,000 tons of phosphoric acid were exported through the Morehead City port, out of 518,000 tons of total exports. Imports through the Wilmington Port included carbon electrodes, cement, liquid nitrogen, marble, slate and stone, scrap iron or steel, structural steel, titanium dioxide, and many other mineral products. Exports included aluminum billets, bricks, copper bar, fertilizers, lithium carbonate, mica, mica schist, ochres, titanium dioxide, and many other mineral products.

During the year North Carolina began investigating the possibility of developing deepwater ports within the State. One of the studies examined and discussed in detail several existing North Carolina State statutes which do or may apply to deepwater ports; the involvement of local governmental authorities was also considered.<sup>11</sup>

Reflecting the general slowdown in the economy during the year, commercial sales of electrical power to industry lagged behind those of 1974. The principal suppliers of electrical power in North Carolina continued new construction and development in the State in an attempt to supply the everincreasing demands for this source of energy. Duke Power Co. completed Unit 2 of the Belews Creek Steam Station and placed it in commercial operation on December 13, 1975. The completed station is rated at 2,200,000 kilowatts, making it the largest coal-fired generating station in the Duke system. At yearend

<sup>11</sup> Dawson, A. C., III. Deepwater Port Development in North Carolina: The Legal Context. Univ. of N.C. Sea Grant Pub. UNC-SG-75-08, March 1975, 37 pp. Available from 1235 Burlington Laboratories, N.C.S.U., Raleigh, N.C. 27607.

the total generating capability of Duke Power Co. was 12,361,000 kilowatts. Construction proceeded on Duke's McGuire Nuclear Station and at yearend Unit I was approximately 64% completed and Unit 2 was about 48% completed. The two 1,180,000-kilowatt nuclear units are scheduled for operation in 1978 and 1979.

In 1970, Duke Power Co. organized Eastover Mining Co. and Eastover Land Co. to help assure an adequate supply of coal for the company's coal-fired generating stations. On December 31, 1975, Eastover owned or had controlling interest in approximately 30,600 acres of coal reserves, with an estimated 250 million tons of recoverable reserves located in Virginia and eastern Kentucky. The 1975 production from operating mines was approximately 2 million tons.

Carolina Power & Light Co. (CP&L) placed Unit No. 2 of the Brunswick Nuclear plant into commercial operation at 790,000 kilowatts. During preoperational testing, this unit produced the first nuclear-generated electricity in North Carolina on April 29. When the second unit is completed in 1977, the plant will represent an investment of \$793 million, including the expense for cooling towers and other modifications to the cooling system which are required under present operating and discharge permits. During the year, CP&L

revised its long-term construction plan due to revised energy forecasts, coupled with the unavailability of capital on reasonable terms. Inservice dates on 10 proposed plant units, including 7 nuclear and 3 coal-fired units, ranged from 1977 to 1990. The company was negotiating at yearend with Pickands Mather & Co. to develop a second deep coal mine in Pike County, Ky. In 1974, an agreement was made to develop the first mine from which initial deliveries of coal are expected in 1976. CP&L expects to receive a total of 1.6 million tons per year for 25 years from the two low-sulfur coal mines.

**Employment and Injuries.**—According to the Annual Report for 1975 on Administration of the Federal Metal and Non-metallic Mine Safety Act (Public Law 89-577), North Carolina had 363 mines and mills active throughout the year. MESA personnel made 430 regular and 352 spot inspections during 1975, and issued 2,129 notices, all of which were abated. In addition, there were nine orders issued and abated. Preliminary data indicated that there were 41 disabling injuries reported at surface mines and 22 disabling injuries in mills. The frequency rate for disabling injuries was 7.83 for surface mines and 9.10 for mills. MESA maintained a field office throughout the year at Salisbury, N.C.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Asbestos.**—Amphibole asbestos was shipped by Powhatan Mining Co. from its Hippy Mine in Yancey County. Quantity and value increased over those of 1974.

**Cement.**—Ideal Basic Industries, Inc., produced portland and masonry cement at its Castle Hayne plant in New Hanover County. Total output and value decreased considerably below those in 1974.

**Clays.**—According to the Brick Association of North Carolina, Inc., North Carolina has been the Nation's leading brick producer since 1962, and continued in this position during 1975. During the year there were approximately 800 million brick valued at \$48 million (13% of the total U.S. production) manufactured in the State from common clay and shale produced in North Carolina. Common clay

and shale was used primarily in the manufacture of face and common brick, sewer pipe, concrete block, structural concrete, and cement. Total output was 2.6 million tons, valued at \$4.1 million, a decrease of 25% in tonnage and 12% in value below that of 1974. Common clay and shale was produced at 47 mines in 22 counties by 25 companies. Leading producers of common clay and shale were Solite Corp. (2 mines), Sanford Brick Corp. (3 mines), Pine Hall Brick & Pipe Co. (4 mines), and Boren Clay Products Co. (5 mines). Other significant producers with one mine each were Pomona Corp., Ideal Basic Industries, Kendrick Brick & Tile Co., and Triangle Brick Co. These 8 companies with 18 mines accounted for 65% of the total output and 70% of the total value of common clay and shale produced in 1975.

Kaolin was produced at three mines by two companies in three counties. Harris Clay Co. continued to be the only producer of water-washed kaolin in the State, producing from mines in Avery and Mitchell Counties. The kaolin was used in chemical manufacturing, the manufacture

of fine china dinnerware, and in the manufacture of paint and fiberglass. Kings Mountain Mica Co., Inc., produced unprocessed kaolin at its Cleveland County mine and used the material primarily in the manufacture of face brick.

Table 4.—North Carolina: Common clay and shale sold or used by producers, by county

County	1974			1975		
	Number of mines	Short tons	Value	Number of mines	Short tons	Value
Alamance -----	--	W	W	2	61,049	\$79,400
Buncombe -----	1	36,000	\$45,000	1	36,000	48,600
Cabarrus and Durham -----	4	276,137	396,040	4	226,436	396,403
Chatham -----	4	596,360	761,563	4	452,649	802,996
Cumberland -----	1	16,000	25,600	1	10,000	16,500
Davidson -----	1	75,000	82,500	1	80,000	96,000
Guilford -----	3	103,548	129,500	3	66,075	89,300
Harnett -----	4	53,000	68,900	4	40,180	56,560
Henderson -----	1	54,000	67,500	1	54,000	72,900
Iredell -----	1	30,509	38,100	1	26,897	35,000
Lee -----	4	471,800	680,500	4	333,750	489,850
Montgomery and New Hanover -----	3	169,302	297,598	4	166,405	404,125
Rockingham -----	5	594,446	599,586	5	435,621	514,921
Rowan -----	4	146,264	182,100	4	126,845	167,900
Sampson -----	1	42,096	52,700	1	28,544	38,600
Stanly -----	3	386,664	536,100	3	237,320	372,700
Stokes -----	1	28,866	21,650	1	14,255	14,255
Union -----	1	178,400	446,000	1	128,575	321,500
Undistributed <sup>1</sup> -----	6	163,433	217,418	2	57,369	76,140
Total -----	48	3,421,825	4,643,355	47	2,581,960	4,093,650

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

<sup>1</sup> Includes Halifax, Moore, and Wake Counties (1974), and data indicated by symbol W.

**Feldspar.**—North Carolina again led the Nation in the production of feldspar. Crude output as flotation concentrate and feldspar-silica mixtures combined decreased 26%, and value was 28% below that of 1974. Six companies operated eight mines in Cleveland, Gaston, and Mitchell Counties.

Leading producers in total output were The Feldspar Corp., Sobin Chemicals, Inc., and Lawson-United Feldspar and Mineral Co. The ratio of flotation concentrate to feldspar-silica mixture produced was about 5 to 1.

Sobin Chemicals, Inc., completed and placed into operation a new plant that has been under construction for the past several years. The new Penland plant replaces the old operations at Kona and Spruce Pine.

International Minerals & Chemical Corp. (IMC), according to several reports, gained complete control of Sobin Chemicals, Inc., early in the year and at yearend was reorganizing Sobin and Commercial Solvents into Sobin International, composed of an

industrial chemicals division and a biochemicals division. The industrial chemicals division will be made up of industrial minerals which includes the mining and marketing of feldspar materials, electrochemicals, and the industrial chemicals operations formerly under Commercial Solvents. The biochemicals section will concentrate on animal health products and products for the pharmaceutical industry. Headquarters for the new chemical group will be New York City.

**Gem Stones.**—Amateur collectors and rockhounds collected a variety of precious and semiprecious gems and mineral specimens from several areas of the State. Most of the collecting activity was centered around Franklin in Macon County, Spruce Pine in Mitchell County, and near Hiddenite, Alexander County. Garnet, rubies, and sapphires are found in the Franklin area, emerald and aquamarine gems are found in the Spruce Pine area, and hiddenite and emerald are found in the Hiddenite area. Many of the lesser gems and

minerals are also associated with these deposits. A brochure on North Carolina gems, listing rockhound collecting sites, may be obtained free of charge from the Travel and Promotion Division, North Carolina Department of Natural and Economic Resources, Box 27687, Raleigh, N.C. 27611.

**Graphite.**—Synthetic graphite products including anodes, electrodes, crucibles and vessels, and graphite specialties were produced by Great Lakes Carbon Corp. at its plant near Morganton. The plant uses coal tar pitch obtained from out-of-State sources as raw material.

**Iodine.**—Mallinckrodt Chemical Works, near Raleigh, Wake County, consumed crude iodine in the manufacture of several products. The company operated three plants in the Raleigh area and produced high-purity specialty chemicals, plastics, and other products.

**Lithium Minerals.**—North Carolina continued to lead the Nation in lithium mineral production. Approximately 36% of the world's lithium reserves are in the tin-spodumene belt of North Carolina. Two companies operated lithium mining and processing facilities in the State during 1975. Foote Mineral Co., which is 92% owned by Newmont Mining Corp., was a major domestic producer of spodumene concentrate. Foote reported in its 1975 annual report that a major portion of its capital expenditures during the year, which was the highest single year's capital outlay in company history, was expended on the new lithium carbonate plant at Kings Mountain. The plant was expected to commence commercial production in the fourth quarter of 1976. Foote began construction of the 12-million-pound-per-year plant in 1974. The new plant will employ the sulfuric acid roast process to extract lithium from the spodumene concentrate and a salable byproduct, sodium sulfate, will also be produced.

Lithium Corp. of America, Inc. (Lithcoa), a wholly owned subsidiary of Gulf Resources and Chemical Corp., produced spodumene from pegmatite deposits in the Bessemer City area and shipped concentrates to its nearby lithium chemicals plant for processing. Lithcoa remained a major world producer of lithium compounds, metal, and metal derivatives; over 20 lithium products for commercial use were made at Bessemer City. According to

Lithcoa's annual report, the year 1975 was one of significant advancement for the company. Among the achievements listed were record production and recovery from the mine and mill complex. New equipment was installed to meet the unique needs of the lithium battery market. Initial sales were made of lithium battery electrolyte as well as special metal fabrications. A new catalyst, dibutyl magnesium, for the polymerization of polyethylene was developed and initial sales made in 1975. The chemical plant, because of the generally reduced demand caused by the worldwide recession, operated at 90% of capacity. Production of lithium carbonate equivalent totaled 24.3 million pounds in 1975, compared with 25.7 million pounds produced in 1974, a record year. Chemical plant recoveries were higher than in the previous year because of an intensive process improvement program and the availability of higher grade flotation concentrate from the beneficiation plant. The lithium hydroxide circuit capacity was increased by 20% to meet the increased world sales demand.

During 1975, an intensive exploratory drilling program in the proximity of the present mining operation resulted in the addition of 14 million tons to Lithcoa's previously reported ore reserves. Proven and probable ore reserves, averaging 1.5% lithia, were 27.5 million tons at yearend compared with 13.3 million tons at the end of 1974. The new total reserves are estimated to be sufficient to sustain current production levels for approximately 50 years. In 1975, the company also increased its ore beneficiation capacity by 20%.

Sales of Lithcoa's Spartan Minerals Division, which produces feldspathic products for the whiteware, latex, and glass container industries, were below expectations. Substantial sales (47% of the total tonnage sold) were made to the glass container industry.

**Mica.**—North Carolina continued to lead the Nation in scrap and flake mica output. Total production by seven companies in five counties was 75,297 tons valued at \$3.3 million. This was a slight decrease in quantity and \$414,000 in value below 1974 figures. Leading producers were Harris Mining Co., Kings Mountain Mica Co., Inc. (two mines) and The Feldspar Corp. (two mines). Other producers were

Deneen Mica Co., Inc., Sobin Chemicals, Inc., and Lawson-United Feldspar and Mineral Co.

Ground mica from crude scrap and flake was produced by companies in Buncombe, Macon, Mitchell, and Yancey Counties. Both wet- and dry-grinding methods were employed and at least one plant used both

methods. The ground mica was used in rubber filler, joint cement, roofing, paint, wallpaper, plastics, and for other uses.

Sheet mica production remained practically at a standstill. Only a small amount of production was reported to the Federal Bureau of Mines in 1975.

Table 5.—North Carolina: Ground mica sold or used by producers, by use

Use	1974 <sup>r</sup>		1975	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Roofing -----	6,677	\$350,099	6,832	\$346,863
Paint -----	9,675	1,978,510	8,363	1,805,767
Rubber -----	6,560	1,417,352	4,300	932,334
Joint cement -----	15,242	1,178,114	16,914	1,364,781
Other uses <sup>1</sup> -----	22,446	1,445,427	30,307	1,674,318
Total -----	60,600	6,369,502	66,716	6,124,063

<sup>r</sup> Revised.

<sup>1</sup> Includes brick, plastics, textile coating, wallpaper, well drilling, and other uses.

**Olivine.**—North Carolina led the Nation in olivine production. International Minerals & Chemical Corp. operated two mines—one in Avery County and the other in Yancey County. Output and value increased considerably over that of 1974. The material was used primarily by the foundry industry as molding sand.

**Phosphate Rock.**—The production of phosphate rock at the Lee Creek complex of Texasgulf, Inc., Beaufort County, continued to increase both in quantity and value compared with 1974 figures. The major portion of the rock was used for the production of phosphoric acid (as 54% P<sub>2</sub>O<sub>5</sub>) and in the manufacture of dry phosphate fertilizers. The decrease in world consumption of fertilizers for the first time in many years and the decline of domestic fertilizer prices in 1975 had a depressing effect on the entire domestic fertilizer producing industry. However, most of the industry is expecting an upsurge in the coming year with increases in domestic acreage to be planted and strengths in the grain markets providing the necessary impetus for consumption.

Texasgulf, Inc., continued to be the only phosphate rock producer in the State during the year. According to Texasgulf's 1975 annual report, phosphate rock production during 1975 set a new yearly record and was 3% higher than in 1974. Production of superphosphoric acid also established a record high for the year and

increased 14% over 1974. Production of hydrofluosilicic acid (23% H<sub>2</sub>SiF<sub>6</sub>), a by-product of the phosphoric acid plant, began in 1975 and the first sale was made in December. The facility is designed to produce 8,000 tons per year of 100% equivalent hydrofluosilicic acid. The 23% acid is used primarily for municipal water fluoridation.

During 1975 rapid progress was made in the continued expansion of the company's phosphate fertilizer complex at Lee Creek, near Aurora. The fourth sulfuric and phosphoric acid units were completed and started up at the beginning of the fourth quarter. These new plants have increased production capacity by 170,000 tons to a total of 680,000 tons of 100% P<sub>2</sub>O<sub>5</sub> per year. A new 255,000-ton-per-year granular triple superphosphate plant and a new superphosphoric acid plant were completed in December. Superphosphoric acid capacity was increased by about 50% to nearly 270,000 tons per year.

Texasgulf's phosphate mining capacity in 1975 was increased by the addition of a 50-cubic-yard dragline and a new 30-inch dredge. The expansion of mining and concentrating capacity from 3.5 million to 5 million tons of phosphate rock per year will be sufficient to supply all of the company's presently planned fertilizer additions and also provide over 500,000 tons per year of phosphate rock for outside sales.

Overseas shipments of phosphoric acid from the company's phosphoric acid terminal located on deepwater at Morehead City began in June. The first export shipments of phosphate rock in 2 years were made in December 1975, and the company's reentry into the phosphate rock market was made possible by the expanded mining capacity. Texasgulf increased its phosphate acreage by about 50% with the purchase of 16,497 acres in Pamlico County. Prior to the purchase, Texasgulf reportedly owned some 30,000 acres of land in the State.

A letter of intent was signed with Toyo Soda of Japan for the evaluation of a food-grade purified phosphoric acid processing plant to be constructed at the Lee Creek operation. The purified acid would compete with electric furnace acid in the detergent, animal feed, and food supplement industries. Preliminary plans are for the production of 75,000 tons per year of 100%  $P_2O_5$  product equivalent. Many electric furnace operations may soon have to close down because of the high costs of electric power.

Texasgulf was one of eight companies which in 1975 established a Webb-Pomerene Act corporation to market their export sales of phosphate fertilizer products which qualify under the Act. Other members of the new corporation, the Phosphate Chemicals Export Association, Inc. (Phoschem), include Agrico Chemical Co., Beker Industries Corp., W. R. Grace & Co., International Minerals & Chemical Corp., Philipp Brothers of Engelhard Minerals & Chemicals Corp., and the Royster Co. Phoschem is now responsible for export sales of all phosphate fertilizer products for the participating companies.

Texasgulf's phosphate ore reserves in North Carolina are reported to be ample to support capacity production from expanded facilities for many decades to come. At present there are more than 1,000 employees working at the Lee Creek complex, with a total annual payroll of \$14 million. Texasgulf pays 15% to 20% of Beaufort County's property taxes and since 1966 has paid a total county property tax bill of \$2.7 million.

North Carolina Phosphate Corp. (NCP), composed jointly of Kennecott Copper Corp. and Agrico Chemical Co., announced in 1974 that it would develop a large phosphate mining operation in Beaufort County. During 1975 plans for devel-

opment continued and the company has been gathering necessary staff and proceeding with preliminary studies leading up to acquisition of State and Federal permits that must be obtained before any operation can begin. Target date for the new operation is 1977. The staff, temporarily housed in offices in Washington, N.C., will eventually operate from headquarters near Aurora.

**Sand and Gravel.**—Total sand and gravel production and value decreased in 1975 for the first time in several years due primarily to reduced construction and building activity during the year. Total production was 8.2 million tons valued at \$15.6 million, a decrease of 36% in quantity and 25% in value below that of 1974. Sand and gravel was produced by 115 companies at 148 operations in 61 counties. Leading counties listed in order of descending rank of production were Anson, Harnett, Cumberland, and Buncombe. These four counties accounted for 50% of the State's output of sand and gravel.

Construction sand and gravel comprised the bulk of the material produced. Output for construction purposes totaled 7.6 million tons valued at \$12.9 million.

Industrial sand was produced at 7 operations; output was 539,000 tons valued at \$2.7 million.

Sand and gravel in North Carolina was transported 78% by truck, 7% by railroad, and the remainder by other methods or used at plantsite.

According to a survey of sand and gravel operations made during the year on the source of water for sand and gravel processing, 15 operations used water from rivers, 4 from lakes, 21 from pits created by the operation, 2 from wells, and 35 used no water in processing. It was also determined that 1,167 gallons of water was needed to process 1 ton of sand and gravel and that 338 pounds of waste was generated in producing 1 ton of sand and gravel. Waste is defined as all undersized material, silt or clay.

**Stone.**—Stone was the leading mineral commodity produced in the State during 1975. Total stone output was 28.3 million tons valued at \$69.3 million, a decrease of 19% in tonnage and 8% in value below that of 1974. Crushed and broken stone accounted for most of the production with only a small amount of dimension stone produced. Production was reported from



Table 6.—North Carolina: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Alamance	---	---	---	1	W	W
Anson	3	W	W	2	W	W
Avery	1	109	262	1	W	6
Beaufort	3	82	181	3	W	W
Bertie	3	152	221	5	109	164
Bladen	1	W	W	1	W	W
Brunswick	2	W	W	---	---	---
Buncombe	2	W	W	4	449	967
Burke	1	W	W	1	W	W
Cabarrus	2	W	196	3	198	149
Caldwell	1	30	89	2	W	W
Camden	3	5	7	1	W	W
Catawba	5	160	252	6	233	271
Chowan	1	2	1	1	3	1
Cleveland	3	136	200	4	126	190
Craven	1	W	W	1	62	W
Cumberland	6	1,065	911	6	524	680
Currituck	---	---	---	1	W	W
Davidson	2	W	W	1	W	W
Davie	1	W	W	1	W	W
Duplin	3	W	W	2	W	W
Edgecombe	4	233	412	3	178	249
Franklin	1	53	117	1	50	126
Gaston	6	82	W	6	W	W
Greene	1	W	W	1	W	W
Guilford	2	W	W	3	180	72
Harnett	2	W	W	2	W	W
Haywood	1	W	W	---	---	---
Hertford	2	W	W	4	W	W
Hyde	1	11	3	1	8	2
Jackson	---	---	---	1	52	W
Johnston	3	W	W	4	38	49
Jones	1	W	13	1	W	12
Lee	2	W	W	2	W	W
Lenoir	3	W	W	3	W	W
McDowell	5	346	672	5	234	524
Macon	1	34	W	1	14	W
Madison	2	W	W	---	---	---
Martin	1	7	2	1	32	8
Montgomery	3	144	122	3	109	98
Moore	4	372	302	2	W	W
New Hanover	1	W	W	2	W	81
Northampton	2	187	73	4	63	37
Onslow	2	W	W	1	W	W
Orange	2	W	W	2	W	W
Pasquotank	3	27	25	3	59	41
Pitt	5	210	314	3	124	174
Richmond	3	307	351	3	210	730
Robeson	1	W	185	1	W	18
Rockingham	4	103	125	5	97	200
Rowan	4	21	W	4	W	W
Rutherford	1	W	W	1	W	W
Sampson	4	W	W	3	W	W
Scotland	1	W	W	1	W	W
Surry	2	30	30	3	W	W
Swain	1	W	W	1	W	W
Transylvania	1	W	W	1	8	18
Tyrrell	1	3	1	---	---	---
Wake	1	W	W	1	18	36
Washington	1	34	9	1	51	13
Wayne	12	266	335	11	154	222
Wilkes	1	122	225	1	89	205
Wilson	1	W	W	1	W	W
Yadkin	---	---	---	1	W	W
Yancey	2	W	W	3	W	W
Other counties <sup>1</sup>	11	8,451	15,208	---	4,699	10,269
Total <sup>2</sup>	156	12,784	20,844	148	8,169	15,610

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

<sup>1</sup> Includes some sand and gravel that cannot be assigned to specific counties, and items indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 7.—North Carolina: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	6,003	8,315	4,405	6,170
Gravel -----	2,518	5,830	1,530	3,864
Unprocessed:				
Sand and gravel -----	3,215	2,543	1,695	1,196
Industrial:				
Sand -----	466	1,684	171	752
Gravel -----	582	2,185	368	1,939
Total -----	12,784	20,557	8,169	13,921

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

Table 8.—North Carolina: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially, by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -	3,335	5,646	1,979	4,811
Highway and bridge construction -----	288	595	88	133
Other construction (dams, waterworks, airports, etc.) -----	181	339	3	6
Concrete products (cement blocks, brick, pipe, etc.) -----	1,945	2,924	1,338	2,296
Bituminous paving (asphalt and tar paving) ---	1,033	1,950	328	491
Roadbase and subbase -----	560	1,019	951	1,756
Fill -----	69	107	33	41
Other -----	87	177	27	54
Unprocessed:				
Roadbase and subbase -----	1,310	968	328	254
Fill -----	1,560	1,298	564	430
Other -----	--	--	233	281
Industrial sand and gravel -----	1,049	3,869	539	2,691
Total -----	11,417	18,892	6,471	<sup>1</sup> 13,245

<sup>1</sup> Data do not add to total shown because of independent rounding.

Table 9.—North Carolina: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects, by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -	58	74	40	63
Highway and bridge construction -----	249	376	343	778
Other construction (dams, waterworks, airports, etc.) -----	3	5	W	W
Concrete products (cement blocks, brick, pipe, etc.) -----	W	W	30	76
Bituminous paving (asphalt and tar paving) ---	326	530	482	722
Roadbase and subbase -----	387	689	292	395
Fill -----	--	--	--	--
Other -----	--	--	--	--
<b>Unprocessed:</b>				
Roadbase and subbase -----	78	W	360	175
Fill -----	266	278	119	110
Other -----	--	--	33	45
Total <sup>1</sup> -----	1,367	1,952	1,698	2,365

W Withheld to avoid disclosing individual company confidential data; included with "Non-residential and residential construction." "Unprocessed roadbase" value included with "Unprocessed fill."

<sup>1</sup> Data may not add to totals shown because of independent rounding.

106 quarries in 56 counties. Rowan County led the State with seven quarries; Cherokee, Mecklenburg, Montgomery, and Wake Counties had five quarries each; Guilford, Mitchell, and Watauga Counties had four quarries each; and Avery, Davidson, and Surry Counties had three quarries each. Leading individual counties in output were Mecklenburg, Guilford, and Wake. There were 8 quarries that produced over 800,000 tons of stone each, 14 that produced over 500,000 tons each, and 37 that produced over 100,000 tons each.

Leading producing companies were Martin Marietta Corp. with 26 quarries scattered throughout the State, Vulcan Materials Co. with 13 quarries, and Nello L. Teer Co. with 7 quarries. These 3 companies with 46 quarries accounted for 73% of the total State quantity and 71% of the total value.

Granite was produced at 75 quarries; crushed granite was produced at 66 quarries, and the remaining quarries produced dimension granite. Total output was 22.3 million tons valued at \$53.8 million. Crushed limestone was produced at eight quarries; total production was 4 million tons valued at \$10.1 million. Other stone produced was dimension and crushed marble, marl, sandstone, crushed quartz, dimension quartzite, traprock, and slate.

The major uses for crushed stone were as roadbase material, concrete aggregate,

bituminous aggregate, and for unspecified aggregate use. Principal uses for dimension stone was for curbing, construction, monumental, and structural purposes.

The stone was transported 95% by truck, over 4% by rail, and less than 1% by waterway.

**Talc and Pyrophyllite.**—The combined output and value of talc and pyrophyllite mined was 59,000 short tons, valued at \$985,000, a considerable decrease in quantity but only a slight decrease in value below that of 1974. Prepared products, consisting principally of ground material, were valued at \$1.5 million. Talc was produced by only one company, Hitchcock Corp., near Murphy, Cherokee County, for use in the manufacture of toilet preparations and by the textile industry. Both sawed and ground talc was produced. Five companies produced pyrophyllite in Alamance, Granville, Moore, and Orange Counties. Leading individual producers, listed in order of output, were Standard Minerals Co., Inc., Glendon Pyrophyllite, Inc., and Hitchcock Corp. Glendon Pyrophyllite operated three mines in two counties.

**Vermiculite.**—Two companies exfoliated vermiculite from crude ore mined in South Carolina. W. R. Grace & Co. operated a plant near High Point, Guilford County, using captive ore and produced an exfoliated material for use in concrete and

Table 10.—North Carolina: Crushed granite sold or used by producers, by county

County	1974			1975		
	Number of quarries	Quantity (short tons)	Value (thousands)	Number of quarries	Quantity (short tons)	Value (thousands)
Ashe -----	1	W	W	1	126,000	W
Cabarrus -----	1	79,156	\$158	1	59,690	\$107
Caldwell -----	1	312,000	663	1	270,500	W
Guilford -----	5	3,295,522	6,702	4	2,063,182	4,830
Richmond -----	1	W	W	1	275,500	W
Surry -----	3	W	1,908	3	1,257,795	2,297
Wake -----	4	2,381,753	4,888	5	1,843,972	4,242
Undistributed <sup>1</sup> -----	50	22,086,120	42,679	50	16,406,798	39,497
Total -----	66	28,154,556	<sup>2</sup> 56,999	66	22,303,437	50,973

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

<sup>1</sup> Includes Alamance, Anson, Avery, Buncombe, Burke, Caswell, Catawba, Chatham, Cherokee (1975), Cleveland, Davidson, Davie, Edgecombe (1975), Forsyth, Gatsen, Granville (1974), Hawwood, Henderson, Iredell, Jackson, Lee, Macon, Mecklenburg, Mitchell (1974), Nash, Orange, Pitt, Polk (1975), Randolph, Rockingham, Rowan, Rutherford, Stokes (1974), Swain (1975), Transylvania, Union, Vance, Watauga, Wilkes, Wilson, and Yadkin Counties, and counties indicated by symbol W.

<sup>2</sup> Data do not add to total shown because of independent rounding.

plaster aggregate and for loose fill and block insulation. Carolina Wholesale Florists, Inc., operated a plant near Sanford, Lee County, and produced expanded material for horticultural use and for loose-fill insulation.

## METALS

**Aluminum.**—Aluminum Company of America (Alcoa) produced primary aluminum from imported alumina at its smelter near Badin, Stanly County. Quantity decreased 17% while value increased 16% above that of 1974. According to Alcoa's 1975 annual report the company during the year was investigating processes to use several domestic substances as alternative sources of alumina. In addition to its smelting operations at Badin, Alcoa operated an electric public utility, Nantahala Power & Light Co., at Franklin, Macon County. In connection with its operations, Alcoa was a major producer of electrical energy and generated approximately one-half of the power required for smelting operations in the United States. The company also operated a metal fabricating facility near Laurinburg, Scotland County.

**Iron Ore.**—Magnetite, for use as a heavy media agent in the processing of coal, was recovered at the Cranberry mine and plant of Greenback Industries, Inc., near Cranberry, Avery County. The company completed and placed in operation in 1975 its new ball mill and classifiers that were being installed late in 1974. The new

equipment was to increase processed magnetite output to 60,000 tons per year. The company has been working dump materials near the mine, but at yearend was making plans to resume underground mining at the old minesite.

**Tungsten.**—There was no recorded production of tungsten in North Carolina during 1975. Ranchers Exploration & Development Corp. continued to keep its Tungsten Queen mine and mill near Townsville in standby condition as it has since 1971 when the mine was closed. There was no indication of when operations may resume.

## MINERAL FUELS

There was no production of mineral fuels in North Carolina during 1975.

**Petroleum and Natural Gas.**—According to the Oil and Gas Section, North Carolina Division of Resource Planning and Evaluation, there were no exploratory oil or gas wells drilled in the State during 1975. Cities Service Oil Co. and Colonial Oil and Gas Co. continued to lease State-owned submerged lands for oil and gas exploration in the coastal area of the State.

During September 1975, the U.S. Department of the Interior's Bureau of Land Management (BLM) asked for information on which tracts should be offered in a proposed Outer Continental Shelf (OCS) offshore oil and gas lease sale in the South Atlantic submerged land area known as the Southeast Georgia Embayment. The area

to be considered totaled 20.7 million acres involving 3,726 tracts off the coasts of the States of North Carolina, South Carolina, Georgia, and Florida. The proposed acreage lies in water from about 40 to 1,800 feet deep and ranges from 3 to 132 miles offshore. The general area is bounded on the north by Cape Fear on the coast of North Carolina and on the south by Cape Canaveral on the coast of Florida.

The South Atlantic sale was proposed for November 1976. The call is a first step leading to a sale decision which involves

public participation. The U.S. Department of the Interior is responsible for managing and developing the submerged lands and mineral resources of the OCS pursuant to the OCS Lands Act of 1953. The program is handled jointly by BLM and the U.S. Geological Survey. BLM handles leasing, and the USGS prelease resource evaluation and postlease administration. The USGS estimates that there are from 2 billion to 4 billion barrels of oil and from 5 trillion to 14 trillion cubic feet of gas on the OCS of the Atlantic Coast alone.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Aluminum, smelter:</b> Aluminum Company of America.	1501 Alcoa Bldg. Pittsburgh, Pa. 15219	Plant -----	Stanly.
<b>Asbestos:</b> Powhatan Mining Co -----	6721 Windsor Mill Rd. Baltimore, Md. 21207	Open pit mine --	Yancey.
<b>Cement:</b> Ideal Basic Industries, Inc. <sup>1,2</sup>	420 Ideal Cement Bldg. Denver, Colo. 80202	Plant -----	New Hanover.
<b>Clays:</b> Boren Clay Products Co --- Pine Hall Brick & Pipe Co. Sanford Brick Corp ----- Solite Corp -----	Pleasant Garden, N.C. 27813 Box 11044 Winston-Salem, N.C. 27106 Box 33 Gulf, N.C. 27256 Box 9138 Richmond, Va. 23227	Open pit mines and plant. -----do ----- -----do ----- -----do -----	Chatham, Guilford, Sampson, Rockingham and Stokes. Chatham, Lee, Stanly. Rockingham.
<b>Feldspar:</b> The Feldspar Corp. <sup>1,2,3</sup> ---- Lawson-United Feldspar and Mineral Co. <sup>3</sup> Sobin Chemicals, Inc. <sup>3</sup> ----	Spruce Pine, N.C. 28777 Minipro, N.C. 28777 Old Orchard Road Skokie, Ill. 60079	Open pit mines and plants. -----do ----- -----do -----	Mitchell. Do. Do.
<b>Iron ore:</b> Greenback Industries, Inc -	Greenback, Tenn. 37742	Underground mine and plant.	Avery.
<b>Lithium minerals:</b> Foote Mineral Co. <sup>1</sup> -----  Lithium Corp. of America, Inc. <sup>4</sup>	Box 792 Kings Mountain, N.C. 28086 449 N. Cox Road Gastonia, N.C. 28052	Open pit mine and plant. -----do -----	Cleveland. Gaston.
<b>Mica:</b> Harris Mining Co. <sup>1,2</sup> ----- Kings Mountain Mica Co., Inc. <sup>4</sup>	Box 623 Spruce Pine, N.C. 28777 Box 709 Kings Mountain, N.C. 28086	Open pit mines -- -----do -----	Avery and Mitchell. Cleveland.
<b>Olivine:</b> International Minerals & Chemical Corp.	Box 672 Spruce Pine, N.C. 28777	-----do -----	Avery and Yancey.
<b>Perlite, expanded:</b> Carolina Perlite Co., Inc --	Box 741 Hillside, N.J. 07205	Plant -----	Rowan.
<b>Phosphate rock:</b> Texasgulf, Inc -----	200 Park Ave. New York, N.Y. 10017	Open pit mine and plant.	Beaufort.
<b>Sand and gravel:</b> Barrus Construction Co --- Becker Sand & Gravel Co - W.R. Bonsal Co -----	P.O. Box 399 Kingston, N.C. 28501 Box 848 Cheraw, S.C. 29520 Box 33 Lilesville, N.C. 28091	Pits ----- -----do ----- -----do -----	Various. Cumberland, Harnett, Moore. Anson.

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Sand and gravel—Continued			
B.V. Hedrick Gravel and Sand Co. <sup>1</sup>	Swannanoa, N.C. 28778	Pits -----	Buncombe.
Nello L. Teer, Co. <sup>1</sup> -----	Box 1131 Durham, N.C. 27702	----do -----	Harnett.
Stone:			
Central Rock Co -----	Box 510 Greensboro, N.C. 27409	Quarry -----	Guilford.
Martin Marietta Corp -----	Box 30013 Raleigh, N.C. 27612	Quarries -----	Various.
Nello L. Teer Co -----	Box 1131 Durham, N.C. 27702	----do -----	Do.
Vulcan Materials Co -----	Box 7506 Reynolds Station Winston-Salem, N.C. 27106	----do -----	Do.
Wake Stone Co -----	Box 176 Knightdale, N.C. 27545	Quarry -----	Lee and Wake.
Talc and pyrophyllite:			
Glendon Pyrophyllite, Inc -	Box 306 Carthage, N.C. 28327	Open pit mines and plant.	Alamance and Moore.
Hitchcock Corp -----	Box 459 Murphy, N.C. 28906	----do -----	Cherokee.
Piedmont Minerals Co., Inc.	P.O. Box 7247 Greensboro, N.C. 27407	Open pit mine and plant.	Orange.
Standard Minerals Co., Inc.	Robbins, N.C. 27325 -----	----do -----	Moore.
Vermiculite, expanded:			
Carolina Wholesale Florists, Inc.	Box 537 Sanford, N.C. 27330	Plant -----	Lee.
W.R. Grace & Co -----	62 Whittemore Avenue Cambridge, Mass. 02140	----do -----	Guilford.

<sup>1</sup> Also stone.<sup>2</sup> Also clays.<sup>3</sup> Also mica.<sup>4</sup> Also feldspar.



# The Mineral Industry of North Dakota

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the North Dakota Geological Survey under a cooperative agreement for collecting information on minerals.

By Harold J. Polta<sup>1</sup>

Mineral output in North Dakota in 1975 was valued at \$201.5 million, up 26% from that of 1974. Petroleum (crude) continued as the State's principal mineral commodity, accounting for about 74% of total State mineral output value. The next highest was coal production, valued at \$27.0 million, which represented about 13% of total value. Natural gas accounted for 3%, and sand and gravel for 4%.

Total value of petroleum production increased \$30.7 million, or 26% over that of 1974; value of coal (lignite) increased \$10.7 million, or 65%; and value of natural gas decreased \$0.5 million, or 8%. The total value of sand and gravel output, the only major nonmetallic mineral, was \$8.1 million, \$1.9 million more than in 1974.

**Legislation and Government Programs.**—The great concern that production of coal, its conversion to energy, and its transportation proceed in an orderly fashion, with minimum impact on the environment and lifestyle of North Dakota citizens, was evidenced by the emphasis the 1975 State Legislature placed on legislation affecting mineral development.

Included in the bills that became law were HB-1062, which concerns coal development and surface owner relationships; HB-1083, which requires filing of certain exploration drill hole information with the county registrar of deeds; HB-1084, which requires the filing of other drill hole information with the State Geologist; HB-

1221, which inaugurated an energy conversion tax; SB-2031, which imposed a severance tax on coal; SB-2050, which required a site compatibility certificate for energy conversion plants and transmission lines; SB-2058, which defined legal terms used in mineral rights conveyances; SB-2086, which required certain reports to various State agencies by coal-mining operations; SB-2093, which gave the surface owner prior right to purchase mineral rights; SB-2095, which required a State mining permit and reclamation bond for strip-mining operations; SB-2147, which required the logging and filing of basic drill hole data with the State Geologist; SB-2153, which established minimum royalties for State-owned minerals; and SB-2467, which provided for establishing a Natural Resources Council.

The legislation that will probably have the greatest effect on the development of the State's energy resources included the energy conversion tax, the coal severance tax, the energy conversion and transmission facility siting act, and the amendments and changes in the State's mining and reclamation laws.

The energy conversion tax provided for a levy of 0.25 mill on each kilowatt of electricity produced by generating plants; either 2.5% of gross receipts or 10 cents on each 1,000 cubic feet of gas produced by

<sup>1</sup>State Liaison Officer, Bureau of Mines, Bismarck, N. Dak.



Table 1.—Mineral production in North Dakota <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Coal ----- thousand short tons	7,463	\$16,351	8,515	\$27,010
Gem stones -----	NA	2	NA	2
Natural gas ----- million cubic feet	31,206	6,210	24,786	5,701
Peat ----- short tons	240	W	W	W
Petroleum (crude) ----- thousand 42-gallon barrels	19,697	119,022	20,452	149,705
Sand and gravel ----- thousand short tons	4,991	6,211	5,636	8,133
Stone ----- do	35	115	30	153
Value of items that cannot be disclosed: Clays, lime, natural gas liquids, salt, and values indicated by symbol W -----	XX	11,516	XX	10,800
Total -----	XX	159,427	XX	201,504
Total 1967 constant dollars -----	XX	75,377	XX	<sup>p</sup> 79,796

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

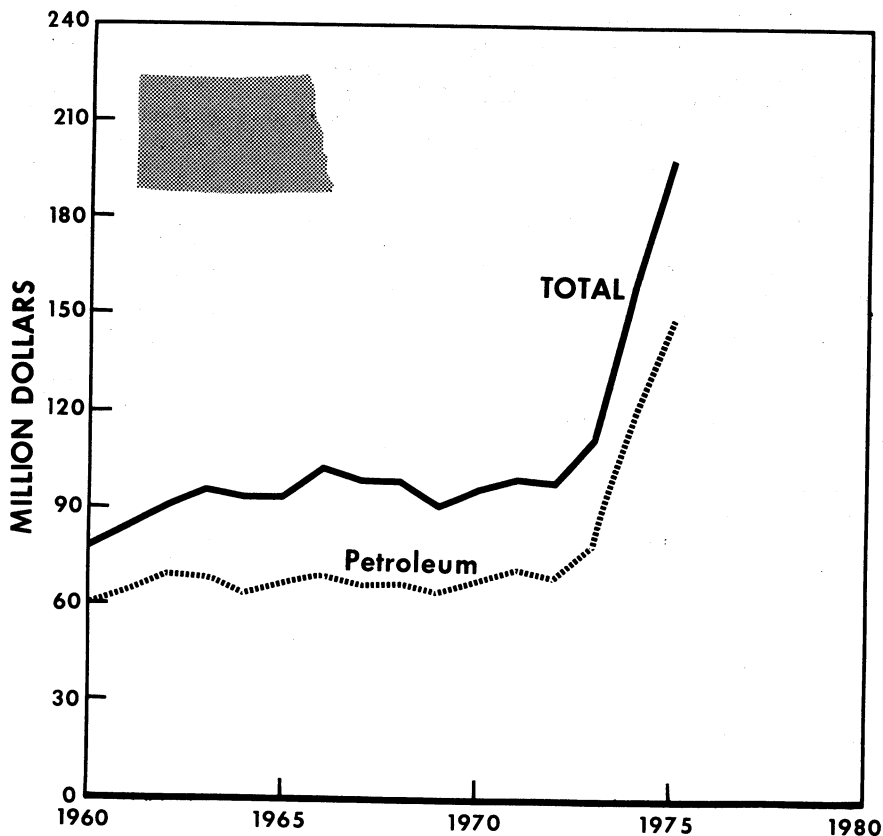


Figure 1.—Value of petroleum and total value of mineral production in North Dakota.

Table 2.—Value of mineral production in North Dakota, by county <sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams -----	W	--	Sand and gravel.
Barnes -----	\$171	\$199	Do.
Benson -----	47	29	Petroleum.
Billings -----	12,532	W	Petroleum, sand and gravel, peat.
Bottineau -----	W	W	Petroleum, coal, sand and gravel.
Bowman -----	W	W	Petroleum, coal, natural gas liquids, sand and gravel.
Burke -----	9,140	10,300	Sand and gravel.
Burleigh -----	1,368	604	Do.
Cass -----	7	W	Sand and gravel, stone.
Cavalier -----	W	--	Petroleum, sand and gravel.
Dickey -----	22	34	Do.
Divide -----	1,061	W	Sand and gravel.
Dunn -----	25	W	Do.
Eddy -----	W	W	Sand and gravel.
Foster -----	W	--	Petroleum.
Golden Valley -----	343	W	Sand and gravel.
Grand Forks -----	W	247	Coal, sand and gravel.
Grant -----	11	30	Sand and gravel.
Griggs -----	45	W	Do.
Kidder -----	W	W	Petroleum, sand and gravel.
Logan -----	W	--	Sand and gravel, stone.
McHenry -----	140	W	Coal.
McIntosh -----	( <sup>3</sup> )	--	Clays, sand and gravel.
McKenzie -----	26,917	31,269	Petroleum, sand and gravel.
McLean -----	300	617	Sand and gravel, stone.
Mercer -----	10,279	W	Petroleum, sand and gravel.
Morton -----	W	W	Sand and gravel.
Mountrail -----	2,072	2,263	Coal, sand and gravel.
Nelson -----	--	W	Lime, sand and gravel.
Oliver -----	W	W	Sand and gravel.
Pembina -----	W	37	Do.
Pierce -----	W	15	Do.
Ramsey -----	--	W	Petroleum.
Ransom -----	57	W	Sand and gravel, lime.
Renville -----	W	W	Sand and gravel.
Richland -----	12	W	Stone, sand and gravel.
Rolette -----	W	61	Petroleum, sand and gravel.
Sheridan -----	W	147	Petroleum, coal, sand and gravel.
Slope -----	514	W	Do.
Stark -----	W	W	Sand and gravel.
Steele -----	W	--	Do.
Stutsman -----	333	410	Do.
Towner -----	W	W	Do.
Traill -----	209	216	Do.
Walsh -----	187	452	Coal, petroleum, sand and gravel.
Ward -----	W	W	Sand and gravel.
Wells -----	77	118	Petroleum, natural gas liquids, salt, sand and gravel, coal.
Williams -----	36,009	41,608	
Undistributed <sup>4</sup> -----	57,549	112,799	
Total <sup>5</sup> -----	159,427	201,504	

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

<sup>1</sup> The following counties are not listed because no production was reported: Emmons, Hettinger, La Moure, Sargent, and Sioux.

<sup>2</sup> Value of petroleum is based on an average price per barrel for the State.

<sup>3</sup> Less than ½ unit.

<sup>4</sup> Includes gem stones, natural gas, some sand and gravel which cannot be assigned to specific counties, and values indicated by symbol W.

<sup>5</sup> Data may not add to totals shown because of independent rounding.

coal gasification plants; and 2.5% of gross receipts from all other coal-energy conversion plants.

The new coal severance tax laws provided for a tax of 50 cents on each ton of coal produced during the 2-year period starting July 1, 1975, and allow for increases depending on the wholesale price index. Because of the escalator clause, the

severance tax was raised from 50 cents per ton to 52 cents on October 1, 1975.

The energy conversion and transmission facility siting act provided that "No utility shall begin construction of an energy conversion facility or transmission facility on or after either January 1, 1976, or the date of promulgation of criteria and standards . . . whichever date is earlier, or

Table 3.—Indicators of North Dakota business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	269.5	268.0	-0.6
Unemployment -----do-----	13.4	13.3	-.7
<b>Employment (nonagricultural):</b>			
Mining -----do-----	1.7	1.8	+5.9
Manufacturing -----do-----	14.1	15.2	+7.8
Contract construction -----do-----	12.1	12.2	+.8
Transportation and public utilities -----do-----	13.0	12.9	-.8
Wholesale and retail trade -----do-----	52.8	54.4	+3.0
Finance, insurance, real estate -----do-----	8.2	8.7	+6.1
Services -----do-----	37.1	39.1	+5.4
Government -----do-----	51.8	52.7	+1.7
Total nonagricultural employment -----do-----	190.8	197.0	+3.2
<b>Personal income:</b>			
Total -----millions--	\$3,629	\$3,652	+.6
Per capita -----do-----	\$5,698	\$5,737	+.7
<b>Construction activity:</b>			
Number of private and public residential units authorized	3,429	5,144	+50.0
Value of nonresidential construction -----millions--	\$47.6	\$46.7	-1.9
Value of State road contract awards -----do-----	\$40.8	\$53.0	+29.9
Shipments of portland and masonry cement to and within North Dakota -----thousand short tons--	330	380	+15.2
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$159.4	\$201.5	+26.4
Value per capita, resident population -----do-----	\$250.67	\$316.33	+26.2
Value per square mile -----do-----	\$2,256.10	\$2,851.54	+26.4

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

exercise the right of eminent domain in connection with such construction without first having obtained a certificate of siting compatibility" from the Public Service Commission (PSC).

Amendments and changes in the State's mining and reclamation laws increased the PSC's powers and authorities over the control of mining and reclamation in the State. Among other things, it reiterated the

requirement of mining and reclamation permits, made soil surveys mandatory, raised the reclamation bond to \$1,500 per acre (but allows for even higher bond requirements), and allows the PSC to require the operator to "save, segregate, and respread suitable plant growth material within the permit area up to a maximum of five feet."

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Coal (Lignite).**—North Dakota coal production in 1975 totaled 8.5 million short tons, up 13% from the 7.5 million tons produced in 1974 and the highest on record. The quantity produced accounted for 1.3% of the total U.S. bituminous coal and lignite production in 1975, compared with 1.2% of total production in 1974. Total value of coal produced was \$27 million, compared with \$16.4 million in 1974. Average value of coal, f.o.b. mine, was \$3.17 per short ton in 1975 compared with \$2.19 per ton in 1974.

All coal production was by strip-mining methods with the use of large draglines for stripping and power shovels and front-end loaders for mining the coal.

Mercer County continued as the leading lignite producer, accounting for 44% of the State total. Next largest producers were Bowman and Oliver Counties. These three counties accounted for about 90% of State production.

The United Mine Workers (UMW) coal strike curtailed production the first half of the year, affecting production at Consolidation Coal Co.'s Glenharold and Velva mines from January 13 through April 16 and at

the North American Coal Corp.'s Indian Head mine from January 13 through June 8.

**Table 4.—North Dakota: Lignite strip production, by county, in 1975**

(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines	Production (thousand short tons)	Value (thousands)
Bowman -----	1	1,953	W
Burke -----	1	405	W
Grant -----	1	4	W
Mercer -----	3	3,743	W
Oliver -----	1	1,984	W
Stark -----	1	142	W
Ward -----	1	324	W
Williams -----	1	10	W
Total -----	10	8,515	\$27,010

W Withheld to avoid disclosing individual company confidential data.

Principal coal producers in 1975 were Baukol-Noonan, Inc., which operated its Noonan mine near Larson and its Center mine near Center; Consolidation Coal Co., which operated its Glenharold mine near Stanton and its Velva mine near Velva; Knife River Coal Mining Co., which operated its Gascoyne mine near Gascoyne and its South Beulah mine near Beulah; and The North American Coal Corp., which operated its Indian Head mine near Zap. Collectively these four companies accounted for 98% of State coal production in 1975.

Most of North Dakota coal production was for consumption by nearby in-State powerplants; the only major exception was Knife River Coal Mining Co.'s shipments to Otter Tail Power Co.'s new 440-megawatt plant at Big Stone City, South Dakota, which went into operation in May. Knife River increased production capacity of its Gascoyne mine 2.5 million tons per year at a reported cost of \$10 million to provide coal for the new plant for the next 32 years.

Consolidation Coal Co. increased production capacity about 2 million tons per year at its Glenharold mine to provide coal for Basin Electric Power Cooperative's newly completed 460-megawatt Leland Olds Unit No. 2 power-generating addition at Stanton. Cost of the mine expansion was reported as \$9 million. These expansions are expected to bring North Dakota coal production to about 12.1 million tons in 1976, an increase of more than 40% over that in 1975.

Assured large increases in consumption at powerplants already under construction will boost North Dakota coal production 250% over that in 1975 to 20 million tons annually by 1980; additional highly probable increases would boost production 450% over that in 1975 to 36 million tons by 1981; and possible increases would boost production 622% to 50 million tons per year by 1981.

Production at Baukol-Noonan's Center mine is expected to increase by 2.8 million tons annually with completion of the Square Butte powerplant. This \$225 million, 400-megawatt addition to Minnkota Power Cooperative's Milton R. Young plant, now under construction, is scheduled for completion in 1977.

North American's production is expected to increase 5.5 to 6.0 million ton per year by 1980. Its subsidiary, The Falkirk Mining Co., started development of the Falkirk mine on August 4. Its entire production will be for consumption by the \$500 million, 1,000-megawatt Coal Creek electricity-generating complex under construction near Falkirk by United Power Association and Cooperative Power Association. First deliveries from the mine are scheduled for May 1978, and the mine is to reach full production capacity upon completion of the entire power-generating project, now scheduled for November 1979.

Production by North American Coal will very probably increase an additional 14 million tons per year by 1981, depending on continued progress of plans for construction of a 250-million-cubic-foot-per-day coal gasification plant by American Natural Gas Co. and its subsidiaries, Michigan-Wisconsin Pipeline Co. and American Natural Gas Coal Gasification Co. Plans call for North American to supply coal for the gasification complex through its subsidiary, The Coteau Properties Co. Present plans call for completion of the complex in 1980.

Knife River Coal Mining Co. will probably increase its production rate by 2 million tons per year if and when a planned power generation project is completed near Beulah. Present plans call for completion of the proposed 440-megawatt Coyote I powerplant by Montana-Dakota Utilities Co., Northwestern Public Service Co., and Otter Tail Power Co. in 1981.

Amx Coal Co. may become another major coal producer in North Dakota by 1981,

depending on continued progress on plans by Natural Gas Pipeline Co. of America to build a \$1 billion-plus coal gasification complex in Dunn County. Operation of the complex would require an estimated 14 million tons of coal annually.

Research and studies relating to all aspects of increased production and consumption of coal continued. Work underway included geologic mapping and drilling, collection of hydrologic and water quality data, water use studies, strip mine reclamation research, efforts to improve coal gasification and pollution control processes, social and economic impact studies, manpower availability studies, and a \$2 million computerization effort to compile, retrieve, and manipulate the vast amount of information being generated. Both industry and government were contributing to the intensive research and study effort.

Bureau of Mines mined-land reclamation research continued at the University of North Dakota under a research grant totaling over \$1 million over a 5-year period. The grant allows research begun by the Bureau in 1973 at its Grand Forks Energy Research laboratory to continue. (The energy research facility was incorporated into the newly created Energy Research and Development Administration (ERDA) in January 1974.) The objective of Project Reclamation is to investigate the nature of spoil materials overturned in the process of coal mining so that better ways to bring the land back to original productivity can be developed.

At its research center in Grand Forks, ERDA continued and expanded research on coal gasification formerly conducted by the Bureau of Mines. Objectives of the research were to extend process efficiencies and capabilities and to find ways to reduce detrimental environmental effects.

The North Dakota Geological Survey continued geologic mapping and exploration, including drilling, to provide information required to locate, delineate, and evaluate the coal and other mineral deposits in the State. It was also much involved in studies related to mined land reclamation and ground water. Several reports summarizing results of Survey efforts were published.<sup>2</sup>

The U.S. Geological Survey (USGS) had several teams of geologists in the field mapping geology, with emphasis on the areas containing Federal coal. The objective was

to provide information required to delineate Known Coal Leasing Areas (KCLA's) so that the areas can be nominated for leasing. The Survey's hydrologic branch continued to collect basic hydrologic and water quality data.

The U.S. Department of Agriculture, North Dakota State University, and the University of North Dakota, in active cooperation with industry, also continued to spend considerable sums on strip mine spoil bank reclamation with the objective of finding the most economic ways to put strip-mined land into productive use in the shortest time.

Other studies relating to increased coal production and conversion to energy concerned social and economic impacts, manpower training including minority groups, water and land use, scenic and wildlife protection, and environmental effects of all kinds. Funding often was provided through joint Federal-State efforts with many Federal agencies contributing.

**Natural Gas.**—Natural gas production totaled 24,786 million cubic feet, of which 12,121 million cubic feet went to public utilities for distribution to customers and 12,665 million cubic feet was returned to oil and gas fields for lease use including gas lift operations. Most of the gas was produced in the State's five gas-processing plants from casing-head gas, defined as "any gas or vapor, or both gas and vapor, indigenous to and produced from a pool classified as an oil pool by the (State Industrial) Commission." Production from the State's two producing gasfields totaled only 299 million cubic feet. Casing-head gas received by plants for processing totaled 32,911 million cubic feet; this figure in-

<sup>2</sup> Cvanara, A.M. Geology of the Fox Hills Formation (Late Cretaceous) in the Williston Basin of North Dakota, With Reference to Uranium Potential. N. Dak. Geol. Survey, Rept. Inv. 55, 1976, 16 pp.

Geology of the Cannonball Formation (Paleocene) in the Williston Basin, With Reference to Uranium Potential. N. Dak. Geol. Survey, Rept. Inv. 57, 1976, 22 pp.

Jacob, A. F. Geology of the Upper Part of the Fort Union Group (Paleocene), Williston Basin, With Reference to Uranium. N. Dak. Geol. Survey, Rept. Inv. 58, 1976, 49 pp.

Moore, W. L. Geology of the Hell Creek (Cretaceous) and Ludlow Formations (Paleocene) in Southwestern North Dakota, With Reference to Uranium Potential. N. Dak. Geol. Survey, Rept. Inv. 56, 1976, 40 pp.

Moran, S. R., G. H. Groenewold, L. Hemish, and C. Anderson. Development of a Pre-mining Geological Framework for Landscape Design Reclamation in North Dakota. N. Dak. Geol. Survey, Misc. Series No. 55, 1976, 9 pp.

cluded an unknown but considerable quantity of recycled material.

**Natural Gas Liquids.**—Production of natural gas liquids declined slightly in 1975. Propane accounted for most of the output followed by butane and natural gasoline. Hunt Industries ceased operation of its North Tioga gas plant in October. Casing-head gas formerly processed at the plant is now being processed at Burham Oil & Gas Co.'s Tioga gas plant. Other casing-head-gas processing plants operating in the State at yearend were Red Wing Creek gas plant south of Watford City, Coyote Creek gas plant west of Bowman, and the Lignite gas plant at Lignite.

**Petroleum.**—Crude oil production in 1975 totaled 20.5 million barrels, up about 4% from the 19.7 million barrels produced in 1974. The increase terminated the consistent downward trend since 1966 when production reached a record high of 27.1 million barrels. North Dakota's 1975 production accounted for 0.7% of total U.S. production, compared with 0.6% in 1974. Total value of crude oil produced was \$149.7 million, up \$30.7 million from its 1974 value of \$119.0 million. According to the North Dakota Geological Survey, the State had 2,036 wells capable of producing at the end of 1975, compared with 1,988 wells a year earlier. Their combined production rate at yearend was about 1.8 million barrels a month.

Drilling activity was on the increase the entire year, with the targets generally being deeper and often in heretofore unproductive areas. At yearend there were 25 to 28 drilling rigs operating in the State, compared with 10 to 12 in the previous year. Many of the rigs operating reportedly had moved south from across the border in Canada because of the more favorable economic conditions in the United States.

The North Dakota Geological Survey reported issuing 264 oil and gas well drilling permits in 1975, an increase of 52% over the 174 issued in 1974. The number of wells completed during the year totaled 202, the highest since 1969 and an increase of 104% over the 99 drilled in 1972, when drilling activity had declined to its lowest point since oil was discovered in North Dakota in 1951. The Survey classified 100 of the wells drilled as development wells and 102 as wildcats and/or extension and outpost wells located within 1½ miles of an established field boundary.

The 100 development wells resulted in 61 producers and 39 dry holes; the 102 wildcat, extension, and outpost wells resulted in 15 producers and 87 dry holes. The eight new pools discovered by wildcats were the Boxcar Butte-Red River, Hamlet-Madison, West Tioga-Red River, Little Deep Creep-Madison (a rediscovery), Cold Turkey Creek-Red River, Grand River-Red

Table 5.—North Dakota: Oil and gas well drilling completions, by county

County	Development		Wildcat		Outpost		Extension		Total wells
	Oil	Dry	Oil	Dry	Oil	Dry	Oil	Dry	
Billings	3	2	--	--	--	--	3	--	8
Bottineau	5	7	--	9	--	3	--	2	26
Bowman	1	3	2	3	--	--	3	--	12
Burke	3	--	--	3	--	2	1	2	11
Divide	3	4	--	1	1	--	--	--	9
Dunn	2	--	--	2	--	--	--	--	4
Emmons	--	--	--	5	--	--	--	--	5
Golden Valley	--	--	--	3	--	--	--	--	3
Grant	--	--	--	1	--	--	--	--	1
Hettinger	--	--	--	2	--	--	--	--	2
McIntosh	--	--	--	3	--	--	--	--	3
McKenzie	6	5	--	--	--	1	--	1	13
Morton	--	--	--	1	--	--	--	--	1
Mountrail	--	--	--	2	--	--	--	--	2
Pierce	--	--	--	3	--	--	--	--	3
Renville	26	11	2	11	--	3	1	5	59
Slope	--	--	--	1	--	--	--	--	1
Stark	6	7	--	3	--	--	--	2	18
Ward	--	--	--	7	--	2	--	--	9
Williams	6	--	2	3	--	--	--	1	12
<b>Total</b>	<b>61</b>	<b>39</b>	<b>6</b>	<b>68</b>	<b>1</b>	<b>11</b>	<b>8</b>	<b>13</b>	<b>202</b>

Source: North Dakota Geological Survey.

**Table 6.—North Dakota: Crude oil production, by county**  
(Thousand 42-gallon barrels and thousand dollars)

County	Quantity		Principal fields, 1975, in order of production
	1974	1975	
Billings -----	2,074	2,116	Fryburg, Medora, Rocky Ridge.
Bottineau -----	2,634	2,486	Newburgh, South Westhope, Wiley.
Bowman -----	1,437	1,437	Cedar Creek, Medicine Pole Hills, Coyote Creek.
Burke -----	1,186	1,024	Rival, North Tioga, Northeast Foot-hills, Black Slough.
Divide -----	169	234	North Tioga, Hamlet.
Dunn -----	1	44	Lost Bridge.
Golden Valley -----	56	49	Square Butte.
McHenry -----	15	19	Pratt.
McKenzie -----	4,441	4,257	Antelope, Charlson, Blue Buttes, Hawkeye, Clear Creek.
Mountrail -----	342	304	Tioga.
Renville -----	1,531	1,801	Sherwood, Glenburn.
Slope -----	85	79	Eleven Bar.
Stark -----	1,050	1,909	Dickinson, West Dickinson, Zenith.
Ward -----	231	175	South Lone Tree, Lone Tree.
Williams -----	4,394	4,518	Beaver Lodge, Tioga, Grenora, Capa.
Total -----	<sup>1</sup> 19,697	20,452	
Value -----	\$119,022	\$149,705	

<sup>1</sup> Data do not add to total shown because of independent rounding.

River, Lost Bridge-Madison, and Midway-Silurian.

The Boxcar Butte-Red River pool discovered by the Kerr-McGee Corp. Sheep Federal #1 in McKenzie County was reportedly completed on June 3. Crude production of 657 barrels per day (bpd) was from the Red River Formation at depths of 13,446 to 13,480 feet and 13,506 to 13,520 feet.

The Hamlet-Madison pool discovered by Filon Exploration Co.'s Vatne et al. #1 in Divide County was completed February 19, 1975, at a depth of 11,082 feet. Production of 134 bpd was reported from the Madison Formation from a depth of 7,792 to 7,802 feet.

The West Tioga-Red River discovery well in Williams County by Texacota Oil Co., the M. Borstad #1, reached a total depth of 13,075 feet. Production of 215 bpd of oil was reported from the 12,732- to 12,750-foot and the 12,822- to 12,866-foot intervals.

The Little Deep Creek pool in Renville County was discovered by Kissinger Petroleum Co.'s Koch-Haarsager #4-10. Well completion was reported on February 5. Production was 99 bpd from the Madison Formation in a zone 4,881 to 4,904 feet below the surface.

The Cold Turkey Creek-Red River pool in Bowman County was discovered by the Ken Luff-Hanover Petroleum Co. with its Ferris et al. #1-22. The 9,800-foot-deep

well was reported completed on May<sup>15</sup>. Production of 440 bpd was from the Red River Formation.

The Grand River-Red River pool discovery well, the E. Hanson 1-6 in Bowman County, was completed by Ken Luff on July 17 at a depth of 9,600 feet. Production of 132 bpd of oil was reported from the Red River Formation from the 9,353- to 9,359-foot and 9,416- to 9,432-foot intervals.

The Lost Bridge-Madison pool discovery well, the Signalness #1, was completed by Adobe Investment Corp. on April 4. This Dunn County discovery was producing 260 bpd from the Madison from a depth of 9,370 to 9,379 feet.

The Midway-Silurian discovery by Tiger Oil Co. in Williams County was reported completed on June 6. Production of 624 bpd was reported from the Nelson #21-29 discovery well from the Red River at a depth of 12,746 to 12,781 feet.

Renville County led the field in number of successful wells completed. The 37 development wells drilled resulted in 26 producers and 11 dry holes.

#### NONMETALS

**Clays.**—Production of common clay and shale decreased 36%; its value decreased 34%. Most of the clay was used in the production of lightweight aggregate and brick.

**Gem Stones.**—Agate, chalcedony, jasper,

petrified wood, and similar semiprecious gem stones gathered by amateur collectors accounted for all State gem stone production.

**Lime.**—American Crystal Sugar Co. produced quicklime in Pembina County, and Minn-dak Farmers Cooperative produced in Richland County. All production was for use in sugar refining.

**Peat.**—Peat Products Co. continued to produce reed-sedge peat in Bottineau County. Production was small because of the limited market in the four-State marketing area. The entire production was used for horticultural purposes.

**Salt.**—Production of salt decreased 7.7%; but its value increased 10%. Hardy

Salt Co. continued as the only producer. All production was in Williams County by solution mining methods. Most of the salt was for use as stock feed, as an additive in oil well drilling solution, and in water softening.

**Sand and Gravel.**—The quantity of sand and gravel produced in 1975 totaled 5,636,000 short tons valued at \$8.1 million. Compared with 1974, production increased 13%; its value increased 31%. Sand and gravel accounted for 4% of the value of all mineral commodities produced in the State. It was outranked in both output and value only by petroleum and lignite. Average value was \$1.44 per ton, compared with \$1.24 per ton in 1974.

Table 7.—North Dakota: Construction sand and gravel sold or used by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	782	1,416	826	1,319
Gravel -----	3,700	4,216	2,670	4,106
Unprocessed: Sand and gravel -----	509	486	2,140	1,961
Total -----	4,991	6,118	5,636	7,386

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

Table 8.—North Dakota: Construction aggregate (blended sand and gravel) sold or used commercially by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	848	2,228	1,138	2,606
Highway and bridge construction -----	89	144	W	W
Other construction (dams, waterworks, airports, etc.) -----	56	106	113	235
Concrete products (cement blocks, brick, pipe, etc.) -----	72	212	96	217
Bituminous paving (asphalt and tar paving) -----	509	446	207	493
Roadbase and subbase -----	322	285	109	150
Fill -----	111	169	W	W
Other -----	11	15	--	--
Unprocessed:				
Roadbase and subbase -----	80	53	273	278
Fill -----	356	360	196	254
Total -----	2,454	4,018	2,132	<sup>1</sup> 4,232

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>1</sup> Data do not add to total shown because of independent rounding.



**Table 9.—North Dakota: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	W	W	165	278
Highway and bridge construction -----	42	165	158	243
Other construction (dams, waterworks, airports, etc.) -----	W	W	W	W
Concrete products (cement blocks, brick, pipe, etc.) -----	--	--	W	W
Bituminous paving (asphalt and tar paving) -----	493	584	564	962
Roadbase and subbase -----	1,771	1,313	841	752
Fill -----	96	58	W	W
Other -----	62	W	110	83
<b>Unprocessed:</b>				
Roadbase and subbase -----	--	--	1,400	1,394
Fill -----	73	73	266	189
Other -----	--	--	W	W
Total -----	2,537	2,193	<sup>1</sup> 3,505	3,901

W Withheld to avoid disclosing individual company confidential data; included with "Highway and bridge construction."

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Stone.**—The only stone production in the State consisted of field stone (glacial erratics collected from farmers' fields) and scoria (a baked clay formed by a naturally occurring process whereby lignite strata burning in situ baked the overlying clay formations). The field stone is used sporadically as riprap in construction of dams, canals, and similar structures; the scoria is used as a kind of low-quality traprock in road construction by county highway departments and ranchers, with smaller quantities used in landscaping.

**Sulfur.**—Natural gas processing plants

at Lignite, Burke County, owned by Texaco, Inc., and at Tioga, Williams County, owned by Burham Oil & Gas Co., recovered elemental sulfur as a by-product. Both production and value accounted for less than 1% of State mineral commodity production and value totals.

**Vermiculite.**—Robinson Insulation Co. at Minot continued to produce exfoliated vermiculite from vermiculite shipped into the State. The material was used for block insulation, loose fill insulation, concrete aggregate, plaster aggregate, and litter (agriculture).

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Clays: Hebron Brick Co -----	Hebron, N. Dak. 58638 ----	Pit and plant	Morton.
Coal: Baukol-Noonan, Inc -----	Noonan, N. Dak 58765 ----	Strip mines and plants.	Burke and Oliver.
Consolidation Coal Co -----	Box 200 Stanton, N. Dak. 58571	---do-----	Mercer and Ward.
Knife River Coal Mining Co --	1915 North Kavaney Dr. Bismarck, N. Dak. 58501	---do-----	Mercer, Oliver, Ward.
The North American Coal Corp (The Falkirk Mining Co. and The Coteau Properties Co.	Kirkwood Office Tower Bismarck, N. Dak. 58501	---do-----	Mercer and McLean.
Lime:			
American Crystal Sugar Co --	101 North 3d St. Moorhead, Minn. 56506	Shaft kiln at beet sugar refinery.	Pembina.
Minn-dak Farmers Coop -----	Wahpeton, N. Dak. 58075 -	---do-----	Richland.
Natural gas and petroleum, crude:			
Amerada Hess Corp -----	1 Hess Plaza Woodridge, N.J. 07095	Oil -----	Various.
American Oil Co -----	Box 549 Mandan, N. Dak. 58554	Refinery ----	Morton.
Amoco Production Co -----	Box 5430-A Chicago, Ill. 60680	Wells -----	Various.
Burmah Oil & Gas Co -----	Box 457 Tioga, N. Dak. 58852	Gas processing plant.	Williams.
Chevron Oil Co., Western Div -	Box 599 Denver, Colo. 80202	Oil and gas exploration and production.	Various.
Chandler & Associates, Inc ---	1401 Denver Club Bldg. Denver, Colo. 80202	Oil and gas exploration.	Do.
Farmers Union Central Exchange (CENEX).	Box 126 Laurel, Mont. 59044	Gas-processing plant, exploration, production.	Yellowstone and various.
Hunt Industries -----	1401 Elm St. Dallas, Tex. 75202	Gas-processing plant, oil and gas production.	Williams.
Kerr-McGee Corp -----	Box 25861 Oklahoma City, Okla. 73125	---do-----	McKenzie.
Marathon Oil Co -----	539 South Main St. Findlay, Ohio 45840	Production, marketing, refining.	Various.
Petroleum, Inc -----	Suite 800, 300 West Douglas Wichita, Kans. 67202	Oil and gas exploration and production.	Do.
Shell Oil Co -----	1710 Broadway Denver, Colo. 80202	Production and marketing.	Various.
The Signal Companies, Inc ---	1200 Security Life Bldg. Denver, Colo. 80202	Drilling, production.	Do.
Tenneco Oil Co -----	Box 2511 Houston, Tex. 77001	Oil -----	Do.
Texaco, Inc -----	Box 2100 Denver, Colo. 80201	Production --	Do.
Union Oil Co. of California --	Box 7600 Los Angeles, Calif. 90017	Exploration and production.	Various.
Westland Oil Co -----	504 East Central Minot, N. Dak. 58701	Refinery ---	Williams.
Salt: Hardy Salt Co -----	Box 728 Williston, N. Dak. 58801	Well and plant.	Do.
Sand and gravel:			
Dakota Sand & Gravel Co ---	Box 22 Bismarck, N. Dak. 58501	Pit and plant	Burleigh.
Jamestown Sand & Gravel Co -	Ypsilanti, N. Dak. 58497 --	---do-----	Stutsman.
Minot Sand & Gravel Co -----	Box 116 Minot, N. Dak. 58701	---do-----	Ward.
Northern Improvement Co ---	Box 1254 Bismarck, N. Dak. 58501	---do-----	Various.
Shenney Sand & Gravel, Inc -	Box 843 New Rockford, N. Dak. 58356	---do-----	Eddy and Foster.



# The Mineral Industry of Ohio

By William S. Miska <sup>1</sup>

The value of Ohio's mineral production during 1975 increased 22% over that of 1974, reaching \$1.4 billion, another alltime record high for the 14th consecutive year. The increase was mainly the result of higher unit values for output of coal, natural gas, crude petroleum, lime and salt. Only the output of coal, crude petroleum, and salt increased in quantity. The quantities of all other mineral commodities mined in Ohio declined.

Mineral production value in the State was divided as follows: Coal, 57%; petroleum, 8%; stone, 8%; lime, 7%; portland and masonry cements, 6%; sand and gravel, 5%; natural gas, 4%; salt, 4%; and all remaining commodities combined, 1%.

Ohio's leading mineral producing counties were Belmont and Jefferson, with output valued at \$251 million and \$76 million, respectively. Nationally, the State continued to be an important producer of bituminous coal, stone, lime, salt, and clay.

**Legislation and Government Programs.**—During 1975, the Ohio General Assembly enacted the following laws that directly or indirectly affect the mineral industry:

1. Amended Substitute House Bill 191, which became effective October 10, 1975, replaces the existing system of 1-year licenses for coal strip mining with a sys-

<sup>1</sup> State Liaison Officer—(Indiana and Ohio), Bureau of Mines, Bloomington, Ind.

Table 1.—Mineral production in Ohio <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>Cement:</b>				
Masonry -----thousand short tons..	158	\$5,227	136	\$4,576
Portland -----do-----	2,884	73,815	2,364	70,268
Clays -----do-----	4,325	13,488	3,451	11,822
Coal (bituminous) -----do-----	45,409	559,519	46,770	766,875
Gem stones -----do-----	NA	8	NA	W
Lime -----thousand short tons..	4,171	93,695	3,482	95,136
Natural gas -----million cubic feet..	92,055	44,371	84,960	59,982
Peat -----thousand short tons..	5	74	4	99
Petroleum (crude) -----thousand 42-gallon barrels..	9,088	89,348	9,578	113,917
Salt -----thousand short tons..	5,029	49,089	5,083	54,661
Sand and gravel -----do-----	41,353	68,258	37,195	68,552
Stone -----do-----	<sup>2</sup> 51,709	<sup>2</sup> 105,098	46,303	108,580
Value of items that cannot be disclosed:				
Other nonmetals and values indicated by symbol W -----	XX	5,680	XX	1,996
Total -----	XX	1,107,670	XX	1,356,454
Total 1967 constant dollars -----	XX	523,706	XX	<sup>P</sup> 537,156

<sup>P</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes dimension stone; included with "Value of items that cannot be disclosed."

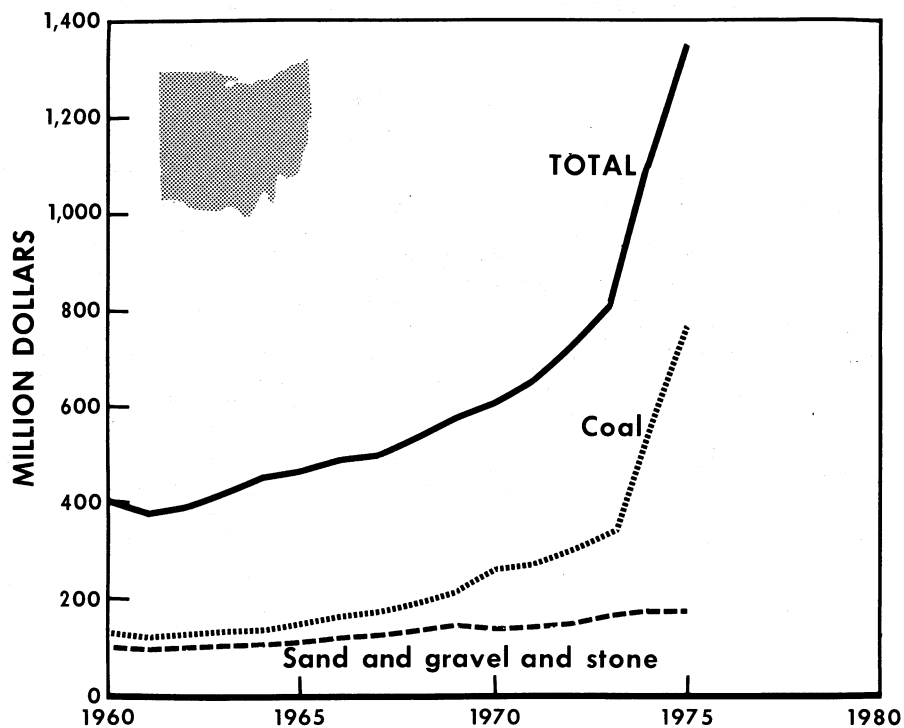


Figure 1.—Value of coal, sand and gravel, stone, and total value of mineral production in Ohio.

Table 2.—Value of mineral production in Ohio, by county <sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams	W	W	Stone.
Allen	\$2,564	\$2,056	Do.
Ashland	345	382	Sand and gravel.
Ashtabula	W	W	Lime, sand and gravel.
Athens	W	2,389	Coal, stone, sand and gravel, clays.
Auglaize	W	W	Sand and gravel, stone, clays.
Belmont	189,976	251,055	Coal, stone.
Brown	W	271	Sand and gravel, stone.
Butler	3,988	4,102	Sand and gravel.
Carroll	3,155	W	Coal, stone, sand and gravel, clays.
Champaign	W	W	Sand and gravel, peat.
Clark	W	W	Sand and gravel, stone.
Clermont	W	W	Do.
Clinton	W	W	Stone, sand and gravel.
Columbiana	10,701	13,547	Coal, clays, sand and gravel.
Coshocton	W	W	Coal, sand and gravel, stone, clays.
Crawford	W	W	Stone, sand and gravel.
Cuyahoga	16,374	19,279	Salt, lime, clays, sand and gravel, peat.
Darke	W	W	Sand and gravel, clays.
Defiance	W	W	Sand and gravel.
Delaware	3,123	2,907	Stone, clays.
Erie	12,861	W	Lime, stone, sand and gravel.
Fairfield	586	627	Sand and gravel.
Fayette	W	W	Stone.
Franklin	10,787	W	Sand and gravel, stone, clays, peat.
Gallia	W	W	Coal, sand and gravel, stone.
Geauga	W	W	Sand and gravel, stone.
Greene	29,600	W	Cement, stone, sand and gravel, clays.
Guernsey	12,735	W	Coal, stone.
Hamilton	6,912	6,765	Sand and gravel.
Hancock	1,218	W	Stone, lime.
Hardin	W	W	Stone.
Harrison	W	W	Coal, stone, clays.
Henry	W	W	Sand and gravel, clays.
Highland	1,083	1,244	Stone, sand and gravel.
Hocking	W	W	Coal, sand and gravel, clays.
Holmes	8,282	8,763	Coal, stone, clays, sand and gravel.
Huron	W	W	Sand and gravel, stone.
Jackson	8,297	13,702	Coal, clays, stone, sand and gravel.
Jefferson	70,136	75,623	Coal, clays.
Knox	W	W	Stone, sand and gravel.
Lake	30,626	W	Lime, salt, sand and gravel.
Lawrence	9,330	W	Cement, coal, clays, sand and gravel, stone.
Licking	W	W	Sand and gravel, clays.
Logan	1,048	990	Stone, sand and gravel.
Lorain	14,060	W	Lime, stone, sand and gravel, grindstone.
Lucas	10,609	W	Cement, stone, sand and gravel, clays.
Madison	W	W	Stone, sand and gravel.
Mahoning	13,221	W	Coal, stone, clays, sand and gravel, peat.
Marion	2,293	2,254	Stone, sand and gravel, clays.
Medina	W	W	Sand and gravel, clays.
Meigs	W	W	Coal, sand and gravel.
Mercer	W	W	Stone.
Miami	W	4,023	Stone, sand and gravel.
Monroe	12,659	W	Coal, stone, sand and gravel.
Montgomery	W	W	Sand and gravel, stone.
Morgan	6,413	W	Coal, sand and gravel, stone.
Morrow	123	140	Sand and gravel.
Muskingum	79,336	W	Coal, cement, stone, sand and gravel, clays.
Noble	W	W	Coal, stone, clays.
Ottawa	15,631	W	Stone, lime, gypsum.
Paulding	W	W	Cement, stone, clays.
Perry	25,107	36,293	Coal, stone, clays.
Pickaway	W	W	Sand and gravel, stone.
Pike	W	W	Do.
Portage	5,939	6,593	Sand and gravel.
Preble	W	W	Sand and gravel, stone.
Putnam	664	533	Stone, clays.
Richland	W	W	Sand and gravel, clays, peat.
Ross	W	W	Sand and gravel, stone.
Sandusky	44,265	W	Lime, stone.
Scioto	1,363	W	Stone, clays, sand and gravel.
Seneca	13,314	W	Lime, stone, clays.
Shelby	W	734	Stone, clays, sand and gravel.
Stark	18,174	19,550	Cement, coal, sand and gravel, stone, clays.
Summit	W	W	Salt, sand and gravel, stone.
Trumbull	W	W	Sand and gravel, stone.
Tuscarawas	24,219	W	Coal, sand and gravel, clays, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Ohio, by county<sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Union -----	W	W	Stone.
Van Wert -----	\$848	\$1,222	Do.
Vinton -----	13,263	W	Coal, clays.
Warren -----	W	W	Sand and gravel, stone.
Washington -----	W	1,745	Coal, sand and gravel, stone.
Wayne -----	18,425	21,217	Salt, sand and gravel, stone, coal, clays.
Williams -----	585	564	Sand and gravel, peat.
Wood -----	2,622	2,698	Stone.
Wyandot -----	10,733	W	Stone, lime, sand and gravel, peat, clays.
Undistributed <sup>2</sup> -----	340,069	855,189	
Total <sup>3</sup> -----	1,107,670	1,356,454	

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

<sup>1</sup> Fulton County is not listed because no production was reported. County data for natural gas and petroleum values are not available; included with "Undistributed."

<sup>2</sup> Includes natural gas, petroleum, gem stones, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Ohio business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands--	4,708.0	4,726.0	+0.4
Unemployment ----- do-----	225.0	430.0	+91.1
<b>Employment (nonagricultural):</b>			
Mining ----- do-----	24.4	26.8	+9.8
Manufacturing ----- do-----	1,413.8	1,258.0	-11.0
Contract construction ----- do-----	164.8	145.6	-11.7
Transportation and public utilities ----- do-----	223.7	214.7	-6.1
Wholesale and retail trade ----- do-----	874.4	866.1	-.9
Finance, insurance, and real estate ----- do-----	176.6	176.4	-.1
Services ----- do-----	674.4	695.8	+3.2
Government ----- do-----	613.1	625.9	+2.1
Total nonagricultural employment ----- do-----	4,170.2	4,009.5	-3.9
<b>Personal income:</b>			
Total ----- millions--	\$58,901	\$62,514	+6.1
Per capita ----- do-----	\$5,481	\$5,810	+6.0
<b>Construction activity:</b>			
Number of private and public residential units authorized--	42,444	39,080	-7.9
Value of nonresidential construction ----- millions--	\$813.7	\$689.1	-15.3
Value of State road contract awards ----- do-----	\$212.5	\$261.0	+22.8
Shipments of portland and masonry cement to and within the State ----- thousand short tons--	3,530	3,027	-14.2
<b>Mineral production value:</b>			
Total crude mineral value ----- millions--	\$1,107.7	\$1,356.5	+22.5
Value per capita, resident population ----- do-----	\$99.64	\$126.28	+26.7
Value per square mile ----- do-----	\$25,973.27	\$32,884.48	+26.6

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

tem of 3-year permits and 1-year licenses; revises coal strip mine operator reporting requirements and procedures for posting bond; and revises provisions governing extension of the reclamation period. The act sets the annual license fee at \$150 and the fee for a permit at \$30 per acre to be mined during the 3-year period.

2. Amended House Bill 63 was enacted effective August 26, 1975. The act estab-

lished a joint legislative Ohio Land Use Review Committee to review land use activities and submit a final report of related legislative proposals by January 31, 1977. The act required the committee to establish citizen advisory committees and to conduct meetings and public hearings at various locations.

3. Amended Substitute House Bill 584, which became effective August 26, 1975,

creates the Ohio Energy and Resources Development Agency (ERDA); abolishes the Ohio Development Center and incorporates its property, staff, and assets into ERDA; and allows ERDA to assume some of the powers and duties of the Energy Emergency Commission when the commission expires on January 1, 1976. The act empowers ERDA to construct, lease, or dispose of powerplants, gasification or fuel refinery facilities, or any other facilities for the development or conservation of energy; permits ERDA to make loans for energy development facilities to be financed by revenue bonds and notes and to undertake and make grants for energy development or conservation research and demonstration projects from General Revenue Fund appropriations, Federal assistance, and other sources of grant money; extends personal property and corporate franchise tax exemptions to federally assisted coal gasification or conversion facilities and to privately sponsored coal conversion or coal desulfurization facilities that demonstrate new technology or commercial feasibility; and empowers the Governor to declare energy emergencies and energy crises and to take actions designed to alleviate or manage energy crises.

4. Amended Substitute Senate Bill 104 was enacted effective August 1, 1975. The act permits direct loans from the State to private corporations and individuals for industrial development activities and procurement of pollution control and solid waste facilities; permits bonds to be issued for the construction of facilities producing electricity that also convert or dispose of solid waste; and has other provisions concerning exemption from taxes and prevailing wage requirements at such facilities.

On October 10, 1975, the Ohio Division of Reclamation replaced a system of 1-year licenses for coal strip mining with a system of 3-year permits and 1-year licenses. During the remainder of the year, 102 companies received licenses, and 76 permits to strip-mine were issued to these companies. The annual expiration date for licenses is August 31. Under the new and old systems, 33,775 acres of coal lands were bonded during 1975. Only about half of the total acreage under bond is expected to be affected by mining. The division approved grading work for partial release of bond on 12,700 acres during 1975. Remaining bond

was also released for completion of planting work on 14,300 acres.

The Ohio Division of Geological Survey published Report of Investigations No. 97, Potential Use of Ohio Clays in the Well-Plugging Industry; Information Circular No. 42, Catalog of Oil and Gas Wells in "Newburg" (Silurian) of Ohio; Information Circular No. 43, Surbsurface Liquid-Waste Injection in Ohio; Geological Notes No. 1, Preliminary Report on Potential Hydrocarbon Reserves Underlying the Ohio Portion of Lake Erie; and Geological Notes No. 2, Sand and Gravel Resources of Madison County, Ohio. Among other publications released by the Ohio Division of Geological Survey were Bulletin 65, Ohio—An American Heartland, and Educational Leaflets 8 and 9 on coal and earthquakes in Ohio, respectively.

**Employment and Injuries.**—During 1975, Federal mine inspectors from the Mining Enforcement and Safety Administration conducted 5,015 inspections and investigations at Ohio coal mines as follows: 693 regular health and safety inspections, 2,517 spot inspections, 347 violation follow-up inspections, and 1,458 other inspections and investigations including such matters as accidents, accident prevention, electrical, and complaints. Federal metal and nonmetal mine inspectors performed a total of 661 regular inspections and 583 spot inspections at clay, cement, stone, sand and gravel, peat, gypsum, and salt operations.

State mine inspectors from the Ohio Division of Mines conducted 3,747 inspections at coal and nonmetal operations and spent a total of 998 days witnessing the plugging of abandoned oil and gas wells which had been drilled through coal-bearing formations.

Employment in Ohio's mineral industries, excluding petroleum and natural gas, totaled 21,197 persons during 1975. Coal industry employment ranked first with 63% of the total, followed by limestone and dolomite, 10%; sand and gravel, 9%; lime, 6%; clays, 4%; cement and sandstone, 3% each; and all remaining industries combined, 2%.

Injuries in coal mining operations included 6 fatalities, 580 nonfatal disabling injuries, and 405 nondisabling injuries. Nonmetal mineral producers reported 5



Table 4.—Ohio: Mineral industry employment and injuries in 1975<sup>1</sup>

Mineral	Number employed	Man-hours	Fatal injuries	Fatal frequency rate (per million man-hours)	Nonfatal disabling injuries	Nonfatal disabling frequency rate (per million man-hours)
<b>Coal:</b>						
Underground -----	8,394	15,103,539	4	0.26	470	31.12
Surface -----	4,162	9,366,416	1	.11	89	9.50
Mills -----	777	1,540,743	1	.65	21	13.63
Total -----	13,333	26,010,698	6	.23	580	22.18
<b>Cement:</b>						
Underground -----	67	138,148	--	--	--	--
Surface -----	114	161,979	--	--	6	37.04
Mills -----	487	898,027	--	--	--	--
Office -----	43	76,120	--	--	--	--
Total -----	711	1,274,274	--	--	6	4.71
<b>Clays:</b>						
Underground -----	56	115,544	--	--	4	34.62
Surface -----	207	314,128	1	3.18	--	--
Mills -----	450	774,623	--	--	6	7.75
Office -----	112	197,521	--	--	--	--
Total -----	825	1,401,816	1	.71	10	7.13
<b>Gypsum:</b>						
Underground -----	20	44,360	--	--	--	--
Surface -----	9	18,051	--	--	--	--
Mills -----	20	48,811	--	--	2	40.97
Total -----	49	111,222	--	--	2	17.98
<b>Lime:</b>						
Surface -----	247	573,411	--	--	24	40.11
Mills -----	757	1,605,833	--	--	22	13.70
Office -----	168	314,178	--	--	--	--
Total -----	1,172	2,493,422	--	--	46	18.05
<b>Limestone and dolomite:</b>						
Underground -----	17	34,906	--	--	--	--
Surface -----	915	1,838,491	1	.54	37	20.13
Shop -----	10	17,914	--	--	--	--
Mills -----	857	1,732,619	1	.58	23	13.27
Office -----	302	580,353	--	--	--	--
Total -----	2,101	4,204,233	2	.48	60	14.27
<b>Sandstone:</b>						
Surface -----	202	376,374	--	--	29	66.42
Mills -----	365	741,550	--	--	24	31.02
Office -----	73	142,917	--	--	--	--
Total -----	640	1,260,841	--	--	53	38.07
<b>Miscellaneous stone:</b>						
Surface -----	3	1,716	--	--	--	--
Office -----	2	1,144	--	--	--	--
Total -----	5	2,860	--	--	--	--
<b>Peat:</b>						
Surface -----	1	1,050	--	--	--	--
<b>Sand and gravel:</b>						
Surface -----	1,619	2,764,894	1	.36	40	13.38
Office -----	352	582,464	--	--	--	--
Total -----	1,971	3,347,358	1	.30	40	11.05
<b>Salt:</b>						
Underground -----	299	686,591	1	1.46	19	27.67
Mills -----	31	59,928	--	--	4	66.75
Office -----	59	119,577	--	--	--	--
Total -----	389	866,096	1	1.15	23	26.56
<b>Grand total:<sup>2</sup></b>						
Underground -----	459	1,019,549	1	.98	23	22.56
Surface -----	3,317	6,050,094	3	.50	136	21.16
Shop -----	10	17,914	--	--	--	--
Mills -----	2,967	5,861,391	1	.17	81	13.65
Office -----	1,111	2,014,274	--	--	--	--
Total -----	7,864	14,963,222	5	.33	240	15.44

<sup>1</sup> All data are preliminary.<sup>2</sup> Excludes coal.

Source: Mining Enforcement and Safety Administration.

fatalities, 240 nonfatal disabling injuries, and 129 nondisabling injuries.

The Portland Cement Association awarded safety trophy reawards to Columbia Cement Corp.'s Zanesville plant, Diamond-Kosmos Cement Division of The Flintkote Co.'s Middlebranch plant, Marquette Cement Manufacturing Co.'s Superior plant, and Universal Atlas Cement Division of United States Steel Corp.'s plant at Fairborn. Each of the plants completed the year without a lost-time accident.

In its 1975 safety contest, the National Sand and Gravel Association awarded certificates of achievement in safety to contestants who operated in 1975 without lost-time accidents as follows: Class B (plants producing from 550,000 to 1,499,999 tons)—American Aggregates Corp., Dayton north plant; and two Dravo Corp. plants, Camp Dennison and Cleves; Class C (225,-

000 to 549,999 tons)—American Materials Corp., Hamilton plant; Dravo Corp., Ross plant; Standard Slag Co., Cutlip plant; Class D (170,000 to 224,999 tons)—American Aggregates Corp., Springfield plant; Class E (60,000 to 169,999 tons)—American Materials Corp., Harrison plant; Rubber City Sand & Gravel Co., Knight plant; Sidney Sand & Gravel Co., Sidney plant.

Four Ohio operations received safety awards for an injury-free year during 1975 in the National Crushed Stone Association 50th Annual Safety Contest as follows: Group III (50,001 to 100,000 man-hours worked)—National Lime & Stone Co., general offices; Group IV (30,001 to 50,000 man-hours worked)—two National Lime & Stone Co. quarries, Findlay and Buckland; Group V (less than 30,000 man-hours worked)—Western Ohio Stone Corp., Lima quarry.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Coal (Bituminous).**—Ohio's coal production in 1975 was 47 million tons valued at \$767 million. In terms of value, coal continued to be the State's principal mineral commodity. Output increased 3% in quantity and 37% in value. Value of Ohio's coal averaged \$16.40 per ton at the mine in 1975, compared with \$12.32 per ton in 1974. Of the 348 mines that produced coal, 267 strip mines accounted for 53% of the total output; 33 underground mines, 33%; 23 strip-auger mines, 13%; and 25 auger mines, 1%.

Belmont County was the leading area in coal tonnage and accounted for 15.3 million tons, followed by Harrison, Jefferson, and Muskingum Counties, with 6.6 million, 4.1 million, and 3.2 million tons, respectively. Coshocton and Perry Counties also were major coal-producing areas.

Nineteen mechanical coal cleaning plants produced 14.1 million tons of salable coal and 7.7 million tons of refuse. Three of the plants operated six thermal drying units to dry 605,000 tons of coal.

About 28.4 million tons of Ohio's coal output was transported by rail or water, including 15 million tons by unit train; 12.6 million tons was transported by truck; 5.7 million tons was conveyed to mine-

mouth electric power generating plants; and the rest was consumed locally.

Ohio was the leading consumer of the Nation's coal output. Coal consumption in Ohio during 1975 was 68,019,000 tons, of which about 49% came from mines in the State; 35%, from West Virginia, Virginia, and eastern Kentucky; 10%, from Pennsylvania; 3%, from western Kentucky; 2%, from Wyoming and Utah; and most of the remaining 1% from Indiana and Colorado. Electric utilities used 68% of the coal consumed in the State; coke and gas plants used 18%; and most of the remainder was used by industrial plants. Although Ohio consumes half again as much tonnage of coal as it produces, about 27% of its own production was shipped to out-of-State customers as follows: Michigan, 20%; Tennessee, 4%; West Virginia and Pennsylvania, 2%; and most of the remainder to Wisconsin, New York, Minnesota, and Canada.

The Ohio State Supreme Court defined the areas in which coal mines can be assessed sales and use taxes. The court said underground mining begins with the digging of the mine shaft and ends with the coal-blending facility, while strip mining begins with removal of the overburden from the vein. For tax purposes, only such items as are used or consumed after the

mining process begins and before it ends are exempted. The court's decision affirmed the Board of Tax Appeals action, appealed by Consolidation Coal Co., which held that standby safety equipment, equipment used for strip mine blasting and road maintenance, and equipment to reclaim strip-mined areas were taxable.

Quarto Mining Co., owned by North American Coal Co., announced plans to expand output at its Powhatan No. 4 and Powhatan No. 7 mines in Monroe County. Both are slated to reach an annual capacity of 3.2 million tons. The No. 4 is expected to reach full production in 1978, and No. 7 in 1980 or 1981. The combined output of 6.4 million tons will be sold to a consortium of electric-power-generating companies. More than 50,000 acres of coal lands have been acquired for assignment to the two mines, and each mine will have sufficient reserves in the Pittsburgh seam to last more than 30 years.

The Youghiogheny and Ohio Coal Co. held groundbreaking ceremonies in July for the new Cadiz Portal for the Nelms No. 1 mine near Cadiz in Harrison County. Construction of the 530-foot shaft is expected to be completed by early 1977. An 8,000-foot-long conveyor will be constructed to transport coal from the new shaft to the coal preparation plant at the mine's Nelms Portal. Late in the year, Youghiogheny and Ohio Coal Co. officials announced that the company would be sold to the Panhandle Eastern Pipe Line Co.

Island Creek Coal Co. began work to reopen its Vail mine in Harrison County. An underground operation, the Vail mine was first opened in 1968 and closed in November 1972. Output at the mine was expected to reach an annual capacity rate of 400,000 tons by mid-1976.

Blue Creek Coal Co. was fined \$10,000 for mining without a license. It was the firm's third conviction for violation of the State's mining law in a little more than a year.

The Miner One training program at Clarington, Belmont County, was doubled in size during the latter part of June to meet the demand for qualified trainees in underground coal mine jobs. The program, which entails 6 weeks of training in 9 specialized courses, was expanded to 6 classes with a total of 120 trainees. Classes were staggered so that every 2 weeks 40 trainees will have completed their six

weeks of training. About 98% of the 400 men trained in the school year ending in June obtained employment in coal mines.

**Coke and Coal Chemicals.**—Ohio ranked third in coke production in the Nation after Pennsylvania and Indiana. Output of coke, produced by 8 firms at 12 plants in 10 counties, decreased 4%. During the year, 12,296,000 tons of coal was carbonized to produce 8,467,000 tons of coke, a yield of about 69%. No coking coal was produced in Ohio. About 66% of the coking coal used in the State came from West Virginia, Virginia, and Kentucky; 33% came from Pennsylvania; and the remainder came from several Southeastern and Western States. The value of the coal carbonized was \$517,948,000, or \$42.12 per ton.

The steel industry consumed 7,595,000 tons, or 90%, of the coke production for making pig iron and steel. The value of the coke used for iron and steel making was \$585,161,000. Coke was produced by Semet-Solvay Division of Allied Chemical Corp. in Lawrence County; Armco Steel Corp. at two plants in Butler County; Diamond Shamrock Chemical Co. in Lake County; Empire-Detroit Steel Div. of Cyclops Corp. in Scioto County; Interlake Steel Corp. in Lucas County; Republic Steel Corp. at four plants in Trumbull, Stark, Cuyahoga, and Mahoning Counties; United States Steel Corp. in Lorain County; and Youngstown Sheet & Tube Co. in Mahoning County. These companies also produced 739,000 tons of coke breeze for utilization at agglomeration plants and for other industrial uses.

**Peat.**—Peat sales totaled 4,444 tons valued at \$99,300, a decrease of 4% in quantity but an increase of 34% in value compared with the 1974 figures. The average value of peat increased \$6.46 per ton to \$22.35, compared with \$15.89 per ton in 1974. Seven companies reported peat production in seven counties. The types of peat produced included humus, moss peat, and reed-sedge. The peat was used principally in bulk form for soil conditioning. Other uses included potting soils and worm culture.

**Petroleum and Natural Gas.**—Production of crude petroleum increased for the second consecutive year. The total amount produced from 15,165 wells<sup>2</sup> was 9,578,000

<sup>2</sup> World Oil. Feb. 15, 1976, p. 92.

barrels, or 5.4% more than produced in 1974. Total value of crude production was \$113,917,000, an increase of 27% from 1974 output.

The number of wells drilled for oil and gas during 1975 decreased 32%, from 1,788 wells in 1974 to 1,220 wells in 1975, and total footage drilled decreased 33%, from 7,359,000 feet to 4,898,000 feet, during the same period, according to the Ohio Division of Oil and Gas. Of the 1,220 wells, 98 were classified by the division as exploratory and 1,122 as proved field wells. Rotary tools were used to drill 666 wells, or 55% of the total, and cable tools drilled 554 wells, or 45%. The drilling success ratio for all wells drilled was 90.6%, with 208 wells producing oil, 417 gas, and 480 a combination of oil and gas. Dry holes

totalled 115 and accounted for 8.5% of the total footage drilled.

Clinton and Medina Sandstones of Silurian age were the principal targets with 1,028 productive wells and 74 dry holes drilled into these rocks. The Lower Mississippian Berea Sandstone was second with 54 productive wells and 8 dry holes.

A total of 41 of Ohio's 88 counties reported oil and gas drilling activity during 1975, and 33 of the 41 counties reported finding oil or gas. Muskingum County with 127 wells drilled remained the most active county for the second consecutive year. Coshocton County ranked a close second with 125 wells drilled, and Carroll County was third with 96 wells.

Natural gas production decreased 8% in quantity and increased 35% in value. The 84,960 million cubic feet of natural gas

Table 5.—Ohio: Oil and gas well drilling in 1975, by county

County	Gas wells	Oil wells	Combination wells <sup>1</sup>	Dry holes	Total		Percent productive
					Wells	Footage	
Ashland	1	2	1	3	7	9,743	57.1
Ashtabula	8	--	15	1	24	83,316	95.8
Athens	--	3	2	1	6	4,322	83.3
Carroll	2	70	23	1	96	539,346	99.0
Columbiana	3	--	--	3	6	36,994	50.0
Coshocton	33	24	60	8	125	436,052	93.6
Crawford	--	--	--	2	2	5,900	--
Cuyahoga	--	--	--	1	1	5,800	--
Fairfield	2	3	1	--	6	15,506	100.0
Fayette	--	--	--	1	1	2,204	--
Gallia	4	1	7	--	12	20,373	100.0
Geauga	--	--	--	1	1	4,175	--
Guernsey	16	--	31	3	50	311,634	94.0
Harrison	7	1	1	1	10	49,212	90.0
Henry	3	--	--	1	4	7,257	75.0
Hocking	3	11	45	5	64	194,620	92.2
Holmes	7	4	29	3	43	139,320	93.0
Huron	--	--	--	1	1	1,900	--
Jefferson	--	--	--	1	1	1,475	--
Knox	4	13	34	4	55	158,067	92.7
Lawrence	1	--	--	--	1	2,795	100.0
Licking	1	17	23	5	46	131,538	89.1
Lorain	1	--	--	4	5	11,654	20.0
Mahoning	17	11	--	3	31	168,531	90.3
Medina	8	--	5	3	16	55,486	81.3
Meigs	10	1	1	3	15	32,160	80.0
Monroe	--	--	--	1	1	1,120	--
Morgan	10	--	5	--	15	69,562	100.0
Morrow	1	2	1	11	15	47,881	26.7
Muskingum	51	17	51	8	127	485,976	93.7
Noble	21	2	1	9	33	157,095	72.7
Paulding	1	--	--	--	1	1,410	100.0
Perry	6	10	58	7	81	269,062	91.4
Portage	24	--	40	6	70	294,135	91.4
Scioto	--	--	--	1	1	376	--
Stark	15	8	14	3	40	196,475	92.5
Summit	4	--	--	--	4	14,762	100.0
Trumbull	67	--	4	2	73	353,022	97.3
Tuscarawas	66	6	18	--	90	448,861	100.0
Washington	8	--	3	3	14	37,397	78.6
Wayne	12	2	7	5	26	91,396	80.8
Total	417	208	480	115	1,220	4,897,915	90.6

<sup>1</sup> Produces both oil and gas.

Source: Ohio Division of Oil and Gas.

produced in Ohio during 1975 accounted for 9% of the 956,876 million cubic feet of gas used by Ohio consumers. Natural gas consumption in the State was divided as follows: Residential, 45%; industrial, 36%; commercial, 17%; electric utilities, natural gas pipeline companies, and other consumers, 2%. Because of shortages and curtailments, natural gas consumption in 1975 was 12% less than in 1974.

Reserves at the end of 1975 amounted to 1,354,010 million cubic feet of natural gas and 121 million barrels of crude petroleum, according to the American Gas Association and the American Petroleum Institute. Compared with yearend 1974, reserves of natural gas increased by 45,800 million cubic feet and proved reserves of crude petroleum decreased by 3 million barrels. Of the natural gas reserves at yearend 1975, 384,990 million cubic feet was held in underground storage reservoirs.

According to the Ohio Energy and Resource Development Agency, about 50 industrial firms were active in "self-help" natural gas drilling efforts during 1975. The "self-help" program was launched by the Governor to encourage industries faced with natural gas supply curtailments to drill on their own property or contract directly with oil and gas drilling firms. Among the large Ohio industrial firms engaged in successful gas drilling activities were General Motors Corp., Youngstown Sheet & Tube Co., Kaiser Aluminum Corp., Ford Motor Corp., Whirlpool Corp., American Motors Corp., and Park-Ohio Industries, Inc. Youngstown Sheet & Tube Co. completed 7 new gas wells in 1975 which increased the company's total to 25 "self-help" wells.

Total crude oil distillation capacity of Ohio's six operating petroleum refineries as of January 1, 1975, was 569,400 barrels per day, the same as on January 1, 1974. The refineries and their capacities at yearend follow in barrels per calendar day: Ashland Oil, Inc., 64,000 at Canton, Stark County; Gulf Oil Corp., 42,100 at Cleves, Hamilton County, and 50,300 at Toledo, Lucas County; Standard Oil Co. of Ohio, 168,000 at Lima, Allen County, and 120,000 at Toledo, Lucas County; and Sun Oil Co., 125,000 at Toledo, Lucas County.

Crude oil input to Ohio's refineries plus two asphalt-processing plants operated by Chevron Asphalt Co. in Hamilton County

and Standard Oil Co. of Ohio in Cuyahoga County totaled 183,583,000 barrels, of which 71% was domestically produced crude oil and 29% was foreign.

#### NONMETALS

**Abrasives.**—Cleveland Quarries Co. produced grindstones as a byproduct of sandstone quarrying at its South Amherst Quarries in Lorain County. Output decreased in both quantity and value compared with the 1974 figures. Manufactured metallic abrasives such as iron and steel shot and grit also were produced in Ohio by five companies at six plants in Butler, Cuyahoga, Lucas, and Richland Counties.

**Cement.**—Portland cement was produced at eight plants, five of which also produced masonry cement. Portland cement production decreased 21% to 2,292,414 tons, and shipments decreased 18% to 2,363,695 tons. Stocks of portland cement at yearend 1975 were 196,644 tons, 28% less than in 1974. Value of portland cement shipments in 1975 was down 4% to \$70.3 million, and the average value per ton increased 16% to \$29.72, compared with \$25.59 in 1974. Type I (general construction use) and Type II (moderately low-heat and moderate degree of resistance to sulfate attack) comprised 98% of the portland cement shipped; all others combined comprised only 2%.

Disposition of portland cement shipped by Ohio manufacturers was as follows: 67% to ready-mix concrete producers; 19% to concrete product manufacturers for concrete blocks, concrete pipes, precast prestressed concrete, and other concrete products; 8% to highway contractors; 5% to building material dealers; and 1% to other contractors and miscellaneous customers. Apparent consumption of portland cement in Ohio during 1975 was 2,847,500 tons, a decrease of 14%.

Masonry cement production decreased 14% to 136,927 tons, and shipments decreased 14% to 136,272 tons. Stocks of masonry cement at yearend 1975 were 12,208 tons, 655 tons larger than those of 1974. Value of masonry cement shipments in 1975 was down 12% to \$4.6 million, and the average value per ton increased 47 cents to \$33.58 compared with \$33.11 per ton in 1974. Apparent consumption of masonry cement in Ohio during 1975 was 178,600 tons, a decrease of 12%.

Universal Atlas Cement Division of United States Steel Corp. permanently shut down its Fairborn plant in the latter part of 1975. Contributing factors to the shutdown were an unfavorable outlook with respect to rising energy and other production costs and environmental problems.

**Table 6.—Ohio: Portland cement salient statistics**  
(Short tons)

	1974	1975
Number of active plants	8	8
Production	2,918,233	2,292,414
Shipments from mills:		
Quantity	2,883,997	2,363,695
Value	\$73,814,615	\$70,268,466
Stocks at mills, Dec. 31	272,863	196,644

**Table 7.—Ohio: Masonry cement salient statistics**  
(Short tons)

	1974	1975
Number of active plants	5	5
Production	159,621	136,927
Shipments from mills:		
Quantity	157,860	136,272
Value	\$5,226,681	\$4,575,629
Stocks at mills, Dec. 31	11,553	12,208

**Clays.**—Combined clay and shale output decreased 20% in quantity and 12% in value. Total clay production in 1975 consisted of 2,654,000 tons of common clay and shale with a value of \$6 million, and 797,000 tons of fire clay with a value of \$5.8 million. Average unit value per ton of common clay and shale increased \$0.30 to \$2.26; value of fire clay rose \$0.89 to \$7.32 per ton. Ohio ranked second in the Nation in the production and value of common clay and shale, and second in production and third in value nationally in the output of fire clay.

Clay and shale was produced from 99 mines operated by 77 companies in 35 counties. Nine companies with 19 mines produced 45% of the State's common clay and shale and 40% of the fire clay. Seven counties—Tuscarawas, Stark, Greene, Cuyahoga, Jackson, Mahoning, and Jeffer-

son—accounted for 63% of the common clay and shale output and 78% of the fire clay.

About 44% of common clay and shale production was used to manufacture building brick; 24% in making portland cement; 11%, for sewer pipe; 5%, for drain-tile; and the remainder was used for flue linings, pottery, concrete block, and various ceramic uses. Fire clay uses were as follows: 52%, firebrick, blocks, and shapes; 17%, foundry sand; 10%, refractory mortar and cement; 10%, sewer pipe; 11%, flue linings, glazes, glass, enamels, pottery, and various ceramic uses.

**Gem Stones.**—Flint, the State's official gem stone, was sought after by gem and mineral specimen collectors. Most of the search for flint was centered in the vicinity of Flint Ridge in southeastern Licking County and the adjacent area of Muskingum County. Other specimens collected included calcite, celestite, and jasper. Value of materials collected remained about the same as in 1974.

**Graphite (Synthetic).**—The Ohio Carbon Co. produced graphite shapes from petroleum and pitch coke at its plant in Cleveland. Output and value decreased from those of 1974.

**Gypsum.**—Crude gypsum production from Ohio's two gypsum mines declined 19% and was 30% below the 1972 record. United States Gypsum Co. operated an underground mine, and The Celotex Corp. mined gypsum in an open pit. Both mines were located near Sandusky Bay in Ottawa County.

United States Gypsum Co. and The Celotex Corp. calcined gypsum at plants in Ottawa County, and National Gypsum Co. calcined gypsum at a plant in Lorain County. Output of calcined gypsum was 339,000 tons, 11% less than 1974 and 22% below the 1973 level.

**Lime.**—Ohio ranked first in lime production and consumption in the Nation. Sixteen companies produced lime at 17 plants in 10 counties. Leading counties were Sandusky, Lake, Lorain, and Erie. Leading producers were United States Steel Corp., Diamond Shamrock Corp., Martin Marietta Chemicals, Republic Steel Corp., and Huron Lime Co. The recession had a significant impact on the output of lime, which decreased 17% in quantity to 3,482,000 tons compared with 4,171,000

tons in 1974. However, value of output increased 1.5% from \$93.7 million in 1974 to \$95.1 million in 1975. Lime consumption in Ohio in 1975 was 2,762,000 tons, compared with 3,596,000 tons in 1974. The lime was used in steelmaking furnaces, refractory dolomite, alkalies, glass, and other uses.

Martin Marietta Chemicals completed installation of preheaters on the two largest limekilns at its Woodville plant. The preheaters, which use process heat to rise the temperature of raw materials fed to the kiln, substantially improved fuel efficiency.

In June, Ohio Lime Co. began construction of a kiln preheater and new crushing, grinding, and screening facilities at its Woodville plant, which will nearly double the plant's lime capacity when completed in November 1976.

**Perlite.**—Crude perlite mined in Western States was expanded at four plants: United States Gypsum Co. at its gypsum plant in Ottawa County; National Gypsum Co. at its gypsum plant in Lorain County; The Celotex Corp. at Lockland in Hamilton County; and Cleveland Gypsum Co. at Cleveland in Cuyahoga County. The quantity of expanded perlite sold or used, 11,941 tons, decreased about 2% from that of 1974, but the value increased 21% to \$996,000. Average value per ton increased to \$83.41, compared with \$67.97 in 1974. The principal uses for perlite in Ohio were for plaster aggregate, various formed products, and insulation.

**Salt.**—Ohio ranked fourth in salt production in the Nation. Salt sold or used totaled 5.1 million tons, 1% above the quantity sold or used in 1974. However, value of salt output in 1975 increased 11% to \$54.7 million. Four firms with six operations located in four counties sold or used salt in the form of rock, brine, and evaporated brine. Rock salt was recovered from underground mines in Cuyahoga and Lake Counties. Brine was pumped from wells in Lake, Summit, and Wayne Counties. Evaporated salt producers used both the vacuum and the open-pan processes to recover a high-purity finely crystalline salt from brine. Ohio's salt output was used mainly for control of ice on highways, various chemical applications, and human and animal consumption.

Diamond Crystal Salt Co. began construction of air-quality-control devices on the coal-fired boilers at its Akron plant in Summit County. When completed at a cost of about \$670,000, the boilers will be able to increase steam generation to power brine evaporators while reducing air pollution emissions. In Meigs County, Excelsior Salt Works, Inc., ceased producing salt.

**Sand and Gravel.**—Sand and gravel production in Ohio totaled 37.2 million tons valued at \$68.6 million. Although the quantity produced was 10% lower than in 1974, the value of output was nearly the same. About 98% of the total tonnage was construction sand and gravel, and 2% was industrial sand produced for chemical

Table 8.—Ohio: Lime sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Steel, basic oxygen furnace -----	1,991	42,850	1,719	43,870
Refractory dolomite -----	738	18,770	468	15,120
Glass -----	296	6,376	251	6,400
Steel, electric -----	96	2,074	91	2,316
Finishing lime -----	91	2,545	76	2,279
Steel, open-hearth -----	51	1,105	W	W
Mason's lime -----	51	1,414	39	1,182
Sewage treatment -----	14	312	27	691
Agriculture -----	14	412	11	418
Other uses <sup>1</sup> -----	828	17,840	800	22,860
Total <sup>2</sup> -----	4,171	93,695	3,482	95,136

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

<sup>1</sup> Includes alkalies, magnesite, calcium carbide, water purification, sugar refining, soil stabilization, fertilizer, other metallurgical uses (1975), rubber, paint (1974), and uses indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

and foundry industry use. Construction sand and gravel accounted for 94% of the total value, and industrial sand accounted for 6%. Sand and gravel was mined in 65 counties at 327 locations. Production ranged from less than 12,000 tons in one county to 4,162,000 tons in another county. Output exceeded 2 million tons in four counties—Butler, Franklin, Hamilton, and Portage. In addition, seven other counties had production exceeding 1 million tons each.

Four operations produced 1 million tons or more each; 5, between 500,000 and 1 million tons each; 46, between 200,000 and 500,000 tons each; 69, between 100,000 and 200,000 tons each; 112, between 25,000 and 100,000 tons each, and 91, less than 25,000 tons. The largest producers were American Aggregates Corp. and its subsidiary American Materials Corp., Ohio Gravel Division of Dravo Corp., and Standard Slag Co.

Of the 36,416,000 tons of construction sand and gravel produced in 1975, 14,778,000 tons, or 41%, was processed sand, 17,871,000 tons, or 49%, was processed gravel, and 3,767,000 tons, or 10%, was unprocessed sand and gravel. Processing consisted of washing, screening, sizing, or crushing.

Commercial sale or use of construction aggregate (blended sand and gravel) and industrial sand and gravel accounted for 78% of the total output and 78% of the total value. Construction aggregate sold or used for publicly funded projects accounted for 22% of the total output and value. The principal uses of the material were highway construction and paving, building construction, and fill.

About 90% of Ohio's sand and gravel output was transported to consumers by truck, 4% by barge, 1% by rail, and 1% by other means. The remaining 4% was used at the minesites.

Ohio Gravel Division of Dravo Corp. donated a 42-acre parcel of land along the Little Miami River in Hamilton County to The Nature Conservancy, a national conservation group. The land became part of a scenic river conservation project. At the company's Ross plant in Hamilton County a dredge was placed in service to mine sand and gravel below the water table. The dredge is expected to extend the life of the operation by about 30 years.

**Slag (Iron-Blast-Furnace).**—Production of iron-blast-furnace slag was 5,364,000 tons valued at \$13,348,000, according to the National Slag Association. Output was 12% less and value was 15% less than in 1974. The average unit price decreased from \$2.56 to \$2.49 per ton.

Screened air-cooled iron-blast-furnace slag comprised 76% of the total tonnage and 79% of the value. The remaining output was unscreened air-cooled slag, granulated slag, and expanded slag. Air-cooled slag was used chiefly as an aggregate in paving and highway construction and as a raw material in the manufacture of mineral wool. In addition to highway construction, granulated slag was used for soil conditioning and in the manufacture of cement. The chief use for expanded slag was as an aggregate in concrete-block manufacture.

**Stone.**—Production of stone in Ohio totaled 46.3 million tons with a value of \$108.6 million. Compared with the 1974 figures, the quantity produced declined about 10% and the value of production increased 3%. Stone output in 1975 follows: Crushed and broken limestone and dolomite, 44.9 million tons with a value of \$98.4 million (97% of the total tonnage and 90% of total value); crushed and broken sandstone and quartzite, 1.3 million tons with a value of \$7.2 million (2.8% of total tonnage and 7% of total value); and dimension limestone and sandstone, 86,161 tons with a value of \$3.0 million (0.2% of total tonnage and 3% of total value). The average value of all crushed and broken stone increased 25 cents per ton to \$2.28, limestone increased 23 cents to \$2.19 per ton, dolomite increased 8 cents to \$2.20 per ton, sandstone increased 13 cents to \$3.40 per ton, and quartzite increased \$4.60 to \$8.18 per ton. The average value of dimension limestone and sandstone increased 60 cents to \$35.17 per ton.

Stone was produced by 108 companies at 173 quarries in 65 counties. Nine quarries had an output exceeding 900,000 tons each; 18, between 500,000 and 900,000 tons each; 74, between 100,000 and 500,000 tons each; and 72, less than 100,000 tons each, of which 47 produced less than 25,000 tons each. Sandusky County, with an output of 5.6 million tons of crushed and broken stone, was the leading producer, followed by Ottawa County with 4.0 million tons, Wyandot with 3.1



**Table 9.—Ohio: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mix concrete):				
Nonresidential and residential construction—	9,983	16,881	9,024	17,233
Highway and bridge construction -----	659	1,107	639	1,136
Other construction (dams, waterworks, airports, etc.) -----	227	391	200	382
Concrete products (cement blocks, brick, pipe, etc.) -----	3,333	5,720	2,515	4,703
Bituminous paving (asphalt and tar paving) ---	10,253	16,299	8,993	16,273
Roadbase and subbase -----	2,613	4,336	1,832	3,427
Fill -----	1,436	2,248	1,506	2,406
Other -----	466	761	439	807
<b>Unprocessed:</b>				
Roadbase and subbase -----	534	595	607	694
Fill -----	3,224	2,975	2,472	2,337
Other -----	--	--	159	116
<b>Industrial sand and gravel</b> -----	857	3,954	779	4,059
<b>Total</b> -----	<b>33,615</b>	<b>55,267</b>	<b>1 29,166</b>	<b>53,573</b>

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Table 10.—Ohio: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mix concrete):				
Nonresidential and residential construction—	994	1,541	1,032	1,993
Highway and bridge construction -----	2,027	3,626	2,637	5,081
Other construction (dams, waterworks, airports, etc.) -----	446	863	294	533
Concrete products (cement blocks, brick, pipe, etc.) -----	213	351	53	87
Bituminous paving (asphalt and tar paving) ---	2,607	4,514	2,468	4,984
Roadbase and subbase -----	937	1,517	782	1,408
Fill -----	235	335	163	277
Other -----	21	34	72	139
<b>Unprocessed:</b>				
Roadbase and subbase -----	41	57	320	282
Fill -----	217	153	207	194
Other -----	--	--	2	3
<b>Total</b> -----	<b>7,738</b>	<b>12,991</b>	<b>8,030</b>	<b>1 14,979</b>

<sup>1</sup> Data do not add to total shown because of independent rounding.

Table 11.—Ohio: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Ashland	5	227	345	4	216	382
Ashtabula	9	128	202	9	109	195
Athens	5	159	315	4	190	440
Auglaize	5	487	731	4	381	564
Butler	11	2,823	3,988	12	2,639	4,102
Champaign	4	306	456	4	244	421
Clark	9	1,117	1,555	9	953	1,344
Clermont	1	106	211	1	96	214
Clinton	1	14	23	1	13	23
Columbiana	2	W	W	2	12	19
Coshocton	6	462	706	6	437	749
Crawford	1	W	W	1	28	56
Cuyahoga	2	123	105	2	W	W
Darke	4	532	863	4	461	901
Defiance	1	W	W	2	W	W
Erie	8	154	457	6	129	424
Fairfield	3	351	586	3	310	627
Franklin	12	3,673	5,900	10	2,686	4,900
Gallia	3	119	230	3	103	214
Geauga	5	580	1,465	4	653	1,670
Greene	10	1,215	1,665	10	783	1,261
Hamilton	16	4,586	6,912	16	4,162	6,765
Henry	1	W	W	1	66	153
Highland	1	12	9	1	22	17
Huron	4	188	372	3	W	W
Jackson	1	17	94	1	18	68
Knox	6	495	322	5	409	776
Lawrence	2	W	315	1	W	304
Licking	7	841	1,156	8	577	913
Logan	4	236	344	4	194	314
Lorain	4	477	983	4	476	1,043
Lucas	3	496	599	3	509	726
Madison	5	193	300	3	178	279
Mahoning	2	W	W	1	29	62
Marion	4	240	374	4	230	411
Medina	6	602	989	6	442	801
Meigs	4	1,327	2,794	4	1,458	3,236
Miami	6	741	1,136	7	743	1,414
Montgomery	13	2,293	3,752	11	1,989	3,450
Morrow	1	86	123	1	81	140
Pickaway	3	387	571	3	392	575
Pike	4	288	427	3	354	644
Portage	25	3,407	5,939	27	3,234	6,593
Richland	5	589	952	5	523	947
Ross	10	1,157	2,590	9	1,142	2,729
Scioto	4	126	210	4	165	320
Shelby	6	346	375	5	287	376
Stark	15	1,665	3,265	12	1,653	3,676
Summit	19	1,318	2,640	16	1,277	2,531
Tuscarawas	10	1,250	2,174	10	1,340	2,455
Warren	10	1,570	2,474	9	1,343	2,417
Washington	5	295	482	5	266	493
Wayne	4	590	1,018	4	521	973
Williams	4	399	577	5	306	559
Wyandot	5	292	421	4	234	371
Other counties <sup>1</sup>	22	2,266	3,269	21	2,131	3,418
Total <sup>2</sup>	348	41,353	68,258	327	37,195	68,552

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

<sup>1</sup> Includes Allen (1974), Brown, Carroll, Defiance, Hocking, Holmes, Lake, Monroe, Morgan, Muskingum, Preble, and Trumbull Counties.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

million tons, and Mahoning and Erie with 2.9 million tons each.

National Lime & Stone Co., Standard Slag Co., and Woodville Lime & Chemical Co. were the largest producers of crushed stone, all of which was limestone. Ten companies mined and crushed dolomite at 10 quarries in Clinton, Hardin, Ottawa, Sandusky, and Seneca Counties. Output of crushed and broken limestone and dolomite in 1975 was 10% lower in quantity and 1% less in value than in 1974. The principal uses for the crushed and broken limestone and dolomite tonnage in 1975 follow: 46% for roadbase and paving materials, 12% for concrete aggregate, 9% for manufacturing portland cement, 9% for flux stone, 6% for manufacturing lime, 6% for agricultural uses, 3% for railroad ballast, and 9% for riprap and jetty stone, manufacture of dead-burned dolomite, glass manufacture, and various other miscellaneous chemical and industrial uses.

Production of crushed and broken sandstone and quartzite in 1975 declined 21% in quantity but increased 29% in value compared with the 1974 figures. Crushed sandstone was produced by 11 companies at 22 quarries in 9 counties. The largest producing counties were Geauga, Lorain, Trumbull, Huron, and Stark. The bulk of the sandstone was used for refractory purposes and as an aggregate. Two companies

produced quartzite from three quarries in Knox, Perry, and Pike Counties. Most of the quartzite was used to make glass and as a flux stone.

Dimension stone output increased slightly in both quantity and value compared with the 1974 figures. Eleven companies produced dimension sandstone from 24 quarries in 9 counties. The largest producing counties were Lorain, Coshocton, Scioto, and Knox. Two companies produced dimension limestone in Miami and Seneca Counties.

About 72% of Ohio's stone production was transported by truck, 14% by rail, 5% by water, and 9% by other means. Erie County ranked first among all counties in truck haulage with 2.3 million tons of stone transported by this method, followed by Sandusky County with 2.2 million tons, and Mahoning County with 2.1 million tons. Railroads hauled stone in 20 counties. Wyandot County ranked first in rail haulage with 1.7 million tons, followed by Sandusky County with 1.6 million tons and Marion County with 0.8 million tons. Water-borne shipments of stone on the Ohio River originated in Adams County, Lake Erie shipments originated in Ottawa and Sandusky Counties. Ottawa County led in waterway stone shipments with 1.9 million tons, followed by Sandusky County with 0.4 million tons.

Table 12.—Ohio: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	2,909	5,733	2,583	5,741
Concrete aggregate -----	6,331	11,870	5,455	11,536
Dense-graded roadbase stone -----	4,537	8,564	4,748	9,871
Macadam aggregate -----	7,173	12,676	5,933	11,611
Surface treatment aggregate -----	2,127	4,525	2,092	4,689
Other construction aggregate and roadstone -----	6,423	12,170	5,251	11,051
Agricultural limestone <sup>1</sup> -----	2,051	4,400	2,485	6,362
Cement manufacture -----	5,677	11,232	4,107	9,799
Dead-burned dolomite -----	1,314	2,338	795	1,412
Filter stone -----	39	66	39	77
Glass manufacture -----	570	2,815	459	2,860
Lime manufacture -----	1,965	3,545	2,791	4,702
Manufactured fine aggregate (stone sand) -----	342	662	363	864
Mine dusting -----	166	858	W	W
Flux stone -----	4,698	9,424	4,022	8,365
Railroad ballast -----	1,235	1,873	1,453	2,736
Riprap and jetty stone -----	1,141	3,132	903	2,223
Other uses <sup>2</sup> -----	1,388	3,636	1,461	4,459
Total <sup>3</sup> -----	50,085	99,517	44,940	98,358

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

<sup>1</sup> 1974 data include other soil conditioners, poultry grit and mineral food.

<sup>2</sup> Includes terrazzo and exposed aggregate, refractory stone, chemical stone, whitening, other fillers, soil conditioners (1975), poultry grit and mineral food (1975), and uses indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 13.—Ohio: Crushed and broken limestone and dolomite sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1974		1975	
	Quantity	Value	Quantity	Value
Adams	W	W	W	W
Allen	1,272	2,527	967	2,056
Athens	W	W	W	W
Auglaize	W	W	W	W
Belmont	W	W	140	433
Brown	79	143	57	104
Carroll	W	W	W	W
Clark	W	W	W	W
Clermont	W	W	W	W
Clinton	W	W	W	W
Crawford	W	W	W	W
Delaware	1,672	2,811	1,350	2,635
Erie	W	W	W	W
Fayette	W	W	W	W
Franklin	W	W	W	W
Gallia	184	W	W	W
Greene	2,016	3,558	1,540	2,887
Guernsey	W	W	W	W
Hancock	W	W	497	971
Hardin	W	W	W	W
Harrison	W	W	230	455
Highland	W	W	521	1,227
Holmes	W	W	W	W
Jackson	W	W	W	W
Lawrence	45	106	15	63
Logan	434	704	354	676
Lorain	1	2	W	W
Lucas	2,420	4,867	1,779	3,989
Madison	W	W	W	W
Mahoning	3,268	6,522	2,907	6,717
Marion	991	1,723	828	1,708
Mercer	W	W	W	W
Miami	W	W	W	W
Monroe	W	W	W	W
Montgomery	W	W	W	W
Morgan	58	255	68	163
Muskingum	1,922	4,711	1,715	5,552
Noble	W	W	W	W
Ottawa	3,677	W	4,002	9,391
Paulding	1,757	3,005	W	W
Ferry	W	W	W	W
Pickaway	W	W	W	W
Pike	W	W	W	W
Preble	W	W	W	W
Putnam	323	634	223	509
Ross	W	W	W	W
Sandusky	5,348	11,569	5,646	12,026
Seneca	W	W	W	W
Shelby	355	569	232	358
Stark	W	W	W	W
Summit	W	W	W	W
Tuscarawas	W	W	W	W
Union	W	W	W	W
Van Wert	512	848	719	1,222
Warren	W	W	W	W
Washington	38	115	24	79
Wayne	W	W	W	W
Wood	1,362	2,622	1,198	2,698
Wydoot	W	W	3,077	6,654
Undistributed	22,351	52,226	16,839	35,789
Total <sup>1</sup>	50,085	99,517	44,940	98,358

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

In September, after more than 2 years in development, Central Silica Co. opened a new quartzite quarry near Glass Rock in Perry County. The quarry is linked to the processing plant by a new 2½-mile-long aerial tramway. A new pebble mill also was put into operation to increase the firm's output of finely ground silica.

**Sulfur (Recovered Elemental).**—Elemental sulfur was recovered as a byproduct from petroleum refining operations by Ashland Oil, Inc., at its Canton refinery in Stark County, Standard Oil Co. of Ohio at its Lima refinery in Allen County, and Gulf Oil Corp. at its Toledo refinery in Lucas County. Sales increased 56% to 15,104 long tons, compared with 9,694 long tons in 1974. Value of sales more than doubled from \$291,790 in 1974 to \$639,678 in 1975.

**Vermiculite (Exfoliated).**—The Cleveland Gypsum Co., Division of Cleveland Builders Supply Co., processed crude vermiculite mined out-of-State and shipped to its Cleveland plant. Sales increased over those of 1974. The exfoliated vermiculite was used for concrete and plaster aggregate, insulation, and soil conditioning.

#### METALS

**Aluminum.**—Production of primary aluminum at the Hannibal reduction plant of Ormet Corp. decreased, but value increased. Ormet Corp., jointly owned by Consolidated Aluminum, Inc. and Revere Copper & Brass Inc., produced aluminum by reducing alumina obtained by barge from a company-owned plant at Burnside, La. The recession forced the firm to shut down 3 of the plant's 6 potlines and to lay off nearly half of the 2,200 employees. The cutback in employment and production capacity began in January, and operation remained at the reduced level during the remainder of the year. The installation of electrostatic precipitators for controlling smokestack emissions was completed at a cost of nearly \$5 million. In August, plans were announced for construction of a multi-million-dollar dry-scrubber system designed primarily to eliminate particulate fluoride emissions. Officials said the unit would be housed in a building "roughly the size of a football field three stories high" and consume about 10,000 kilowatts of electricity per hour when in operation. Construction of the scrubber began in

April 1976, with completion expected in July 1978.

**Beryllium.**—Bertrandite ore mined by Brush Wellman, Inc., at its Spor Mountain mine in Millard County, Utah, was processed into beryllium hydroxide at its facility at Delta, Utah, and shipped to the corporation's Elmore plant in Ottawa County. Beryllium metal, alloys, oxide, and other compounds were produced from the beryllium hydroxide, as well as from beryl ore processed at Elmore. The Elmore plant also produced shapes from beryllium metal and alloys as well as ceramics for electrical use from beryllium oxide.

**Ferroalloys.**—Ohio was the leading producer of ferroalloys, accounting for about one-third of the national total. However, shipments decreased 24% to 598,570 tons compared with 782,837 tons in 1974. Value of shipments in 1975 totaled \$340,111,000. The ferroalloys produced consisted mainly of alloys of iron and chromium, manganese, silicon, and vanadium. Six companies produced ferroalloys at eight plants in Ashtabula, Guernsey, Jefferson, Monroe, Muskingum, and Washington Counties.

Ohio Ferro-Alloys Corp. entered into three agreements with the Ohio Air Quality Development Authority for the issuance of Air Quality Revenue Bonds totaling \$10.5 million for expansion of air pollution control facilities at its three Ohio plants. Part of the bonding authority was used to borrow \$1.5 million to cover the cost of two volatilized-silica collectors at the Powhatan plant, and \$2 million was borrowed to install air pollution control equipment on a furnace at the Philo plant. At the Philo plant, a new electric furnace to produce ferrosilicon was completed and energized late in December.

Union Carbide Corp. obtained a full year of production from a computer-controlled furnace at its Ashtabula plant. Late in the year, Satralloy, Inc., converted a ferrochrome furnace to production of high-carbon ferromanganese at its Steubenville plant.

**Iron and Steel.**—Ohio's principal pig iron and steel producers were Armco Steel Corp. in Butler County; Jones and Laughlin Steel Corp. in Cuyahoga County; Republic Steel Corp. with major facilities in Mahoning, Trumbull, and Stark Counties; United States Steel Corp. in Cuyahoga,

Lorain, Mahoning, and Trumbull Counties; and Youngstown Sheet & Tube Co. in Mahoning County.

Pig iron production was 14.1 million tons, a decrease of 3.3 million tons or 19%. Pig iron shipments totaled 14 million tons valued at \$2.5 billion, compared with 1974 shipments of 17.6 million tons valued at \$2.8 billion. The average value of pig iron increased 16%, from \$156.46 per ton in 1974 to \$181.22 per ton in 1975. Ohio had 40 blast furnaces, but according to the American Iron Ore Association, the number of furnaces operating ranged from a high of 29 at the end of January to a low of 20 at the end of June; 22 were in operation at yearend.

Steel output reported by the American Iron and Steel Institute was 19.6 million tons, a decrease of 5.6 million tons, or 22%. Steel was produced in basic oxygen furnace (BOF) shops by all producers except Youngstown Sheet & Tube Co., and United States Steel Corp. at their Mahoning County operations, where open-hearth furnaces were used. Steel was also produced from scrap in electric furnaces.

Armco Steel Corp. completed construction of additional material-handling facilities designed to increase steel output at the Middletown BOF shop in Butler County. A 2,500-ton-per-day sintering plant also was completed and put into operation. The plant processes flue dust, mill scale, ore fines, and other iron wastes into a sintered product suited for use in blast furnaces. Construction of a new 114-oven coke plant was underway with completion expected in 1976. Ground was broken on a new \$8 million research laboratory building. When completed in 1976, the two-storied, 69,000-square-foot laboratory will provide space for an additional 100 scientists and technicians.

Republic Steel Corp. commenced engineering and construction of a \$35 million suppressed-combustion system to control air pollution emissions at its BOF shop in Cleveland. The company's long-term debt was increased by \$60 million in May with the sale of Pollution Control Bonds to finance air quality facilities in Ohio. Other major projects underway in 1975 included construction of an argon-oxygen decarbonization facility at its Canton plant in Stark County for stainless steel production and a \$20 million production line for

manufacturing electrical steels at its Warren plant in Trumbull County. Late in 1975, a major expansion of research facilities in Independence, Cuyahoga County, was completed. The expansion provided an additional 27,000 square feet of space, permitting the company to consolidate all of its research facilities at one location.

Youngstown Sheet & Tube Co. announced plans to replace 12 open-hearth furnaces with a BOF shop at its Campbell Works near Youngstown in Mahoning County. Engineering work was initiated but construction was deferred pending generation of funds to support the project.

**Titanium.**—The RMI Co. produced titanium sponge metal by sodium reduction of titanium tetrachloride at its Ashtabula plant. Some titanium sponge was sold and the remainder was shipped to the company's plant in Niles for melting and processing. The RMI Co. was the only domestic producer to sell titanium sponge on the open market.

New Jersey Zinc Co. and Glidden-Durkee Div. of SCM Corp. produced titanium dioxide at plants in Ashtabula. Titanium dioxide pigment is used in paints, paper coatings, plastics, and a wide variety of miscellaneous applications. Output of titanium dioxide pigment was lower in 1975 than in 1974.

Primary titanium metal shipped from Henderson, Nev., was rolled and fabricated at Toronto, Ohio, by Titanium Metals Corp. of America.

**Zinc.**—ASARCO Incorporated produced zinc oxide directly from zinc concentrate at its Columbus plant in Franklin County. ASARCO acquired the plant from American Zinc Co. in 1972. The principal uses for the zinc oxide were in the manufacture of rubber, paint, ceramics, and various chemical applications.

**Zirconium.**—Foote Mineral Co. processed zircon at its Cambridge plant in Guernsey County to produce magnesium-zirconium alloys. Harshaw Chemical Co., Inc., recovered zirconium oxide at its plant in Lorain County, for use as ceramic-base colors. Ohio Ferro-Alloys Corp. produced zirconium-silicon alloys at Brilliant in Jefferson County. Zirconium Corp. of America produced zirconium oxide as well as zirconia refractories at its plant in Cuyahoga County. The Chas. Taylor Division of NL Industries, Inc. in Hamilton

County produced zircon refractories. Continental Mineral Processing Corp. milled zircon at Sharonville in Hamilton County for use by iron and steel foundries and the ceramic industry. TRW Inc. at Minerva in Stark County and Sherwood Re-

fractories Co. (acquired by TRW Inc. in 1974) at Cleveland in Cuyahoga County produced zircon cores and molds for investment casting of high-temperature alloys. TRW Inc. also produced zircon concentrates for sandblasting.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Cement:</b>			
The Flintkote Co. <sup>1</sup> -----	Middle Branch, Ohio 44652-	Plant -----	Stark.
General Portland Cement Co. <sup>1,2</sup> -----	709 Clay St. Ft. Wayne, Ind. 46802	-----do -----	Paulding.
Marquette Cement Manufacturing Co. <sup>2</sup> -----	20 North Wacker Dr. Chicago, Ill. 60606	-----do -----	Lawrence.
Medusa Corp. <sup>1,2,3</sup> -----	Box 5668 Cleveland, Ohio 44101	-----do -----	Lucas.
Southwestern Portland Cement Co. <sup>1,2</sup> -----	Box 191 Fairborn, Ohio 45324	-----do -----	Greene.
United States Steel Corp. <sup>1,2,4</sup> -----	600 Grant St. Pittsburgh, Pa. 15230	-----do -----	Do.
<b>Clays:</b>			
Belden Brick Co -----	Box 910 Canton, Ohio 44701	Pits -----	Tuscarawas.
Cedar Heights Clay Co ----	Box 368 Oak Hill, Ohio 45656	-----do -----	Jackson.
H. K. Porter Co -----	Porter Bldg. Pittsburgh, Pa. 15219	Underground mines.	Columbiana and Jefferson.
<b>Coal:</b>			
Central Ohio Coal Co ----	Box 18, Bowling Green Station New York, N.Y. 10004	Strip -----	Morgan and Muskingum.
Consolidation Coal Co ----	Cadiz, Ohio 43907 -----	Strip, auger, under- ground mines.	Belmont, Harrison, Jefferson.
Hardy Coal Co -----	Berlin, Ohio 44160 -----	Strip mines -----	Coshocton, Holmes, Tuscarawas.
Ohio River Collieries Co --	Route 1 Bloomington, Ohio 43910	Strip and auger --	Belmont.
Peabody Coal Co -----	301 North Memorial Dr. St. Louis, Mo. 63102	Strip mines -----	Coshocton and Perry.
R&F Coal Co -----	Box 218 Cadiz, Ohio 43907	-----do -----	Belmont, Harrison, Noble.
<b>Ferrous alloys:</b>			
Foote Mineral Co -----	Route 100 Exton, Pa. 19341	Plants -----	Guernsey and Jefferson.
Interlake, Inc -----	13-5th & Perry Ave. Chicago, Ill. 60604	-----do -----	Washington.
Ohio Ferro-Alloys Corp ---	839 30th NW Canton, Ohio 44709	-----do -----	Jefferson, Monroe, Muskingum.
Union Carbide Corp. <sup>4</sup> ----	Box 176 Marietta, Ohio 45750	-----do -----	Ashtabula and Washington.
<b>Graphite, synthetic:</b>			
Ohio Carbon Co -----	12508 Berea Rd. Cleveland, Ohio 44111	-----do -----	Cuyahoga.
<b>Gypsum:</b>			
The Celotex Corp. <sup>5</sup> -----	1500 North Dale Mabry Tampa, Fla. 33607	Pit -----	Ottawa.
National Gypsum Co. <sup>4,5</sup> -----	325 Delaware Ave. Buffalo, N.Y. 14202	Plant -----	Lorain.
United States Gypsum Co. <sup>1,4,5</sup> -----	101 South Wacker Dr. Chicago, Ill. 60606	Underground -----	Ottawa.
<b>Lime:</b>			
Huron Lime Co -----	Box 428 Huron, Ohio 44839	Plant -----	Erie.
Martin-Marietta Chemicals.	Executive Plaza II Hunt Valley, Md. 21030	-----do -----	Sandusky.
Ohio Lime Co -----	123 East Main St. Woodville, Ohio 43469	-----do -----	Do.
Pfizer, Inc -----	Box 46 Gibsonburg, Ohio 43431	-----do -----	Do.
Republic Steel Corp -----	Box 6778 Cleveland, Ohio 44101	-----do -----	Lake.
Peat: The Humus Co -----	2628 South Michigan St. South Bend, Ind. 46614	Bog -----	Wyandot.

See footnotes at end of table.

Table 14.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Perlite, expanded:</b>			
Cleveland Gypsum Co., Division of Cleveland Builders and Supply Co. <sup>8</sup>	2100 West 3d St. Cleveland, Ohio 44113	Plant -----	Cuyahoga.
<b>Petroleum refineries:</b>			
Ashland Oil and Refining Co.	1409 Winchester Ave. Ashland, Ky. 41101	Plants -----	Stark.
Chevron Asphalt Co -----	555 Market St. San Francisco, Calif. 94105	Plant -----	Hamilton.
Gulf Oil Corp -----	Pittsburgh, Pa. 15219 -----	Plants -----	Hamilton and Lucas.
Standard Oil Co. of Ohio --	Midland Bldg. Cleveland, Ohio 44115	---do -----	Allen and Lucas.
Sun Oil Co -----	1608 Walnut St. Philadelphia, Pa. 19103	Plant -----	Lucas.
<b>Salt:</b>			
Diamond Shamrock Corp --	300 Union Commerce Bldg. Cleveland, Ohio 44115	Well -----	Lake.
International Salt Co -----	Clarks Summit, Pa. 18411 --	Underground -----	Cuyahoga.
Morton International Inc --	110 North Wacker Dr. Chicago, Ill. 60606	---do -----	Lake and Wayne.
<b>Sand and gravel:</b>			
American Aggregates Corp. <sup>1</sup>	Garst Ave. at Ave. B Greenville, Ohio 45331	Pits and dredge ---	Champaign, Clark, Darke, Franklin, Licking, Mont- gomery.
American Materials Corp -	P.O. Box 154 Hamilton, Ohio 45010	Pits -----	Butler and Hamilton.
F. H. Brewer Co -----	P.O. Box 123 Lancaster, Ohio 43130	---do -----	Athens and Fairfield.
Dravo Corp -----	5253 Wooster Rd. Cincinnati, Ohio 45226	---do -----	Butler, Hamilton, Warren.
<b>Stone:</b>			
Carbon Limestone Co -----	Lowellville, Ohio 44436 ----	Quarries -----	Mahoning.
France Stone Co -----	1800 Toledo Trust Bldg. Toledo, Ohio 43604	---do -----	Lucas, Sandusky, Seneca.
Kraemer Co -----	Bolander Rd. Clay Center, Ohio 43408	---do -----	Ottawa.
Maumee Stone Co -----	Box 369 Maumee, Ohio 43537	---do -----	Lucas, Ottawa, Paulding, Wood.
MCQ Industries, Inc -----	2100 Tremont Center Columbus, Ohio 43221	---do -----	Franklin.
National Lime & Stone Co. <sup>4</sup>	First National Bank Bldg. Findlay, Ohio 45840	---do -----	Various.
Sandusky Lime & Stone Co. <sup>4</sup>	Box 527 Sandusky, Ohio 44870	Quarry -----	Erie.

<sup>1</sup> Also stone.<sup>2</sup> Also clays.<sup>3</sup> Also sand and gravel.<sup>4</sup> Also lime.<sup>5</sup> Also perlite.<sup>6</sup> Also exfoliated vermiculite.





# The Mineral Industry of Oklahoma

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

By R. H. Arndt,<sup>1</sup> K. S. Johnson,<sup>2</sup> and J. F. Roberts<sup>2</sup>

A modest 7% increase in total value of raw mineral materials produced in 1975 over that of 1974 followed the 60% gain made between 1973 and 1974. The total mineral output value of about \$2.3 billion reflected largely a continued increase in the value of fuels from about \$2 billion to \$2.2 billion, or approximately 7% between 1974 and 1975, in contrast to a cumulative value increase of less than 1% for all other commodities over the same period. The State ranked seventh in mineral production value among all States in 1975. Based on 1967 constant dollars, the value of produced minerals in Oklahoma actually declined by 11% from its 1974 position.

Spiraling values of commodities, however, did not accurately reflect the quan-

tity of minerals produced. Among the fuels, only coal and helium registered gains in quantity. Basic construction materials, including clays, gypsum, sand and gravel, and stone, had a cumulative tonnage loss of 5% with sand and gravel experiencing the only tonnage gain. Production losses contrasting with value increases were similarly registered by prepared mineral products such as cement and lime. Even with decreased production, Oklahoma retained third and fourth place respectively among all States in the volume of produced natural gas and crude petroleum and held fifth place in gypsum production.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Oklahoma City, Okla.

<sup>2</sup> Geologist, Oklahoma Geological Survey, Norman, Okla.

Table 1.—Mineral production in Oklahoma<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ----- thousand short tons--	1,289	\$2,105	995	\$1,701
Coal (bituminous) ----- do-----	2,356	24,759	2,872	47,946
Gypsum ----- do-----	1,225	5,622	1,028	4,835
Helium:				
High purity ----- million cubic feet--	169	5,915	224	7,411
Crude ----- do-----	184	1,608	148	1,776
Natural gas ----- do-----	1,638,942	458,904	1,605,410	513,731
Natural gas liquids:				
Natural gasoline and cycle products				
thousand 42-gallon barrels--	12,581	84,638	10,835	63,383
LP gases ----- do-----	31,231	166,461	29,640	140,197
Petroleum (crude) ----- do-----	177,785	1,277,076	163,123	1,389,164
Pumice ----- thousand short tons--	W	W	1	W
Sand and gravel ----- do-----	8,708	13,772	9,591	16,749
Stone ----- do-----	22,228	36,599	20,111	36,840
Value of items that cannot be disclosed:				
Cement, copper, feldspar (1974),				
lead (1974), lime, salt, silver,				
tripoli, zinc (1974), and values				
indicated by symbol W -----	XX	† 45,142	XX	43,362
Total -----	XX	† 2,122,601	XX	2,267,095
Total 1967 constant dollars -----	XX	† 1,003,566	XX	† 897,770

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

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Oklahoma, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975, in order of value
Adair -----	--	\$31	Sand and gravel.
Alfalfa -----	\$23,185	21,548	Petroleum, natural gas, natural gas liquids, sand and gravel.
Atoka -----	W	W	Stone, petroleum, sand and gravel.
Beaver -----	77,273	83,904	Natural gas, petroleum, natural gas liquids, sand and gravel, pumice, petroleum.
Beckham -----	10,690	8,471	Natural gas, natural gas liquids, petroleum.
Blaine -----	44,053	47,103	Natural gas, petroleum, natural gas liquids, gypsum, sand and gravel.
Bryan -----	3,198	4,117	Natural gas, petroleum, stone, sand and gravel.
Caddo -----	34,230	49,268	Petroleum, natural gas, natural gas liquids, gypsum, sand and gravel, stone.
Canadian -----	41,643	46,011	Natural gas, petroleum, natural gas liquids, sand and gravel, clays, gypsum.
Carter -----	188,534	197,812	Petroleum, natural gas, natural gas liquids, sand and gravel, stone.
Cherokee -----	1,311	W	Stone, sand and gravel.
Choctaw -----	W	W	Do.
Cimarron -----	20,784	23,172	Helium, natural gas, petroleum, natural gas liquids.
Cleveland -----	18,023	18,312	Petroleum, natural gas, sand and gravel.
Coal -----	4,560	4,948	Petroleum, natural gas, stone.
Comanche -----	6,521	6,856	Stone, petroleum, gypsum, natural gas, sand and gravel.
Cotton -----	W	6,737	Petroleum, sand and gravel, natural gas.
Craig -----	6,973	W	Coal, stone, petroleum, natural gas.
Creek -----	61,014	64,638	Petroleum, natural gas liquids, stone, natural gas, clays.
Custer -----	11,687	9,857	Natural gas, natural gas liquids, petroleum, sand and gravel, clays.
Delaware -----	W	W	Stone.
Dewey -----	52,931	57,429	Natural gas, petroleum, natural gas liquids.
Ellis -----	15,891	17,702	Natural gas, petroleum.
Garfield -----	53,416	57,370	Petroleum, natural gas, natural gas liquids, sand and gravel.
Garvin -----	115,230	104,745	Petroleum, natural gas liquids, natural gas, sand and gravel.
Grady -----	57,344	58,150	Petroleum, natural gas, natural gas liquids, sand and gravel.
Grant -----	10,935	11,781	Petroleum, natural gas, natural gas liquids.
Greer -----	586	860	Stone, natural gas, clays, petroleum, sand and gravel.
Harmon -----	W	W	Salt, natural gas.
Harper -----	42,051	40,354	Natural gas, natural gas liquids, petroleum, sand and gravel.
Haskell -----	W	W	Natural gas, coal.
Hughes -----	8,001	9,383	Petroleum, natural gas, sand and gravel.
Jackson -----	5,423	3,596	Petroleum, gypsum, copper, sand and gravel, silver.
Jefferson -----	5,508	5,602	Petroleum, natural gas.
Johnston -----	4,277	5,035	Sand and gravel, stone, petroleum.
Kay -----	36,874	34,269	Petroleum, natural gas liquids, stone, natural gas, sand and gravel.
Kingfisher -----	116,163	116,095	Petroleum, natural gas, natural gas liquids, sand and gravel.
Kiowa -----	2,817	2,785	Stone, petroleum, natural gas, sand and gravel.
Latimer -----	22,961	W	Natural gas.
Le Flore -----	7,786	19,457	Coal, natural gas, sand and gravel, clays, stone.
Lincoln -----	17,052	19,142	Petroleum, natural gas, natural gas liquids.
Logan -----	13,686	16,200	Petroleum, natural gas, natural gas liquids, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Oklahoma, by county <sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975, in order of value
Love -----	\$11,792	\$10,973	Petroleum, natural gas, natural gas liquids.
McClain -----	36,704	40,713	Petroleum, natural gas, natural gas liquids, sand and gravel.
McCurtain -----	W	W	Sand and gravel, stone.
McIntosh -----	1,301	W	Natural gas, stone, petroleum.
Major -----	71,511	74,070	Petroleum, natural gas, natural gas liquids.
Marshall -----	8,944	8,865	Petroleum, natural gas liquids, natural gas.
Mayes -----	10,005	11,571	Cement, stone, clays, petroleum, sand and gravel.
Murray -----	11,326	12,321	Petroleum, stone, natural gas.
Muskogee -----	3,964	5,635	Petroleum, coal, sand and gravel, stone, natural gas.
Noble -----	13,559	16,955	Petroleum, natural gas, natural gas liquids.
Nowata -----	3,847	5,537	Petroleum, coal, stone, sand and gravel, natural gas.
Okfuskee -----	7,608	8,649	Petroleum, natural gas, natural gas liquids.
Oklahoma -----	49,617	47,856	Petroleum, natural gas liquids, natural gas, sand and gravel, clays.
Okmulgee -----	7,846	11,573	Petroleum, coal, natural gas, stone.
Osage -----	78,471	108,240	Petroleum, stone, natural gas.
Ottawa -----	W	1,291	Sand and gravel, stone, tripoli.
Pawnee -----	10,087	10,314	Petroleum, stone, natural gas, sand and gravel.
Payne -----	15,144	20,532	Do.
Pittsburg -----	13,845	16,670	Natural gas, coal, stone, sand and gravel, petroleum.
Pontotoc -----	60,046	62,786	Petroleum, cement, stone, sand and gravel, natural gas, clays, natural gas liquids.
Pottawatomie -----	17,617	22,333	Petroleum, sand and gravel, natural gas.
Pushmataha -----	5	W	Sand and gravel.
Roger Mills -----	5,279	8,369	Natural gas, petroleum.
Rogers -----	26,307	W	Cement, coal, petroleum, stone, clays, natural gas.
Seminole -----	52,595	51,889	Petroleum, natural gas liquids, stone, natural gas, sand and gravel, clays.
Sequoyah -----	W	4,572	Lime, natural gas, stone, sand and gravel.
Stephens -----	217,933	224,546	Petroleum, natural gas, natural gas liquids.
Texas -----	144,270	145,087	Natural gas, petroleum, natural gas liquids, sand and gravel.
Tillman -----	1,179	W	Petroleum, sand and gravel.
Tulsa -----	16,176	17,624	Petroleum, stone, sand and gravel, clays, natural gas.
Wagoner -----	844	853	Petroleum, sand and gravel, natural gas.
Washington -----	6,206	7,699	Petroleum, stone, sand and gravel, natural gas.
Washita -----	850	866	Natural gas, petroleum.
Woods -----	14,766	16,030	Natural gas, petroleum, salt.
Woodward -----	27,737	26,361	Natural gas, natural gas liquids, petroleum, sand and gravel.
Undistributed <sup>2</sup> -----	r 32,621	93,075	
Total -----	r s 2,122,601	2,267,095	

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

<sup>1</sup> Petroleum is based on an average price per barrel for the State, and natural gas is based on an average price per cubic foot for the State.

<sup>2</sup> Includes value of items that cannot be assigned to specific counties and values indicated by symbol W.

<sup>3</sup> Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Oklahoma business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	1,126.0	1,155.0	+2.6
Unemployment -----do-----	49.0	83.0	+69.4
<b>Employment (nonagricultural):</b>			
Mining -----do-----	38.5	39.9	+3.6
Manufacturing -----do-----	155.9	149.5	-4.1
Contract construction -----do-----	46.8	43.0	-8.1
Transportation and public utilities -----do-----	56.7	55.1	-2.8
Wholesale and retail trade -----do-----	202.3	209.4	+3.3
Finance, insurance, and real estate -----do-----	45.5	46.9	+3.1
Services -----do-----	135.5	141.1	+4.1
Government -----do-----	197.2	202.5	+2.7
Total nonagricultural employment -----do-----	878.9	887.4	+1.0
<b>Personal income:</b>			
Total -----millions--	\$12,933	\$14,237	+10.1
Per capita -----do-----	\$4,823	\$5,250	+8.9
<b>Construction activity:</b>			
Number of private and public residential units authorized--	11,825	10,208	-13.7
Value of nonresidential construction -----millions--	\$313.4	\$167.3	-46.6
Value of State road contract awards -----do-----	\$84.5	\$99.0	+17.2
Shipments of portland and masonry cement to and within Oklahoma -----thousand short tons--	1,530	1,235	-19.3
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$2,122.6	\$2,267.1	+6.8
Value per capita, resident population -----do-----	\$791.72	\$835.03	+5.5
Value per square mile -----do-----	\$30,358.00	\$32,424.59	+6.8

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

**Legislation and Government Programs.**

Oklahoma's mining laws were modified by the State Legislature to allow both men and women over 18 years of age to work in underground mines. Functions of the State Mining Board were merged with the office of the Chief Mine Inspector, Department of Mines, for better budgeting and management. The State Legislature passed and submitted to public vote a resolution whereby selection of the State's chief mine inspector would be changed from elective to appointive status. Voters subsequently approved the resolution. Consequently the office will be filled by appointment starting January 1, 1979. Resolutions asking voters to decide whether or not to allow future storage and use of plutonium in Oklahoma and the construction of nuclear plants were defeated by the legislature. A bill to provide eminent domain for the construction and operation of coal slurry pipelines remained in committee at the end of the legislature's 1975 session in anticipation of renewed consideration in 1976. Resolutions from the State Legislature to the U.S. Congress opposed congressional bills to eliminate a deple-

tion allowance on oil production and supported retention of an existing depletion allowance. In addition, the State Legislature passed and the Governor signed a bill to retain the State's 20% depletion allowance for crude oil producers despite Congress' elimination of the Federal allowance.

Among the policies and thrusts of the State Government was the transfer of Camp Gruber in east-central Oklahoma from Federal ownership to State control. Studies had shown that the area has physical qualities favorable for development of a regional energy park and characteristics of environment that could be most easily managed by the State. A transfer plan (phase 1 of a statewide plan) to provide water from southeastern counties to 20 water-deficient southwestern counties was prepared by the U.S. Army Corps of Engineers and presented to the Legislative Council Committee on Environmental and Natural Resources by the Oklahoma Water Resources Board. Estimates indicated that installation of a gathering, transport, storage, and dissemination system would cost \$1.7 billion.

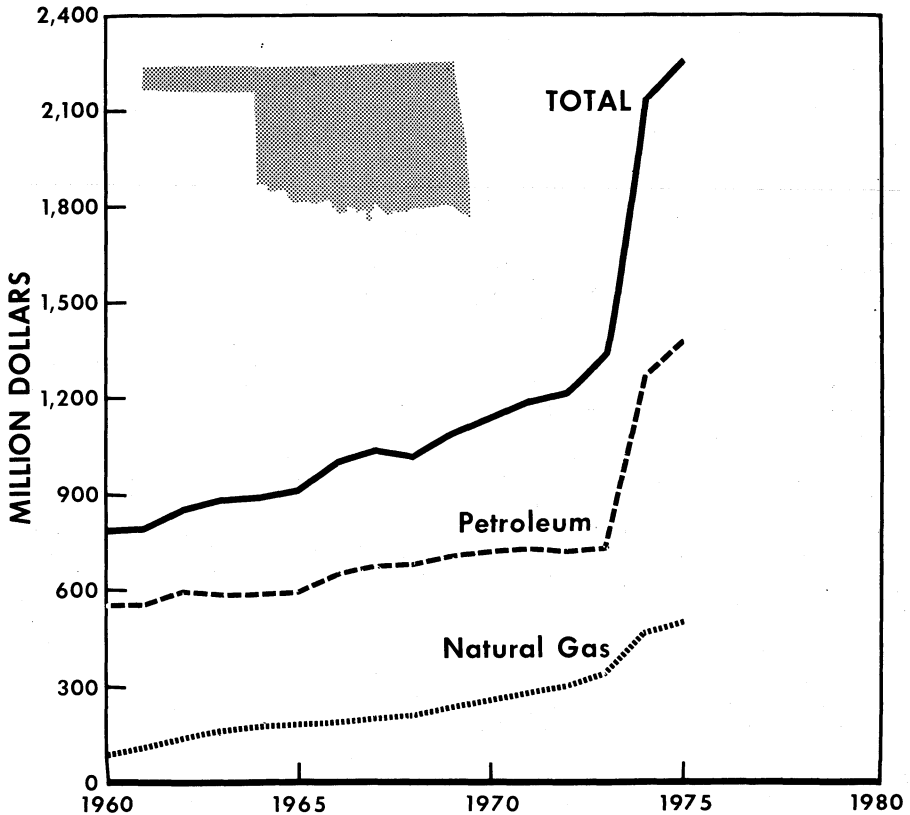


Figure 1.—Value of natural gas, petroleum, and total value of mineral production in Oklahoma.

Emphasizing its considerable economic dependence on production and regulation of hydrocarbons, the State undertook late in the year to intervene in a suit filed in the U.S. Court of Appeals for the District of Columbia in which consumer groups sought to force the Federal Power Commission to control intrastate sales of natural gas.

Activities of the Oklahoma Geological Survey were directed toward recognition, delineation, and inventory of mineral resources. Cooperative programs were established with the U.S. Geological Survey to sample and analyze coals for their chemical nature and trace element content, and

with the Federal Bureau of Mines to study quality, distribution, and thickness of coalbeds and their roof rock conditions and minability. Location, description, and classification of minor concentrations of copper, lead, and zinc and their geologic environment were begun, as was an inventory of surface-mined lands (excluding coal) to identify location, commodity mined, extent of mining, tonnage removed, the time of mining, and the extent of any reclamation performed. Studies made on strata of the Hunton Group in the Anadarko Basin included the distribution of porosity and permeability as related to occurrence of oil and natural gas. Signif-

icant major publications included Bulletin 120, *Geology and Mineral Resources of Choctaw County, Oklahoma*, and *Hydrologic Atlas 4, Reconnaissance of the Water Resources of the Oklahoma City Quadrangle, Central Oklahoma*, which was prepared in cooperation with the U.S. Geological Survey.

Federal agencies addressed a variety of problems of the mineral industry through contractual and sponsored research. Investigations in coal mining, including design of systems to locate trapped miners, design of longwall mining systems, and evaluation of techniques to control horizontal drilling in coalbeds, were sponsored by the Federal Bureau of Mines. Continental Oil Co., Ponca City; Fenix & Scisson, Inc., Tulsa; and McCarthy Engineering & Construction, Inc., Tulsa, were contractees for these purposes. James H. Cobbs Engineering, Tulsa, provided management services. Fenix & Scisson, Inc., Tulsa, investigated rubbilization and in situ retorting of deep oil shale deposits. The University of Oklahoma, Oklahoma Geological Survey, was involved in the definition of coal resources and their characteristics. Bartlesville Energy Research Center, U.S. Energy Research and Development Administration (ERDA), pursued the problems of controlling pollutants from engines operated underground.

Research at the Bartlesville Energy Research Center involved oil and gas extraction, oil and gas utilization, advanced research and supporting technology, and a series of miscellaneous contract projects for other agencies. Research to enhance oil recovery from reservoirs with the use of micellar and polymer flushing treatments was applied to the Bartlesville sand near Nowata in Nowata County and cooperatively with Phillips Petroleum Co. and Kewanee Oil Co. to parts of the Burbank oilfield in Osage County. Chemical explosive fracturing and massive hydraulic fracturing of reservoir rocks, drilling research, identification of residual oils and stimulation of their production, thermodynamics of tertiary recovery systems, and characterizations of reservoirs were also being investigated. A grant to Oklahoma State University supported research in biodegradation of organic chemicals injected into deep wells. Recycling of waste oils, automobile engine combustion effi-

ciency, and utilization of alternative fuels for internal combustion engines were among a host of oil and gas utilization studies. Advanced research and supporting technology dealt with thermodynamics of various hydrocarbons and with characterization, heat values, and applicabilities of various products developed in coal gasification and in the synthesis of oil from coal.

**Employment and Wages.**—Average employment in all mining in 1975 was 39,940. Of these, 38,250 were oilfield workers and about 1,690 mined other minerals according to the Oklahoma Employment Security Commission. Under continued acceleration in the petroleum industry, the number of oilfield workers increased 3.2% from 37,500 in December 1974 to 38,700 in December 1975. A slowing of other mining reduced supporting employment by 20% in the same period. Average wages in 1975 for oilfield workers were \$5.34 per hour. Average oilfield wages in December 1975 were \$5.54 per hour, some 11% above those in December 1974. Oilfield wages were exceeded only by those in petroleum refining and construction among 14 manufacturing industries and 5 nonmanufacturing industries in December 1975.

**Transportation.**—About 392,000 tons of mineral materials, including chemical fertilizers, petroleum products, sand and gravel, and coal, were transported on the McClellan-Kerr Arkansas River Navigation System. Coal shipments of 167,868 tons were about 47% less than in 1974. Shipments of 19,106 tons of petroleum products exceeded the 1974 total by 7%. Sand and gravel shipments increased about 3% to 123,534 tons. Shipments of chemical fertilizers were 81,850 tons. Coal and petroleum products were primarily outbound. Sand and gravel was hauled internally, and chemical fertilizers were mostly inbound.

Financial difficulties experienced by Chicago, Rock Island and Pacific Railroad early in the year threatened loss of the main east-west rail artery for southern and central Oklahoma and a major north-south route. State and Federal actions helped the railroad overcome its problems and averted serious consequences to the State's aggregate, gypsum, coal, and brick industries. The Missouri, Kansas and Texas

Railroad Co. applied to the Interstate Commerce Commission to abandon a rail line between Bartlesville and Oklahoma City, but the application was not acted upon during the year.

Interstate transportation of crude oil from the Texas gulf coast to Oklahoma was improved by completion of the

Texoma Pipeline, with its terminus at Cushing and satellite projects for storage and distribution of the crude oil to individual refineries and other States. Intra-state pipelines for transporting natural gas were constructed by Mustang Fuel Corp., Texas Oil & Gas Corp., and Oklahoma Natural Gas Co. (ONG).

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

Continuing escalation in mineral fuels prices raised the total value of these commodities produced in Oklahoma in 1975 to \$2.2 billion. The new record value was achieved in spite of reduced output of natural gas, natural gas liquids, and crude petroleum from quantities produced in 1974. Helium and coal production increased in 1975.

The search for liquid hydrocarbons involved drilling of 3,646 wells, about 19% above the number drilled in 1974, and total footage drilled increased 9% to 18,253,324 feet according to the American Petroleum Institute (API). Well completions included 1,743 oil wells, 638 gas wells, and 1,265 dry holes. Both the number of exploratory wells drilled (394) and the success ratio among exploratory wells (28%) were virtually unchanged from those of 1974. Average drilling depth of all wells decreased from 5,470 feet in 1974 to 5,006 feet in 1975, reflecting a notable increase in the number of wells of shallow to moderate depth drilled. Osage County led all counties in number of completed wells for the fifth consecutive year with 456, followed in order by Garfield and Carter Counties.

Increased drilling activity was supported by 38 public sales of mineral rights by State, Federal, Indian, municipal, and private entities. Bonuses paid were more than \$5.6 million. Sale of mineral rights on State lands brought total bonus payments of approximately \$1.3 million. Sales of mineral rights on Indian lands totaled \$3.9 million, led by \$1.8 million in sales at Anadarko and \$1.5 million in sales by the Osage Tribal Council in Osage County. Sales by the Bureau of Land Management totaled \$0.4 million. A tract of land adjacent to a producing area on the southwest side of East Binger field in Caddo

County brought \$3,003.47 per acre, the highest unit bonus recorded during the year. Oil and gas were being produced in this area from the Marchand sand at approximately 10,000 feet. A tract near a well producing gas from the Arbuckle in West Mayfield field, Beckham County, brought \$3,001.51 per acre. Production rates of as high as 120 million cubic feet of gas per day from the Arbuckle have been reported at West Mayfield.

Coal output increased 22% with an increase in unit value from \$10.51 per ton in 1974 to \$16.69 in 1975. As a result, at least 1,000 tons of coal was produced at each of 31 mines. Normal 1-year mining permits that were issued by the Oklahoma Department of Mines to 14 previously permitted operators and 16 new operators, including several reorganized firms, involved a total of 39 minesites. Five firms that held 1974 permits did not renew in 1975.

**Carbon Black.**—Output of carbon black by Continental Carbon Co. at Ponca City in Kay County remained about the same as that of 1974. Total value of the carbon black, which is produced from liquid hydrocarbons, increased slightly over that of 1974. The principal use for carbon black is in the manufacture of rubber for heavy-duty applications.

**Coal.**—Coal mining continued to expand in 1975 with shipments of almost 2.9 million tons, an increase of 22% above those made in 1974. Value of shipments rose 94% above that of 1974 to \$47.9 million owing in part to a concurrent increase in unit value of coal from \$10.51 per ton in 1974 to \$16.69 per ton in 1975. The coal was obtained from 31 strip mines scattered through 8 counties in eastern Oklahoma. Collectively the 10 mines in Craig and Rogers Counties provided 68% of the shipped coal. Le Flore



and Haskell Counties, each with seven mines, were respectively the third and fourth most productive areas.

The number of miners employed rose from 518 in 1974 to 858 in 1975, according to the Oklahoma Department of Mines. Working a total of 204,306 man-days, they mined 2,850,427 tons of coal for an average of 13.95 tons of coal per man-day. No fatalities and 11 compensable nonfatal injuries were recorded by the State chief mine inspector.

Mining permits for new companies included sites on the Stigler coalbed near Stigler, Quinton, and Lequire in Haskell County, on Stigler and Cavanal coalbeds near Poteau and Bokoshe in Le Flore County, on the Stigler coalbed near Porum and Webbers Falls in Muskogee County, and on the Croweburg coalbed near Henryetta in Okmulgee County. Sites of new mining permits in Rogers County were on the Weir-Pittsburg coalbed near Foyil and Chelsea, on the Croweburg coalbed near Alluwe, and on the Rowe coalbed near Inola. In Craig County new permits were issued to mine the Mineral coalbeds near Welch.

Garland Coal & Mining Co. began mining on a Federal lease at its Bokoshe No. 10 mine in Le Flore County. Starting from a previously abandoned strip pit, the firm planned to strip mine both Upper and Lower Hartshorne coals to a maximum overburden thickness of about 90 feet. At that point plans call for Colorado Fuel & Iron Co. to convert the property to underground mining on both Upper Hartshorne and Lower Hartshorne coalbeds, which have average thicknesses of 2.5 and 3 feet, respectively. Garland also completed construction of a 200,000-ton-per-year coal preparation plant which was started in 1974 on the Bokoshe site. The plant utilizes a water bath, vibrating tables, screens, and heavy media.

As a result of a dispute over the legality of certain provisions of the national bituminous coal wage agreement, miners struck the Lone Star Steel Co.'s Starlight mine near McCurtain in Haskell County. The strike subsequently spread to the firm's Pocahontas mine near Dow in Pittsburg County, where miners employed by Surface Industries of Dallas, lease operators, demanded union representation. In the face of threatened violence and continued

inability to come to agreement with the United Mine Workers of America, Lone Star closed both mines.

Paul Rees Coal Co. started construction of a coal preparation plant near Heavener in Le Flore County. A coal preparation plant, formerly property of the Howe Coal Co., was bought by Zapata Fuels Co. of Pennsylvania. Purchasers were undecided about leaving this plant, which had a designed capacity of 500 tons per hour in Oklahoma, or dismantling it for shipment and reassembly at a Pennsylvania site.

McNabb Coal Co. of Catoosa announced plans to strip mine 150 acres underlain by about 0.5 million tons of metallurgical coal at a depth of about 50 feet within 0.25 mile of a developing residential area on the west side of Claremore in Rogers County. Local residents and business interests expressed both opposition and support. The coal company proposed reclaiming the pit by returning and leveling overburden in its normal stratigraphic sequence, and replacing topsoil. Negotiations continued at yearend.

The Oklahoma Geological Survey analyzed about 60 samples of Oklahoma coal to help assess its potential suitability for various purposes including electric power generation, coke manufacture, cement plant fuel, gasification, and liquefaction. The project was aided by a \$7,050 grant from the U.S. Geological Survey. The Federal Bureau of Mines provided correlative analytical services under a cooperative agreement with the State Geological Survey. Trace element and proximate and ultimate analyses of the coal and mineral analyses of associated underclays were provided by the Federal agencies.

Northeastern Counties of Oklahoma Economic Development District undertook feasibility studies for establishing a district solid waste processing, recycling, and disposal system. Organic and other decomposable residues of the system would be experimentally incorporated with strip mine spoils as soil treatment if cooperators could be found among coal mining companies in the district.

Oklahoma coal was marketed principally in Missouri and to a lesser extent in Iowa for electric power generation. Cement industries in Texas and Arkansas used the coal for kiln fuel. Coking coal

was shipped to Texas, Colorado, and Japan. Essentially none of the coal was used in Oklahoma, where air quality standards allow 1.2 pounds of SO<sub>2</sub> emissions per million British thermal unit (Btu) of fuel; according to the State Air Quality Service, this is equivalent to about 0.7% to 0.8% sulfur in coal with a heat value of 12,000 to 14,000 Btu per pound. The Oklahoma Geological Survey has shown that the weighted average sulfur content of original and remaining coal resources in the State is 2.2% with a local minimum sulfur content of 0.4%. Consequently electric power companies in Oklahoma planned to use western coal to generate 2,930 megawatts of electricity in six new generating units that were under construction or firmly planned in 1975.

Coal was shipped by rail, barge, and truck. Loading docks on the McClellan-Kerr Arkansas River Navigation System at Port Carl Albert, near Keota, handled most of the barged coal during the year. Barged coal was preponderantly coking coal bound for New Orleans and transshipment to steel plants in Japan. Shipments from Rogers and Craig Counties to electric power generating plants in Missouri and Iowa were made largely by unit train, but also by truck. Shipments to Texas and Arkansas utilized both rail and truck.

The city of Henryetta in Okmulgee County sought aid from the Oklahoma Geological Survey and the Department of Geology at Oklahoma State University in respect to potentialities for surface subsidence above shallow abandoned underground coal mines at Henryetta. The city was planning to develop the surface as an industrial park.

**Helium.**—The quantity of high-purity helium extracted in Oklahoma in 1975 rose 33% above that of 1974 to 224 million cubic feet valued at \$7.4 million coincident with a 10% increase in both quantity and value of crude helium produced. Helium was extracted at the Federal Bureau of Mines plant near Keyes. Price of high-purity helium f.o.b. Keyes remained at \$35 per thousand cubic feet under a system for financing the Federal long-range helium conservation program. Construction of an ionization chromatograph to increase the sensitivity of analytical procedures used in quality control at the Keyes plant was completed in June. Prin-

cipal purchasers of the helium were ERDA, Department of Defense, National Aeronautics and Space Administration, and National Weather Service. Excess helium was stored by the Bureau of Mines in the Cliffside gasfield in Texas.

**Natural Gas.**—Following the pattern of declining production set in the previous 2 years, the quantity of natural gas marketed in Oklahoma dropped an additional 2% in 1975 to 1,605 billion cubic feet. However, the value of natural gas marketed in 1975 rose 12% over that of gas marketed in 1974 to a total value of \$513,731,000. Average unit value increased from 28 cents per thousand cubic feet in 1974 to 32 cents per thousand cubic feet in 1975. Natural gas was produced in 65 counties from a total of 9,769 wells. According to figures compiled by the Oklahoma Corporation Commission (OCC). Div. of Oil and Gas Conservation, Texas County, with gas runs of 254 billion cubic feet during the year, led all other producing counties. It was followed successively by Beaver, Major, and Harper Counties. In the fourth quarter of the year, gas was produced from a total of 3,975 wells in these four counties. Oklahoma retained its 1974 position as third ranking source of natural gas behind Texas and Louisiana, accounting for 8% of the Nation's total marketed natural gas.

Although drillers brought in 638 new gas wells including 52 successful wildcats, this was 14% less than the number of gas well completions in 1974. Among the successful exploratory gas wells, seven were in Caddo County, five in Pittsburg County, and four each in Ellis and Woodward Counties. Exploration was notably successful in two areas, the Anadarko Basin and the Arkoma Basin. Thirty-three of the discoveries were on the northeast flank of the Anadarko Basin between Garvin County on the southeast end and Ellis County on the northwest end. Natural gas was found broadly in strata of the Morrow and Springer of the Pennsylvania system, and the Hunton of the Devonian system, and less broadly in other sands of the Pennsylvanian. Producing strata in the new wells were found at depths ranging from about 8,200 feet to almost 16,000 feet.

Whereas most of the wells were completed flowing from 1 to 5 million cubic feet per day through a choke, El Paso

Natural Gas Co.'s No. 1 Hunt-Cross in Roger Mills County flowed 10 million cubic feet per day through a choke. Production was obtained from the upper Morrow perforated between 15,530 feet and 15,538 feet. Total depth of the well was 16,120 feet. Cotton Petroleum Corp.'s No. 1 Circle Bar K in Grady County was completed with a choked flow of 11.7 million cubic feet per day of natural gas, with 70 barrels of condensate per million cubic feet of gas, through perforations in the Springer between 12,930 feet and 12,979 feet. Calculated open flow potential of this well was 31 million cubic feet per day. A calculated open flow potential of 14.1 million cubic feet per day was reported for Hillard Oil & Gas No. 1 Phillips-Duncan in Woodward County. Choked flow was 3.4 million cubic feet per day with 65.2 barrels of condensate and  $\frac{1}{3}$  barrel of water for 16 $\frac{3}{4}$  hours from the relatively rarely reported First Wilcox (Simpson Sand, Middle Ordovician) perforated between 10,868 feet and 10,886 feet. Total depth of the well was 11,220 feet.

Exploratory drilling in the Arkoma Basin in the east-central part of the State was relatively successful. Nine wildcats were completed as gas wells in the area of LeFlore, Pittsburg, and McIntosh Counties. In general, producing strata were encountered at depths of less than 10,000 feet. The Morrow and Red Oak beds were common producers. One well in Pittsburg County had a choked flow of more than 5 million cubic feet of gas per day and a calculated open flow of 13.9 million cubic feet from the Morrow. Discoveries of natural gas in the northern shelf areas that extend from eastern Oklahoma across the northern tier of counties to the west end of the Panhandle were relatively discouraging. Discoveries included one in Osage County, three in Woods County, and two each in Harper and Texas Counties. A calculated open flow potential of 37.6 million cubic feet of gas per day was encountered in the Morrow, perforated between 5,870 feet and 5,890 feet in Cities Service Gas Co. No. 2 Eckstein-A in Texas County. Only one producing exploratory well (a Morrow well in Love County) was completed in the Ardmore Basin of southern Oklahoma.

The number of field well completions in 1975 was 14% less than the 683 field wells completed in 1974. Twenty or more wells were drilled in each of 13 counties, which cumulatively accounted for 63% of all field wells drilled. Osage County led with 52 wells, followed by Beaver with 37 and Pittsburg with 33. The remaining counties were Blaine, Woods, Canadian, Texas, Alfalfa, Grady, Ellis, Harper, Dewey, and Garfield.

Reserves diminished by 2% during the year. Remaining reserves on December 31, 1975, were 13.083 trillion cubic feet.

Consumption of natural gas within the State amounted to 565.4 billion cubic feet valued at \$396.8 million. Residential customers took 14% of that; commercial, 7%; industrial, 25.3%; and electrical utilities, 53.2%. All other activities used less than 1%. Average value of consumed gas ranged from 52.5 cents per thousand cubic feet for electric utilities to \$1.218 per thousand cubic feet for residential customers. Gross deliveries of gas to interstate pipeline amounted to about 2.1 trillion cubic feet. With receipts of 1.2 trillion cubic feet from interstate gaslines, the net deliveries amounted to 869.4 billion cubic feet.

Previous delivery records were broken in the 24-hour period from 8:00 a.m., January 5 to 8:00 a.m., January 6 when ONG delivered 1.4 billion cubic feet of natural gas to approximately 1,600,000 customers. A 3-day period of delivery averaging 1.263 billion cubic feet per day was completed without interruption to any customers.

Verdigris plant of Agrico Chemical Co. was dedicated in June. ONG began delivering 45 million cubic feet of gas per day to produce a thousand tons of ammonia, 630 tons of urea, and 630 tons of nitric acid every 24 hours. Construction continued through the year on ammonia plants by W.R. Grace & Co. at Woodward and by a joint venture of Farmland Industries, Inc., and Agrico Chemical Co. at Enid. Nipak, Inc., Pryor, started construction on a 63,000-ton-per-year urea expansion, scheduled for completion early in 1976. Ford Motor Co. completed its Tulsa glass plant, which uses 17 million cubic feet of gas per day at peak production.

Mustang Fuel Corp. completed both the longest of the natural gas pipelines under

construction in Oklahoma, a 120-mile, 20-inch transmission line from Calumet in Canadian County to Konawa in Seminole County, and a 32-mile, 16-inch line from Tribbey in Pottawatomie County to Harrah in Oklahoma County. The Intrastate Kinta Gas Gathering System in Haskell County was completed by Texas Oil & Gas Corp., and a 17-mile section of 8-inch line was installed from Durant, Okla., to Denison, Tex., by Lone Star Gas Co. ONG installed 24 miles of 16-inch line from Hydro in Caddo County to Thomas in Custer County and began construction of 103 miles of combined 24-inch and 20-inch transmission line extending from central Oklahoma gathering systems to storage facilities near Depew in Creek County. The firm was also constructing 22 miles of 16-inch line from Enid in Garfield County to Hennessey in Kingfisher County.

A \$20 million project to upgrade gathering systems in the Laverne and Woodward areas of Harper and Woodward Counties, involving about 67 miles of pipeline and almost 31,000 additional horsepower in compressor capacity planned by Michigan-Wisconsin Pipe Line Co., received authorization for construction from the Federal Power Commission. The Osage Nation and Transco Energy Co. (Transco) agreed on tentative plans to allow Transco to explore for natural gas and to install a natural gas gathering system in Osage County. The Osage Nation would profit both by its royalty interest in produced gas and by a net profits interest.

Both ONG and Cities Service sought rate increases during 1975. ONG filed for \$4.9 million in rate increases that would boost the costs to the average residential consumer approximately \$2.28 per year. The company submitted four alternative plans designed to keep the increase to a minimum among the low-volume users and to make the costs for high-volume users proportionately larger. Cities Service requested the Federal Power Commission to approve a 13% rate hike on sales to local distributors in Oklahoma, Missouri, Kansas, Nebraska, and Texas. Costs to suppliers in Oklahoma communities would be about \$627,000 out of the total \$20 million annual increase requested.

**Natural Gas Liquids.**—With output of 40,475,000 barrels of natural gas liquids,

Oklahoma ranked third nationally behind Texas and Louisiana in 1975 and provided 7% of the total national output. Natural gas liquids produced in the State in 1975 were 8% less in quantity than in 1974, and 19% less in value than in the previous year. Liquefied petroleum gas (LPG) plus ethane constituted 73% of the product. The remainder included natural gasoline and isopentane, plant condensate, and all other associated substances. The Oil and Gas Journal reported that 81 natural gas processing plants were in operation at year-end. The volume of proved reserves of natural gas liquids at yearend was estimated by the American Gas Association (AGA) to be 299.2 million barrels, an increase of 3% above 1974 reserves.

Warren Petroleum Co. addressed the industry's needs by designing and constructing small-scale equipment to process hydrocarbons and high-pressure dehydrated residues in isolated areas. Facilities to process as much as 2 million cubic feet of hydrocarbons daily are incorporated in a portable cryogenic unit that covers an area 8 by 10 feet on the ground and is 30 feet high. The electrically operated plant extracts propane, butane, and heavier hydrocarbons without emitting polluting wastes.

Amoco Production Co. had two natural gas cryogenic processing plants under construction for completion early in 1976. Modifications of the 40-million-cubic-foot-per-day plant in Blaine County and the 140-million-cubic-foot-per-day plant in Woodward County were scheduled to cost an estimated \$10.15 million. Burmah Oil and Gas Co. was constructing a turbo-expander plant in Carter County to process natural gas.

**Petroleum.**—Oklahoma maintained its nationwide fourth position among oil-producing States despite an 8% decrease in the output of crude oil from the levels of 1974. The State's wells yielded 163.1 million barrels of oil in 1975. Average well-head value of the oil rose \$1.34 per barrel to \$8.52 in 1975, generating a total value of almost \$1.4 billion. Oil was produced in 65 counties, the principal counties being Stephens, with 25.2 million barrels of oil; Carter, 22.8 million barrels; and Garvin, 12.3 million barrels. Osage, Kingfisher, Texas, Creek, Seminole, and Grady Counties complete the list of counties in which production was more than 5 million bar-

rels and which in total accounted for 66% of the State's output.

At yearend oil was being produced from 71,576 wells, 221 fewer than at yearend 1974. Stripper wells numbered 58,736, a reduction of 2% from the 1974 level. These wells produced 45% of the State's crude oil (72.7 million barrels), according to a joint national survey by the Interstate Oil Compact Commission and the National Stripper Well Association. Average daily production per well based on all wells was 6.2 barrels of crude oil. Production at a rate of 200% of the allowable under the depth/acreage formula was permitted by the OCC, Div. of Oil and Gas Conservation, in an attempt to meet demands that exceeded production. Stocks of crude oil produced and held in Oklahoma were 12.9 million barrels at the beginning of the year and 15.3 million barrels at yearend.

Exploratory drilling resulted in 59 successful oil wells distributed in 32 counties. Payne County, which led the number of discoveries with six, was followed by Osage, five; McClain, four; and three each for Dewey, Garvin, Logan, and Pottawatomie Counties. Discoveries were most abundant in the northern shelf area in north-central Oklahoma where 26 oil wells were completed. Southern-central Oklahoma had 11 oil-producing wildcats. The Anadarko Basin in western Oklahoma had six exploratory oil wells.

Oil discoveries were made principally in sands of Pennsylvanian age and in the Mississippian limestone in the north-central part of the State. Producing strata included Red Fork, Bartlesville, Oswego, Burgess, Skinner, Cleveland, Mississippi Chat, and the Hunton strata. The initial production of exploratory wells in Payne County ranged from 12 to 155 barrels of oil per day. Skinner and Burgess sands of the Pennsylvanian and Mississippian strata were the reservoir rocks. The shallowest pay zone was found at 3,493 feet in the Skinner, and the deepest pay zone was found at 4,995 feet in the Mississippian.

Exploratory wells producing from the Pennsylvanian strata of southern-central Oklahoma generally yielded less than 100 barrels of oil per day at depths ranging from 3,946 feet in Garvin County to 5,444 feet in McClain County. Wells completed in the Hunton ranged from 28 barrels of oil per day plus water to 185 barrels of oil per day. The deepest of the Hunton producing strata was at 8,734 feet in Cleveland County. One well in Cleveland County encountered oil that flowed at a rate of 173 barrels of oil per day, with 52,600 cubic feet of gas per day in the Second Bromide of the Ordovician at a depth of 7,644 feet. Mapco No. 1 Howell in Murray County, flowing at a rate of 1,392 barrels of oil per day from the Oil Creek Formation (Ordovician), had the largest initial production from exploratory wells drilled in Oklahoma during 1975.

Cottage Grove production yielding 372 barrels of oil per day was found at a depth of 8,568 feet in southeastern Ellis County. Other strata producing in the western part included the Tonkawa, Cleveland, Red Fork, and Mississippi lime.

The number of field wells drilled in 1975 rose to 1,684 from 1,098 in 1974. Ranked in order of the number of field wells completed were Osage County, 272; Carter, 99; Kingfisher, 98; Garfield, 83; Washington, 81; Stephens, 79; Creek, 65; and Seminole, 56. Except for Carter, Seminole, and Stephens Counties, the leading counties are concentrated in the north-central to northeastern part of the State. Major County led the western counties with 55 field well completions, followed distantly by Texas County, 29; Dewey, 26; Comanche, 21; and Beaver, 20.

Continued slowing of the rate of oil withdrawals in 1975 allowed the increment of new reserves resulting from extensions, revisions, and new discoveries to exceed total withdrawals for the year. According to the API, reserves at yearend were 1,240 million barrels of oil, some 0.6% above those on December 31, 1974.

Table 4.—Oklahoma: Estimated proved recoverable reserves of crude oil, natural gas liquids, and natural gas

Commodity	Proved reserves Dec. 31, 1974	Changes in proved reserves due to extensions, revisions, and new discoveries in 1975	Proved reserves Dec. 31, 1975	Change from 1974 (percent)
Crude oil -----thousand 42-gallon barrels--	1,232,377	7,310	1,239,687	+ 0.6
Natural gas liquids -----do-----	290,327	8,828	299,155	+ 3.0
Natural gas -----million cubic feet--	13,390,312	307,284	13,083,028	- 2.3

Sources: American Petroleum Institute and American Gas Association.

Table 5.—Oklahoma: Oil and gas well drilling completions, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Alfalfa	36	24	14	2	--	8	84	526,970
Atoka	4	--	1	--	--	--	5	8,686
Beaver	20	37	46	--	--	4	107	741,542
Beckham	--	2	1	--	--	--	3	24,657
Blaine	15	30	33	--	2	3	83	791,291
Bryan	--	2	--	--	--	2	4	26,540
Caddo	41	17	6	2	7	5	78	843,692
Canadian	15	29	16	1	2	6	69	686,203
Carter	99	1	19	--	--	3	122	502,819
Cimarron	3	5	10	--	--	--	20	93,634
Cleveland	6	--	3	1	--	1	11	81,903
Coal	7	3	8	2	--	5	25	131,664
Comanche	21	3	4	2	--	5	35	85,873
Cotton	13	--	1	--	--	3	17	37,930
Craig	3	--	7	1	--	1	12	6,538
Creek	65	5	22	--	--	4	96	244,199
Custer	1	7	2	--	3	6	19	265,855
Dewey	26	20	20	3	2	8	79	748,024
Ellis	5	22	25	2	4	6	64	614,821
Garfield	83	20	16	1	--	8	128	517,057
Garvin	39	2	29	3	1	10	84	481,689
Grady	18	24	11	--	2	6	61	579,450
Grant	3	5	13	--	--	15	36	180,181
Greer	--	5	5	--	3	2	15	23,656
Harmon	--	--	--	--	--	1	1	3,250
Harper	1	21	33	--	2	4	61	388,369
Haskell	--	6	8	--	--	4	18	101,914
Hughes	5	10	17	--	--	5	37	120,799
Jackson	--	--	--	--	--	2	2	12,733
Jefferson	2	--	3	1	--	8	14	37,729
Johnston	--	--	--	1	--	1	2	8,757
Kay	33	5	25	2	--	12	77	252,692
Kingfisher	98	7	13	1	--	--	119	939,108
Kiowa	11	--	11	1	--	--	23	17,876
Latimer	--	4	3	--	--	--	7	55,148
Le Flore	--	4	5	--	3	1	13	87,719
Lincoln	21	4	21	2	--	12	60	264,022
Logan	39	10	16	3	--	9	77	399,895
Love	3	--	6	--	1	8	18	114,772
McClain	13	3	12	4	--	3	35	323,425
McCurtain	--	--	3	--	--	3	6	3,457
McIntosh	--	10	2	--	1	1	14	34,498
Major	55	18	21	1	--	1	96	742,685
Marshall	3	1	3	1	--	2	10	51,460
Mayes	--	--	--	1	--	2	3	3,344
Murray	8	--	6	1	--	2	17	63,597
Muskogee	10	2	6	--	--	--	18	27,528
Noble	34	11	26	1	--	8	80	306,843
Nowata	51	1	18	--	--	--	70	70,478
Okfuskee	7	1	10	1	--	2	21	65,232
Oklahoma	2	--	--	--	--	4	6	32,681
Oklmulgee	41	19	26	--	--	1	87	181,897

See footnote at end of table.

Table 5.—Oklahoma: Oil and gas well drilling completions, by county—Continued

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Osage -----	272	52	113	5	1	13	456	1,010,853
Pawnee -----	11	1	10	1	--	6	29	85,377
Payne -----	48	4	26	6	1	7	92	374,285
Pittsburg -----	--	33	18	--	5	4	60	281,578
Pontotoc -----	31	3	5	--	--	2	41	91,285
Pottawatomie -----	15	--	13	3	--	8	39	186,802
Roger Mills -----	4	8	7	1	2	6	28	399,264
Rogers -----	44	--	5	--	--	--	49	26,195
Seminole -----	56	5	19	--	--	4	84	290,551
Sequoyah -----	--	2	2	--	--	--	4	24,610
Stephens -----	79	5	21	1	--	4	110	467,614
Texas -----	29	26	31	--	2	7	95	552,159
Tillman -----	1	--	1	--	--	1	3	15,579
Tulsa -----	45	--	11	--	--	--	56	81,127
Wagoner -----	3	--	7	--	--	--	10	8,817
Washington -----	81	--	12	--	--	--	93	102,932
Washita -----	--	1	--	--	1	1	3	26,045
Woods -----	4	30	31	1	3	8	77	456,780
Woodward -----	1	16	44	--	4	3	68	564,589
Total -----	1,684	586	982	59	52	283	3,646	18,253,324

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Table 6.—Oklahoma: Crude oil production, indicated demand, and stocks, in 1975, by month  
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End-of-month stock originating within Oklahoma
January -----	13,987	12,893	14,048
February -----	13,796	13,451	14,393
March -----	14,482	14,662	14,213
April -----	12,497	12,300	14,410
May -----	13,795	13,158	15,047
June -----	13,703	14,737	13,963
July -----	13,687	14,305	13,345
August -----	12,964	13,036	13,273
September -----	13,995	14,325	12,943
October -----	13,561	12,012	14,492
November -----	13,169	13,190	14,471
December -----	13,487	12,649	15,309
Total:			
1975 -----	163,123	160,768	XX
1974 -----	177,785	177,077	XX

XX Not applicable.

Table 7.—Oklahoma: Crude petroleum production, by field  
(Thousand 42-gallon barrels)

Field	1974	1975	Cumulative to Dec. 31, 1975
Allen	2,540	2,245	129,166
Bowlegs	1,665	1,245	159,737
Burbank	3,685	3,380	507,419
Cement	1,280	2,490	142,726
Cushing	2,965	2,670	465,852
Edmond, West	625	530	155,677
Eola-Robberson	3,720	3,150	111,127
Fitts	2,565	2,650	153,523
Glenn Pool	1,980	1,775	311,196
Golden Trend	8,135	6,190	408,201
Healdton	7,575	6,720	300,960
Hewitt	6,595	5,500	224,486
Oklahoma City	2,000	1,915	735,811
Seminole Greater	1,010	880	200,336
Sho-Vel-Tum	34,250	32,600	1,035,056
Sooner Trend	9,810	9,140	208,554
St. Louis	1,100	970	217,115
Other fields	86,285	79,073	NA
Total	177,785	163,123	--

NA Not available.

Source: Oil and Gas Journal data adjusted to Bureau of Mines total.

Getty Oil Co. began a program of enhanced oil recovery in the Glenn Pool, southern Tulsa County. Two wells were drilled to the Bartlesville sand for testing preliminary to experimental chemical treatment of the sands. Independent Oil & Gas Ltd. was attempting to reestablish commercial oil production in the Bartlesville sand in the Chelsea field, discovered in 1889 in Rogers County. Core analyses indicate that as much as 6,000 barrels of oil remain per acre in the sand, which is 20 feet thick. Massive rehabilitation of wells and equipment was undertaken.

Tertiary recovery projects were begun by Continental Oil Co. (Conoco), Phillips Petroleum Co., and Kewanee Oil Co. Conoco started a water-assisted combustion project involving 26 wells over a 22.5-acre test plot near Loco in Stephens County to recover oil from a producing stratum at 250 feet depth. The project will require about 2 years to determine whether it will be effective in producing oil. Phillips Petroleum Co., cooperating with the Bartlesville Energy Research Center, started a 51-month project to apply a micellar-polymer recovery project on 90 acres in the Burbank field of Osage County. The objective is to increase production by 600,000 barrels of oil above yields expected by present practices in a period of 5 years. If successful, the system would be extended over the north

Burbank unit for recovery of about 50 million barrels of oil not now recoverable. Kewanee Oil Co. entered a 3-year cost-sharing project to inject polymer in the Stanley Stringer of the Burbank field.

Late in the year accelerated drilling to the Marchand sand was undertaken in East Binger field in Caddo County where operators were attempting to bring about a full field development of about 64 wells in an area of about 49 square miles. Phillips Petroleum Co., one of the principals, indicated that rapid depletion of gas pressure under a temporary allowable required a cut in that allowable and unitization of the field under a system of miscible gas injection, with a goal of recovering about 57 million barrels of oil by 1995. Natural gas had also been discovered in the Springer at greater depth, and later drilled wells were completed in a manner to allow a return and deepening to the Springer strata. Additional waterflood projects were requested for a part of the Delaware Childers field in Nowata County where oil was produced from the Bartlesville sand and in the Keystone field of Tulsa and Creek Counties to stimulate production of oil from the Burbank sand. On authority of an order issued by the OCC in 1974, Sun Oil Co. installed a secondary recovery system in the Norge-Marchand unit in Grady County.



The longest strike in Conoco's history ended from March 1 to June 24 at its Ponca City refinery.

Completion of an atmospheric crude oil distillation unit at Kerr-McGee Corp.'s Wynnewood refinery increased capacity of the refinery by 16,000 barrels of crude oil per day and brought the total plant capacity to 50,000 barrels of oil per day. Sun Oil Co., Tulsa, started construction for converting a reforming unit to produce cyclohexane. Universal Oil Products HB Unibond process being installed will have an initial capacity of about 20 million gallons per year. The firm was also engineering a \$10 million plant expansion designed to increase the refinery's production of lube oil by 35%, plus the capability to produce about 90 million pounds of wax annually. Completion of construction that was started at the Vickers Petroleum Corp. refinery at Ardmore in 1974 raised the refinery capacity to 60,000 barrels of crude oil per day.

Most pipeline and related construction during the year was related to needs of the Texoma and Seaway Pipelines. Skelly Pipe Line Co. started construction on three tanks with total capacity of 650,000 barrels to receive crude oil from both Texoma and Seaway Pipelines at Cushing. Seaway Pipeline Inc. also commenced construction of nine storage tanks at Cushing. Their planned capacity when completed in 1976 is 2.72 million barrels of crude oil. Osage Pipeline Co., which is owned 60% by Skelly Pipe Line Co. and 20% each by Mobil Oil Corp. and National Cooperative Refinery Association, laid a 20-inch pipeline from the Seaway and Texoma terminals at Cushing to Augusta and Eldorado, Kans., at a cost of \$25 million. After pumps are installed in 1976, the capacity of the line will be 170,000 barrels of oil per day. Vickers Petroleum Corp. undertook construction of 30 miles of 12-inch crude oil pipeline from Ardmore to Wynnewood, where it would connect with the spur from Texoma Pipeline. Initial capacity of 35,000 barrels of oil per day would be expanded to 50,000 barrels of oil per day. Crude oil started flowing into the Texoma terminal at Cushing on November 6 at a rate of 16,000 barrels of oil per day.

The OCC undertook a program of inspecting all wells in waterflood fields to

determine that all waterflood recovery systems were in compliance with State regulations. Commissioners of the Land Office announced modifications for State primary oil and gas leases starting January 1, 1976. Thereafter, only leases on producing formations would be renewed after expiration of the primary term. Leases on nonproducing formations would terminate. After several years of litigation between the Osage Indian Tribe and the city of Pawhuska for the value of oil and gas rights under the Pawhuska city lake, the U.S. District Court established a value of \$50 per acre for the 858 acres involved, giving the Osage Indian Tribe \$42,900 in contrast to their claims for \$221,000.

### NONMETALS

**Cement.**—A decrease of 15% in the shipments of portland cement and 11% in shipments of masonry cement in 1975 from levels of 1974 resulted largely from an extended shutdown at the Martin Marietta Corp. cement plant in Tulsa. Contrastingly, the value of shipped portland cement increased 2% and that of masonry cement 10% above the values in 1974. Oklahoma's three cement plants all produced both portland and masonry cement. The portland types included general purpose, moderate-heat, high-early-strength, high-sulfate-resistance, oil-well, waterproof, and other types. Building material dealers required 11% of the shipped cement; concrete product manufacturers, 8%; ready-mixed companies, 59%; and contractors and others, 22%. Martin Marietta closed its Tulsa plant to install coal-burning equipment in place of natural gas equipment previously used to fire kilns. Newly installed equipment included a Raymond mill for crushing coal, equipment to store, haul, and distribute the coal, and modifications to the antipollution equipment in the plant.

Total quantities of energy and raw materials used in the State's six cement kilns were also reduced by about 11% below those in 1974. Limestone, clay and shale, bauxite, sand, iron ore, and gypsum used amounted to 2.4 million tons. Natural gas consumed was 6.8 billion cubic feet, and electric power amounted to 177.9 million kilowatt-hours.

**Clay and Shale.**—Clay production in Oklahoma declined for the second successive year, with an output of 995,000 tons valued at \$1,701,000. These were respectively 23% and 19% less than the output and value in 1974. Pontotoc County, leading in production, in conjunction with Rogers and Canadian Counties, provided 59% of the clay and shale mined. A total of 16 mines operated by 13 firms were scattered through 11 productive counties. Only common clay and shale was mined. Portland cement required 39% of the produced clay, common brick and face brick required 38%, and concrete block and structural concrete products required 21%. The remainder of the clay was utilized in the manufacture of sewer pipe, pottery, and flower pots. Commercial Brick Corp. at Wewoka in Seminole County completed construction of a fully automated brick plant designed to produce 27 million face brick per year. Acme Brick Co., abandoning its midtown Tulsa pit, centered its Tulsa mining and brick manufacturing activities on its east-side plant.

**Gypsum.**—Oklahoma retained its place among the States as fifth in the production of crude gypsum, with output of about 1 million tons valued at \$4.8 million. This represented losses of 16% in tonnage and 14% in value as contrasted with 1974. Gypsum was mined in Blaine, Caddo, Canadian, Comanche, and Jackson Counties by seven companies in seven mines. United States Gypsum Co.'s mine at Southard in Blaine County was the fourth largest gypsum operation in the Nation. The quantity of gypsum calcined by United States Gypsum Co. and Republic Gypsum Co. increased 5% over that of 1974 and was 2% above the former record set in 1973.

**Iodine.**—Ground was broken near Woodward in Woodward County in September for construction of Amoco Production Co. and Houston Chemical Co. (PPG Industries, Inc.) iodine extraction plant. Initial production capacity of the plant when completed early in 1977 will be about 2 million pounds of iodine annually, which is almost one-third of U.S. demand. The iodine will be extracted from brines found in Morrow strata of Pennsylvanian age at depths ranging from 7,000 to 7,500 feet. Concentrations of iodine in the brine have been reported to be as high as 250 parts

per million. Recovery of brine and reinjection of all produced and stripped brine into the Morrow will involve 14 wells spaced over an area of 160 acres. Well drilling and well management will be by Amoco Production Co., whereas Houston Chemical Co. will operate the plant and market the product. Ethyl Corp., which had established a closed brine withdrawal and reinjection system near Vici in northern Dewey County in order to study iodine supply and extraction problems, made no announcement of intent regarding future production of iodine.

**Lime.**—The output of lime was reduced 22% from that of 1974. The value of the product, however, increased 21% relative to value in 1974. Loss in output was partly attributable to downtime at St. Clair Lime Co.'s Marble City plant in Sequoyah County. Modifications of the kiln and addition of fan and blower capacity raised the plant's productive capacity by 200 tons per day. Both quicklime and hydrated lime were produced from limestone from the Quarry Mountain Formation of Silurian age. The product was used principally as a soil stabilizer in construction, to control the pH of agricultural soils, and for chemical purposes. Total shipment of 135,968 tons of lime to Oklahoma consumers in 1975 included 116,850 tons of quicklime and 19,118 tons of hydrated lime.

**Pumice (Volcanic Ash).**—Both quantity and value of volcanic ash mined by Axtell Mining Corp. in Beaver County in 1975 were less than in 1974.

**Salt.**—Production of salable brines and salt in 1975 was less than in 1974. Total value of the product, however, increased in 1975. Brines were obtained through relatively shallow wells drilled into salt beds in the Flowerpot Formation of Permian age in Harmon and Woods Counties. Dissolution of the salt by penetrating ground water yields natural brines that are pumped from the wells to solar evaporating pans for precipitation of crystalline salt. Brines were sold for use in drilling oil and gas wells, and crystalline salt was marketed as stockfeed, as a reactivator for zeolites in water softeners, and as a road deicer.

**Sand and Gravel.**—After a reversal in 1974 of the increasing production that has

characterized sand and gravel, in recent years, production again rose in 1975.

Blended sand and gravel sold or used by producers in 1975 increased above levels in 1974 by 10% in quantity to 9.6 million tons and 22% in value to \$16.7 million.

Production was reported in 49 counties from a total of 130 operations. Tulsa, Oklahoma, Johnston, and Muskogee Counties, which ranked first through fourth respectively in total output, accounted for 53% of the quantity of blended sand and gravel sold or used. Led by Johnston County, the State's prime source of high-purity silica sand, the same counties generated 50% of the value of sand and gravel sold or used. Four firms each produced more than 0.5 million tons of sand and gravel and together generated 28% of the State's product. Commercial activities accounted for 83% of all the sand and gravel sold or used. The remainder went to publicly funded projects. Concrete aggregate for all uses and purposes required 49% of the sand and gravel. Sand and gravel in concrete aggregate, bituminous paving, and roadbase and sub-base sold or used for highway construction of all kinds amounted to 1.3 million tons, or 13% of the product. Residential and nonresidential construction required 33% of the product in the form of concrete aggregate.

Although industrial sand made up only 11% of sand and gravel sold or used, it accounted for 34% of the total value as a result of its high average unit value of \$5.23 per ton f.o.b. plant. Processed and blended sand and gravel for other purposes had an average unit value of \$1.67 per ton f.o.b. plant. Unprocessed sand and gravel had an average unit value of \$0.55 per ton.

Transport of 88% of the produced sand and gravel by truck illustrates the general proximity of sources and markets. Contrastingly, much of the industrial sand was transported by rail from sources in Johnston and Pontotoc Counties to consumers both in the State and nationwide.

Whereas processed and unprocessed sand was commonly utilized for construction, both ground and unground industrial sand was sold or used for special purposes. These were glassmaking, foundry molding sand, sandblasting, engine sand, oil well treatment, filtration, abrasives, and a variety of ceramic products including enamel, pottery, porcelain, and tile. Industrial sand was produced by Pennsylvania Glass Sand Corp., Johnston County; Midcontinent Glass Sand Co., Pontotoc County; Arkhola Sand and Gravel, Muskogee County; and Mohawk Rock and Sand Co. and Arkansas River Sand Co., Div. of Tulsa Sand Co., Tulsa County.

**Table 8.—Oklahoma: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
<b>Construction:</b>				
<b>Processed:</b>				
Sand -----	5,130	6,582	4,937	7,450
Gravel -----	672	1,491	784	1,837
Unprocessed: Sand and gravel -----	1,999	1,115	2,791	1,527
<b>Industrial:</b>				
Sand -----	907	4,572	1,078	5,640
<b>Total</b> -----	<b>8,708</b>	<b>13,760</b>	<b>2 9,591</b>	<b>16,454</b>

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

**Table 9.—Oklahoma: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ---	3,302	4,726	3,057	5,143
Highway and bridge construction -----	350	584	377	568
Other construction (dams, waterworks, airports, etc.) -----	179	268	77	103
Concrete products (cement blocks, brick, pipe, etc.) -----	429	526	574	946
Bituminous paving (asphalt and tar paving) -----	289	423	166	335
Roadbase and subbase -----	156	232	213	334
Fill -----	222	145	238	154
Other -----	W	W	164	754
<b>Unprocessed:</b>				
Roadbase and subbase -----	369	212	186	69
Fill -----	1,366	684	1,231	749
Other -----	--	--	557	202
Industrial sand and gravel -----	907	4,572	1,078	5,640
<b>Total</b> -----	<b>7,569</b>	<b>12,872</b>	<b><sup>1</sup> 7,920</b>	<b>14,997</b>

W Withheld to avoid disclosing individual company confidential data; included with "Non-residential and residential construction."

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Table 10.—Oklahoma: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ---	85	87	151	197
Highway and bridge construction -----	432	595	291	419
Other construction (dams, waterworks, airports, etc.) -----	195	356	161	219
Bituminous paving (asphalt and tar paving) -----	26	43	120	274
Roadbase and subbase -----	78	70	113	121
Fill -----	W	W	18	10
Other -----	59	30	--	--
<b>Unprocessed:</b>				
Roadbase and subbase -----	264	219	514	298
Fill -----	--	--	60	51
Other -----	--	--	244	163
<b>Total</b> -----	<b>1,139</b>	<b>1,400</b>	<b><sup>1</sup> 1,671</b>	<b>1,752</b>

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

<sup>1</sup> Data do not add to total shown because of independent rounding.

Pennsylvania Glass Sand Corp. completed a new pit and processing plant for industrial sand in Johnston County about 5 miles north of Mill Creek. Sand from the Oil Creek Formation is mined hydraulically and pumped to the plant where it is washed, filtered, dried, and loaded into railroad cars by fully automated equipment. Environmental controls include a continuous circulating water system incorporating both plant processes and a settling pond for rejects, and dust and stack controls in the drying system. Plant capacity is 750,000 tons per year.

A second float glass line was added to the Ford Motor Co. glass plant in Tulsa, increasing capacity from 550 tons of plate glass per day to about 770 tons per day. Midland Glass Co., Inc., of Cliffwood, N.J., purchased an idle flat glass plant in Henryetta from PPG Industries, Inc. The facility, including about 50 acres of land and 500,000 square feet of building space, was scheduled for remodeling to begin production of glass bottles and jars by mid-1976. A new flat glass plant erected in Pocola by Scott Glass Products, Inc., will produce 2 million square feet of opalescent glass annually. The semiautomatic plant has designed capabilities for doubling initial production.

Dolese Bros., Inc., of Oklahoma City donated half of a 160-acre tract that was formerly a sand pit to Oklahoma City for conversion to a youth park. The abandoned pit lies within a completely developed section of the city.

**Stone.**—Stone production decreased for the second consecutive year in 1975 from the record production in 1973. Output of stone in 1975 was 10% less than in 1974, but total value was 1% more than in 1974, reflecting an increase in the average unit value from \$1.65 per ton in 1974 to \$1.83 per ton in 1975. At a total value of \$36.8 million, produced stone exceeded the values of all other nonfuel minerals produced in the State except cement.

Stone was mined by 49 companies with 86 quarries distributed through 34 counties principally in the north-central, eastern, and southern parts of the State. Tulsa County led output with 3.9 million tons, followed closely by Murray County (3.1 million tons), Comanche County (2.5 million tons), and Kiowa and Rogers Counties. These counties provided 58% of the State's stone output. Three firms individually quarried more than 1 million tons of limestone; their total output amounted to 55% of all stone produced. The State's seven largest quarries, each with output of over 900,000 tons, accounted for almost half of the stone produced.

Limestone, dolomite, sandstone, granite, and silica rock were the principal rock types utilized. All types were prepared as crushed and broken stone which constituted 99.9% of the product. Dimension stone, in the form of rough blocks, irregularly shaped stone, and monumental stone, was obtained from limestone and granite quarries. About 63% of the crushed and broken stone was used for concrete

**Table 11.—Oklahoma: Stone sold or used by producers, by kind**  
(Thousand short tons and thousand dollars)

Kind of stone	1974		1975	
	Quantity	Value	Quantity	Value
<b>Dimension:</b>				
Limestone <sup>1</sup> -----	W	W	W	W
Granite -----	W	W	W	W
Total -----	15	687	21	1,007
<b>Crushed and broken:</b>				
Limestone <sup>1</sup> -----	21,120	34,777	19,220	34,342
Other stone <sup>2</sup> -----	1,093	1,185	870	1,490
Total -----	22,212	35,962	20,090	35,832
<b>Grand total</b> -----	<b>22,228</b>	<b>36,599</b>	<b>20,111</b>	<b><sup>3</sup> 36,840</b>

W Withheld to avoid disclosing individual company confidential data.

<sup>1</sup> Data include dolomite.

<sup>2</sup> Data include granite, sandstone, and chert.

<sup>3</sup> Data do not add to total shown because of independent rounding.

aggregate, dense roadbase, and manufacture of cement. An additional 32% was used for bituminous aggregate, surface treatment, railroad ballast, and jetty riprap. The remainder was prepared as agricultural limestone, poultry grit, macadam aggregate, unspecified aggregate, filter stone, asphalt filler, bedding material, fill, roofing chips, and for the manufacture of glass. The preparation of cement in three State plants and lime in one State plant were the major chemical applications of limestone.

Trucks transported more than 17 million tons of stone, 1.7 million tons was hauled by rail, and unspecified or other forms of transport moved 1.2 million tons of stone. Shipments were made by rail from Atoka, Comanche, Johnston, Murray, Ottawa, Sequoyah, and Tulsa Counties.

Standard Industries sold their operating assets to Warren Bros. Co. of Cambridge, Mass., a subsidiary of Ashland Oil, Inc. Tulsa Rock Co. remained in litigation with residents in Tulsa and Rogers Counties near Owasso over the right to start regular quarrying operations on a developed rural limestone quarry site.

**Sulfur.**—Sulfur was removed from sour gas by Pioneer Gas Producing Co. at its Madill plant in Marshall County. Sulfur was also recovered in petroleum refineries by Texaco, Inc., in its West Tulsa refinery, Tulsa County, and Sun Oil Co. in its Duncan refinery in Stephens County.

**Tripoli.**—American Tripoli Co., Div. of the Carborundum Co., and Midwestern Minerals Corp., mined pulverulent, porous microcrystalline silica in Ottawa County for use in fine-grained abrasives.

## METALS

**Copper.**—Mining of copper ore at the Creta mine in Jackson County was terminated by Eagle-Picher Industries, Inc., in March. Depressed prices of copper and high stripping ratio were significant in shaping the firm's actions. According to the Oklahoma Department of Mines, only 30,003 tons of copper ore was strip mined in Jackson County in 1975, in contrast to 170,380 tons in 1974.

**Silver.**—Concurrently with reduction of copper output at the Creta mine, Jackson County, the amount and value of silver recovered from copper concentrates from the Creta mine were drastically reduced. Mining was terminated in March.

**Uranium.**—Exploration by American Nuclear Corp. for uranium on an 11,000 acre tract southwest of Boise City in Cimarron County was completed. The company was reported at yearend to be making an evaluation of findings preparatory for management decisions in 1976.

Kerr-McGee Corp. began expansion of its Sequoyah facility near Gore in Sequoyah County to double the annual output of uranium hexafluoride. The plant will have capacity to convert 26.9 million pounds of uranium oxide per year to uranium hexafluoride by 1979.

**Zinc and Lead.**—Neither zinc nor lead ore was mined in 1975, nor was any production reported from cleanup operations in Ottawa County. National Zinc Co. approached completion of its electrolytic zinc plant at Bartlesville. By yearend all structural work had been completed and activity focused on final phase of installing the electrolytic system preparatory to putting the plant in operation early in 1976.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Carbon black:</b>			
Continental Carbon Co ---	Box 22085 Houston, Tex. 77027	Furnace -----	Kay.
<b>Cement:</b>			
Ideal Basic Industries, Inc. <sup>1 2</sup>	420 Ideal Cement Bldg. Denver, Colo. 80202	Quarry and plant--	Pontotoc.
Martin Marietta Cement Western Div. <sup>1 2</sup>	5350 East 46th St. Tulsa, Okla. 74135	----do -----	Rogers.
OKC Corp. <sup>1 2</sup> -----	Box 68 Pryor, Okla. 74361	----do -----	Mayes.
<b>Clays:</b>			
Acme Brick Co -----	Box 425 Fort Worth, Tex. 76101	Mine and plant ---	Canadian, Custer, Oklahoma, Tulsa.
Chandler Materials Co ----	Box 627 Tulsa, Okla. 74101	----do -----	Oklahoma and Rogers.
Oklahoma Brick Corp ----	Box 87 Union City, Okla. 73090	----do -----	Canadian.
<b>Coal:</b>			
Bill's Coal Co., Inc -----	Route 1 Welch, Okla. 74869	Strip mine -----	Craig.
Garland Coal & Mining Co--	Box 186 Fort Smith, Ark. 72901	----do -----	Haskell.
Peabody Coal Co -----	301 North Memorial Dr. St. Louis, Mo. 63102	----do -----	Craig and Rogers.
Copper: Eagle-Picher Indus- tries, Inc. <sup>2 3 4</sup>	Box 12130 Reno, Nev. 89510	----do -----	Jackson.
<b>Gypsum:</b>			
Republic Gypsum Co ----	1100 Mercantile Bank Bldg. Dallas, Tex. 75201	Quarry and plant--	Do.
United States Gypsum Co--	101 South Wacker Dr. Chicago, Ill. 60606	----do -----	Blaine.
United States Steel Corp --	600 Grant St., Box 2969 Pittsburgh, Pa. 15230	Quarry -----	Do.
<b>Lime:</b>			
St. Clair Lime Co -----	Box 569 Sallisaw, Okla. 74955	Plant and quarry--	Sequoyah.
<b>Pumice (volcanic ash):</b>			
Axtell Mining Corp -----	Laverne, Okla. 73848	----do -----	Beaver.
<b>Natural gas and petroleum:<sup>5</sup></b>			
<b>Salt:</b>			
Blackmon Salt Co -----	Freedom, Okla. 73842	Solar evaporation--	Woods.
Western Salt Co -----	Route 2 Erick, Okla. 73645	----do -----	Harmon.
<b>Sand and gravel:</b>			
Anderson-Dunham, Inc ----	No. 1 Park Dr. Idabel, Okla. 74745	Pit and plant ---	McCurtain.
Arkholia Sand Plant -----	323 Merchants Bank Bldg. Fort Smith, Ark. 72901	----do -----	Muskogee.
The Dolese Co. <sup>2</sup> -----	13 Northwest 13th St. Oklahoma City, Okla. 73103	----do -----	Canadian, Garfield, Kingfisher, Logan, McClain.
E & A Materials -----	Box 365 Wichita Falls, Tex. 76307	----do -----	Cotton.
Pennsylvania Glass Sand Corp., Oklahoma Works.	Box 36 Mill Creek, Okla. 74856	----do -----	Johnston.
Shoffner Sand & Gravel Co--	Box 863 Edmond, Okla. 73034	----do -----	Oklahoma.
<b>Stone:</b>			
Anchor Stone Co <sup>6</sup> -----	Box 1630 Tulsa, Okla. 74106	Quarry -----	Tulsa.
Leco Materials, Inc. <sup>6</sup> ----	Drawer D, Admiral Station Tulsa, Okla. 74115	----do -----	Nowata and Washington.
McMichael Concrete Co. <sup>6</sup> --	Box 9486 Tulsa, Okla. 74107	----do -----	Tulsa.
The Quapaw Co -----	Box 72 Drumright, Okla. 74030	----do -----	Creek.
<b>Tripoli:</b>			
The Carborundum Co ----	Seneca, Mo. 64865	Open pit -----	Ottawa.

<sup>1</sup> Also clays.<sup>2</sup> Also stone.<sup>3</sup> Also gallium.<sup>4</sup> Also silver.<sup>5</sup> Most of the major oil and gas companies and many smaller companies operate in Oklahoma, and several commercial directories contain lists of them.<sup>6</sup> Also sand and gravel.

# 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 Department of Geology and Mineral Industries for collecting information on all minerals except fuels.

By Walter E. Lewis<sup>1</sup>

The value of Oregon mineral production in 1975 increased about \$2 million over that of 1974 to \$106 million. Value of both sand and gravel and stone was lower than in 1974. Sand and gravel decreased \$1.4 million in value and stone \$3.1 million.

Oregon remained the sole producer of primary nickel in the United States in 1975. The nickel content of ores and concentrates produced was 16,987 short tons. Contrary to anticipation, the high price for gold did not result in a substantial increase in development of dormant gold lode and placer mines in Oregon.

Nonmetals accounted for about 91% of the total value of minerals produced in

Oregon in 1975. Stone and sand and gravel accounted for 72% of the total nonmetals value. Production value for pumice rose from \$1.9 million in 1974 to \$3.9 million in 1975, an increase of 109%, and comprised about 4% of the total value of nonmetals produced.

Reichhold Energy Corp. and Northwest Natural Gas Co. jointly conducted a four-well exploration program for natural gas in western Oregon. The last hole was completed in early November, and no discoveries were announced. Mobil Oil Co. continued its long-term acquisition of lease-

<sup>1</sup> State liaison officer, Bureau of Mines, Salem, Ore.

Table 1.—Mineral production in Oregon<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays -----thousand short tons..	140	\$243	120	\$214
Gem stones -----thousand short tons..	NA	500	NA	500
Lime -----thousand short tons..	98	2,818	96	3,281
Nickel (content of ores and concentrates) short tons..	16,618	W	16,987	W
Pumice -----thousand short tons..	915	1,887	1,470	3,937
Sand and gravel -----do..	18,558	30,948	16,527	29,596
Silver (recoverable content of ores, etc.) thousand troy ounces..	9	42	W	W
Stone -----thousand short tons..	23,353	43,406	21,275	40,321
Value of items that cannot be disclosed:				
Cement, copper, diatomite, emery (1975), gold, lead, talc, and values indicated by symbol W ----	XX	24,076	XX	28,155
Total -----	XX	103,920	XX	106,004
Total 1967 constant dollars -----	XX	49,133	XX	P 41,978

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

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).



Table 2.—Value of mineral production in Oregon, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Baker	\$7,448	\$8,629	Cement, stone, sand and gravel, gold, clays, pumice, silver, copper, lead.
Benton	686	W	Stone, sand and gravel, clays.
Clackamas	15,150	W	Cement, sand and gravel, stone, clays.
Clatsop	1,310	W	Stone, sand and gravel.
Columbia	2,430	W	Sand and gravel, stone.
Coos	1,488	1,004	Stone, sand and gravel.
Crook	W	W	Stone, sand and gravel, clays.
Curry	132	252	Sand and gravel, stone.
Deschutes	1,852	1,634	Pumice, sand and gravel, stone.
Douglas	14,617	W	Nickel, sand and gravel, stone, pumice.
Gilliam	219	30	Stone.
Grant	W	W	Sand and gravel, stone.
Harney	W	611	Stone.
Hood River	W	W	Do.
Jackson	5,883	5,831	Stone, sand and gravel.
Jefferson	W	278	Do.
Josephine	274	W	Sand and gravel, stone, gold, talc, copper, silver, lead.
Klamath	W	W	Sand and gravel, stone, pumice, clays.
Lake	W	W	Stone, pumice, diatomite, sand and gravel.
Lane	7,713	6,721	Sand and gravel, stone, pumice.
Lincoln	1,190	1,328	Stone, sand and gravel.
Linn	3,920	W	Sand and gravel, pumice, stone, emery.
Malheur	W	W	Sand and gravel, lime, stone.
Marion	1,899	W	Sand and gravel, stone, clays.
Morrow	W	W	Stone, sand and gravel.
Multnomah	W	W	Sand and gravel, lime, stone, clays.
Polk	535	662	Stone, sand and gravel.
Sherman	W	62	Stone.
Tillamook	W	614	Stone, sand and gravel.
Umatilla	2,369	1,338	Do.
Union	W	W	Sand and gravel, stone.
Wallowa	W	47	Do.
Wasco	305	831	Stone, sand and gravel.
Washington	4,030	5,063	Stone, sand and gravel, clays.
Wheeler	W	W	Stone, sand and gravel.
Yamhill	2,079	W	Stone, sand and gravel, clays.
Undistributed <sup>1</sup>	28,392	71,071	
Total <sup>2</sup>	108,920	106,004	

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

<sup>1</sup> Includes gem stones and stone that cannot be assigned to specific counties, and values indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

holdings in the Willamette Valley. Reportedly, the company now has under lease or option to lease more than 200,000 acres.

Alumax Pacific Corp. changed the site of its proposed aluminum plant in Oregon from Warrenton to Umatilla because it could not meet the zero emission standard for fluorides at the Warrenton site.

About 25 mining and exploration companies were active in Oregon during the year. The greater exploration effort centered around gold and nickel. There were no known mercury mines operating in the State in 1975, and there was no known exploration or development of mercury prospects during the year.

**Legislation and Government Programs.**—The Oregon State Legislature established the Department of Energy, effective July 1, 1975. Within the Department are the En-

ergy Facility Siting Council (EFSC) and the Energy Policy Review Committee (EPRC). The EFSC comprises seven members appointed by the Governor; it has jurisdiction over site location for all power-generating facilities over 25,000 kilowatts, high-voltage transmission lines, pipelines, and solar-collecting facilities. The EPRC comprises nine members, six of whom are members of the State Legislature. Its function is to review activities of the Department of Energy. All energy-related activities of the State have been consolidated into this Department except the rate-setting function, which is the responsibility of the Public Utility Commissioner.

In January, the University of Oregon established a solar energy center to study the utilization of solar energy for heating water and the heating and cooling of build-

Table 3.—Indicators of Oregon business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	1,016.0	1,040.0	+2.4
Unemployment -----do-----	76.0	110.0	+44.7
<b>Employment (nonagricultural):</b>			
Mining -----do-----	1.8	1.5	-16.7
Manufacturing -----do-----	197.5	182.3	-7.7
Contract construction -----do-----	38.7	34.8	-10.1
Transportation and public utilities -----do-----	52.5	49.5	-5.7
Wholesale and retail trade -----do-----	194.2	196.5	+1.2
Finance, insurance, and real estate -----do-----	44.3	44.7	+0.9
Services -----do-----	140.8	145.0	+3.0
Government -----do-----	168.1	176.5	+5.0
Total nonagricultural employment -----do-----	837.9	830.8	-0.8
<b>Personal income:</b>			
Total -----millions--	\$12,176	\$13,201	+8.4
Per capita -----do-----	\$5,398	\$5,769	+6.9
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----	15,922	20,091	+26.2
Value of nonresidential construction -----millions--	\$205.1	\$244.8	+19.4
Value of State road contract awards -----do-----	\$75.0	\$118.0	+54.7
Shipments of portland and masonry cement to and within Oregon -----thousand short tons--	826	775	-6.2
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$103.9	\$106.0	+2.0
Value per capita, resident population -----do-----	\$46.08	\$46.41	+0.7
Value per square mile -----do-----	\$1,071.55	\$1,093.04	+2.0

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and Bureau of Mines.

ings. Oregon State University has had underway for several years a study on wind power.

The Federal Bureau of Land Management (BLM) announced a series of lease sales in 1975 in Oregon's Known Geothermal Resource Areas (KGRA). Lease sales were made in 1975 in the following KGRA's: Mickey Hot Springs, Alvord Hot Springs, Borax Hot Springs, Lake County Crump Geyser, and Vale (second bid offering).

Responsibility for the Federal Bureau of Mines' organic-waste-to-oil plant on the grounds of the Albany Metallurgy Research Center at Albany, Oreg., was transferred to the Energy Research and Development Administration (ERDA). Plant construction in 1975 was delayed because of lack of funding; however, the plant was expected to be completed in the early fall of 1976.

Oregon has adopted a permit coordination program or "one-stop" system designed to give centralized information on State of Oregon permits. Information on any required State permit, license, or certification can be obtained from the Intergovernmental Relations Division, 240 Cottage St. SE, Salem, Oreg. 97310. The "one-stop" review process provides for submission of a master application form on the project,

which is circulated by Intergovernmental Relations to each regulatory agency in the State. These agencies have 30 days to determine if the project requires any of their permits. If it does, the applicant then receives specific application forms for all permits required. Assuming that the initial master application form is properly completed, the system places the burden on the regulatory agency to notify the applicant, who is thus relieved of struggling through a maze of administrative and regulatory laws.

The Oregon Department of Geology and Mineral Industries published a paper describing and cataloging landforms and associated hazards in the Oregon coastal regions.<sup>2</sup> The relative significance of hazard to land use was shown through diagrammatic instructions in the steps to be taken in land-use planning, and tables relating geologic hazards to landforms and land uses. The paper can be read and understood by city and county planning bodies and is in a format that is applicable to the solution of land-use problems in other localities.

<sup>2</sup> Beaulieu, J. D., P. W. Hughes, and R. K. Mathiot. Geologic Hazards Inventory of the Oregon Coastal Zone. Oreg. Dept. Geol. and Miner. Ind., Misc. Paper 17, December 1974.

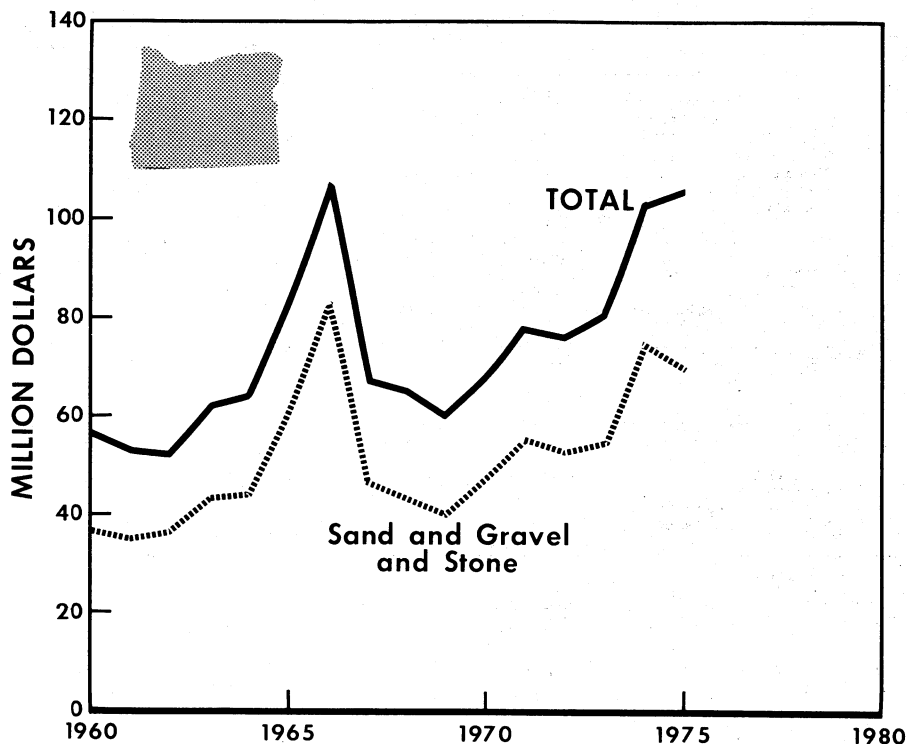


Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Oregon.

The State Geologist, R.E. Corcoran, commented on Federal land withdrawals,<sup>3</sup> using the recent withdrawal of the Jordan Craters area by BLM to lead into his main thesis,

which was that there is a trend toward accelerated withdrawals without consideration for the long-range mineral position of the United States.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Fertilizers.**—Two new barges were being built by Pacific Island Navigation Co. of Portland with the purpose of shipping urea from Alaska to Oregon. The Port of Portland hoped to develop customer demand to fill the barges on the return trip to Alaska. The shipping service would be difficult to sell because previously all barge service between Alaska and the Pacific Northwest was through Puget Sound.

**Pumice.**—The U.S. Forest Service, in an attempt to solve the long-time problem of pumice claims on Rock Mesa in the Three

Sisters Wilderness, Willamette National Forest, decided to make an appraisal to establish the value of the unpatented claims. The appraisal was the first step toward possible purchase of the claims by the Federal Government. John McGuire, Chief, U.S. Forest Service, stated on September 15, 1975, in Bend that he was not sure that his agency could legally purchase the mining claims from U.S. Pumice Co. He also expressed concern that the purchase might

<sup>3</sup> Corcoran, R. E. Potential Geothermal Land Withdrawn From Mineral Exploration. *The Ore Bin* (Dept. of Geol. and Miner. Ind.), v. 37, No. 12, December 1975, p. 203.

set an expensive precedent in other areas where unpatented claims were situated in designated wilderness areas.

**Sand and Gravel.**—The Multnomah County Planning Commission adopted and recommended to the County Commissioners a mineral extraction ordinance which sets regulations for mining sand, gravel, rock, and earthen materials in the county. The ordinance provides that mining uses may be permitted in any district where the Planning Commission finds that an economic deposit of the resource exists. On December 13, 1974, the ordinance was passed by the County Commissioners and became law in the county effective on that date. The passage of the law indicates a recognition by the County Government of the value of sand and gravel and rock deposits to the economy of Multnomah County.

Corvallis Sand & Gravel Co. and the State of Oregon have been disputing in the courts for about 17 years the ownership of portions of the Willamette River where the river has changed course since Oregon became a State. The Oregon Supreme Court ruled on June 17, 1975, that the company owns 3,200 feet of the Willamette River resulting from a new channel cut in 1909. The ruling appears to mean that many property owners along the river can claim that the present bed of the river is owned by them. The State has petitioned the Oregon Supreme Court to review its decision.

The State Department of Geology and Mineral Industries completed a study of the aggregate resources in Josephine County. The study was funded in part by the county. The report contains the baseline later needed for land-use planning in the county.<sup>4</sup>

Ross Island Sand & Gravel, a major sand and gravel producer in the Portland area, has been involved in a controversy for 3 years with the Corps of Engineers and local and State agencies in regard to its mining operations on Ross Island. The company has made two permit applications to the Portland District Corps of Engineers; one requests approval to dredge outside Ross Island, and the other is to close the entrance to Ross Island lagoon to entry by boats except those doing business with the company. A preliminary impact statement released by the Corps in October 1973 stated that the project would provide a quantity of sand and gravel for construction in the Portland-Vancouver metropolitan area equivalent to a 6-year demand; however, at the anticipated rate of dredging, the company would extend its operation over 30 to 40 years. The primary adverse environmental effect would be the loss of 50% of the land area of the Ross Island group.

<sup>4</sup> Schlicker, H.G., R.A. Schmuck, and P. Pescador. Aggregate Resources of Josephine County, Oregon. Josephine County Planning Department in cooperation with the Oreg. Dept. Geol. and Miner. Ind., 1975, 47 pp.

Table 4.—Oregon: Stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Dimension stone total -----	2	100	2	101
Crushed stone:				
Bituminous aggregate -----	1,554	2,776	1,414	2,979
Concrete aggregate -----	1,395	2,817	1,430	3,026
Dense-graded roadbase stone -----	7,586	14,538	4,216	7,320
Macadam aggregate -----	288	430	823	2,295
Surface treatment aggregate -----	1,152	2,150	4,532	10,056
Other construction aggregate and roadstone -----	4,727	9,781	3,311	6,608
Fill -----	62	75	28	34
Railroad ballast -----	820	1,360	455	931
Riprap and jetty stone -----	4,805	7,144	4,341	4,763
Other uses <sup>1</sup> -----	962	2,236	723	1,702
Crushed stone total <sup>2</sup> -----	23,351	43,306	21,273	40,220
Grand total <sup>2</sup> -----	23,353	43,406	21,275	40,321

<sup>1</sup> Includes stone used in agricultural limestone, poultry grit and mineral food, filter stone, manufactured fine aggregate, cement and lime (1974) manufacture, bedding material (1974), building products, drain fields, ferrosilicon, glass manufacture, waste material (1974), and sugar refining (1975).

<sup>2</sup> Data may not add to totals shown because of independent rounding.

## METALS

**Aluminum.**—Alumax Pacific Corp. announced that it was unable to meet the zero emission requirement for fluorides at its proposed aluminum reduction plant site near Warrenton, and therefore would change the plant location to Umatilla. The company obtained a State permit for the plant but was still waiting for a Federal air discharge permit from the Environmental Protection Agency (EPA). Bonneville Power Administration (BPA) signed a contract to transfer the power commitment from Warrenton to Umatilla; however, this agreement resulted in a Federal court suit challenging the prior commitment transfer. U.S. District Court Judge Otto R. Skopil ruled that Alumax may locate the plant in Umatilla and BPA may transfer the power commitment to that site, but he also ruled that BPA must file an acceptable environmental impact statement on the development. BPA appealed the decision. The proposed plant is expected to cost about \$350 million to construct, employ 1,800 workers at the peak of construction, and have an annual capacity of 187,000 tons of ingot aluminum.

The State Department of Geology and Mineral Industries, under contract to the Bureau of Mines, compiled additional information on the ferruginous bauxite deposits occurring in Washington and Oregon.<sup>5</sup> A spokesman for Reynolds Metals Co. announced that the firm may begin mining the ferruginous bauxite deposits in Oregon and build an alumina production plant in either Washington or Oregon by 1980.

**Copper.**—Ranchers Exploration Co. drilled at the old Bolivar copper mine in southeastern Coos County<sup>6</sup>. The State Department of Geology and Mineral Industries began a statewide copper-zinc study in cooperation with the Federal Bureau of Mines. The study involves geologic mapping and statistical evaluation of the Department's stream sediment geochemical analyses program completed previously.

**Gold.**—Approximately 25 mining and exploration companies were active in mineral exploration in Oregon<sup>7</sup>. At least 6 of the 25 were involved in continuing projects. The greater exploration effort centered around gold. The main areas of attraction were the volcanogenic sulfide-type deposits. In northeastern Oregon, Texas Gulf, Inc., explored the old Iron Dyke copper-gold

mine at Homestead in the Snake River Canyon. The river level adit has been rehabilitated, and diamond drilling was in progress. The work had been in progress for about 1 year. The mine produced about 7,000 tons of copper and 25,000 ounces of gold from 1916-28.

In the Granite district in northeastern Oregon, W.A. Bowes & Associates of Colorado were reopening and exploring the old Cougar and Independence mines. The workings have been dewatered. Work had been in progress about 18 months. In southwestern Oregon, the Silver Peak-Almeda (Big Yank) volcanogenic, barite- and sulfide-bearing zone received considerable attention. Homestake Mining Co. obtained clearance to explore the old Almeda mine but dropped the option. The lease on the Almeda was later obtained by Texas Gulf, Inc. The northern portion of the zone near the Silver Peak mine was being explored by Chevron Oil Co.

American Selco, Inc., explored by drilling the Turner-Albright sulfide deposit in the southern part of Josephine County.

The Oregon Metal Mines Handbooks, compiled in the early 1940's and containing detailed information on the history of development, production, ownership, and geology of all known mines in Oregon, was reprinted.<sup>8</sup> Known gold, copper, lead, zinc, platinum, mercury, chromium, nickel, molybdenum, and antimony patented and unpatented claims as of the date of original publication were described in the handbooks.

**Nickel.**—At least three companies were active in exploration of nickel-bearing laterites in southwestern Oregon.<sup>9</sup> Hanna Mining Co., Inspiration Mining Co., and Inter-American Nickel had large projects in progress exploring and developing various nickel prospects in Josephine and Curry Counties.

The State Department of Geology and Mineral Industries completed a study on the nickel resource potential in Oregon for the Federal Bureau of Mines; in the course

<sup>5</sup> Hook, J.W. Ferruginous Bauxites of the Pacific Northwest. *Oreg. Dept. Geol. and Miner. Ind., Open File Rept. 0-76-3, 1976, 26 pp.*

<sup>6</sup> Ramp, L. Exploration Activity—Oregon 1975. Northwest Mining Association Convention, Spokane, Wash., December 1975, 4 pp.

<sup>7</sup> Work cited in footnote 6.

<sup>8</sup> American Trading Co., P.O. Box 1312, Bellevue, Wash. 98009.

<sup>9</sup> Work cited in footnote 6.

of this study, the Department's Grants Pass resident geologist, Len Ramp, developed a photogeologic reconnaissance technique for targeting the deposits utilizing U.S. Forest Service color infrared aerial photographs. The data obtained in the study were placed on open file by the Department at the District Office in Grants Pass.

The Albany Metallurgy Research Center of the Federal Bureau of Mines published a report of investigations on recovering nickel and cobalt from low-grade domestic laterites.<sup>10</sup> The recovery process, which had been tested only on a laboratory scale, selectively recovered nickel and cobalt from low-grade domestic laterites. The oxides in the laterite were selectively reduced with carbon monoxide at 350° to 600° C. The reduced material was leached at ambient temperature and pressure in the presence of oxygen, ammonium sulfate, and ammonium hydroxide. The nickel was selectively recovered from the leach solution by solvent extraction and then stripped from the loaded organic solution with dilute sulfuric acid, which provided a nickel-rich electrolyte. The cobalt was recovered from the leach solution with hydrogen sulfide. Recoveries of up to 90% and 85% of the contained nickel and cobalt, respectively, were obtained at the laboratory level. If the process proved successful at industrial scale, it could be the needed link to start development of low-grade laterites occurring in southwestern Oregon and northwestern California.

**Steel.**—Cascade Steel Rolling Mills, Inc. started construction of a recycling complex near its rolling plant in McMinnville. The complex will cover about 1 acre and be able to process about 8,000 tons of scrap per month.

**Titanium.**—Research scientists at the Albany Metallurgy Research Center developed a procedure for producing synthetic rutile from domestic ilmenite.<sup>11</sup> The Center demonstrated in laboratory tests that the mineral synthesis technique can be applied to ilmenite from two different domestic sources to extract high-quality synthetic rutile. The final crystalline product was comparable with natural rutile in titanium content.

#### MINERAL FUELS

**Coal.**—The State Department of Geology and Mineral Industries released an open file report on the Coos Bay coalfield

in mid-September.<sup>12</sup> The authors reported that on the basis of this study, the field is not economically attractive. However, it was recommended that the field be regarded as a minable resource in the event of either a serious energy shortage in Oregon or development of new mining and gasification technology that would be applicable to the field.

On March 20, Governor Straub signed a site certificate authorizing Portland General Electric (PGE) to build a coal-fired plant and two other plants (either nuclear or coal-fired) near Boardman. The site certificate approved by the Oregon Nuclear and Thermal Energy Council previously specified only that the two additional plants be thermal. The language of the certificate left open the possibility of designating the type in the future on the basis of changing technology and environmental factors at the site. PGE announced in December that it will start site preparation for the \$300 million coal-fired electricity-generating plant early in 1976. Capacity is expected to be 550,000 kilowatts. Low-sulfur subbituminous coal will be obtained from Gillette, Wyo., to fuel the plant. The two additional thermal plants were not scheduled for a decade or more.

**Geothermal.**—The State Department of Geology and Mineral Industries, under Federal Bureau of Mines Contract S0122129, Geothermal Study and Exploration, drilled four wells in an area north of Vale, Malheur County, to a depth of 500 feet and a fifth well to 203 feet for monitoring heat flow in the area. The area north of Vale was selected for the drilling site because earlier shallow drilling had revealed relatively high temperature values. The wells will be used for monitoring temperature gradients to determine heat flow in the area, which lies on the west limb of the Snake River downwarp. The heat flow data could have significant economic as well as scientific results since geothermal gradient

<sup>10</sup> Siemens, R.E., P.C. Good, and W.A. Stickney. Recovery of Nickel and Cobalt From Low-Grade Domestic Laterites. BuMines RI 8027, 1975, 15 pp.

<sup>11</sup> Elger, G.W., D.E. Kirby, S.C. Rhoads, and W.A. Stickney. Synthesis of Rutile From Domestic Ilmenites. BuMines RI. 7985, 1975, 19 pp.

<sup>12</sup> Mason, R., and P. Hughes. Economic Factors Affecting the Mining, Processing, Gasification, and Marketing of Coos Bay Coals. Oreg. Dept. Geol. and Miner. Ind. in cooperation with Coos County Board of Commissioners, the Federal Bureau of Mines Process Evaluation Group, and the Oreg. Economic Development Dept. Open File Rept. 0-75-6, 1975, 61 pp.

studies to date have indicated that the western Snake River Basin is a major geothermal province, similar in some ways to the Imperial geothermal province in California. An 18-square-mile area a few miles south of Vale appeared to have the necessary conditions for a high-temperature geothermal reservoir, including high heat flow, permeable rocks at depth, and a barrier to migration. The data obtained under the Bureau-sponsored study will be published as a State Bulletin.

Additional geothermal studies were underway in Oregon during the year in an attempt to hasten development of the State's geothermal resources.<sup>28</sup> They included (1) a study of heat flow along the Brothers fault zone in central Oregon, (2) an electrical resistivity survey of Glass Butte in Northern Lake County, and (3) a geologic reconnaissance of hot spring areas in the western Cascade Range. In the heat flow study along the Brothers fault zone, the State Department of Geology and Mineral Industries was supported by a grant from the U.S. Geological Survey. The geophysical survey at Glass Butte, which is a rhyodacite dome in the Brothers fault zone, was essentially a search for "hot, dry rocks"; the work was supported by ERDA's Los Alamos Scientific Laboratory in New Mexico. The geologic reconnaissance in the western Cascades was partly supported by the Eugene Water and Electric Board; if the results from the preliminary geologic work were favorable, drilling was planned for 1976.

The BLM prepared an environmental analysis record (EAR) detailing the impact of proposed geothermal leasing of more than 1 million acres of national resource land in Oregon, California, and Nevada. The report discussed the effects of three proposed levels of development—no leasing, limited leasing, and leasing of the total area.

BLM announced a series of lease sales in 1975 in Oregon's KGRA's. Lease sales were made in 1975 in the following KGRA's: Mickey Hot Springs, Alvord Hot Springs, Borax Hot Springs, Lake County Crump Geyser, and Vale (second bid offering). On June 6, BLM received acceptable bonus bids totaling more than \$179,000 on 14 of the 44 units designated for leasing in the Alvord KGRA in Harney County. Companies winning leases were San Juan

Oil Co. (Mapco, Inc.), Getty Oil Co., Southern Union Production Co., Al Aquitaine Explorations Ltd., Chevron Oil Co., and Republic Geothermal, Inc.

During the year, the State Department of Geology and Mineral Industries issued 13 permits for geothermal drilling projects; however, not all companies receiving the permits started drilling during the year. Mapco, Inc., Tulsa, Okla., began drilling a 7,500-foot steam test well in Warner Valley (Alvord desert area) late in October. This was the third well drilled in Oregon since enactment of the State's 1971 Geothermal Law.

**Petroleum and Natural Gas.**—Mobil Oil Co. had in progress one of the most extensive oil and gas land leasing projects ever undertaken in the State. For the past 2 years, the company had been engaged in obtaining mineral rights in the Willamette Valley and southwest coastal area. In April, the State Land Board approved applications for lease options on 40,000 acres of State-owned land in Marion, Linn, and Lane Counties in the Willamette Valley and Douglas and Coos Counties south of the valley and on the coast. Obtaining these leases on State lands was apparently part of Mobil Oil's continuing campaign of strengthening its lease position in the Willamette Valley and southwest coastal areas prior to exploration drilling, which was scheduled to start about July 1976. Estimates of the total lease holdings ranged from about 250,000 to 500,000 acres of private, State, and Federal lands.

Reichhold Energy Corp. and Northwest Natural Gas Co., joint participants in a four-drill-hole exploration program in western Oregon, drilled its first exploratory hole near Tillamook in August. The depth of the hole was 5,557 feet. The second hole was drilled near McCoy, Polk County, 14 miles northwest of Salem, 7,258 feet deep; the third near Independence, Marion County, 5,286 feet deep; and the fourth near Vernonia, Columbia County, 5,805 feet deep. No commercial amounts of oil or gas were reported in any of the four exploratory holes.

In October, BLM reported that eight oil and gas leases on 14,079 acres of Federal land in Columbia County had been issued. The BLM land is between Vernonia and Scappoose in Columbia County and is inter-

<sup>28</sup> Work cited in footnote 6.

mingled with private land, some of which was also under lease. The leases were issued to Gas Producers Enterprises, Inc., Houston, Tex.; Janet K. Dorman, Golden, Colo.; David A. Forson, Lakewood, Colo.; Dorothy L. Wahle, Littleton, Colo.; and Faye A. Reuth, Lakewood, Colo.

In January 1975, an administrative law judge ruled that the Federal Power Commission (FPC) would not have jurisdiction over the sale of liquefied natural gas (LNG) from the Kenai Peninsula in Alaska or over the transport of the LNG by tanker from Alaska to Northwest Natural Gas Co.'s proposed LNG plant at Newport. In late June, the FPC claimed jurisdiction over the sale of Kenai Peninsula LNG, thus overturning the decision of the administrative law judge. Phillips Oil Co. and Marathon Petroleum Co., the producers of the gas in Alaska, indicated that it was difficult for them to comply with certain restrictions imposed by the FPC and thus will not ship to the Newport plant. Regardless of the recent ruling, Northwest Natural Gas was still going ahead with its \$13 million LNG plant, intending to utilize it as a peaking facility.

Construction on the three proposed oil refineries located in Portland, St. Helens, and Rainier did not start. Permits for construction were issued by the State Environmental Quality Commission (EQC) to Columbia Independent Refinery, Inc., Charter

Oil Co., and Cascade Energy Co. At year-end, Columbia Independent Refinery, Inc., which had planned to build on a site leased from the Port of Portland, announced that it had dropped all plans for an oil refinery in Oregon. The reason given by the company for withdrawal was lack of a Federal energy policy favorable to construction of refineries in the United States. The company reported that it had spent close to \$0.5 million on permits and preliminary designs over an 18-month period.

In December 1974, the records on all wells drilled on the Outer Continental Shelf (OCS) were released by the U.S. Geological Survey. The records of eight wells drilled off the Oregon coast were included in the release. Oregon OCS records can be inspected at the U.S. Geological Survey office in Los Angeles, Calif., or the State Department of Geology and Mineral Industries office in Portland, Oreg.

**Nuclear.**—The Trojan nuclear plant near Rainier went on-line December 15, 1975, producing at 10% of its total operating capacity of 1,130,000 kilowatts near the end of the first week of operation. The plant is the first 1,130 megawatt electric pressurized-water reactor plant to go into service. The time period from issuance of a permit to start construction to the beginning of operation was 4 years and 10 months.



Table 5.—Principal producers

Commodity and company	Address	Type of Activity	County
<b>Abrasives:</b> Oregon Emery Co ----	1420 Lehigh Way Albany, Oreg. 97321	Mine -----	Linn.
<b>Aluminum:</b>			
Martin-Marietta Aluminum, Inc.	11300 Rockville Pike Rockville, Md. 20852	Smelter -----	Wasco.
Reynolds Metals Co -----	Troutdale, Oreg. 97060	Plant -----	Multnomah.
<b>Cement:</b>			
Oregon Portland Cement Co. <sup>1</sup>	111 Southeast Madison St. Portland, Oreg. 97214	Plants -----	Baker and Clackamas.
<b>Diatomite:</b>			
A. M. Matlock -----	Box 3307 Eugene, Oreg. 97402	Mine and plant	Lake.
<b>Ferroalloys:</b>			
National Metallurgical Co ----	Springfield, Oreg. 97477	do -----	Lane.
Union Carbide Corp -----	Portland, Oreg. 97200	do -----	Multnomah.
<b>Lime:</b>			
Amalgamated Sugar Co -----	Nyssa, Oreg. 97913	Plant -----	Malheur.
Ash Grove Lime & Portland Cement Co.	101 West 11th St. Kansas City, Mo. 64105	do -----	Multnomah.
Pacific Carbide & Alloys Co ---	Box 17008 Portland, Oreg. 97200	do -----	Do.
<b>Nickel:</b> Hanna Mining Co -----	Riddle, Oreg. 97469	do -----	Douglas.
<b>Perlite (expanded):</b>			
Supreme Perlite Co -----	4600 North Suttle Rd. Portland, Oreg. 97217	do -----	Multnomah.
<b>Pumice:</b>			
Central Oregon Pumice Co ----	5 Greenwood Ave. Bend, Oreg. 97701	Mine and plant	Deschutes.
Graystone Corp -----	Box 1087 Bend, Oreg. 97701	do -----	Do.
<b>Sand and gravel:</b>			
Glacier Sand and Gravel Co --	5979 East Marginal Way Seattle, Wash. 98134	do -----	Multnomah.
Willamette Hi-Grade Concrete Co.	Foot North Portsmouth Ave. Portland, Oreg. 97203	Dredge and plant.	Do.
<b>Steel:</b>			
Cascade Steel Rolling Mills, Inc.	McMinnville, Oreg. 97128	Plant -----	Yamhill.
Oregon Steel Mills -----	Portland, Oreg. 97200	do -----	Multnomah.
<b>Stone:</b>			
Clackamas County Public Works.	902 Abernathy Oregon City, Oreg. 97045	Quarry -----	Clackamas.
L. H. Cobb -----	8275 Southwest 145th Ave. Beaverton, Oreg. 97005	Quarry and plant.	Washington.
Progress Quarry, Inc -----	14515 Scholls Ferry Rd. Beaverton, Oreg. 97005	do -----	Do.
Rivergate Rock Products ----	7881 N.W. St. Helens Rd. Portland, Oreg. 97229	Quarry -----	Multnomah.
Rogers Construction Co -----	Box 16537 Portland, Oreg. 97216	Quarries -----	Multnomah and Washington.
<b>Talc and soapstone:</b> John H. Pugh	2891 Elk Lane Grants Pass, Oreg. 97526	Mine -----	Josephine.
<b>Vermiculite (exfoliated):</b>			
Supreme Perlite Co -----	4600 North Suttle Rd. Portland, Oreg. 97217	Plant -----	Multnomah.
W. R. Grace & Co., Zonolite Div.	62 Whittemore Ave. Cambridge, Mass. 02140	do -----	Do.
<b>Zirconium:</b>			
Oregon Metallurgical Corp ---	Box 580 Albany, Oreg. 97321	do -----	Linn.
Teledyne Wah-Chang Albany Corp.	Box 460 Albany, Oreg. 97321	do -----	Do.

<sup>1</sup> Also stone and clay.

# The Mineral Industry of Pennsylvania

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, under a cooperative agreement for collecting information covering mineral production from mines, quarries, and wells.

By William Keblish <sup>1</sup>

Pennsylvania mineral production reached a record output value of \$2,907.8 million, a \$533.4 million increase above that of 1974. Compared with 1974, increases in value were attained by anthracite coal, bituminous coal, lime, natural gas, petroleum, sand and gravel, and zinc. Compared with 1974, the average f.o.b. mine value of anthracite coal increased \$10.12 per ton and that of bituminous coal increased

\$4.74 per ton. Collectively, solid fuels production accounted for 79.4% of the total mineral production value, and the value of all fossil fuels equaled 82.7% of the total mineral production value.

Pennsylvania led the Nation in the value of stone output but dropped to second place in production; the State was

<sup>1</sup> State Liaison Officer, Bureau of Mines, Harrisburg, Pa.

Table 1.—Mineral production in Pennsylvania <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry -----thousand short tons--	404	\$14,642	357	\$14,640
Portland -----do-----	7,448	191,594	5,815	168,220
Clays <sup>2</sup> -----do-----	2,732	16,496	1,945	13,672
Coal:				
Anthracite -----do-----	6,617	144,695	6,203	198,481
Bituminous -----do-----	80,462	1,637,394	84,137	2,111,009
Gem stones -----do-----	NA	9	NA	9
Lime -----thousand short tons--	2,080	50,147	1,940	60,047
Natural gas -----million cubic feet--	82,637	36,360	84,676	57,156
Peat -----thousand short tons--	30	515	27	488
Petroleum (crude) -----thousand 42-gallon barrels--	3,478	36,220	3,264	39,647
Sand and gravel -----thousand short tons--	18,071	45,181	17,401	48,742
Stone -----do-----	73,092	159,615	60,177	149,670
Zinc (recoverable content of ores, etc.) -----short tons--	20,288	14,567	21,090	16,450
Value of items that cannot be disclosed:				
Clay (kaolin), iron ore, mica (scrap, 1975), natural gas liquids, and tripoli -----	XX	<sup>r</sup> 26,993	XX	29,607
Total -----	XX	<sup>r</sup> 2,374,428	XX	2,907,838
Total 1967 constant dollars -----	XX	1,122,630	XX	<sup>p</sup> 1,151,504

<sup>p</sup> Preliminary. <sup>r</sup> Revised. NA Not available. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes kaolin; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Pennsylvania, by county<sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams	\$14,488	W	Stone, lime, clays, mica.
Allegheny	92,741	\$124,766	Coal, cement, petroleum, stone, clays, sand and gravel.
Armstrong	115,804	W	Coal, sand and gravel, clays, stone, petroleum.
Beaver	W	W	Coal, sand and gravel, clays, petroleum.
Bedford	2,663	W	Stone, coal.
Berks	47,274	49,935	Iron ore, cement, stone, sand and gravel, coal, clays.
Blair	3,569	3,364	Stone, coal, sand and gravel.
Bradford	W	W	Sand and gravel.
Bucks	19,293	W	Stone, sand and gravel, clays.
Butler	48,061	50,648	Coal, cement, stone, lime, petroleum, sand and gravel, clays.
Cambria	W	267,816	Coal.
Carbon	6,825	W	Coal, sand and gravel, stone.
Centre	W	W	Coal, lime, stone, clays.
Chester	13,777	W	Stone, lime, clays.
Clarion	96,284	92,308	Coal, stone, petroleum, clays, sand and gravel.
Clearfield	147,144	173,237	Coal, clays.
Clinton	11,011	W	Coal, stone, clays.
Columbia	1,780	W	Coal, sand and gravel, stone.
Crawford	W	W	Sand and gravel, petroleum.
Cumberland	4,460	W	Stone, sand and gravel, clays.
Dauphin	5,007	W	Stone, coal, sand and gravel.
Delaware	W	W	Stone.
Elk	W	W	Coal, petroleum, stone.
Erie	W	2,970	Sand and gravel, peat.
Fayette	56,523	W	Coal, stone, clays.
Forest	W	W	Petroleum, sand and gravel.
Franklin	W	W	Stone, sand and gravel.
Fulton	W	W	Stone, sand and gravel, coal.
Greene	206,949	W	Coal, petroleum.
Huntingdon	7,599	9,093	Sand and gravel, stone, coal, clays.
Indiana	W	198,168	Coal, stone.
Jefferson	W	44,433	Coal, clays, stone, petroleum.
Juniata	W	312	Stone.
Lackawanna	W	W	Coal, stone, peat.
Lancaster	13,021	W	Stone, clays, sand and gravel.
Lawrence	43,914	W	Cement, coal, stone, sand and gravel, clays, peat.
Lebanon	W	W	Lime, stone.
Lehigh	44,354	W	Cement, zinc, stone.
Luzerne	42,709	W	Coal, stone, sand and gravel, peat, clays.
Lycoming	† 25,945	8,360	Coal, stone, sand and gravel.
McKean	W	W	Petroleum, stone, clays.
Mercer	W	8,239	Coal, sand and gravel, stone, petroleum.
Mifflin	834	W	Stone, sand and gravel, lime.
Monroe	2,285	W	Stone, sand and gravel, peat, clays.
Montgomery	24,314	W	Stone, cement, lime, clays.
Montour	† 868	W	Stone.
Northampton	101,468	82,750	Cement, stone, sand and gravel.
Northumberland	23,782	W	Coal, stone, sand and gravel, clays, tripoli.
Perry	W	W	Stone.
Pike	795	W	Sand and gravel, stone.
Potter	252	W	Petroleum, stone, sand and gravel.
Schuylkill	W	W	Coal, stone, sand and gravel.
Snyder	W	W	Stone, coal.
Somerset	112,149	W	Coal, stone, clays, sand and gravel.
Sullivan	999	551	Coal.
Susquehanna	W	472	Stone.
Tioga	W	W	Coal, stone, sand and gravel.
Union	W	W	Stone, clays.
Venango	W	15,854	Coal, petroleum, sand and gravel, natural gas liquids.
Warren	W	7,346	Petroleum, sand and gravel, natural gas liquids.
Washington	W	W	Coal, petroleum, clays.
Wayne	W	W	Stone, sand and gravel, peat.
Westmoreland	58,744	81,298	Coal, stone, sand and gravel.
Wyoming	1,950	1,775	Sand and gravel.
York	34,288	34,043	Cement, stone, lime, sand and gravel, clays.
Undistributed <sup>3</sup>	† 940,495	1,650,077	
Total <sup>4</sup>	† 2,374,428	2,907,838	

<sup>†</sup> Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

<sup>1</sup> Cameron and Philadelphia Counties are not listed because no production was reported.

<sup>2</sup> Value of petroleum is based on an average price per barrel for the State.

<sup>3</sup> Includes some natural gas liquids that cannot be assigned to specific counties, natural gas, gem stones, and values indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Pennsylvania business activity

	1974	1975 P	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands...	5,043.0	5,072.0	+0.6
Unemployment ----- do-----	258.0	422.0	+63.6
<b>Employment (nonagricultural):</b>			
Mining ----- do-----	42.3	46.5	+9.9
Manufacturing ----- do-----	1,461.8	1,335.8	-8.6
Contract construction ----- do-----	206.4	187.4	-9.2
Transportation and public utilities ----- do-----	266.4	256.2	-3.8
Wholesale and retail trade ----- do-----	898.4	890.9	-.8
Finance, insurance, real estate ----- do-----	209.2	208.1	-.5
Services ----- do-----	772.0	800.3	+3.7
Government ----- do-----	672.5	690.6	+2.7
Total nonagricultural employment ----- do-----	4,529.0	4,415.8	-2.5
<b>Personal income:</b>			
Total ----- millions...	\$64,955	\$70,296	+8.2
Per capita ----- do-----	\$5,485	\$5,943	+8.4
<b>Construction activity:</b>			
Number of private and public residential units authorized...	39,157	33,019	-15.7
Value of nonresidential construction ----- millions...	\$468.3	\$447.9	-4.4
Value of State road contract awards ----- do-----	\$550.0	\$243.0	-55.8
Shipments of portland and masonry cement to and within Pennsylvania ----- thousand short tons...	3,350	2,920	-12.8
<b>Mineral production value:</b>			
Total crude mineral value ----- millions...	‡ \$2,374.4	\$2,907.8	+22.5
Value per capita, resident population ----- do-----	\$200.53	\$245.18	+22.3
Value per square mile ----- do-----	\$52,377.47	\$64,144.35	+22.5

P Preliminary. ‡ Revised.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

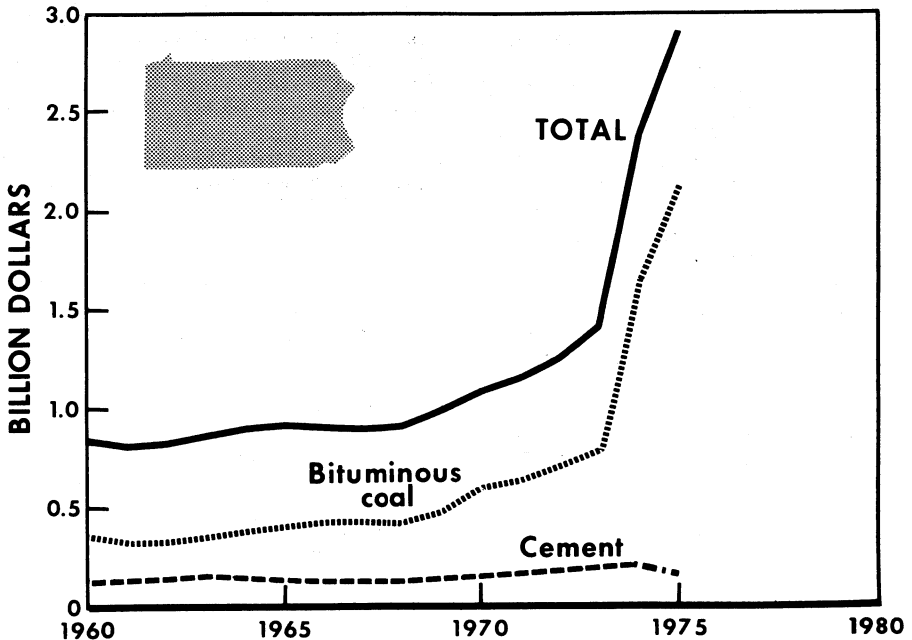


Figure 1.—Value of bituminous coal, cement, and total value of mineral production in Pennsylvania.

second in lime production, third in bituminous coal production, third in cadmium production, third in cement, and seventh in zinc production.

#### Legislation and Government Programs.

—During the year, the General Assembly was involved in continuing negotiations on legislative action pertaining to coal policy. The passing of an amendment to the Revenue Bond and Mortgage Act to provide tax-free financing for coal facilities was significant.

**Environment.**—The Land and Water Conservation and Reclamation Act (Public Law 990, No. 443), approved on January 19, 1968, and later amended by Act 57 of March 5, 1970, appropriated the sum of \$200 million to the Department of Mines and Mineral Industries, now known as the Department of Environmental Resources (DER), for State reclamation projects. Act 193, dated July 12, 1972, allocated \$150 million for the prevention, control, and elimination of air pollution from abandoned burning coal refuse banks, provided such land and bank material is publicly owned; \$30 million was allocated for the prevention of surface subsidence above abandoned mine operations, for the control and extinguishment of surface and underground fires from abandoned mines, and for necessary administration expenses.

Completed projects in the anthracite region totaled 105 at a cost of \$36.8 million. Sixty projects were related to stream pollution abatement, 14 to air pollution, 11 to mine fires, and 20 to subsidence control. Of 335 projects completed in the bituminous region, 244 were related to stream pollution abatement, 8 to air pollution control, 39 to mine fires, and 44 to subsidence. The total cost of completed projects amounted to \$64.3 million.

Four hundred and forty of the 613 reclamation projects have been completed in 36 counties throughout the State. Allegheny County led with 75 projects, followed by Butler, 46; Washington, 45; Schuylkill, 43; Clearfield, 37; and Luzerne, 34. Five current projects related to mine subsidence, 4 to underground mine fires, 3 to control of burning banks, and 161 to stream pollution abatement.

Current State subsidence projects included SL 446, Saline Reformed Church, Salina, Bell Township, Westmoreland County; SL 449, Jefferson Township,

Fayette County; SL 452, Bellemore Elementary School, Washington Township, Fayette County; SL 427, City of Scranton, Lackawanna County which is part of an Appalachian project; and SL 420, City of Wilkes-Barre, Luzerne County. Underground mine fire control projects included SL 335, Upper Tyrone, Fayette County; SL 334, East Huntington Township, Westmoreland County; SL 330, Greater Pittsburgh Airport, Allegheny County; and SL 309, West Mahanoy Township, Schuylkill County. Burning bank projects include SL 208, North Fayette Township, Allegheny County; SL 210-3, Forrestville, Schuylkill County; and SL 211, Williams Township, Dauphin County. Current stream pollution abatement projects are listed in Pennsylvania's DER bond issue report.

Pennsylvania Act 443 empowers and authorizes the DER to construct and operate plants for the control and treatment of water pollution resulting from mine drainage and to assess mine operators a nominal amount according to quantity and quality of mine discharge if mine operators prefer to use State facilities. Since inception of the program, 5 operators in Dauphin County produced a total of 145,000 tons of anthracite and paid \$21,638 to the escrow fund for treatment of mine drainage water, 34 operators in Northumberland County produced 277,992 tons of anthracite and paid \$41,456, and 93 mine operators in Schuylkill County produced 2,682,000 tons and paid \$428,874.

Twelve treatment plants in 10 counties have been constructed or are planned for the prevention, control, and elimination of stream pollution from mine drainage. Seven of the treatment plants have been completed, four were under construction, and one was being designed. The Altoona plant in Blair County will have a daily capacity of 10 million gallons; plant construction began in 1970, and work was still in progress. Bucks Mountain treatment plant has a daily capacity of 5 million gallons and was placed into operation on April 15, 1970. Crooked Creek treatment plant in Indiana County is in the design stages. Hawk Run plant is designed for 500,000 gallons per day; construction began in December 1970, and work was still in progress. Pigeon Creek plant in Carroll Township, Washington County, has a ca-

capacity of 1.15 million gallons per day and was completed in September of 1970. Rausch Creek treatment plant, Schuylkill County, has a planned capacity of 10 million gallons per day; construction began in September 1970, and work was still in progress. Sandy Run plant, Luzerne County, a 15-million-gallon-per-day plant, began operation in April 1970. Slippery Rock Creek has a treatment capacity of 12 to 15 million gallons per day and began operations in December 1970. South Township is rated at 500,000 gallons per day and was placed in operation in April 1971. Swamp Creek plant has a capacity of 10 million gallons and began operating in October 1970. Washington Township treatment plant in Indiana County is the second most expensive of the 12 plants; construction began in July 1975. Wildwood plant in Hampton Township, Allegheny County, has a capacity of 1.15 million gallons, and work was completed in October 1974.

Pennsylvania surface mining operators are required by law to obtain a license prior to mining coal or other minerals. During 1975 a total of 1,041 surface mining licenses were issued by the Pennsylvania DER; 804 were renewals, and 237 were listed as new licenses. License renewals are required each year, and a reduced license cost applies to operators mining 2,000 tons or less of marketable minerals, other than coal. Operators mining without a license shall be guilty of a misdemeanor. A mine drainage permit for surface and/or underground mines must also be obtained from DER prior to mining operations. The applicant must submit information that will enable DER to determine whether or not the proposed mining operation would be conducted in a manner that would prevent pollution to Commonwealth waters. During 1975 a total of 1,149 permit applications were processed (734 were new applications and 415 were amended applications), which resulted in the issuance of 995 permits, 698 of which were for new areas while 297 were amended permits. Only 18 of the applicants were refused a permit. Permits become null and void 2 years after the date of issuance unless within that time the mine has been placed in production. A drainage permit is revoked if the mine operator is in violation of the law. Mine op-

erators are required to submit monthly operation reports concerning water treatment progress, separate acid-forming materials from the spoil which is placed along the bottom of the pit close to the base of the spoil pile to reduce pollution and to divert surface water from acid-bearing strata.

Before a licensed surface mining operator proceeds to mine minerals by surface mining methods, a permit is required for each separate mining location and is valid until the operation is completed or abandoned. Applicants for a mining permit must submit a map of the area to be mined in addition to related information. A reclamation plan must also be submitted showing complete and detailed plans for reclamation of the affected land. During 1975, 1,617 bituminous applications were filed and 1,401 permits issued, including 727 original permits, 610 amended permits, and 64 corrected permits. In the anthracite region 44 applications were filed and 41 permits issued, including 35 original permits, 5 amended permits, and 1 corrected permit.

Prior to commencing mining operations the operator shall file with DER a surety or collateral bond for the land affected by each operation. The amount of the bond required shall be an amount determined by the DER based upon the total estimated cost to the Commonwealth of completing the approved reclamation plan, and no bond shall be filed for less than \$5,000. During 1975 bonds deposited for the bituminous region totaled \$20.4 million, \$9.9 million were surety bonds at \$500 an acre, \$6.4 million were surety bonds at \$1,000 an acre, \$0.6 million were surety bonds at \$1,150 an acre, \$0.054 million were surety bonds at \$1,200 an acre, \$0.020 million were surety bonds at \$3,000 an acre, \$3 million were collateral bonds at \$500 an acre, \$0.37 million were collateral bonds at \$1,000 an acre, and \$0.05 million were collateral bonds at \$1,150 an acre.

In the anthracite region the total bonds deposited amounted to \$0.478 million.

As reclamation occurs, the mine operator may request release of the bond for that area. During 1975 the total bonds released for the bituminous region amounted to \$6 million, of which \$5.4 million represented bonding at \$500 an acre, \$0.58 million represented bonding at \$1,000 an acre, and

\$0.05 million represented bonding at \$400 an acre. In the anthracite region the total amount of bonds released was \$0.47 million. To determine effective reclamation measures the State may hold 5% of the bond for a period of 5 years from the completion date as a contingency allowance for the reimbursement of the Commonwealth of any cost encountered owing to faulty or negligent work on the part of the operator.

Subsidence problems have occurred in the southwestern counties for years. To identify potential problem areas, three maps of the Pittsburgh and Upper Freeport coalbeds have been prepared which will aid planning agencies as well as residents. These maps can be obtained from the U.S. Geological Survey in Washington, D.C.

The Commonwealth of Pennsylvania through its coal and clay mine subsidence insurance fund has paid claims to policy holders for mine subsidence damages in excess of \$1 million since it was established by the General Assembly in 1961. Approximately 7,000 current policies are in effect throughout the State.

Early in April a Federal-State project was approved to protect 70 acres in Plymouth. The endangered area overlies abandoned anthracite mines, and collapse of the mine pillars could cause subsidence. The threatened area includes 520 homes, 5 churches, 2 schools, and a population estimated at 10,400. To provide ground support, controlled backfilling using crushed coal mine waste mixed with water will be flushed down boreholes drilled from the surface.

A subsidence control project using hydraulic flushing involves the Oregon and Welsh Hill sections of Pittston. Filling of 186 acres of mine voids beneath the city will require approximately 1 million cubic yards of refuse material.

Subsidence project number 12, phase 1, Hill Section, City of Scranton, Lackawanna County, involved the backfilling of mine voids in the Clark, the Top Split of the 1 Dunmore, and the 1 and 2 Dunmore beds with 1/2 inch-size breaker refuse material. Phase 2 involved backfilling of mined areas in the abandoned Pine Brook mine. Project number 15, Borough of Swoyersville, Luzerne County, involved subsidence

control by hydraulic backfilling in the 4-foot and 6-foot beds of the abandoned Harry E colliery using minus 1/2-inch crushed mine refuse. Project number 18, Mt. Carmel Borough, Northumberland County, involved backfilling the Middle and Bottom splits of the Mammoth bed of the abandoned Sayre colliery in the vicinity of 8th and Hickory Streets within the borough limits.

Mine fire control projects 49, 50, and 51 have been approved by the Appalachian Regional Commission and were being revised by State reclamation authorities. Project 49 involved the Glen Burn colliery, Cameron-Luke Fidler mines, Shamokin. Phase 1 included exploratory drilling, and Phase 11, flushing an incombustible underground barrier. Projects 50 and 51 are located in western Pennsylvania, and were being revised by State authorities prior to State acceptance of the projects.

An emergency occurred in the Pittsburgh area between November 16 and November 20 when cold air several hundred feet above the ground trapped underlying warmer air, forming what weathermen call an inversion. This inversion trapped pollutants and caused a thick smog, forcing industrial plants to curtail production. United States Steel reported over 1,500 workers laid off because of the smog. While an air pollution index reading of 35 is considered satisfactory, Liberty Borough peaked at a reading of 251 with readings of 173 in Clairton, Hazelwood, Liberty, North Braddock, and the downtown Pittsburgh area. The Allegheny County Health Department ended the emergency alert at 2 p.m. on November 20 as air pollution index levels dropped in industrial areas surrounding the city.

In early October, the U.S. Environmental Protection Agency (EPA), Allegheny County, and Jones and Laughlin Steel Corp. (J&L), a unit of LTV Corp. signed a consent order establishing a timetable for compliance with Federal clean air standards at the firm's Pittsburgh works. Of the \$200 million pollution control plan, \$100 million would be for pollution control equipment and \$100 million for plant modernization which would further reduce air pollutants.<sup>2</sup>

<sup>2</sup> American Metal Market. V. 82. No. 163, Aug. 22, 1975, pp. 1, 20.

Coke oven emissions continued to be a problem throughout 1975. Coke oven doors that are not cleaned after every cycle create carbon and tar deposits which help cause smoke emissions. These emissions include benzopyrene, a suspected carcinogen.<sup>3</sup>

United States Steel has spent \$3 million in developing a coke-side enclosure at its Clairton works. These enclosures will be only a minor part of control measures that will be needed at 250 batteries at 65 U.S. coke plants which employ approximately 15,000 workers. Estimates of the cost to cope with the coke oven problem range from \$500 million to \$4 billion.<sup>4</sup>

Bethlehem Steel Corp. reportedly plans to spend \$74 million by March 1978 on air pollution measures at the Johnstown and Bethlehem plants. A new \$50 million controlled basic oxygen furnace will replace an open hearth furnace at the Johnstown plant, and the remaining \$24 million will cover air pollution control facilities. Bethlehem has already spent \$22.2 million for air pollution control facilities and another \$70 million for water pollution control, some of which has been committed for future needs. Other steel companies throughout Pennsylvania faced similar pollution control problems during 1975. Union Switch and Signal division of Westinghouse Air Brake Co. reported in early May the closing of its forging operations employing 25 people because of difficulties in meeting county air pollution standards.

The electric industry is also required to meet State and Federal air standards. DER has ordered Metropolitan Edison Co. of Reading to pay a \$10,000 per month penalty for excessive emissions from the two coal-fired boilers at the utility's Crawford generating station at Middletown, if State standards are not met by March 1, 1977.

West Penn Power Co. planned to spend \$61 million for a 750-foot chimney, which will be one of the tallest structures in the State, plus other pollution control equipment for its New Castle, Lawrence County, plant. Electrostatic precipitators will be installed to remove 99.5% of the particulate matter from the flue gases. Construction is scheduled for completion in 1979.

The Pennsylvania Power and Light Co. (PP&L) has agreed to install necessary

pollution control equipment by 1980 at its Brunner Island Station, York Haven, and Montour generating plants.

The County Industrial Development Authority (IDA) approved issuance of \$48.8 million in bonds to finance Duquesne Light Co. pollution control projects at its Phillips and Elrama power stations. The \$48.8 million issue brings the total IDA-approved bonds for the two projects to \$88.8 million. IDA bonds carry a lower interest rate because they are tax exempt.

Firestone Tire and Rubber Co. gave permission to experiment with burning high-sulfur coal in a boiler at its tire and plastics facility in Pottstown. The program is designed to evaluate a scrubbing system developed by FMC Corp. of Chicago.

Pennsylvania coal producers were facing a crisis because of the high sulfur content of coal produced. During the past few months industrial firms have canceled coal contracts and switched to oil and gas to meet air pollution regulations. General Public Utilities Corp. and New York State Electric & Gas Corp. revealed plans to build a \$35 million coal-cleaning plant at the Homer City, power station using an advanced technology which removes sulfur from the coal.<sup>5</sup>

This modern coal cleaning process produces a washed coal with only 0.8% sulfur which meets air pollution regulations and a higher sulfur coal of 2.2% sulfur that can be used in existing powerplants.

The Pennsylvania coal industry asked the State legislature for aid in an effort to retain present coal markets. A State report on air quality, based on tests from 17 monitors that make up the Commonwealth of Pennsylvania Air Monitoring System, showed the Allegheny County, Philadelphia, Johnstown, and Beaver Valley air basins have occasional high sulfur dioxide levels, but that the air in the rest of Pennsylvania urban areas is much cleaner than required by Federal standards.

In early September charts presented by the Health Department to the Pennsylvania Health Conference showed that sulfur dioxide content in Philadelphia meets Federal acceptable levels; in 1956 the sulfur dioxide level was more than 400% over the Federal standard. At DuBois, the EPA monitored oxidants in the

<sup>3</sup> Chemical Week. Nov. 26, 1975.

<sup>4</sup> Work cited in footnote 3.

<sup>5</sup> Constructioner. Nov. 10, 1975, p. 16.



air which are produced when auto exhaust pollutants are exposed to sunlight. These oxidants are the chief cause of smog and should not exceed 0.08 part per million (ppm) during any 1 hour.

**Electricity.**—Although the overall amount of power used in Pennsylvania in 1974 declined slightly, the electric utilities expected the State's power-generating capacity to increase 50% in the next 10 years. Business and industry accounted for over two-thirds of Pennsylvania consumption of electricity, and residential use accounts for 28%.<sup>6</sup>

During the year the energy park concept was considered for Pennsylvania. Four utilities, Philadelphia Electric Co., Metropolitan Edison Co. of Reading, Pennsylvania Electric Corp. of Johnstown, and PP&L of Allentown, were exploring 10 possible sites throughout the State where powerplants might be clustered in small geographical areas with advantages in efficiency and pollution control. At yearend the energy park concept was still under study.

In early March the Federal Energy Administration (FEA) was considering a plan for 80 large electric powerplants to stop burning oil or natural gas and switch to coal as a means to conserve oil and natural gas. The plants affected in Pennsylvania were the Mitchell plant, Monongahela; the Springdale plant of Allegheny Power Service Corp.; the Cromby plant, Phoenixville; and Delaware plant, Philadelphia, of Philadelphia Electric Co.

In the next 25 years it is estimated that the United States will need an additional 1.5 million to 2.2 million tons of U-238 as powerplant fuel. With the need for more

energy, the search for uranium continues. In Pennsylvania, uranium-thorium minerals were found to be common in an abandoned serpentine-talc quarry near Easton.<sup>7</sup>

**Transportation.**—The U.S. Railway Association (USRA), a Federal agency, unveiled a plan in late February to streamline seven financially ailing northeast railroads into one profitmaking system as provided for in section 215 of the Regional Rail Reorganization Act of 1973. The program is administered in cooperation with the Department of Transportation. The Consolidated Rail Corporation (ConRail) was created by USRA to facilitate orderly and efficient implementation of the Final System Plan by permitting ConRail to purchase supplies, materials, and equipment as needed when ConRail assumes operation of the bankrupt railroad on March 1, 1976. The bankrupt railroads that would be part of ConRail include the Penn Central, the Reading, the Lehigh Valley, the Central of New Jersey, the Pennsylvania Reading Seashore Lines, the Lehigh and Hudson River, and the Ann Arbor railroads. The Erie Lackawanna Railroad also asked to be included into the ConRail system.

The physical plant of the bankrupts under study reaches into 17 States and includes, among other things, about 21,000 miles of rights-of-way, 43,000 miles of track, more than 20 classification yards and 60 shop facilities, over 8,000 highway grade crossings with automatic protection, some 1,300 automatically controlled interlocking plants, 30,000 bridges, 4,500 locomotives, 175,000 freight cars, and numerous other buildings and properties.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Coal (Anthracite).**—Production of anthracite totaled 6.2 million tons, or 6% less than in 1974. Washery and bank production declined 4.7%, stripping production declined 10.6%, and underground production declined 5.6%.

Schuylkill County was the leading producer of anthracite with 2.75 million tons, followed by Luzerne with 1.69 million tons; Northumberland, 0.79 million tons; Lackawanna, 0.20 million tons; Carbon,

0.095 million tons; Columbia, 0.046 million tons; Sullivan, 0.028 million tons; and Dauphin, 0.025 million tons. Coal production increased in Columbia, Lackawanna, Luzerne, and Sullivan Counties, but decreased in Carbon, Dauphin, Northumberland, and Schuylkill Counties.

Of the total production, 57% was shipped to market by truck, 33%, by rail,

<sup>6</sup> Pennsylvania Electric Association. Facts—1975.

<sup>7</sup> Pennsylvania Geology. V. 6/6, December 1975, p. 11.

8% was sold to local trade, and the remainder was used at the mine for steam and heat.

Leading anthracite producers in order of declining production were Jeddo-Highland Coal Co., Reading Anthracite Co., Bethlehem Mines Corp., Beltrami Enterprises, Inc., Leon E. Kocher Coal Co., Ken Pollock, Inc., Hecla Machinery and Equipment Co., and Heavy Media, Inc.

During 1975, 203 operators were active in the anthracite region, operating 108 deep mines, 102 strip mines, 87 bank mines, and 91 breaker preparation plants; 1 operator was listed as having a tourist mine.

The 3-year contract between the United Mine Workers of America (UMWA) and the Pennsylvania anthracite operators expired on March 31, and a new contract was signed in late April covering approximately 2,300 anthracite workers. Coal supplies were adequate during the year. The opening of the Huber breaker in 1974 helped to guarantee area needs, but the facility was closed during the summer. Many homeowners have converted to other energy sources for home heating, decreasing demand for anthracite. During the winter of 1974-75, a large mine operator donated 188 tons of coal to the Neighborhood Assistance Act, Department of Community Affairs, for distribution to families who were unable to obtain coal for financial or other reasons. Coal prices dropped slightly during the year. At the beginning of 1975, dealers in the anthracite region sold coal for \$60 to \$65 per ton, compared with \$58 to \$62 per ton at yearend. Coal prices were the subject of a U.S. Department of Justice antitrust investigation held in Harrisburg, in early September.

A government-financed study of the anthracite region by Berger Associates of Camp Hill indicated a potential anthracite market of 17 million tons by the year 1990. The report also detailed recommendations for revitalizing the industry.<sup>8</sup>

PP&L of Allentown began a 1-year study of the economics of building an electricity generating station burning anthracite. Four 400,000-kilowatt generating units were being considered which would consume 4 million tons of hard coal per year. Although hard coal is more difficult to extract than bituminous, because of the

steeply pitching seams, the low sulfur content of anthracite requires less air pollution control equipment to meet current air standards.

To assist the anthracite mining industry, a conference on anthracite technology was sponsored by the Office of Coal Research (OCR), and the University of Scranton on January 6-7, 1975. The Special Assistant for Economic Affairs, State Planning and Development, presented a report on "Large Scale Anthracite Mining" which resulted in the Governor's Science Advisory Committee forming an anthracite panel which met in Harrisburg on May 2 and May 30, 1975. The panel's report "Recommendations on a Feasibility Analysis" on open pit anthracite mining was published in January 1976.

A member of the anthracite task force visited the mining regions of England, Germany, and Poland in early November to study mining methods in those countries which may be applicable to the anthracite region. The task force was appointed by the Mining Enforcement and Safety Administration (MESA) to study and identify problems confronting the Pennsylvania anthracite industry.

Beltrami Enterprises announced in late March 1975 the purchase of the Huber breaker, located at Ashley, from the Blue Coal Corp. Seventeen months later the breaker was dismantled for scrap.

Lehigh Valley Anthracite, a subsidiary of Pagnotti Enterprises, West Pittston, planned to reopen the Harry E. breaker in Swoyersville on a limited basis for production of small-size coal for industrial purposes. Twenty men will be employed at the breaker. Pagnotti interests also operate the breakers located at Jeddo Highland and Shenandoah, and one at the Hazleton shaft.

Swatara Coal Co., Zerbe, invested over \$2 million in new equipment to meet the rising demand for anthracite. Swatara Coal has between 2,500 and 3,000 acres in reserves in Schuylkill County, and is projecting a production of 150,000 tons per year.<sup>9</sup>

**Coal (Bituminous).**—Pennsylvania ranked third in the Nation in bituminous coal production producing 84.1 million

<sup>8</sup> Coal Mining and Processing. Can Anthracite Make a Comeback. V. 13, No. 1, January 1976, pp. 60-63, 73, 74.

<sup>9</sup> Constructioneer, Aug. 18, 1975, pp. 42, 44.

Table 4.—Pennsylvania: Summary of anthracite mines and production, and number of employees, in 1975

District	Number of mines				Number of employees				Production (short tons)				
	Opera- tors	Deep mines	Bank mines	Strip mines	Breaker and washery plants	Total	Deep mines	Bank mines	Strip mines	Bank mines	Strip mines	Total	
5	29	2	26	--	23	51	14	90	--	232	--	878,507	
6	18	11	17	--	12	40	47	58	--	258	--	278,793	
7	35	1	4	--	12	44	126	21	--	108	--	284,389	
8	17	11	3	--	5	19	57	8	--	69	--	215,088	
9	26	5	28	--	20	53	15	166	--	413	--	297,672	
10	27	17	4	--	10	31	85	12	--	86	--	813,658	
11	16	11	3	--	4	18	124	22	--	88	--	106,119	
12	30	24	2	--	5	31	265	8	--	37	--	221,569	
53	9	--	--	13	--	13	--	--	153	--	173,241	300,081	
56	2	--	--	2	--	2	--	--	12	--	2,714	173,241	
57	11	--	--	17	--	17	--	--	183	--	320,420	2,714	
58	4	--	--	15	--	15	--	--	530	--	924,838	320,420	
59	10	--	--	29	--	29	--	--	221	--	321,004	924,838	
60	14	--	--	26	--	26	--	--	369	--	321,004	321,004	
Total	248	109	87	102	91	389	733	385	1,468	1,291	3,877	5,628,741	2,511,708

<sup>1</sup> One deep mine in the 7th District is a tourist attraction only.

<sup>2</sup> Owing to some companies operating in more than one district, the actual total number of anthracite operators is 208, including 48 companies operating strip mines.

Sources: Pennsylvania Department of Environmental Resources, 1975 Annual Report on Mining, Oil and Gas, and Land Reclamation and Conservation Activities.

Table 5.—Pennsylvania: Production of anthracite coal, and number of employees, in 1975, by county

County	Production (short tons)							Number of employees				
	Deep mines	Bank mines	Strip mines	Total	Deep mines	Bank mines	Strip mines	Breaker and washery	Total			
Carbon	---	54,132	41,131	95,263	50	13	50	---	63			
Columbia	32,199	---	13,634	45,833	16	6	38	18	88			
Dauphin	13,645	11,473	25,118	40,236	---	---	---	---	37			
Lackawanna	---	194,270	8,050	202,320	---	40	2	68	111			
Luzerne	579	332,902	856,568	1,690,049	15	75	442	952	884			
Northumberland	54,513	426,376	310,084	1,790,973	105	31	193	176	507			
Schuylkill	495,687	1,001,262	1,253,828	2,750,777	547	223	718	660	2,148			
Sullivan	---	---	28,408	28,408	---	---	22	9	31			
Susquehanna	---	---	---	---	---	---	---	---	8			
Total	596,623	2,520,415	2,511,703	5,628,741	733	385	1,468	1,291	3,877			

Source: Pennsylvania Department of Environmental Resources, 1975 Annual Report on Mining, Oil and Gas, and Land Reclamation and Conservation Activities.

tons, an increase of 5% compared with 1974 output. Of this total, 46% was produced by surface operations and 54% by auger and deep mine production; these were increases of 8% by surface means and an increase of 2% by other means. Employees in the deep mines increased 16%, strip employees increased 26%, refuse employees increased 36%, tipple and preparation plant employees increased 6%, and auger employees decreased 22%.

Seventeen fatalities occurred in the bituminous region compared with 20 in 1974. Eleven fatalities were underground and six at surface operations. Of the 11 underground fatalities, 2 were caused by roof falls, 1 occurred during timbering operations, and 8 were transportation-related fatalities. Five of the six surface fatalities were related to surface equipment, and one fatality was due to a fall.

The total value of bituminous coal was \$2,111 million, an increase of 29% from the 1974 value due to a price increase of \$4.74 to \$25.09 per ton of coal.

Washington County was the leading bituminous coal producer in the State with 13.4 million tons followed by Indiana, 10.3 million tons; Clearfield, 8.1 million tons; Greene, 8.1 million tons; Cambria, 7.4 million tons; Armstrong, 7.2 million tons; Somerset, 6 million tons; Clarion, 5.3 million tons; and Allegheny, 4 million tons. Lesser amounts of bituminous coal were produced by 19 other counties in the western part of the State. Washington County was the leading producer of underground mined coal, Clearfield County led all other counties in production from surface operations, Indiana County led in auger production, and Cambria County led in refuse production of coal. The number of mines totaled 835, a decrease of 226 from the 1974 total.

During the year, 616 bituminous operators operated 132 underground mines, 661 strip mines, 39 auger mines, and 3 strip-auger mines. The number of strip operations decreased by 202 during 1975.

The leading producers of underground mined coal in declining order, each producing over 1 million tons, were Bethlehem Mines Corp., United States Steel Corp., Consolidation Coal Co., Rochester and Pittsburgh Coal Co., Republic Steel Corp., Greenwich Collieries, Barnes & Tucker Co., Mathies Coal Co., J&L, the

Florence Mining Co., Helvetia Coal Co., Duquesne Light Co., and Gateway Coal Co.

The leading operators of strip and auger coal, each producing over 1 million tons, in declining order, were C&K Coal Co., Benjamin Coal Co., and Shannon Coal Co.

During the year, 36% of the bituminous coal was shipped to market by rail, 18% was shipped by water, and 43% was shipped by truck or transported by belt; 3% was coal used locally for domestic purposes and in the manufacture of coke. Four years ago 50% of the bituminous coal was shipped by rail, 20% by water, and 29% by truck; the remaining 1% was used locally. The primary reason for increased shipments of coal by truck between 1971 and 1975 was the increase in the total number of stripping operations, many of which were not located near rail systems or navigable waterways.

During the year, 34,170 employees were working in the bituminous region; 19,830 were listed as inside employees, and 14,340 as outside employees. Of those working inside the mines, 13,636 were employed on mechanical loading sections, 6,112 in other occupations, and 82 in hand-loading sections. Outside employees consisted of 2,584 superintendents, foremen, and clerks; 36 coke employees; and 11,720 in various other outside occupations.

Fourteen bituminous coal seams were mined by underground methods in Pennsylvania during 1975. Over 83% of the coal was produced in the Pittsburgh, Lower Freeport, Upper Freeport, and Lower Kittanning seams. The Pittsburgh seam accounted for 42% of the underground production; Lower Freeport, 13%; Upper Freeport, 14%; and Lower Kittanning, 14%. The Pittsburgh seam was mined primarily in Washington, Greene, and Allegheny Counties, with lesser production from Fayette, Westmoreland, and Indiana Counties.

The Lower Freeport was mined in Armstrong, Cambria, Jefferson, Indiana, Somerset, and Westmoreland Counties. Production of coal from the Upper Freeport took place in Allegheny, Armstrong, Beaver, Butler, Cambria, Indiana, Somerset, and Westmoreland Counties. The Lower Kittanning coal seam was mined in Armstrong, Cambria, Clearfield, Indiana, Jefferson, and Somerset Counties.

**Table 6.—Pennsylvania: Bituminous coal production, by type of mine and county, 1975**  
(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines						Production (Thousand short tons)				Value (thousands)
	Under-ground		Strip-auger		Total	Under-ground	Strip-auger	Auger	Strip-auger	Total <sup>1</sup>	
	Under-ground	Strip-auger	Strip-auger	Auger							
Allegheny	7	16	--	3	23	3,298	664	--	--	3,967	\$105,780
Armstrong	12	64	--	--	88	4,076	2,977	88	48	7,189	126,619
Beaver	1	5	--	--	6	157	30	--	--	187	4,606
Bedford	--	2	--	--	2	--	W	--	--	W	W
Blair	--	2	--	--	2	--	W	--	--	W	W
Butler	1	21	--	--	26	W	1,109	( <sup>2</sup> )	--	1,373	27,069
Cambria	18	22	--	--	40	5,623	1,766	--	--	7,380	287,816
Centre	1	13	--	--	13	W	W	--	--	1,469	31,933
Clarion	52	51	--	--	95	W	5,324	12	--	8,124	31,733
Clearfield	4	90	--	--	95	W	7,380	( <sup>2</sup> )	--	8,124	16,733
Clinch	--	7	--	--	7	--	433	--	--	433	8,475
Elk	--	14	--	--	18	--	651	31	--	692	11,168
Fayette	3	62	--	--	65	W	W	--	--	2,816	58,974
Fulton	--	1	--	--	1	--	W	--	--	W	W
Greene	15	25	--	--	40	7,175	880	--	--	8,055	268,029
Huntingdon	--	1	--	--	1	--	W	--	--	W	W
Indiana	27	52	--	--	87	7,860	2,863	89	--	10,312	198,001
Jefferson	4	42	--	--	48	W	2,014	( <sup>2</sup> )	--	2,147	43,446
Lawrence	--	17	--	--	18	--	W	--	--	564	9,316
Lycoming	--	3	--	--	3	--	W	--	--	W	W
Mercer	--	3	--	--	3	--	336	--	--	336	7,473
Somerset	21	67	--	--	92	2,091	3,889	44	--	6,024	161,754
Tioga	--	2	--	--	2	--	W	--	--	W	W
Venango	--	10	--	--	10	--	451	--	--	451	7,247
Washington	13	26	--	--	40	10,974	2,886	1	--	13,360	480,280
Westmoreland	5	44	--	--	49	960	1,886	--	--	2,846	73,787
Undistributed	--	--	--	--	--	2,422	4,664	90	--	1,084	12,390
Total <sup>1</sup>	132	661	3	835	3,835	44,631	39,105	354	48	84,137	2,111,009

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."  
<sup>1</sup> Data may not add to totals shown because of independent rounding.  
<sup>2</sup> Included with strip to avoid disclosing individual company confidential data.

Only one underground mine, located in Centre County, produced coal from the Brookville seam. Six underground mines, located in Greene County, produced coal from the Sewickley seam.

Of the 154 underground mines in the bituminous field, as listed by the Pennsylvania DER, 19 were classified as shaft mines, 23 as slope mines, 91 as drift mines, 13 as having shaft and slopes, and 8 as shaft and drift mines.

The thinnest seam being mined by underground means was a 29-inch Lower Kittanning seam located in Clearfield County, while the thickest seams were the 108-inch-thick Freeport seam in Armstrong County and the 108-inch Pittsburgh seam in Fayette County. The average thickness of the Pittsburgh seam in southwestern Pennsylvania is 66 to 70 inches in Washington and Greene Counties where the majority of the Pittsburgh seam coal is produced.

During 1975, coal became more important as an energy source because of the declines of oil and gas supplies and the Nation's dependence on foreign oil suppliers. In early July the FEA ordered 25 utility companies to burn coal rather than oil or natural gas in 74 powerplants across the Nation, which reportedly would save an estimated 64 million barrels of oil and 88 billion cubic feet of natural gas per year.

New coal mine development and expansion planned in Pennsylvania totaled 28.7 million tons. Thirty-five planned underground mines have an estimated capacity of 25.7 million tons, and two surface mines have a capacity of 3 million tons. Of the anticipated tonnage, approximately 12.2 million tons of coal is classified as metallurgical and 16.5 million tons as steam coal.

To meet the demand for coal, United States Steel Co. is currently developing the Cumberland mine located at Kirby, Greene County. Two 2,400-foot-long slopes will intersect the coal seam. A cleaning plant plus two coal silos will be constructed near the mine, and the cleaned coal will be shipped by rail over the 17-mile line which is under construction, terminating near Alicia on the Monongahela River. The coal will be shipped to Ontario Hydro, Canada's largest utility, under a 30-year contract calling for 90 million tons of coal. United States Steel is also developing the

Dilworth mine, located on the Monongahela River about 65 miles south of Pittsburgh. Dilworth's expected 4-million-ton production per year will eventually replace production from the vast Robena complex, which was started in 1943 and is nearing exhaustion of its reserves. Coal produced at Dilworth will be barged to the Robena cleaning plant, and the processed coal will be shipped to the Clairton works for conversion into coke, coke oven gas, and coal chemicals.

Bethlehem Mines Corp., a subsidiary of Bethlehem Steel Corp., will open mine 38E north of Ehrenfeld, near Johnstown. Production is expected to be 400,000 tons per year of metallurgical coal, and the mine will employ 280 when fully operational in 1978. Coal will be mined from the Upper Freeport seam and cleaned in the Cambria Slope preparation plant in Ebensburg. Life expectancy of the mine is over 25 years.

Consolidation Coal Co. opened the Laurel mine located along Route 160, about midway between Central City and Reels Corner. The National Mines Corp. property is managed by Consol, and the mine will have a life expectancy of over 17 years. High-grade metallurgical coal, less than 1% sulfur, will be produced from the Lower Kittanning or "B" seam, with full production of 800,000 tons per year anticipated by 1977.

Cerro Corp., which purchased the Fetterolf Coal Co. in Somerset County in early 1974, announced plans to open two new mines and to expand coal preparation facilities to meet metallurgical coal needs overseas. Fetterolf's coal-producing capacity will be increased from 1 million to 1.4 million tons of cleaned coal annually. Cerro Corp. also acquired the Stott Coal Co., Philipsburg, which has an annual capacity of 400,000 tons of metallurgical coal per year, in late August 1975.

Emerald Mines Corp., a subsidiary of Lykes-Youngstown Corp., has planned a 2-million-ton-per-year mine near West Waynesburg, Green County. Metallurgical coal will be mined from the 18,118 acres of coal reserves and used primarily for the steel industry.

Rochester and Pittsburgh Coal Co. is developing three mines in the Shelocta area, Armstrong County. The Urling No. 1, Urling No. 2, and Margaret 11 mines

will supply 4.2 million tons of coal per year to the Keystone generating station near Elderton.

J&L plans to acquire additional Freeport coal seam reserves near Waynesburg and possibly open a mine to produce metallurgical coal.

At the J&L Shanopin mine, seven women were recently hired and after a 90-day training period will be placed in the permanent positions for which they are best qualified.

Barnes & Tucker, a subsidiary of Alco Standard Corp., entered into new coal lease agreements in central Pennsylvania. These properties contain an estimated recoverable coal reserve of 184 million tons, of which 165 million tons are undeveloped coal properties.

Gulf Resources and Chemical Corp. purchased the W. P. Stahlman Coal Co. of Brookville. The company had been producing about 265,000 tons of strip-mined coal annually in Clarion and Jefferson Counties. Gulf intends to increase production in the near future.

Zapata Corp.'s subsidiary, Penn West Fuels Inc., has acquired Doverspike Bros. Coal Co., which has 8,000 acres of coal near Kittanning. Zapata's other mines are located near Indiana and in Boone and Logan Counties, W. Va.

Oil Shale Corp. purchased producing coal properties in central Pennsylvania which produced 400,000 tons of coal per year. Oil Shale holds western oil-shale lands and is a petroleum refiner and marketer.

PP&L entered into agreement with Manor Real Estate Co. of Philadelphia for the purchase of 11,000 acres of coal in southwestern Pennsylvania for \$1,183 per acre. The agreement was signed by two PP&L affiliates, Greene Manor Coal Co. and Greene Hill Coal Co. Pennsylvania Mines Corp., a wholly owned subsidiary of PP&L, also owns Greenwich Collieries, Rushton Mining Co., and Tunnelton Mining Co. Other planned mines include GM&W Coal Co., Grove Nos. 2, 3, and 4; Helvetia Coal Co., Lucerne Nos. 8 and 9; North American Coal Corp., Josephine No. 2; North Somerset Mining and Construction Co.; Barnes & Tucker, Tanoma mine, and Yellow Creek mine; Canterbury Coal Co., Dianne mine; Old Home Manor, No. 4 mine, Five Points; and Solar Fuel

Co., Solar Fuel Nos. 7, 9, 10, 11, and 12.

In 1974 United States Steel's Maple Creek No. 2 mine received the Nation's highest underground coal mining award, "The Sentinels of Safety," for the best safety record of any underground coal mine in the Nation. United States Steel's coal mines have earned the award 16 times since 1952, with the Frick district mines receiving the award 9 times. For 1975 another Pennsylvania mine, Banning No. 4 mine owned by the Republic Steel Corp., located at West Newton, received the award for a record of 550,892 man-hours worked without a disabling injury. The annual competition is cosponsored by MESA and the American Mining Congress to promote greater interest in safety and to promote development of more effective accident prevention programs, and 1975 was the 50th year of competition among domestic producers of minerals.<sup>10</sup>

The major coal seams being surface-mined are the Lower Kittanning with 6 million tons produced in 1975; Upper Freeport, 5 million tons; Waynesburg, 3 million tons; Pittsburgh, 3 million tons; Middle Kittanning, 2.2 million tons; Lower Freeport, 1.8 million tons; Brookville, 1.7 million tons; and Clarion, 1.3 million tons. The Lower Kittanning, the most extensively surface-mined seam in the State, was worked in Armstrong, Beaver, Butler, Clearfield, Cambria, Clinton, Centre, Clarion, Elk, Fayette, Indiana, Jefferson, Lawrence, Somerset, and Venango Counties.

DER issued 184 mining permits to mine operators with surface operations in the Lower Kittanning; 38 of these were located in Clearfield County, 24 in Clarion, 14 in Jefferson, and the remainder in the other listed counties. Only one permit each was issued in Clinton and Lawrence Counties.

The Lower Kittanning is actually a complex of five splits which may be combined, forming an unusually thick seam such as the one being mined in Somerset County, which is 72 inches thick. At one location in Clearfield County the Lower Kittanning is 60 inches thick, while elsewhere in the county it is only 18 inches thick. In Clarion County the Lower Kit-

<sup>10</sup> Coal Mining and Processing. V. 2, No. 4, April 1975. Mining Congress Journal. November 1976.



tanning being mined by one operator is only 12 inches thick but its thickness ranges from 18 to 36 inches in other locations within the county.

Very little is known of the Lower Kit-tanning in the southwestern part of the State since it lies approximately 900 feet below the rich Pittsburgh seam, which is being mined extensively in Washington and Greene Counties.

The Upper Freepport, the second most productive seam strip mined, maintains a minable thickness of 36 to 46 inches over most of the area.

The Waynesburgh coal is surface-mined in Fayette, Westmoreland, Greene, and Washington Counties, and usually occurs 300 to 400 feet above the Pittsburgh bed.

The 4- to 6-foot Pittsburgh seam is usually deep-mined in the southwestern part of the State; it is strip-mined mainly in Fayette, Westmoreland, and Washington Counties, with lesser amounts produced in Allegheny, Armstrong, Indiana, and Somerset Counties.

Of the bituminous coal stripped and shipped to market, 61% is by truck, 35% by rail, and 4% by water. Sixty-five percent of the auger-mined coal was shipped to market by rail and 35% by truck.

Each day U.S. coal mines vent to the atmosphere more than 200 million cubic feet of methane containing 180 billion Btu the energy equivalent of 7,200 tons of coal.<sup>11</sup> Research studies indicate it is technically feasible to degasify portions of the Pittsburgh coalbed with horizontal boreholes drilled into a coalbed from the bottom of any shaft. For more effective degasification, shafts should be sunk to the coalbed long before normally required.<sup>12</sup>

Drilling for commercial quantities of gas began in early September when Pennsylvania Enterprises, Inc., a parent company of Pennsylvania Gas and Water Co., began drilling in Hanover Township between Middle Road and Sans Souci Parkway in Wilkes-Barre. The 1,800-foot hole will be drilled into the Red Ash seam.

The Bureau of Mines announced in early April that drilling will take place in the coalbeds near Pittsburgh and in Schuylkill County to evaluate their potential as producers of pipeline gas.

The Pennsylvania State University (Penn State) formed a research group to conduct a 5-year program on methane ex-

traction from coal seams before mining and recovery of the gas for use as a fuel. First-year project plans include five boreholes: Three at United States Steel's Cumberland mine, one in the anthracite seam, and one on State land. Penn State scientists are investigating injection of liquid silicic acid gel into the coal seam to prevent drainage of methane into the working face area.

In late December, National Mine Service Co. planned a joint venture with Gebr. Eickhoff of Bochum, West Germany, to make and distribute longwall mining equipment in the United States. The new company plans to produce two Eickhoff longwall systems each month.

A recent study by the Maritime Administration showed that inland waterways will move 82% more coal annually by the year 2000. In the Pittsburgh district, 63,957,724 tons of cargo moved by water on the Allegheny, Monongahela, and upper Ohio Rivers in 1975. Of this total, 72%, or 46 million tons, was coal, an increase of 1.5 million tons over the average for the last 10 years.

Current navigation projects on the Monongahela River are the Grays Landing lock and dam and the replacement Point Marion lock. Other locks and dams that may be renovated include lock 3 at Elizabeth, which is 70 years old, and Dam 2 at North Braddock, 72 years old.

In early July Congress was urged to list parts of the Allegheny River between the Kinzua Dam and the town of East Brady as possible additions to the Federal scenic and wild river system. The Allegheny River Protective Association (ARPA) is also trying to preserve the river as a scenic and recreational area and has discouraged dredging for sand and gravel. Dredge operators must currently obtain a State permit as well as a Corps of Engineers permit prior to mining.

Efforts to classify the Laurel Hill Creek Watershed as a conservation area may prevent strip mining of coal in the western part of Somerset County. The Laurel Watershed Association was organized in

<sup>11</sup> Irani, M. C., P. W. Jeran, and M. Deul. Methane Emission From U.S. Coal Mines in 1973. A Survey. A Supplement to IC 8558. BuMines IC 8659. 1974, 47 pp.

<sup>12</sup> Fields, H. H., J. H. Perry, and M. Deul. Commercial-Quality Gas From a Multipurpose Borehole Located in the Pittsburgh Coalbed. BuMines RI 8025, 1975, 14 pp.

early June when mine operators filed for a strip-mining permit. In early February residents of southern Venango County protested against strip mining because it may endanger the water supply and affect a watershed reclamation project. Residents of Harrison Park, Penn Township, opposed strip mining on the 110-acre Berlin Road Turnsik Farm, which borders Bushy Run Park, and the Donora Council was reviewing the Palmer Park coal-stripping problem.

The Leechburg Mining Co. near Apollo was allowed to reopen in 1974 after plans included restoration at the rate of 20 acres per year of a waste area that caused acid pollution of the Kiskiminas River.

The Laurel mine near Central City in the northeastern part of Somerset County spent nearly \$1 million to comply with the environmental requirements. The slurry from the cleaning plant's settling lagoons remains a problem, and a State permit is being obtained.

**Coke.**—Commonwealth of Pennsylvania Court has supported DER's refusal to allow Lucerne Coke Co. to reactivate 264 beehive coke ovens, located near Homer City, on the grounds that no evidence was presented that the beehive ovens could be

operated in compliance with State air quality standards. The coke ovens had been shut down since 1971.

**Petroleum and Natural Gas.**—The American Petroleum Institute reported a total of 1,399 wells drilled for a total footage of 3,353,341 feet. Of these, 1,290 were drilled in proven fields and 109 were listed as exploratory wells.

Most of the activity in shallow gasfields was in Indiana County with 388 gas wells; Westmoreland, 62; Jefferson, 60; Armstrong, 46; Clearfield, 20; Washington, 14; and McKean, 10. The majority of the shallow oil development was in Warren County with 273 wells producing from the Glade sandstone; Venango County, with 175 oil wells producing from the Red Valley and Venango Second sandstones; McKean County with 146 wells in the Second and Third Bradford; and Forest County with 72 wells producing from the Red Valley and Venango Second sandstones.

Pennsylvania-grade crude petroleum production totaled 3.2 million 42-gallon barrels valued at \$39.6 million, with an additional 67,000 barrels of Corning-grade crude oil valued at \$787,240, a decrease of 6% in quantity but a 9% increase in value compared with the 1974 figures.

Table 7.—Pennsylvania: Oil and gas well drilling completions, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Armstrong	--	46	3	--	--	1	50	170,110
Beaver	--	--	--	--	2	1	3	6,751
Bedford	--	--	--	--	--	1	1	7,203
Blair	--	--	--	--	--	1	1	11,355
Butler	2	--	2	--	--	2	6	9,169
Cambria	--	1	--	--	3	2	6	23,158
Cameron	--	--	--	--	--	1	1	6,925
Clarion	1	6	1	--	--	--	8	19,332
Clearfield	--	17	--	--	3	5	25	89,544
Crawford	4	1	--	1	2	4	12	31,100
Elk	4	3	--	--	--	4	11	32,000
Erie	--	4	1	--	3	3	11	39,096
Fayette	--	1	--	--	2	4	7	34,632
Forest	68	2	--	4	2	--	76	79,980
Indiana	--	373	4	--	15	2	394	1,394,483
Jefferson	--	57	--	--	3	2	62	214,066
Lawrence	--	--	--	--	--	1	1	949
McKean	146	7	--	--	3	2	158	295,556
Mercer	3	1	--	--	--	2	6	10,387
Potter	10	1	--	--	--	--	11	20,232
Somerset	--	--	--	--	2	4	6	56,937
Venango	172	1	1	3	--	2	179	147,990
Warren	270	--	3	3	1	1	278	331,058
Washington	--	14	--	--	2	--	16	64,497
Westmoreland	--	59	1	--	3	7	70	256,831
Total	680	594	16	11	46	52	1,399	3,353,341

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

Most of the Corning-grade crude was produced in Crawford County from the Medina sandstone.

Natural gas production totaled 84.7 billion cubic feet, an increase of 2% from that of 1974. The shallow reservoirs, Upper Devonian or younger, produced 72 billion cubic feet; the deep reservoirs, Middle Devonian or older, produced 12 billion cubic feet. The estimated number of producing gas wells totaled 17,500. Natural gas liquid production decreased 8% compared with 1974 output.

A shale oil discovery was made in Vernon Township, Crawford County. The No. 1-A Dwight L. Moody well had an initial production of 184 barrels of oil per day from the Venango Second sandstone at a depth of 622 feet.

The first reported shale gas well in Pennsylvania was drilled in Beaver County, fracturing the Upper Devonian shale at a depth of 3,500 to 4,700 feet with an initial production of 150,000 cubic feet of gas per day. The No. 1-R. L. Lambert well, drilled to a depth of 8,636 feet into the Oriskany Sandstone in Somerset County, produced an initial flow of 2,500 thousand cubic feet per day of natural gas. The No. 2 Minard Run tract well in McKean County was drilled to a depth of 10,478 feet into the Cambrian Little Falls Dolomite with an open flow estimated at 500,000 cubic feet of gas per day.<sup>13</sup>

Commercial gas-bearing Medina sandstone was located as far south as southern Venango County, which could result in gas being produced in all of the counties of northwestern Pennsylvania.

PSU researchers are conducting field tests near Bradford in addition to laboratory studies to increase yield from previously depleted oilfields through the use of a third-stage method called micellar-polymer flooding. In this method a detergent (micellar fluid) is pumped into an injection well, cleaning oil from the rock grains as it moves. Then a second substance, a polymer, is injected behind the detergent solution to move it through the rock.<sup>14</sup>

Adobe Oil and Gas Corp. of Midland, Tex., reported a second confirmation well in the Keystone Lake gasfield in Westmoreland County from the Murrysville sand at 1,905 feet, flowing at a daily rate of 20 million cubic feet. Additional drilling

is planned in this area. The gas is contracted at 80 cents per thousand cubic feet.

Columbia Gas Co. of Pennsylvania, servicing 176 industrial and 190,000 residential customers in western Pennsylvania, announced gas curtailments, as did Equitable Gas Co. and Peoples Natural Gas Co. Industrial customers were expected to have gas supplies reduced 20% to 55% during the winter months. In late October the Public Utility Commission (PUC) ordered Columbia Gas Co. to limit winter fuel curtailments to public schools to 10% below 1974 levels, but authorized 40% cutbacks for commercial customers.

Bethlehem Steel Corp. will operate for a 2-year period a newly designed Synthoil plant being constructed at Bruceton. The cost-sharing cooperative agreement between Bethlehem and the Federal Government proposes development for early industrial use of the Synthoil process, which converts coal into a clean-burning liquid fuel.

Another research project at Bruceton involves the Synthane process, which converts coal into synthetic methane. The Bruceton plant was designed and engineered by C-E.

Continental Oil Co.'s Conoco Coal Development Div., Library, Pa., was awarded a 4-year contract to determine the technical and economic potential of the zinc halide hydrocracking process for producing clean liquid fuels from coal. The first phase of the work will be completed at the Library Research Center.

Foster Wheeler Energy Corp. was awarded a contract to design and operate a coal liquefaction pilot plant near Pittsburgh capable of producing 24 barrels per day of clean fuel oil from 8 tons of coal using the Synthoil process.

**Peat.**—At least 90% of the peat found in Pennsylvania occurs in areas north of the glacial terminal moraine. Mine operators in six counties reported a total sales of 27,000 tons, 10% less than in 1974. The value of peat was \$488,000, or 5% less than in 1974. The leading producing counties were Lackawanna, Wayne, Luzerne, Erie, Lawrence, and Monroe. Uses were mainly for humus and agricultural purposes.

<sup>13</sup> Pennsylvania Geology, November 1975, p. 9.

<sup>14</sup> Earth and Mineral Sciences, January 1976, pp. 30-31.

## NONMETALS

**Abrasives.**—Silicon carbide abrasives were produced by one company located in Allegheny County. Metallic abrasives were produced by four companies in three counties in western Pennsylvania. The total amount of metallic abrasives sold or used was 27% less in tonnage and 22% less in value than in 1974. Types of abrasives produced were chilled iron shot and grit, annealed iron shot and grit.

Sintermet, a subsidiary of Asko, Inc., has begun production of wear-resistant tungsten carbide tooling for the steel industry at a new plant in Kittanning. The new plant was designed by Swindell-Dressler specifically for the manufacture of large-size carbide parts and has a hydraulic press capable of handling green parts up to 22 inches wide.

**Cement.**—Portland cement shipments from 17 plants in 8 counties were 22% less in quantity and 12% less in value, even though the average value per short ton increased \$3.21 over that of 1974. Masonry cement shipments from 15 plants in 8 counties were 11.5% less in quantity with no change in total value, although the average value was \$4.71 per short ton greater than in 1974. Northampton and Lawrence Counties were the largest producers of both portland and masonry cements.

Ready-mixed concrete companies used 58% of the finished portland cement, concrete product manufacturers used 22%, building material dealers used 11%, highway contractors used 8%, and the remaining 1% was used by other manufacturers and miscellaneous customers.

Consumption of energy for the producing plants showed the following changes compared with 1974: Natural gas increased 341%, fuel oil decreased 52%, bituminous coal decreased 24%, anthracite decreased 95%, electricity generated at the plants decreased 22%, and electricity purchased decreased 21%.

**Clays.**—Total production of common clay and shale, excluding kaolin, was 1,945,301 tons valued at \$13,671,605, or 29% less in tonnage and 17% less in value than in 1974. Common clay and shale accounted for 60% of the total tonnage and 24% of the value of all clays and shales, excluding kaolin. Twenty-seven companies

having 43 operations in 23 counties produced common clay and shale, and 20 companies with 38 operations in 10 counties produced fire clay. Common clay and shale averaged \$2.84 per ton, and fire clay averaged \$13.27 per ton. Two companies produced 37% of the common clay and shale, resulting in 48% of the total value of common clay and shale, and two companies produced 30% of the fire clay, amounting to 64% of the value of all fire clay produced in the State. Medusa Corp. produced unprocessed kaolin in Cumberland, and Narvon Mining and Chemical Corp. produced calcined kaolin in Lancaster County.

**Gypsum.**—U.S. Gypsum Co. calcined gypsum at Philadelphia. Output declined 37% and was 57% below the 1973 record.

**Lime.**—Ten plants in eight counties produced 1,940,000 short tons of burned and hydrated lime, 7% less than in 1974. Value of total production was \$60,047,000, or 20% more than 1974. The average value of all production in 1975 was \$30.95 per short ton, \$6.84 more than in 1974. Pennsylvania ranked second in the United States with 10.14% of the total production and 11.46% of the total value. Centre County was the leading producer in the State with 33% of the total production and 30% of the total value. Other producing counties include Adams, Butler, Chester, Lebanon, Mifflin, Montgomery, and York.

**Mica.**—Scrap and flake mica was produced by one company in Adams County. Processed mica was used in paints, roofing, electric insulation, welding rods, rubber, and textile coating.

**Mullite.**—One company produced high-temperature sintered mullite at a plant in Philadelphia County. Compared with 1974, production was 19% less, but value was 15% more. Mullite is a heat-resistant mineral, a silicate of aluminum used in furnace linings.

**Perlite.**—Crude perlite was shipped into the State and expanded at five plants by five companies operating in five counties. Production totaled 33,693 short tons, or 12% less than 1974. The quantity sold or used in 1975 was 33,343 short tons valued at \$2.6 million with an average value of \$78.55. Principal uses for the product were formed products, fillers, and masonry and cavity fill insulation.

Table 8.—Pennsylvania: Clays sold or used by producers, by use<sup>1</sup>  
(Short tons)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Common brick	53,495		68,549	
Face brick	1,417,532		851,421	
Electrical porcelain	--		955	
Firebrick, block, and shapes	707,966		646,602	
Flue linings	41,444		41,421	
Brakes, clutches, linoleum, and other fillers	3,128		--	
Mortar and cement, refractory	12,948		16,378	
Portland and other cements	172,432		108,675	
Pottery	192		--	
Roofing granules	--		8,305	
Sewer pipe	101,988		W	
Floor and wall tile, ceramic	6,000		4,300	
Drain, quarry, and structural tile	33,947		50,671	
Waterproofing and sealing	--		2,354	
Other uses <sup>2</sup>	113,853		96,379	
Exports:				
Face brick	28,984		--	
Refractories	9,087		48,791	
Sewer pipe	28,984		--	
Total	2,731,980		1,945,301	

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

<sup>1</sup> Excludes kaolin.

<sup>2</sup> Includes high-alumina refractories (1974), lightweight aggregate, paint (1975), terra cotta, and data indicated by symbol W.

Table 9.—Pennsylvania: Lime sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Steel, BOF	1,004	23,800	982	29,900
Water purification	214	5,083	205	6,223
Steel, electric	111	2,620	124	3,762
Sewage treatment	154	3,639	101	3,081
Mason's lime	80	2,282	86	2,227
Steel, open-hearth	W	W	66	1,999
Agriculture	37	949	50	1,704
Acid mine water	67	1,594	36	1,096
Finishing lime	W	W	24	630
Paper and pulp	23	550	23	714
Tanning	W	W	6	192
Other uses <sup>1</sup>	390	9,630	237	8,514
Total	2,080	50,147	1,940	60,047

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

<sup>1</sup> Includes refractory dolomite, other chemical uses, soil stabilization (1974), other metallurgy, petroleum refining, explosives, sand-lime brick, insecticides, silica brick, wire drawing, other ore concentration, sugar refining (1975), paint, magnesite (1975), alkalies, and other uses indicated by symbol W.

**Sand and Gravel.**—The total output of sand and gravel decreased 4% in quantity, but increased 8% in value compared with the 1974 figures. Of the 16.4 million short tons of sand and gravel used for construction, 52% was processed sand, 42% was processed gravel, and 6% was unprocessed sand and gravel. Production of sand and gravel for construction declined 3% but increased 3% in value to \$2.42 per short ton. The primary uses of construction sand and gravel were for residential construction, highway and bridge construction, concrete products, and bituminous paving.

Output of industrial sand and gravel totaled 1 million short tons, decreasing 9%; value increased 9%, and average unit value was \$7.08 per short ton. Industrial sand was used for glass, molding, and foundry purposes.

The number of sand and gravel mines totaled 112, 1 more than in 1974. Production came from 39 of the State's 67 counties. The leading producing counties in order of declining production were Bucks, Armstrong, Erie, and Beaver. Bucks County ranked first in value, followed by Armstrong, Beaver, and Erie.

**Table 10.—Pennsylvania: Construction and industrial sand and gravel sold or used by producers**

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand .....	8,949	20,922	8,495	21,111
Gravel .....	7,359	16,838	6,947	17,771
Unprocessed:				
Sand and gravel .....	664	673	954	810
Industrial:				
Sand .....	1,099	6,508	1,005	7,120
Total .....	18,071	44,941	17,401	<sup>2</sup> 46,813

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

**Table 11.—Pennsylvania: Construction aggregate and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	5,639	12,977	4,775	12,943
Highway and bridge construction .....	749	1,939	1,125	2,661
Other construction (dams, waterworks, airports, etc.) .....	257	822	510	1,512
Concrete products (cement blocks, bricks, pipe, etc.) .....	2,437	5,687	1,937	5,215
Bituminous paving (asphalt and tar paving) .....	1,219	2,738	1,052	2,756
Roadbase and subbase .....	778	1,623	760	1,828
Fill .....	160	346	150	318
Other uses .....	190	451	140	348
Unprocessed:				
Roadbase and subbase .....	305	220	138	161
Fill .....	356	451	359	379
Other uses .....	---	---	347	173
Industrial sand and gravel .....	1,099	6,508	1,005	7,120
Total <sup>1</sup> .....	13,189	33,762	12,299	35,415

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Table 12.—Pennsylvania: Construction aggregate sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	195	440	286	828
Highway and bridge construction -----	1,559	3,510	1,703	4,074
Other construction (dams, waterworks, airports, etc.) -----	129	292	88	230
Concrete products (cement blocks, bricks, pipe, etc.) -----	W	W	218	451
Bituminous paving (asphalt and tar paving) -----	2,012	5,487	1,801	5,790
Roadbase and subbase -----	696	1,147	557	1,100
Fill -----	42	89	232	549
Other -----	249	454	108	215
<b>Unprocessed:</b>				
Roadbase and subbase -----	W	W	5	W
Fill -----	W	W	104	95
<b>Total -----</b>	<b>4,882</b>	<b>11,419</b>	<b>5,102</b>	<b>13,327</b>

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

**Stone.**—Pennsylvania ranked first in value and second in quantity of total stone produced, compared with other States. Total stone production dropped 18%; total value dropped 6% but increased an average of \$0.27 per short ton. Total stone production in Pennsylvania totaled 60 million short tons valued at \$150 million with an average value per short ton of \$2.49, compared with 73 million short tons valued at \$160 million or \$2.18 per short ton in 1974.

Pennsylvania quarries totaled 246, or 5 fewer than in 1974. Dimension stone was produced by 31 quarries, and crushed and broken stone by 216 quarries. The types of stone produced in Pennsylvania were limestone, dolomite, granite, sandstone, quartzite, traprock, slate, and other stone.

Crushed and broken limestone in excess of 43 million short tons valued at \$103 million with a unit value of \$2.38 per short ton was produced at 140 quarries. Major uses of limestone were dense-graded roadbase stone, cement manufacture, other

construction aggregate and roadstone, bituminous and concrete aggregate, and lime manufacture. Highest unit values of crushed and broken limestone were for whiting, \$13.75 per short ton; refractory stone, \$13.04; abrasives, \$9.20; mine dust, \$8.07; poultry grit, \$6.80; and filler, \$6.38.

Crushed and broken dolomite in excess of 2.6 million short tons valued at \$6 million was produced at seven quarries. Uses of dolomite included agricultural limestone, concrete aggregate, bituminous aggregate, cement manufacture, and flux stone. The average unit value was \$2.39 per short ton.

Granite included both dimension and crushed and broken stone. The unit value of rough granite blocks was \$71.31 per short ton and value of flagging stone was \$29 per short ton. Unit value of all granite dimension stone was \$55.57 per short ton.

Crushed and broken stone also included sandstone, quartzite, traprock, and other stones. Other dimension stone included sandstone, quartzite, other stone, and slate.

Table 13.—Pennsylvania: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	4,966	10,122	4,280	10,326
Concrete aggregate -----	4,759	9,509	4,462	10,226
Dense-graded roadbase stone -----	12,536	23,960	9,710	20,165
Macadam aggregate -----	1,245	2,483	1,026	2,278
Other construction aggregate and roadstone -----	6,882	13,968	6,142	13,630
Surface treatment aggregate -----	3,154	5,826	2,566	5,343
Agricultural limestone <sup>1</sup> -----	2,080	7,366	1,707	6,948
Cement manufacture -----	10,055	16,498	7,089	13,958
Lime manufacture -----	4,422	9,862	3,471	8,665
Filter stone -----	231	W	46	W
Flux stone <sup>2</sup> -----	4,117	10,521	2,729	8,772
Manufactured fine aggregate (stone sand) -----	684	1,768	481	1,260
Mine dusting <sup>3</sup> -----	113	846	123	995
Mineral fillers, extenders, whittings -----	267	2,388	213	1,629
Railroad ballast -----	857	1,972	695	1,783
Refractory stone -----	4	W	2	W
Riprap and jetty stone -----	509	1,143	321	778
Other uses <sup>4</sup> -----	835	3,056	937	2,710
Total <sup>5</sup> -----	57,715	121,289	46,020	109,466

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

<sup>1</sup> 1974 data also include poultry grit and mineral food.

<sup>2</sup> 1974 data also include dead-burned dolomite.

<sup>3</sup> 1974 data also include abrasives.

<sup>4</sup> Includes stone used in abrasives (1975), acid neutralization, building products, glass manufacture, waste material, poultry grit and mineral food (1975), and uses indicated by symbol W.

<sup>5</sup> Data may not add to totals shown because of independent rounding.

Table 14.—Pennsylvania: Crushed limestone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Armstrong -----	4	165	461	4	160	531
Berks -----	9	3,442	6,529	9	2,444	4,744
Blair -----	5	1,516	W	5	1,066	2,312
Butler -----	6	W	W	5	1,675	6,132
Centre -----	8	2,910	6,213	7	2,546	6,213
Chester -----	3	W	W	3	2,956	6,234
Cumberland -----	6	1,672	3,419	6	1,221	2,743
Fayette -----	6	W	W	4	1,342	3,785
Huntingdon -----	5	W	W	5	696	1,416
Juniata -----	--	--	--	1	179	312
Lawrence -----	4	1,442	3,413	4	1,090	3,198
Lebanon -----	3	W	W	3	2,725	6,949
Lehigh -----	8	2,818	W	8	2,088	3,787
Mifflin -----	5	W	W	5	324	745
Northampton -----	11	4,976	7,319	11	3,699	5,826
Northumberland -----	1	W	W	1	137	386
Schuylkill -----	1	232	340	1	202	408
Somerset -----	3	W	W	4	581	2,129
Westmoreland -----	6	W	W	3	679	2,011
York -----	10	W	W	10	3,591	9,131
Undistributed <sup>1</sup> -----	49	38,542	93,594	48	16,619	40,473
Total <sup>2</sup> -----	153	57,715	121,289	147	46,020	109,466

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

<sup>1</sup> Includes Adams, Bedford, Bucks, Carbon, Clarion, Clinton, Columbia, Dauphin, Franklin, Fulton, Lancaster, Luzerne (1975), Lycoming, Monroe, Montgomery, Montour, Perry, Pike (1974), Snyder, and Union Counties, and counties indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.



**Sulfur.**—Petroleum refineries in Delaware and Philadelphia Counties and one steel company in Allegheny County produced 67,988 long tons and sold or used 67,736 long tons of sulfur valued at \$2,550,873 with a value of \$37.66 per long ton. Compared with 1974, production of sulfur increased 165%; sulfur sold or used increased 165%; total value increased 299%; and the unit price was up 51%. Stocks of sulfur increased from 1,087 long tons on January 1 to 1,339 long tons at yearend.

**Tripoli (Rottenstone).**—Crude tripoli was mined and processed by Keystone Filler & Manufacturing Co., Northumberland County. Compared with 1974 estimated figures, the tonnage sold or used was 71% less and its value was 93% less. Tripoli was used as an abrasive with minor use as a filler.

**Vermiculite.**—Crude vermiculite shipped into the State was exfoliated by three companies in three counties. The major uses of the product were for loose fill insulation, block insulation, concrete aggregates, horticulture, and soil conditioning.

#### METALS

**Cadmium.**—Smelter production of cadmium decreased 77% in quantity and 86% in value compared with 1974.

**Iron Ore.**—Bethlehem Mines Corp. produced by five plants in four counties, mine in Berks County. Production was less than in 1974. All concentrates were pelletized prior to shipment to Bethlehem's steelmaking facilities.

**Iron Oxide Pigments.**—Natural or manufactured iron oxide pigments was produced by five plants in four counties. Iron oxide pigments were also produced from steel mill wastes at one location in Allegheny County during 1975.

**Iron and Steel.**—According to the American Iron and Steel Institute (AISI), Pennsylvania was the leading raw steel producer in the Nation with a production of 25,761,000 short tons, or 22% of the Nation's total, compared with 33,535,000 short tons, or 23% of the Nation's total, in 1974. Pennsylvania led the Nation in consumption of pig iron with 17,642,000 short tons, or 22% of the Nation's total. Other leading States in order of decreasing consumption were Indiana, Ohio, Michigan, and Illinois. Shipments of pig iron

from Pennsylvania plants totaled 17,285,731 short tons valued at \$2.9 billion—21% less in quantity but 13% more in value than in 1974. The average value of pig iron was \$168.32 per short ton, or 42% more than in 1974. Blast furnace pig iron was classed as 93% basic, 4% bessemer, and 3% malleable and foundry. Stocks of pig iron at furnaces totaled 124,646 tons on January 1, and 204,818 tons at yearend. Active blast furnaces numbered 34 on January 1 and 25 at yearend. Idle blast furnaces totaled 16 on January 1 and 25 at yearend.

Early in February, steelmaking in the Pittsburgh district was at 90% of full capacity. Although local demand for finished steel was below the 1974 level, all major procedures had order backlogs in such major product lines as plate, oil country pipe and tube, special quality bar, tinplate, specialty tubing, and hot-rolled sheet and band. While these backlogs were diminishing, producers were building inventories of semifinished steel and some were building stock for customer accounts. Several producers of stainless steel trimmed their output and reduced their work force because of reduced demand.<sup>15</sup>

Demand for steel products continued to drop in late May with some mills operating at 60% of capacity. The uncertainty of the automotive industry, which buys approximately 25% of all the steel shipped in the United States, added to the industry's problems. United States Steel reported in late June that 4,000 of the 30,000 hourly workers employed at district plants were idle. J&L reported 3,000 of the 15,000 workers at Aliquippa and Pittsburgh were idle. Wheeling-Pittsburgh Steel Corp. reported that 15% of the work force was out of work.

Bethlehem Steel Corp. planned to close its four remaining fabricating shops during the next 2 years. The Leetsdale shop was to be phased out in 1977. The Pottstown, Montgomery County, shop was scheduled to close by late 1976, and the Bethlehem, Lehigh County, facility was scheduled to close by mid-1976. Although the fabricating facilities will be affected, the steel-making facilities will continue normal operations.

<sup>15</sup> American Metal Market. V. 82, No. 31, Feb. 13, 1975, p. 5.

Lukens Steel Co. closed its open hearth operations in Coatesville and announced operation of its fourth electric arc furnace for the production of plate steels. The fourth unit, of 150-ton capacity, is equipped with a direct evacuation dust control system, a secondary canopy system, and a new baghouse.

Harsco Corp. announced plans in late September to halt steelmaking operations at its Harrisburg Steel Co. Div. by year-end. Harrisburg Steel will continue to manufacture high-pressure stainless gas cylinders using domestic steel purchased from other producers.

United States Steel closed its Pittsburgh steelmaking operations for repairs for 1 week, resuming operations on December 27.

Orders for steel became stronger in late August and early September, and industry representatives looked forward to 1976 with optimism.

Plant improvements were planned throughout the steel industry. J&L planned a \$200 million modernization for its Pittsburgh steel works consisting of construction of a two-furnace basic oxygen shop and improved pollution control equipment for the coke ovens and other facilities.

United States Steel's Imperial Works, Oil City, will receive new machine tools; considerable tooling equipment will be rebuilt; and provisions will be made for additional welding and burning equipment to meet oil and gas industries needs.<sup>16</sup>

Bethlehem Steel Corp. planned to spend more than \$600 million during the next 5 years for furnace fume filters and other environmental protection equipment. At Bethlehem's Johnstown plant, construction of a two-vessel oxygen steelmaking shop was scheduled for operation in 1978, which will replace open hearth furnaces.

Armco Steel Corp.'s Butler plant will install an argon-oxygen decarburization (AOD) vessel for the final refining and purifying of molten steels. Improvements to the dust collection systems were also planned.

Washington Steel Corp., Washington, was constructing a new mill for hot-rolling slabs and planned improvements to the electric furnaces and pressure-casting equipment and installation of a third slab-grinding machine.<sup>17</sup>

Jessop Steel Co. planned to boost capacity of stainless steel plate and other steel-producing facilities by 18% by installing new equipment, making building modifications, and improving handling equipment for the argon-oxygen vessel. Jessop Steel's Washington plant is said to be the only completely integrated stainless plate facility in the United States making plates more than 84 inches wide.<sup>18</sup>

Allegheny Ludlum Industries, Inc., located at Brackenridge announced a major expansion program of \$40 million to \$50 million over the next few years, which would include a 100-ton AOD vessel and a purifying unit to cut production costs. The expansion and modernization will increase the melting capacity of the Brackenridge plant by 30%, to 500,000 tons annually. Future improvements include a continuous slab caster and a 100-ton ultra-high-powered electric furnace.

Alan Woods Steel Co. continued with previous expansion plans; iron production has been increased 11%.

Babcock and Wilcox planned a \$50 million seamless tubing facility for its Ambridge plant, increasing production of seamless tubing, speciality oil well tubing, and pressure and mechanical tubing.

Oakmont Corp., Oakmont, planned a \$1 million expansion program to increase steelmaking capacity from 80,000 to 95,000 tons annually and to increase its steel wheel forging production 20%.

**Molybdenum.**—The Molybdenum Div. of AMAX Inc. produced technical-grade molybdc oxide at its Langeloth plant. The ore is mined at the company's operations in Colorado. The molybdc oxide from the Langeloth plant will feed the roaster complex at the Fort Madison, Iowa, plant.<sup>19</sup>

Molybdenite, a metallic bluish-gray sulfide ore mineral of molybdenum, was found as flakes up to 3/4 inch across in a roadcut near Reading. The occurrence was not of economic size, but identify the general area as one which may be mineralized with other important elements.<sup>20</sup>

<sup>16</sup> American Metal Market. V. 82, No. 33, Feb. 17, 1975, p. 18.

<sup>17</sup> American Metal Market. V. 82, No. 14, Jan. 21, 1975, p. 4.

<sup>18</sup> American Metal Market. V. 82, No. 28, Feb. 10, 1975, p. 23A.

<sup>19</sup> American Metal Market. V. 82, No. 186, Sept. 25, 1975, p. 2.

<sup>20</sup> Work cited in footnote 7.

**Zinc.**—Compared with other States, Pennsylvania ranked seventh in zinc production, producing 11,090 short tons valued at \$16.4 million. The unit price of zinc was \$0.39 per pound, or \$780 per ton, an increase of 8% in value as compared with that of 1974.

St. Joe Minerals Corp. became the first domestic zinc producer to disclose plans in early January for reducing zinc production by more than 10% from its Monaca smelter.<sup>21</sup> In early March an additional 30% reduction took place, bringing the total announced reduction to 40%.<sup>22</sup>

New Jersey Zinc Co. had difficulties in obtaining sufficient natural gas supplies in

early February and requested Federal Power Commission assistance. Since early January, New Jersey Zinc Co. has been producing zinc metal at 75% capacity and zinc pigments at less capacity because of a weakened zinc market. To treat effluents, New Jersey Zinc will test a pilot treatment facility using bulrushes at the zinc mine in Friedensville, which will remove zinc, sulfides, and other pollutants from the mine's waste water.<sup>23</sup>

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<sup>21</sup> Pages 1 and 24 of work cited in footnote 17.  
<sup>22</sup> American Metal Market. V. 82, No. 54, Mar. 19, 1975, p. 1.

<sup>23</sup> Newsweek. Apr. 14, 1975, p. 86.

Table 15.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives: Satellite Alloy Corp.	9800 McKnight Rd. Pittsburgh, Pa. 15237	Plant -----	Allegheny.
Cement:			
Amcord, Inc. <sup>1</sup> -----	610 Newport Center Dr. Newport Beach, Calif. 92660	---do -----	Northampton.
Coplay Cement Manufacturing Co. <sup>1</sup>	Nazareth, Pa. 18064 -----	---do -----	Lehigh and Northampton.
Keystone Portland Cement Co. <sup>1</sup>	Box 1785 Allentown, Pa. 18105	---do -----	Northampton.
Louisville Cement Co -----	501 South 2d St. Louisville, Ky. 40202	---do -----	Lawrence.
Medusa Corp. <sup>1,2</sup> -----	Box 5668 Cleveland, Ohio 44101	---do -----	Lawrence and York.
Penn-Dixie Industries, Inc. <sup>1,2</sup>	60 East 42d St. New York, N.Y. 10017	---do -----	Butler and Northampton.
United States Steel Corp. <sup>1,3</sup>	600 Grant St. Pittsburgh, Pa. 15230	---do -----	Allegheny and Northampton.
Clays:			
Dresser Industries, Inc ---	Box 6504 Houston, Tex. 77005	Pit -----	Clearfield and Somerset.
Glen-Gery Corp -----	227 North 5th St. Reading, Pa. 19601	Pit -----	Adams, Berks, Northumberland, Union, York.
Hanley Co -----	28 Kennedy St. Bradford, Pa. 16701	Pit -----	Jefferson and McKean.
Resco Products -----	Box 108 Morristown, Pa. 19404	Pit -----	Clearfield and Huntingdon.
Coal, anthracite:			
Greenwood Stripping Corp.	1 Venice St. Nesquehoning, Pa. 18240	Strip -----	Carbon and Schuylkill.
Jeddo-Highland Coal Co --	800 Exeter Ave. West Pittston, Pa. 18643	Strip and culm bank.	Luzerne.
Leon E. Kocher Coal Co --	Box 127 Valley View, Pa. 17983	Underground ----	Schuylkill.
Reading Anthracite Co ---	200 Mahantongo St. Pottsville, Pa. 17901	Culm bank and strip.	Northumberland and Schuylkill.
Coal, bituminous:			
Barnes & Tucker Co -----	357 Lancaster Ave. Haverford, Pa. 19041	Underground ----	Cambria.
Bethlehem Mines Corp. <sup>4,5</sup> --	701 East 3d St. Bethlehem, Pa. 18016	---do -----	Cambria and Washington.
C&K Coal Co -----	Box 69 Clarion, Pa. 16214	---do -----	Greene.
Pittsburg & Midway Coal Co.	10 Main Center Kansas City, Mo. 64105	---do -----	Washington.
Graphite, synthetic:			
Air Reduction Co., Inc --	Theresa St. St. Marys, Pa. 15857	Plant -----	Elk.
Charles Pfizer & Co., Inc. <sup>5</sup> -	235 East 42d St. New York, N.Y. 10017	---do -----	Northampton.
Stackpole Carbon Co -----	St. Marys, Pa. 15857 -----	---do -----	Elk.
Gypsum, calcined: United States Gypsum Co. <sup>6</sup>	101 South Wacker Dr. Chicago, Ill. 60606	---do -----	Philadelphia.
Iron oxide pigments:			
The Prince Manufacturing Co.	Bowmanstown, Pa. 18030 --	---do -----	Carbon.
Reichard-Coulston, Inc ---	15 East 26th St. New York, N.Y. 10010	---do -----	Northampton.
Lime:			
The J. E. Baker Co. <sup>1</sup> -----	Box 1189 York, Pa. 17405	---do -----	York.
Mercer Lime & Stone Co.---	1640 Oliver Bldg. Pittsburgh, Pa. 15222	---do -----	Butler.
National Gypsum Co. <sup>1,2,7</sup> ---	325 Delaware Ave. Buffalo, N.Y. 14202	---do -----	Centre.
Peat:			
Gouldsboro-Wayne Peat Co.	Box 68 Gouldsboro, Pa. 18424	Bog -----	Wayne.
Lake Benton Peat Moss --	1418 North Main St. Scranton, Pa. 18508	Bog -----	Lackawanna.

See footnotes at end of table.

Table 15.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Perlite, expanded:</b>			
Armstrong Cork Co -----	Lancaster, Pa. 17603 -----	Plant -----	Lancaster.
Atlantic Perlite -----	Box 845 ----- Primose, Pa. 19018	-----do -----	Delaware.
Pennsylvania Perlite Corp. -----	Box 2002 ----- Lehigh Valley, Pa. 18001	-----do -----	Lehigh and York.
Perlite Manufacturing Co. -----	Box 478 ----- Carnegie, Pa. 15106	-----do -----	Allegheny.
<b>Petroleum refineries:<sup>8</sup></b>			
<b>Sand and gravel:</b>			
Davison Sand & Gravel Co. -----	34th Ave. and 4th St. ----- New Kensington, Pa. 15068	Dredge -----	Westmoreland.
Dravo Corp -----	1 Oliver Plaza ----- Pittsburgh, Pa. 15222	-----do -----	Beaver.
Erie Sand Steamship Co --	Erie, Pa. 16500 -----	-----do -----	Erie.
Lycoming Silica Sand Co. <sup>1</sup> -----	401 Broad St., Box 159 ----- Montoursville, Pa. 17754	Pit -----	Lycoming.
Shippingport Sand & Gravel Co. -----	1200 Slambaugh Bldg. ----- Youngstown, Ohio 44501	Pit -----	Armstrong.
Warner Co. <sup>1,4</sup> -----	1721 Arch St. ----- Philadelphia, Pa. 19103	Pit -----	Bucks.
<b>Stone:</b>			
G. & W. H. Corson, Inc. <sup>4</sup> -	Plymouth Meeting, Pa. ----- 19462	Quarry -----	Montgomery.
The General Crushed Stone Co. -----	712 Drake Bldg. ----- Easton, Pa. 18042	-----do -----	Bucks, Chester, Delaware, Lancaster, Luzerne, Perry.
Glasgow Quarry, Inc -----	Route 2, Box 121 ----- Glasgow, Mo. 65254	-----do -----	Montgomery.
Martin-Marietta Corp ----	11300 Rockville Pike ----- Rockville, Md. 20852	-----do -----	Centre, Chester, Fayette, Northampton.
New Enterprise Stone & Lime. -----	New Enterprise, Pa. 16664. -----	-----do -----	Bedford, Blair, Cumberland, Franklin, Huntingdon, Somerset.
<b>Sulfur:</b>			
Atlantic Richfield Co -----	3144 Passyunk Ave. ----- Philadelphia, Pa. 19145	Plant -----	Philadelphia.
British Petroleum Corp., Ltd. -----	Box 423 ----- Marcus Hook, Pa. 19061	-----do -----	Delaware.
Gulf Oil Corp -----	Box 7408 ----- Philadelphia, Pa. 19101	-----do -----	Philadelphia.
Sun Oil Co -----	1608 Walnut St. ----- Philadelphia, Pa. 19103	-----do -----	Delaware.
Tripoli, rottenstone: Keystone Filler & Manufacturing Co. -----	Muncy, Pa. 17756 -----	Pit -----	Northumberland.
<b>Vermiculite, exfoliated:</b>			
Hyzer & Lewellen -----	Box 155 ----- Southampton, Pa. 18966	Plant -----	Bucks.
W. R. Grace & Co -----	62 Whittemore Ave. ----- Cambridge, Mass. 02140	-----do -----	Lawrence.

<sup>1</sup> Also stone.<sup>2</sup> Also clays.<sup>3</sup> Also coal.<sup>4</sup> Also lime.<sup>5</sup> Also iron ore.<sup>6</sup> Also expanded perlite.<sup>7</sup> Also cement.<sup>8</sup> Many major oil companies operate refineries in Pennsylvania and several commercial directories contain lists of them.

# The Mineral Industry of Puerto Rico, The Virgin Islands, and Pacific Island Possessions

The Puerto Rico section of this chapter has been prepared through cooperation among the Bureau of Mines and the Geological Survey, U.S. Department of the Interior, and the following Commonwealth of Puerto Rico agencies: Department of Natural Resources and Economic Development Administration (Fomento).

By John W. Sweeney <sup>1</sup>

## PUERTO RICO

Reflecting the continued recession in Puerto Rico, a dramatically reduced operating budget of \$883 million, \$160 million less than in fiscal year 1975, was submitted to the legislature. The Governor's Commonwealth message referred to 1975 as a year of "economic crisis" and said the limited reduced budget would demand restraints by all citizens.

The Water Resources Authority (WRA) plans to construct a \$515 million, 600-megawatt nuclear plant at Arecibo were postponed owing to a drop in demand combined with a lack of capital. Revised plans called for construction to begin in 1985.

The Legislature approved the Puerto Rico Mineral Resource Development Act on July 2, 1975. The purpose of the act is to create the Puerto Rico Mineral Resource Development Corporation with financial and operational capacity to carry out the mineral resources development policy of the Commonwealth of Puerto Rico, as established in the Act creating the Department of Natural Resources and in the

Mining Act; to define its powers, duties, and functions; to authorize it to prospect for, develop, exploit, process, refine, sell, and otherwise utilize mineral resources of Puerto Rico for the benefit of the people of Puerto Rico; to authorize the Corporation to borrow money and issue bonds and other debentures; to provide that the property, income, and bonds of the Corporation are tax exempt; and to appropriate funds for its operation.

Sporadic negotiations continued between copper mining companies and Puerto Rican officials, as impasse continued over the proposed development of the Puerto Rican porphyry copper deposits.

At the end of 1975 the Department of Natural Resources reported seven exclusive exploration permits in effect, as shown in table 3.

**Legislation and Government Programs.**—The Caribbean District of the Water Resources Division of the U.S. Geological Sur-

<sup>1</sup> State Liaison Officer (Florida and Puerto Rico), Bureau of Mines, Tallahassee, Fla.

Table 1.—Mineral production in Puerto Rico <sup>1</sup>  
(Thousand short tons and thousand dollars)

Mineral	1974		1975	
	Quantity	Value	Quantity	Value
Cement, portland -----	1,881	70,277	1,582	60,968
Clays -----	291	392	341	440
Lime -----	39	2,923	28	2,231
Salt -----	29	624	27	639
Sand and gravel -----	NA	NA	NA	NA
Stone -----	14,362	41,640	13,595	47,515
Total -----	XX	115,796	XX	111,793
Total 1967 constant dollars -----	XX	54,748	XX	P 44,270

<sup>P</sup> Preliminary. NA Not available. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Puerto Rico, by district <sup>1</sup>  
(Thousands)

Senatorial district	1974	1975	Minerals produced in 1975 in order of value.
Aguadilla -----	\$271	\$624	Stone.
Arecibo -----	35	193	Do.
Guayama -----	--	127	Do.
Humacao -----	--	66	Do.
Mayaguez -----	2,701	3,798	Stone, salt.
Ponce -----	41,259	27,244	Cement, lime, stone, clays.
San Juan -----	38,360	43,873	Cement, stone, clays.
Undistributed <sup>2</sup> -----	33,167	35,868	
Total <sup>3</sup> -----	115,796	111,793	

<sup>1</sup> Sand and gravel production values are not available.

<sup>2</sup> Stone values which cannot be assigned to specific districts.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Exclusive prospecting permits in Puerto Rico, December 31, 1975

Permit holder	Date	Parent company	Minerals
Puerto Rico Petroleum Exploration Corp. <sup>1</sup>	July 14, 1968	-----	Gas and oil.
Oceanic Exploration Co. <sup>2</sup>	Sept. 24, 1971	Eastman Dillon Union Securities & Co., Inc.	Do.
P. R. Water Resources Authority	Jan. 21, 1975	-----	Do.
Jorge Luis Blanco	Dec. 11, 1975	-----	Gold and silver.
Ponce Mining Co. <sup>3</sup>	May 15, 1961	AMAX	Copper.
Cobre Caribe S.A. <sup>3</sup>	Aug. 5, 1963	Kennecott Copper Corp	Do.
Oceanic Exploration Co. <sup>3</sup>	Oct. 27, 1970	Eastman Dillon Union Securities & Co., Inc.	Do.

<sup>1</sup> Surrendered permit at expiration.

<sup>2</sup> Application for renewal under review.

<sup>3</sup> Applied for a mining lease.

vey issued five open-file reports.<sup>2</sup> Also issued were two annual basic-data reports<sup>3</sup> and one water resources investigations report.<sup>4</sup>

Surface-water, ground-water, and water-quality data-collection networks were continued. Hydrologic studies were continuing in the north coast limestone area. Studies being concluded are those in the Rio Piedras basin, the proposed Utuado copper-mining area, the Maunabo basin, the San Juan lagoons, Lago Loiza, and Laguna Tortuguero. A reconnaissance study of leachates from six solid-waste disposal sites and a flood-frequency study of Puerto Rico are being completed. Flood-inundation mapping of a number of areas in Puerto Rico is underway. A study of irrigation and groundwater recharge using sewage effluent was begun at Fort Allen, Puerto Rico.

#### REVIEW BY MINERAL COMMODITIES

**Nonmetals.—Cement.**—Puerto Rican Cement Co., Inc. and the San Juan Cement Co., Inc., produced portland cement from their plants in Ponce, San Juan, and Dorado. Total sales of portland cement were 1.6 million short tons valued at \$60.9 million, reflecting decreases of 16% in sales and 13% in value from the 1974 figure. The consumption pattern of portland cement in Puerto Rico was 42.8% to ready-mix companies; 31.4% to building materials dealers; 13.9% to concrete products manufacturers; 7% to highway contractors, and 5% for miscellaneous applications.

During 1975 overall construction and cement consumption declined, reflecting the island's economic recession. Moreover, abnormal weather conditions and a hurricane during September seriously disrupted construction activities. The private housing sector in particular was seriously depressed, adding to the decline in cement consumption. There was an 11-month strike at the Ponce plant, the major plant of the Puerto Rican Cement Co., Inc., which even so supplied 62% of the island's total consumption. Export sales of cement were reduced 50% as sales to the Caribbean declined on account of the recession, but in December the first shipment of 10,000 tons of bulk cement to Venezuelan consumers, who were experiencing a severe cement shortage, was announced.<sup>5</sup>

At yearend the price of bagged cement was \$2.69, a 20% increase over that of 1974. For bulk cement the price was \$2.39, a 21% increase over that of 1974. Even so, Puerto Rican Cement Co., Inc., had a loss of over \$3.5 million, which was more than three times the loss sustained in 1974. Net sales decreased 18%, while total costs and expenses were reduced 11%. Cost of sales represented 81% of net sales, compared with 83.7% in 1974.<sup>6</sup>

During 1975 Puerto Rican Cement operated its plants at Ponce and San Juan below full capacity and announced the gradual closing of its San Juan plant, with full shutdown in mid-1976.<sup>7</sup> In March 1975, Puerto Rican Cement signed a loan agreement for \$15 million for the purchase and installation of pollution control equipment for its plants. The company obtained a

<sup>2</sup> Attanasi, E. D., E. R. Close, and M. A. Lopez. Techniques for Water Demand Analysis and Forecasting: Puerto Rico, a Case Study. U.S. Geol. Survey Open-File Rept., 1975, 76 pp.

Colon-Dieppa, E., and L. J. Mansue. Water Resources of the Proposed Copper Mining Area, Puerto Rico, 1958-74. U.S. Geol. Survey Open-File Rept., 1976, 414 pp.

Quinones-Marquez, F. Chemical, Biochemical, and Bacteriological Determinations at Selected Stream Sites in Puerto Rico. U.S. Geol. Survey Open-File Rept., 1975, 113 pp.

Quinones-Marquez, F., M. A. Lopez, and V. J. Latkovich. Water Records of the Rio Piedras Basin, Puerto Rico, 1971-74. U.S. Geol. Survey Open-File Rept., 1976, 111 pp.

<sup>3</sup> U.S. Geological Survey. Water Resources Data for Puerto Rico, Part 2, Water-Quality Records for 1973, 1975.

Water Resources Data for Puerto Rico, Part 2, Water-Quality Records for 1974, 1976.

<sup>4</sup> Ellis, S. R., and F. Gomez-Gomez. Hydrologic Characteristics of Lagoons at San Juan, Puerto Rico During a January 1974 Tidal Cycle. U.S. Geol. Survey Water Res. Inv. Rept., 1976, 45 pp.

<sup>5</sup> Puerto Rican Cement Co., Inc. Annual Report 1975, P. 1.

<sup>6</sup> See work cited in footnote 5.

<sup>7</sup> See work cited in footnote 5.

**Table 4.—Puerto Rico: Portland cement salient statistics**  
(Short tons)

	1974	1975
Number of active plants	3	3
Production	1,971,448	1,581,846
Shipments from mills:		
Quantity	1,881,284	1,581,577
Value	\$70,276,653	\$60,968,224
Stocks at mills, Dec. 31	43,089	43,355



special escrowed price increase of 5.5 cents per bag, to be used solely for the purpose of repayment of principal and interest on this loan.

**Clays.**—Puerto Rican Cement and San Juan Cement produced 341,342 short tons of common clay, which was used in cement manufacture.

**Lime.**—Puerto Rican Cement Co., Inc., produced lime at Ponce for mason's lime, sugar refining, and other uses. Output was 27,558 tons, a decrease of 28% from that of 1974. The lime was consumed in Puerto Rico and the Virgin Islands.

**Sand and Gravel.**—Sand and gravel was produced in Puerto Rico for building construction purposes by both commercial operators and government-and-contractor operators. Sand was also exported to the Virgin Islands for construction purposes. Accurate statistical data for 1974 and 1975 are not available.

**Stone.**—Limestone, marble, traprock, and granite were produced in Puerto Rico in 1975. Total stone production declined 5% in quantity while the value increased 12% from that of 1974, reflecting reduced construction activity but a continual price rise.

In 1975, 25 companies operated 31 stone quarries with a total output of 13.6 million tons valued at \$47.5 million. Of the crushed and broken stone sold or used by producer, 21.8% was used in cement manufacture and asphalt filler.

**Salt.**—Sal-de Borinquen, Ponce Salt Industries, and Guanica produced salt from seawater by solar evaporation near Mayaguez. Production of salt was 27,000 tons in 1975.

**Sulfur.**—Elemental sulfur was recovered as a byproduct by Puerto Rico Sun Oil Co. and the Commonwealth Oil Refining Co., Inc. at its refineries. The value of byproduct sulfur is not included in table 1.

**Mineral Fuels.**—Commonwealth Oil Refining Co., Inc. (CORCO), the island's largest refinery and petrochemical processor with a rated capacity of 161,000 barrels per day, reported that its petrochemical facilities operated at 49% of capacity and its petroleum refinery at approximately 61% of capacity, with a total of 35.8 million barrels of crude and other feedstocks, which represented 40% less than the 1974 total processed.<sup>8</sup>

Besides the severe drop in demand for petrochemical and petroleum products, operations were also affected by floods resulting from a hurricane. In 1975 CORCO obtained approximately 60% of its crude from Venezuela; most of the remaining supplies came from North Africa and Mid-east sources. In mid-November the company signed new long-term contracts with Algeria for low-sulfur crude oil and condensate that is well suited for CORCO's processing needs.

The refinery runs approximately 98,000 bpd, and more than 70% of the 1975 production was sold in Puerto Rico, including motor gasoline, aviation fuels, and fuel oil for light and heavy industries. CORCO furnished a large volume of basic petrochemicals as feedstock for other petrochemical plants and other industries on the island. CORCO also made bulk sales to major chemical manufacturers in the United States and Europe, even though the demand was low through the first three quarters of 1975.

To meet new environmental regulations, expenditures over a 4-year period will have exceeded \$19 million. In 1975, two more desalination units were added, each with a daily capacity of 1,250,000 gallons.

Owing to an unprecedented drop in petrochemical demand, price weakness attributable to the recession, excess capacity in marine transportation, physical damage and loss of production attributable to a hurricane, etc., net sales were 25.2% less than in 1974 and CORCO experienced a net loss of \$24.2 million.

On June 6, 1975, Tesoro Petroleum Corp. acquired approximately 37% of CORCO's outstanding common stocks, and later Tesoro took working control of the board of directors.

Puerto Rico Sun Oil Co., with a rated capacity of 90,000 bpd, and Gulf Oil Co., with a rated capacity of 40,000 bpd, had a similar pattern to CORCO in their operation procedures and working possibilities.

**Petrochemicals.**—At the end of 1975 there were 60 establishments in the petroleum refining and petrochemical industry in Puerto

<sup>8</sup> Commonwealth Oil Refining Co., Inc. 1975 Annual Report. P. 2.

Rico. By Standard Industrial Classification they were—

SIC	Description	Operations
218	Industrial inorganic chemicals ---	13
282	Plastic materials and synthetic resins, synthetic rubber, synthetic and other manmade fibers, except glass -----	8
286	Industrial organic chemicals -----	23
291	Petroleum refining and related -----	10
295	Paving and roofing materials ---	6

Source: Economic Development Administration. The Petroleum Refining, Petrochemical and Allied Products in Puerto Rico. Industry Profile Series, December 1975.

The majority of the plants are located on the coastal plain adjacent to port sites in the south of the island. The total employment is nearly 8,000, 64% of whom are production workers.

The total value of petrochemical shipments from Puerto Rico in 1975 was \$873.4 million. The U.S. mainland was the largest market for the production, taking 92%. The value of shipments to the United States was 7% greater than in 1974 and was distributed as follows:

Product	1974	1975	Percent change
Gasoline including natural gasoline and gasoline blending agents -----	\$251.50	\$228.07	-9.3
Distillate fuel oils -----	163.40	187.65	+14.9
Ethyl alcohol and alcohol, n.e.c. -----	.02	134.66	--
Organic chemicals, n.e.c. -----	210.60	157.31	-25.3
Mineral tar and crude chemicals of petroleum -----	97.10	74.72	-23.1
Naphtha, mineral spirits, solvents, and other finished light petroleum products, n.e.c. -----	--	12.10	--
Inorganic chemical elements, oxides, and halogen salts -----	--	2.63	--
Kerosine -----	27.68	2.26	--
Inorganic chemicals, n.e.c. -----	--	.41	--
Residual fuel oil -----	--	.07	--
Total -----	750.30	799.88	+6.6

Source: Puerto Rico Planning Board. External Trade Statistics.

Despite the growth of the petroleum refining, petrochemicals, and allied products industries, imports into Puerto Rico were also large (39% over those of 1974). From the total amount imported, 92% came from foreign countries, and the Virgin Islands supplied \$1.3 billion worth. Imports principally comprised petroleum, natural gas, and products derived therefrom; only 2.6% was organic chemicals, crude and finished acids, etc. The importation of crude and unfinished oil into Puerto Rico decreased 6% in 1974 with respect to 1973 and 10% in 1975 with respect to 1974. Importation of finished products into Puerto Rico declined 46% with respect to 1974.

The OPEC countries raised prices approximately 10% in 1975. Naphtha prices also increased greatly during the year. The U.S. Government continued in 1975 to control the price of the "old" crude oil at a ceiling price of \$2.25 per barrel. Remaining U.S. crude averaged \$12.39 per barrel, and the price of foreign crude for Puerto Rico's petrochemicals averaged \$13.70 per barrel.

During 1975, total rated capacity of Puerto Rican refineries was 106.215 million barrels. Importation of crude oil was 72.75 million barrels, 3.1% less than in 1974. The local refineries operated at 68.5% of rated capacity.

Table 5.—Refining and petrochemical industry in Puerto Rico<sup>1</sup>

Basic producers	Principal intermediate producers	Producers of semifinished products
<p><i>Petroleum refiners</i></p> <p>Commonwealth Oil Refining Co., Inc. Yabucoa Sun Oil Co. (Sun Oil Co.) Caribbean Gulf Refining Corp. (Gulf Oil Corp.)</p> <p><i>Basic petrochemical producers</i></p> <p>Commonwealth Petrochemicals, Inc. (CORCO) Puerto Rico Olefins Co. (CORCO-PPG Industries, Inc.) Phillips Core, Inc. Union Carbide Caribe, Inc. Peerless Petrochemicals (P.R.) Inc. (Peerless Oil &amp; Chemical Corp.) Hercor Chemical Corp. (CORCO-Hercules, Inc.)</p> <p><i>Basic chlor-alkali producers</i></p> <p>PPG Industries, Inc. (PPG)</p>	<p><i>Petrochemical processors</i></p> <p>Union Carbide Caribe, Inc. Phillips Core, Inc. Oxochem Enterprise' (CORCO-W. R. Grace &amp; Co.) PPG Industries CORCO Cyclohexane Puerto Rico Chemical Co. (Hooker Chemical Corp.) Styrochem Corp. (CORCO)</p> <p><i>Chlor-alkali processor</i></p> <p>PPG Industries, Inc.</p>	<p>Air Products and Chemicals of Puerto Rico. Reichhold Chemical del Caribe, Inc. International Corry Foam. Union Carbide Caribe, Inc. Caribe Isoprene (1976). Rico Chemical (1976). Chevron Chemical.</p>

<sup>1</sup>Based on report of Economic Development Administration, Commonwealth of Puerto Rico, 1975.

## VIRGIN ISLANDS

The U.S. Virgin Islands, located in the Caribbean, consist of about 50 islands of volcanic origin. St. Croix, St. Thomas, and St. John are the main islands. Most of the population and commercial activity of the Virgin Islands is centered on these three large islands.

Mineral production consists chiefly of basalt, a traprock, which is crushed for use in concrete, asphalt aggregate, or road-stone. Masonry Products V. I. Corp. and St. Croix Stone and Sand Inc., on St. Croix, and Controlled Concrete Inc., St. Thomas, accounted for the total production. Output in 1975 decreased 67% and value decreased 61% from that of 1974,

reflecting a dramatic slowdown in construction on the island coupled with severe wet weather which hampered stone production.

The Hess Oil Virgin Islands Corp. continued operation of its refinery and recovered elemental sulfur in the process.

Table 6.—Production of traprock in the Virgin Islands<sup>1</sup>

	Quantity (short tons)	Value
1974 -----	637,677	\$3,869,282
1975 -----	212,640	1,490,000

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

## PACIFIC ISLAND POSSESSIONS

**American Samoa.**—The Territory of American Samoa consists of seven islands in the South Pacific. The main island is Tutuila, where the village of Pago Pago and the seat of government at Fagatogo are located. Tutuila contains over 80% of the territory's population. Most of the Samoan mineral production is on Tutuila, mainly volcanic cinder and traprock. Output of

cinder in 1975 was 15,000 short tons valued at \$15,000 and output of limestone was 34,375 short tons valued at \$147,000.

The cinder and limestone were crushed and used as aggregate. The pit-run cinder and rock were used in compacted fills, sea-walls, roads, and road improvements.

**Guam.**—Coral limestone was quarried and crushed in several municipalities

throughout the territory for aggregate use. The Guam Public Works Department operated three pits, and Hawaiian Rock Products Co., Pacific Rock Corp., and Perez Bros. Inc. also operated single quarries.

Output increased from 797,776 short tons in 1974 to 780,904 short tons in 1975, and value increased from \$1,444,230 in 1974 to \$1,837,000 in 1975.

Table 7.—Mineral production in the Pacific Island Possessions<sup>1</sup>

Mineral	1974		1975	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
American Samoa:				
Volcanic cinder -----	27,000	\$183,000	15,000	\$15,000
Limestone -----	50,000	122,200	34,375	147,000
Total -----	XX	305,200	XX	162,000
Guam: Limestone -----	797,776	1,444,230	780,904	1,837,000

XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).



# The Mineral Industry of Rhode Island

By William R. Barton <sup>1</sup>

The value of Rhode Island mineral products increased 4% in 1975, primarily as a result of inflationary pressures in the economy. The change in value of mineral production from \$5,984,000 in 1974 to \$6,198,000 in 1975 reflected general stagnation in construction activity because Rhode Island mineral production was almost exclusively gravel, stone, and sand. Almost insignificant amounts of gem stones were collected by hobbyists.

Ilmenite, anthracite, and onshore servicing of offshore petroleum activities offered some promise for broadening Rhode Island's mineral industry base. However, coastal zone management planners were drafting what appear to be very restrictive regulations to govern any mineral-related activities that might affect the coastal zone.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Newmarket, N.H.

Table 1.—Value of mineral production in Rhode Island, by county <sup>1</sup>  
(Thousands)

	1974	1975	Minerals produced in 1975 in order of value
Kent .....	\$2,109	\$2,523	Sand and gravel.
Newport .....	W	W	Stone, sand and gravel.
Providence .....	W	W	Do.
Washington .....	W	1,193	Sand and gravel.
Undistributed <sup>2</sup> .....	3,873	2,482	
Total .....	5,982	6,198	
Total 1967 constant dollars .....	2,829	<sup>p</sup> 2,454	

<sup>p</sup> Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

<sup>1</sup> Bristol County is not shown because no production was reported.

<sup>2</sup> Includes gem stones and values indicated by symbol W.

Table 2.—Indicators of Rhode Island business activity

	1974	1975 P	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands ..	427.7	426.1	-0.4
Unemployment ----- do ..	31.3	59.4	+89.8
<b>Employment (nonagricultural):</b>			
Mining ----- do ..	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )
Manufacturing ----- do ..	125.0	109.1	-12.7
Contract construction ----- do ..	13.3	10.4	-21.8
Transportation and public utilities ----- do ..	14.7	13.3	-9.5
Wholesale and retail trade ----- do ..	74.7	71.4	-4.4
Finance, insurance, and real estate ----- do ..	18.0	17.7	-1.7
Services ----- do ..	<sup>2</sup> 66.3	<sup>2</sup> 65.2	<sup>2</sup> -1.7
Government ----- do ..	54.7	55.9	+2.2
Total nonagricultural employment ----- do ..	366.7	343.0	-6.5
<b>Personal income:</b>			
Total ----- millions ..	\$5,024	\$5,413	+7.7
Per capita ----- do ..	\$5,355	\$5,841	+9.1
<b>Construction activity:</b>			
Number of private and public residential units authorized ----- do ..	3,207	3,360	+4.8
Value of nonresidential construction ----- millions ..	\$45.4	\$42.6	-6.2
Value of State road contract awards ----- do ..	\$15.6	\$15.0	-3.8
Shipments of portland and masonry cement to and within Rhode Island ----- thousand short tons ..	180	145	-19.4
<b>Mineral production value:</b>			
Total crude mineral value ----- millions ..	\$6.0	\$6.2	+1.7
Value per capita, resident population ----- do ..	\$6.38	\$6.53	+2.4
Value per square mile ----- do ..	\$4,929.16	\$5,009.06	+1.6

P Preliminary.

<sup>1</sup> Included with services.<sup>2</sup> Includes mining.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway Heavy Construction Magazine, and U.S. Bureau of Mines.

Table 3.—Worktime and injury experience in the Rhode Island mineral industry in 1975<sup>1 2</sup>

	Men	Man-hours	Fatal injuries	Fatal frequency rate	Non-fatal disabling injuries	Non-fatal disabling frequency rate	Nondisabling injuries	Nondisabling frequency rate
<b>Sand and gravel:</b>								
Surface -----	211	258,863	--	--	10	38.63	1	3.86
Office -----	56	58,788	--	--	--	--	--	--
Total -----	267	317,651	--	--	10	31.48	1	3.15
<b>Limestone:</b>								
Surface -----	3	5,622	--	--	1	177.87	--	--
Mill -----	17	27,160	--	--	--	--	--	--
Office -----	5	10,440	--	--	--	--	--	--
Total -----	25	43,222	--	--	1	23.14	--	--
<b>Granite: Surface</b>								
Surface -----	4	2,000	--	--	--	--	--	--
<b>Miscellaneous stone:</b>								
Surface -----	20	33,844	--	--	1	29.55	--	--
Office -----	3	5,971	--	--	--	--	--	--
Total -----	23	39,815	--	--	1	25.12	--	--
<b>State totals:</b>								
Surface -----	238	300,329	--	--	12	39.96	1	3.33
Mill -----	17	27,160	--	--	--	--	--	--
Office -----	64	75,199	--	--	--	--	--	--
Total -----	319	402,688	--	--	12	29.80	1	2.48

<sup>1</sup> All data are preliminary.<sup>2</sup> Data supplied by Mining Enforcement and Safety Administration.

## REVIEW BY MINERAL COMMODITIES

## NONMETALS

**Cement.**—Shipments of portland cement and masonry cement into Rhode Island from domestic producers was 140,000 tons and 5,000 tons, respectively, compared with 175,000 tons and 5,000 tons in 1974. There are no cement-producing plants in Rhode Island.

**Gem Stones.**—The value of gem stones and mineral specimens collected was estimated at a few thousand dollars in 1975.

**Lime.**—Shipments of lime into Rhode Island amounted to 7,832 tons in 1975 compared with 12,560 tons in 1974.

**Sand and Gravel.**—Production of sand and gravel increased 5% in tonnage and decreased 8% in value. Average value per ton decreased from \$1.61 in 1974 to \$1.42 in 1975. Leading producers were Rhode Island Sand & Gravel Co., Inc., A. Cardi Construction Co., Inc., and Forte Brothers, Inc. These producers accounted for almost 70% of the total output.

**Table 4.—Rhode Island: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	1,115	2,175	1,138	1,905
Gravel -----	1,072	1,890	944	1,689
Unprocessed: Sand and gravel -----	597	417	828	538
Industrial:				
Sand -----	W	W	W	W
Gravel -----	--	--	--	--
Total -----	2,784	4,482	2,910	4,132

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

**Table 5.—Rhode Island: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	345	515	356	700
Highway and bridge construction -----	37	97	176	324
Other construction (dams, waterworks, airports, etc.) -----	19	45	W	W
Concrete products (cement blocks, brick, pipe, etc.) -----	422	627	208	404
Bituminous paving (asphalt and tar paving) -----	497	1,075	240	542
Roadbase and subbase -----	131	288	71	115
Fill -----	107	187	112	141
Other -----	79	479	94	460
Unprocessed:				
Roadbase and subbase -----	518	370	156	62
Fill -----	79	47	218	211
Other -----	--	--	--	--
Industrial sand and gravel -----	W	W	W	W
Total <sup>1</sup> -----	2,234	3,730	1,632	2,959

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.



**Table 6.—Rhode Island: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction	---	---	222	492
Highway and bridge construction	W	W	293	642
Other construction (dams, waterworks, airports, etc.)	---	---	1	2
Concrete products (cement blocks, brick, pipe, etc.)	---	---	---	---
Bituminous paving (asphalt and tar paving)	445	711	415	737
Roadbase and subbase	105	164	W	W
Fill	W	W	---	---
Other	W	W	---	---
<b>Unprocessed:</b>				
Roadbase and subbase	---	---	348	238
Fill	---	---	W	W
Other	---	---	---	---
<b>Total</b> <sup>1</sup>	<b>550</b>	<b>875</b>	<b>1,278</b>	<b>2,112</b>

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Stone.**—Four companies produced stone in 1975. The Conklin Limestone Co., Inc., quarried and crushed limestone at Ashton. The limestone was sold for rubble, agricultural, terrazzo, roofing, filler, and flux purposes. M. A. Gammino Construction Co. produced granite at Cranston for use at bituminous and concrete aggregate, roadbase stone, riprap, railroad ballast, and filter stone. Peckham Brothers Co., Inc., crushed miscellaneous stone near Middletown for macadam aggregate and roadbase use. P.C.A. Construction Co. in Tiverton produced granite riprap.

The Rock of Ages Corp. black granite quarry at Foster, which produced a small amount of dimension stone in 1974, closed down in 1975. Poor quality of stone was the reputed reason.

**Sulfur.**—The Rumford Chemical Works of Essex Chemical Corp. ceased sulfuric acid production in 1975. The East Providence plant shut down due to completion of an Environmental Protection Agency-funded project to recover sulfuric acid and recyclable magnesium oxide from flue gas desulfurization system products generated at utility powerplants.

#### MINERAL FUELS

**Anthracite.**—Three Bureau of Mines analyses of coal specimens from old mine

dumps at Portsmouth stimulated interest in the old Rhode Island anthracite fields. The samples contained 12,000, 12,860, and 13,250 Btu on a moisture-free basis. Volatiles ranged from 7.2% to 4.4%, ash was 13.6% to 4.7%, and sulfur was 0.1% to 0.4%. The specimens analysed did not constitute representative samples, but rather the only material available for analysis at the time. Governor Noel joined those urging investigations to determine if the Narragansett Basin contains any coal deposits with commercial potential.

**Petroleum.**—Statistics on consumption of petroleum products are published annually by the New England Fuel Institute in the March issue of "Yankee Oilman."

The Rhode Island Department of Economic Development was making a major effort to attract support and construction activities ancillary to Outer Continental Shelf development to abandoned Navy bases on Narragansett Bay. In 1975, a Shell Oil Co. research vessel, the "Phaedra," based itself in Newport, R. I. while conducting geophysical exploration over Georges Bank. Before yearend, IMCO Services Division of Halliburton Co. and Ocean Drilling and Exploration Co. were establishing bases at Davisville. A Continental Offshore Stratigraphic Test (COST) drill hole was planned on Georges Bank, about 75 miles away.

New England's last true oil refinery, Mobil Oil Corp., at East Providence was closed down. The 7,500-barrel-per-day refinery produced mostly asphalt. A 4,800-acre site in North Slocum was being considered as a possible site for a refinery by Olympic Refineries, Inc. Prudence Island was suggested as an ideal site for a deep-water oil terminal because there is a 70- to 100-foot-deep channel close inshore.

In July, the high-level Mount Hope suspension bridge was hit and almost knocked down by a British oil tanker while enroute to the Northeast Petroleum Co. terminal in Tiverton.

The Federal Power Commission conducted hearings in Providence on a proposed additional 600,000-barrel LNG tank at the Algonquin LNG Inc. tank farm. Concern was expressed about the potential fire hazard in the area due to other nearby tank farms.

#### METALS

**Titanium.**—Approximately 600 pounds of ilmenite-magnetite ore from Cumberland was shipped to the Bureau of Mines, Albany, Oreg., for testing in new extraction processes. The Cumberland deposit is one of the largest undeveloped ilmenite deposits in the East.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Sand and gravel:</b>			
A. Cardi Construction Co., Inc	451 Arnold Rd. Coventry, R.I. 02816	Pit	Kent.
Exeter Sand & Gravel Co	38 Celia St. Johnston, R.I. 02919	Pit	Washington.
Forte Brothers, Inc	14 Whipple St. Berkeley, R.I. 02900	Pit	Providence.
Material Services, Inc	Greenville Rd. North Smithfield, R.I. 02895	Pit	Do.
Rhode Island Sand & Gravel Co., Inc	Kilverk St. Warwick, R.I. 02886	Pit	Kent.
South County Sand & Gravel Co., Inc	North Rd. Peace Dale, R.I. 02878	Pit	Washington.
Westerly Trucking Co	35 High St. Westerly, R.I. 02891	Pit	Do.
<b>Stone:</b>			
<b>Limestone, crushed:</b>			
The Conklin Limestone Co., Inc	R.F.D. 1 Lincoln, R.I. 02860	Quarry	Providence.
<b>Other stone, crushed &amp; broken:</b>			
M.A. Gammino Construction Co	875 Phenix Ave. Cranston, R.I. 02920	do	Do.
P.C.A. Construction Co	67 Riverside Dr. Tiverton, R.I. 02878	do	Newport.
Peckham Brothers Co., Inc	P.O. Box 193 Newport, R.I. 02840	do	Do.



# 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 Hewson Lawrence <sup>1</sup>

The value of mineral production in South Carolina in 1975 continued the steady increase begun in 1963, reaching a record high of \$115.5 million. Compared with 1974, stone production increased in both value and quantity; sand and gravel, cement, vermiculite, and flake mica (sericite) showed production decreases while increasing in value; peat production remained essentially the same, with an increase in value; and clays decreased in both quantity and value. Cement production

continued to lead in dollar value as the principal mineral commodity in the State. Stone production continued to rank second in value to cement production.

The production of kaolin and vermiculite in South Carolina ranked 2d nationally in quantity; that of flake mica (sericite) ranked 5th in quantity; and that of peat ranked 11th in quantity.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Columbia, S.C.

Table 1.—Mineral production in South Carolina <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays <sup>2</sup> -----thousand short tons--	2,297	\$13,765	1,698	\$12,828
Gem stones -----	NA	5	NA	5
Mica (scrap) -----thousand short tons--	W	252	7	318
Peat -----do-----	18	W	18	W
Sand and gravel -----do-----	7,380	13,054	7,363	14,128
Stone -----do-----	* 12,242	* 21,719	13,836	30,082
Value of items that cannot be disclosed:				
Cement, clays (fuller's earth), stone (crushed and broken) (1974), vermiculite, and values indicated by symbol W -----	XX	56,376	XX	58,106
Total -----	XX	105,171	XX	115,467
Total 1967 constant dollars -----	XX	49,125	XX	P 45,725

<sup>P</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes fuller's earth; included with "Value of items that cannot be disclosed."

<sup>3</sup> Excludes crushed and broken stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in South Carolina, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Aiken	\$9,689	\$9,579	Clays, sand and gravel.
Anderson	2	754	Sand and gravel, stone.
Bamberg	--	W	Sand and gravel.
Berkeley	W	W	Stone.
Charleston	--	6	Sand and gravel.
Cherokee	1,243	W	Stone, clays, sand and gravel.
Chester	--	W	Sand and gravel.
Chesterfield	W	W	Sand and gravel, stone.
Colleton	W	W	Peat, sand and gravel.
Darlington	--	15	Sand and gravel.
Dillon	--	W	Do.
Dorchester	26,802	30,905	Cement, stone, sand and gravel, clays.
Edgefield	W	69	Stone, clays.
Fairfield	2,479	W	Stone.
Florence	W	W	Sand and gravel.
Georgetown	--	W	Stone, sand and gravel.
Greenville	W	W	Do.
Greenwood	W	W	Do.
Horry	W	W	Stone, clays, sand and gravel.
Jasper	W	W	Sand and gravel.
Kershaw	W	W	Sand and gravel, clays, stone.
Lancaster	390	W	Clays, mica, sand and gravel.
Laurens	W	W	Vermiculite, stone.
Lee	--	W	Sand and gravel.
Lexington	W	W	Sand and gravel, stone, clays.
Marion	W	W	Clays, sand and gravel.
Marlboro	3,951	W	Sand and gravel, clays.
Newberry	W	W	Clays.
Oconee	541	334	Stone, sand and gravel.
Orangeburg	W	25,008	Cement, stone, clays, sand and gravel.
Pickens	2,551	2,527	Stone, sand and gravel.
Richland	5,391	W	Stone, clays, sand and gravel.
Saluda	86	W	Clays.
Spartanburg	W	W	Stone, sand and gravel.
Sumter	W	W	Sand and gravel, clays.
Williamsburg	--	W	Sand and gravel.
York	W	W	Stone, sand and gravel, clays.
Undistributed <sup>2</sup>	52,045	46,273	
Total <sup>3</sup>	105,171	115,467	

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

<sup>1</sup> The following counties are not listed because no production was reported: Abbeville, Allendale, Barnwell, Beaufort, Calhoun, Clarendon, Hampton, McCormick, and Union.

<sup>2</sup> Includes gem stones and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of South Carolina business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands--	1,144.0	1,181.0	+3.2
Unemployment ----- do-----	68.0	103.0	+51.5
<b>Employment (nonagricultural):</b>			
Mining ----- do-----	2.0	1.9	-5.0
Manufacturing ----- do-----	376.1	336.4	-10.6
Contract construction ----- do-----	75.5	61.4	-18.7
Transportation and public utilities ----- do-----	42.6	40.3	-5.4
Wholesale and retail trade ----- do-----	176.7	175.5	-.7
Finance, insurance, and real estate ----- do-----	39.3	39.4	+.3
Services ----- do-----	121.5	122.8	+1.1
Government ----- do-----	182.2	200.1	+9.8
Total nonagricultural employment ----- do-----	1,015.8	977.8	-3.7
<b>Personal income:</b>			
Total ----- millions--	\$12,181	\$13,014	+6.8
Per capita ----- do-----	\$4,390	\$4,618	+5.2
<b>Construction activity:</b>			
Number of private and public residential units authorized	15,882	15,358	-3.3
Value of nonresidential construction ----- millions--	\$111.6	\$84.1	-24.6
Value of State road contract awards ----- do-----	\$110.5	\$89.0	-19.5
Shipments of portland and masonry cement to and within South Carolina ----- thousand short tons--	1,197	909	-24.1
<b>Mineral production value:</b>			
Total crude mineral value ----- millions--	\$105.2	\$115.5	+9.8
Value per capita, resident population ----- do-----	\$37.90	\$41.00	+8.2
Value per square mile ----- do-----	\$3,386.60	\$3,718.15	+9.8

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

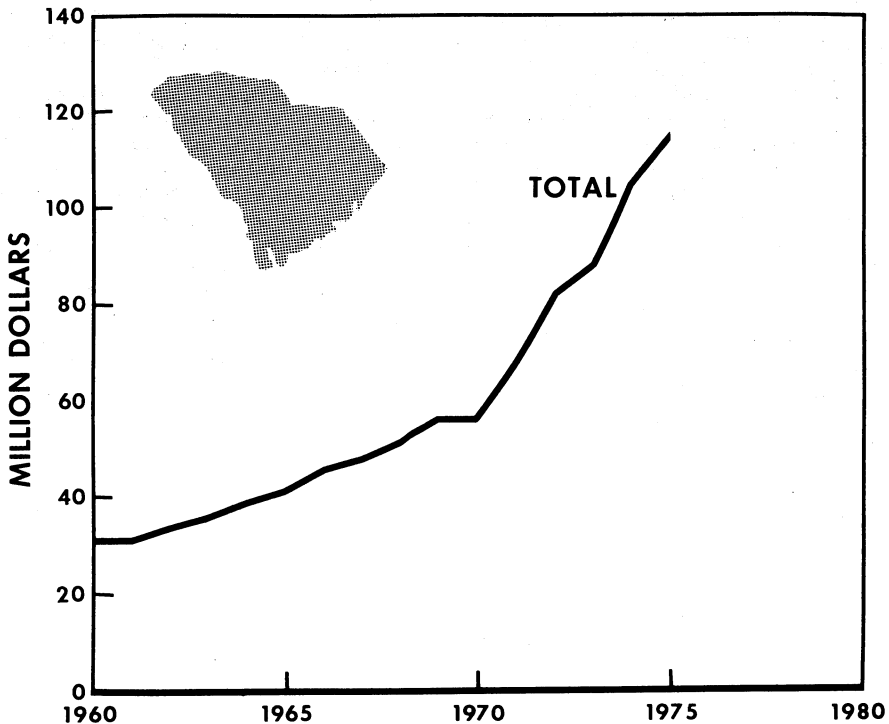


Figure 1.—Total value of mineral production in South Carolina.

The continued enforcement of the South Carolina Mining Act begun in July 1974, resulted in additional mining companies not formerly identified being canvassed for mineral production in 1975. This additional industry coverage accounted for a portion of the increased value of mineral production reported for 1975.

In 1975, mineral commodities were produced by 128 separate companies (an increase of 19 reporting over that of 1974), operating 253 mines located in 37 of the 46 counties of the State. Sand (including gravel and sand-clay mixture) was the leading commodity ranked by the number of operating mines (131), followed by miscellaneous clay (48), crushed stone (34), processed kaolin (14), and vermiculite (13).

Aiken County led in the number of operating mines (25), followed by Kershaw (16), Charleston (15), and Cherokee and Lexington (14 each). No mineral production was reported in Abbeville, Allendale, Barnwell, Beaufort, Calhoun, Clarendon, Hampton, McCormick, and Union Counties. Counties reporting production for 1975 where no production was reported in 1974 were: Bamberg, Charleston, Chester, Darlington, Dillon, Georgetown, Lee, and Williamsburg.

Three South Carolina mining firms transferred ownership: Merry Land and Investment Co., a subsidiary of Merry Companies, Inc., Augusta, Ga., purchased Dorchester Brick Works, Ltd., with operations in Berkeley and Dorchester Counties; Metromont Sand Corp., a division of Metromont Materials, Inc., Spartanburg bought Hidden Valley Sand Co., which operated in Cherokee County; Vulcan Materials Co. purchased the Blythe Brothers Co. quarry in York County.<sup>2</sup>

**Trends and Developments.**—Prospecting within the State was highlighted by a search for uranium in the Piedmont and Blue Ridge areas as well as in certain coastal plains locations. Gold, which was mined until World War II (State Geological Survey Bulletin 32 of 1966 listed 135 abandoned gold mines), is receiving renewed attention with the recent advance in world gold prices. The very large kaolin deposits that exist within the State offer future potential as a source of alumina. The alumina content of the kaolin is high, and if the current cost of bauxite imported

from foreign sources continues to rise, it may make it economically attractive to mine the kaolin for this purpose.

Heavy mineral deposits containing titanium, zirconium, thorium, and rare earths are receiving renewed interest because of recent advances in mining and mineral processing technology, government regulations curtailing permissible uses of white lead pigments, and the greatly increased use of rare earths in color television sets and miniaturized electronic equipment such as hand-held calculators. Significant heavy mineral deposits are located in the flood plains of various parts of the State, coastal wetlands, and the Sea Islands.

**Legislation and Government Programs.**—Under the South Carolina Mining Act of 1974, which requires each organization prior to mining to file for a permit and to include a reclamation plan, a total of 276 mining permit applications were received and 248 permits were issued for 1975. During the same period, a total of 272 reclamation plans were received and 266 plans were approved.<sup>3</sup> The mining act is under the administration of the Mining and Reclamation Department of the South Carolina Land Resources Conservation Commission.

With reclamation and environmental protection (including water quality) a fact of law and with increased demands on available land, many mining companies are now integrating reclamation objectives into their mine development plans. The mining process is now seen as a process which develops the land for subsequent uses. Reclamation progress was highlighted by planting approximately 430 acres with either temporary or permanent vegetation. Substantial amounts of access roads, benches, earth embankments, fencing, surface grading, and terracing were completed.<sup>4</sup>

The Division of Geology of the South Carolina State Development Board continued its ongoing collection and evaluation of basic geologic data during 1975.<sup>5</sup>

<sup>2</sup> Data courtesy of Dept. of Mining and Reclamation, S.C. Land Resources Conservation Commission.

<sup>3</sup> South Carolina Mining and Reclamation Department. Monthly Report, December 1975.

<sup>4</sup> Work cited in footnote 3.

<sup>5</sup> Olson, N. K. Geologic Activities in South Carolina During 1975. Geologic Notes. Division of Geology, South Carolina State Development Board, v. 20, No. 1, Spring 1976, pp. 1-14.

More than 25 geologic and geophysical field investigations were continued or initiated by division geologists, project geologists (mostly university faculty) and consultants. Some of the more important studies were:

- (1) Geologic map of South Carolina.
- (2) Geologic mapping in Aiken, Allendale, Cherokee, Chesterfield, Fairfield, Lancaster, Laurens, Lexington, McCormick, and Richland Counties.
- (3) South Carolina major structures—determination of fault and fracture zones.

Geologic field and office assistance was provided to 33 different industrial prospects requesting data on 16 specific minerals. Gold and crushed stone led the number of requests, followed by sand and gravel,

base metals (copper, lead, and zinc), sericite (flake mica), vermiculite, uranium, phosphate, dimension stone, heavy minerals, kaolin, kyanite, feldspar, diatomite, nickel, and common clay.

Other mineral resources investigations, conducted independent of requests from industries, included barite (and associated sulfur-bearing minerals), sericite, phosphate, gravel, kaolin, diatomaceous earth, peat, nickel, heavy minerals, and several investigations of mineral resources in general over a given area.

Projects completed during 1975 and in preparation for publication were: Granitic stone resources of South Carolina; mineral resources and mineral industries map of South Carolina; simple Bouguer gravity map of South Carolina; and the geology of the Irmo quadrangle, Richland and Lexington Counties.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Portland and masonry cements were produced by Giant Portland Cement Co. and Gifford-Hill & Co., Inc. in Dorchester County, and Santee Portland Cement Co. in Orangeburg County. Santee completed its 5-year expansion program at Holy Hill.

Cement production continued to rank first in value of mineral production. The producing companies, in addition to producing cement, mined marl, limestone, and miscellaneous clays as raw materials. More than 92% of the portland cement shipped was Types I and II and was used principally for ready-mix concrete products and by concrete products manufacturers. Smaller amounts were sold for use in highway construction by building material dealers and other contractors. More than 95% of the shipments were in bulk.

**Clays.**—Clay production in South Carolina consisted of processed kaolin, miscellaneous clays used for the manufacture of brick and cement, and fuller's earth used as an absorbent. Total clay production (excluding fuller's earth) ranked fourth in value of mineral commodities produced in South Carolina, and amounted to 1.7 million tons valued at \$12.8 million.

Processed kaolin was produced only in Aiken County by 5 separate firms operating

a total of 14 mines. South Carolina continued to rank second to Georgia in the production of kaolin. Air-floated kaolin was used principally in rubber products, paints, high-quality paper and fertilizers, pesticides, brick, fungicides, and adhesives. Water-washed kaolin was produced by one company for paper coating.

Included under miscellaneous clays are numerous clay materials such as manganese clay, sericite, and shale. Miscellaneous clay was used almost entirely in the manufacture of brick. Some of the unprocessed kaolin was used in refractories and sanitary ware, as a colorant in brick, and some was used in the manufacture of cement. Miscellaneous clay was produced from 48 mines in 17 counties.

According to data published by the U.S. Bureau of the Census in its monthly Current Industrial Report, Clay Construction Products, South Carolina usually ranked fifth or sixth in the production of brick (building or common and face). North Carolina, South Carolina, and Virginia comprised a regional marketing area which continued to account for approximately 25% of the production and shipments of brick in 1974 and 1975 in the United States.

Fuller's earth was produced at one mine in Sumter County and was sold chiefly for use as an absorbent in products such as cat litter and floor sweeping compounds.



Table 4.—South Carolina: Kaolin sold or used by producers, by kind and use  
(Thousand short tons)

Kind and use	1974	1975
<b>Airfloat:</b>		
Adhesives	19	25
Fertilizers	22	38
Fiberglass	7	30
Firebrick, block, and shapes	W	3
Paint	3	3
Paper filling	W	3
Pesticides and related products	22	24
Plastics	W	2
Rubber	242	186
Other uses <sup>1</sup>	66	23
Exports <sup>2</sup>	54	35
Total	435	372
<b>Unprocessed:</b>		
Face brick; firebrick, block, and shapes; grogs and crudes, refractory (1975); and sanitary ware (1974)	335	174
Grand total	770	<sup>3</sup> 547

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

<sup>1</sup> Includes animal feed (1974); crockery and other earthenware; glazes, glass, and enamels; grogs and crudes, refractory (1975); gypsum products; ink; linoleum (1974); paper coating (1974); pottery; sanitary ware; and data indicated by symbol W.

<sup>2</sup> Includes pesticides and related products, plastics (1975), and rubber.

<sup>3</sup> Data do not add to total shown because of independent rounding.

**Feldspar.**—Spartan Minerals Co. (a division of Lithium Corp. of America) produced a feldspar-silica mixture from tailings shipped to Pacolet, S.C., from the Lithium Corp. spodumene operation in North Carolina. The feldspar-silica mixture was sold for use in glass containers, ceramic whiteware, and as a latex filler. No feldspar is currently being mined in South Carolina.

**Mica, Scrap (Sericite).**—The Mineral Mining Corp. in Lancaster County mined and processed sericite by dry-milling sericite-rich ores and producing a micaceous product which was sold mainly for use in paint, expansion joint cement, and electronics. Although Mineral Mining Corp. is the only processor of the sericite-rich ores, numerous other deposits are mined for use in the manufacture of brick and are reported under miscellaneous clays. Production of sericite decreased in quantity but increased in value from that of 1974.

**Sand and Gravel.**—Producers of sand and gravel in South Carolina included those companies that produced both commodities, those that produced only gravel, and those that produced only sand. The latter group also included producers of fill material, a product that contains sand and/or clay-sand mixture. Whether or not gravel is produced depends upon the loca-

tion of the mining operation in the State, since most sand deposits do not contain any gravel-size components.

Total production of sand and gravel amounted to 7.4 million tons valued at \$14.1 million and ranked third in value of mineral commodities produced in South Carolina. Most of this production was from "sand only" operations and was sold for use as industrial sand in construction.

Pennsylvania Glass Sand Corp. in Lexington County mined and processed a high-quality silica sand for use in the glass, fiberglass, ceramic, and chemical industries in the Southeast. Plant expansion is continuing and completion is expected by the end of 1976. Wedron Silica Div., Del Monte Properties Co. in Kershaw County processed silica sand for glassmaking. One new plant was opened by Metromont Materials Corp. on the Saluda River near Piedmont, Greenville County.

Charleston County had the most operating mines (15), followed by Aiken (11), Lexington (9), and Horry (8). However, according to total quantity of production, Lexington was the leading county followed by Marlboro, Sumter, and Lancaster.

**Stone.**—The value of stone production continued to rank second behind cement and accounted for 26% of the total value of mineral production in the State. Stone

**Table 5.—South Carolina: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	3,719	3,840	2,941	3,742
Gravel -----	1,880	4,752	1,603	4,483
Unprocessed:				
Sand and gravel -----	1,008	575	2,211	1,198
Industrial:				
Sand -----	773	3,884	609	4,036
Gravel -----	--	--	W	W
Total <sup>2</sup> -----	7,380	13,051	7,363	13,460

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand and gravel.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

**Table 6.—South Carolina: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -	4,617	7,535	1,578	3,012
Highway and bridge construction -----	143	150	W	W
Other construction (dams, waterworks, airports, etc.) -----	40	40	W	W
Concrete products (cement blocks, brick, pipe, etc.) -----	466	587	1,272	2,246
Bituminous paving (asphalt and tar paving) ---	198	171	119	133
Road base and subbase -----	W	W	W	W
Fill -----	64	58	63	55
Other -----	W	W	W	W
Unprocessed:				
Road base and subbase -----	536	391	119	82
Fill -----	453	172	216	122
Other -----	--	--	1,325	838
Industrial sand and gravel -----	773	3,884	609	4,036
Total -----	7,290	12,988	5,301	10,524

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

**Table 7.—South Carolina: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction	90	41	183	62
Highway and bridge construction	--	--	697	1,518
Other construction (dams, waterworks, airports, etc.)	--	--	W	W
Concrete products (cement blocks, brick, pipe, etc.)	--	--	--	--
Bituminous paving (asphalt and tar paving)	W	26	767	1,815
Road base and subbase	W	W	18	33
Fill	--	--	--	--
Other	--	--	19	48
<b>Unprocessed:</b>				
Road base and subbase	W	W	W	W
Fill	W	W	W	W
Other	--	--	379	129
<b>Total</b>	<b>90</b>	<b>67</b>	<b>2,063</b>	<b>3,605</b>

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

production decreased in quantity but increased in value, chiefly as a result of a slowdown in the construction industry and an increase in production costs. Crushed stone was produced at 34 mines in 19 counties. Most of the stone produced was granite. Several companies produced limestone, and a few companies mined marl or coquina (shell limestone).

Crushed granite was used for roadbase stone, concrete, bituminous, and asphalt aggregate, railroad ballast, and riprap. Most of the crushed granite was shipped by truck.

Dimension granite was produced at six quarries in Fairfield and Kershaw Counties for use as monumental stone.

Crushed limestone and coquina were used as roadbase stone, agricultural limestone, and concrete and bituminous aggregate.

Crushed marl produced by three cement companies was used in the manufacture of portland cement.

**Vermiculite.**—Production of crude vermiculite decreased approximately 10% in quantity, but increased nearly 23% in value. Crude vermiculite was mined by W. R. Grace & Co. from six mines in Laurens County and from seven mines in Spartanburg County. The ore was exfoliated at two plants, one each in Greenville

and Laurens Counties. The Laurens County plant expansion (main plant equipment added) was completed. W. R. Grace also began new mining operations in Laurens and Spartanburg Counties. Patterson Vermiculite Co. mined crude vermiculite from two mines in Laurens County and exfoliated the ore in a plant in the same county. Principal uses of exfoliated vermiculite are for soil conditioning additives, for manufacture of lightweight aggregates (concrete, plaster, and fireproofing), and in loose and block insulation. Crude vermiculite production in South Carolina was second to that of Montana, the only other producing State.

**Zircon.**—Milled zircon was produced by M & T Chemicals, Inc., in Georgetown County using raw materials obtained from Florida, Georgia, and Australia. Zircon concentrates were processed by fine grinding (dry and wet with chemicals added) and shipped for foundry, wall tile, white-ware, and general ceramic uses.

#### METALS

No metals were mined in South Carolina in 1975. Metals formerly mined included gold, tin, lead, manganese, and copper. However, several metals were processed from ores obtained from out-of-State sources.

**Ferroalloys.**—Special ferroalloys were produced by Airco Alloys and Carbide Division of Airco, Inc. in Charleston. Two furnaces (the largest operating furnaces in the world) replaced five older furnaces solely in the interest of a cleaner environment. The installation for controlling emissions at this complex consists of two large electrostatic precipitators. Ore is received from Russia, Turkey, Southern Rhodesia, the Republic of South Africa, India, Iran, Albania, and other countries.

**Gold.**—Continued interest in gold mining was evident as core drilling programs started in 1974 adjacent to several abandoned gold mines progressed, notably the Haille (Lancaster County), Bremer (Chesterfield), Ferguson (York), and several in the McCormick County area.

**Iron and Steel.**—Steel was produced at Georgetown by the Georgetown Steel Co., a subsidiary of Korf Industries of West Germany. Raw material for the steel was in the form of prerduced pellets made by

the Midrex process. This steel plant is one of two U.S. plants that currently use this process which allows a higher quality steel to be produced. As a result, Georgetown Steel Co. is effectively expanding its market base.

#### MINERAL FUELS

**Peat.**—Crude peat was mined from a bog near Green Pond, Colleton County, by United States Peat Corp. and hauled to the company's processing and shipping plant at Green Pond. The change in its mining method during 1974 from one of cultivating and drying of the peat to one of dredging and decanting the peat continued to effect economies in production. Production, reported as 18,000 tons, remained essentially the same as for 1974. The crude peat is mixed with special additives at the processing plant, bagged, and shipped to consumers for use in general soil improvement.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Cement:</b>			
Giant Portland Cement Co ----	P.O. Box 218 Harleyville, S.C. 29448	Plant -----	Dorchester.
Gifford-Hill & Co., Inc -----	P.O. Box 326 Harleyville, S.C. 29448	----do -----	Do.
Santee Portland Cement Co ---	P.O. Box 698 Holly Hill, S.C. 29059	----do -----	Orangeburg.
<b>Clays:</b>			
<b>Common clay and shale:</b>			
Giant Portland Cement Co.	P.O. Box 218 Harleyville, S.C. 29448	Mine -----	Dorchester.
Gifford-Hill & Co., Inc ---	P.O. Box 326 Harleyville, S.C. 29448	----do -----	Orangeburg.
Richtex Corp -----	P.O. Box 3307 Columbia, S.C. 29230	----do -----	Fairfield, Lexington, Richland.
Santee Portland Cement Co	P.O. Box 698 Holly Hill, S.C. 29059	----do -----	Orangeburg.
Southern Brick Co -----	P.O. Box 208 Ninety Six, S.C. 29666	----do -----	Aiken, Greenwood, Newberry, Saluda.
<b>Fuller's earth:</b>			
Bennett Mineral Co -----	P.O. Box 158 Pinewood, S.C. 29125	Mine and plant.	Sumter.
<b>Kaolin, processed:</b>			
J. M. Huber Corp -----	P.O. Box 306 Langley, S.C. 29834	----do -----	Aiken.
Dixie Clay Co -----	P.O. Box B Bath, S.C. 29816	----do -----	Do.
<b>Feldspar, crude:</b>			
Spartan Minerals Co., Div. of Lithium Corp. of America.	P.O. Box 520 Pacolet, S.C. 29372	Plant -----	Spartanburg.
<b>Mica, scrap (sericite):</b>			
Mineral Mining Corp -----	P.O. Box 458 Kershaw, S.C. 29067	----do -----	Lancaster.
<b>Peat:</b>			
United States Peat Corp -----	P.O. Box 245 Green Pond, S.C. 29446	Bog and plant.	Colleton.

Table 8.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Sand and gravel:</b>			
Brewer Sand Co., Inc -----	Rt. 2 Lancaster, S.C. 29720	Pit and plant	Chesterfield.
Deerfield Sand & Mining Co --	P.O. Box 580 Ridgeland, S.C. 29936	----do -----	Jasper and Orangeburg.
Foster-Dixiana Sand Co -----	P.O. Box 5447 Columbia, S.C. 29250	----do -----	Lexington.
Gifford-Hill & Co., Inc. (Becker Sand & Gravel Co.).	P.O. Box 848 Cheraw, S.C. 29520	----do -----	Colleton and Dorchester.
Lone Star Industries -----	P.O. Box 5185 Columbia, S.C. 29205	----do -----	Richland.
Metromont Sand Corp. (Div. Metromont Materials Corp.).	P.O. Box 1292 Spartanburg, S.C. 29304	----do -----	Anderson, Cherokee, Spartanburg.
Pennsylvania Glass Sand Corp.	P.O. Box 84 Cayce, S.C. 29033	----do -----	Lexington.
Smith Paving & Grading Co --	P.O. Box 86 Turbeville, S.C. 29162	----do -----	Lee.
<b>Stone:</b>			
Granite, crushed and broken:			
Lone Star Industries -----	P.O. Box 268 Columbia, S.C. 29205	Quarry -----	Fairfield, Greenwood, Laurens, Richland.
Martin Marietta Aggregates.	P.O. Box 1758 Columbia, S.C. 29202	----do -----	Fairfield, Lexington, Richland, York.
Vulcan Materials Co -----	P.O. Drawer 8834 Greenville, S.C. 29604	----do -----	Greenville, Laurens, Pickens, Spartanburg.
Granite, dimension:			
Coggins Industries, Inc ---	Box 250 Elberton, Ga. 30635	----do -----	Kershaw.
Comolli Granite Co -----	RFD 2, Box 297 Kershaw, S.C. 29067	----do -----	Do.
Winnsboro Granite Corp --	Rion, S.C. 29132 -----	----do -----	Fairfield.
Limestone, crushed:			
Martin Marietta Aggregates.	650 Knox Abbott Dr. Cayce, S.C. 29033	Quarry and plant.	Berkeley and Georgetown.
Vulcan Materials Co -----	P.O. Drawer 8834 Greenville, S.C. 29604	----do -----	Cherokee.
Marl, crushed:			
Giant Portland Cement Co	P.O. Box 218 Harleyville, S.C. 29448	Pit -----	Dorchester.
Gifford-Hill & Co., Inc ---	P.O. Box 326 Harleyville, S.C. 29448	----do -----	Do.
Santee Portland Cement Co	P.O. Box 698 Holly Hill, S.C. 29059	----do -----	Orangeburg.
Vermiculite, crude and exfoliated:			
W. R. Grace & Co -----	Rt. 1 Enoree, S.C. 29335	Mine and plant.	Greenville, Laurens, Spartanburg.
Patterson Vermiculite Co -----	----do -----	----do -----	Laurens.

# The Mineral Industry of South Dakota

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

By James H. Aase<sup>1</sup> and Janice A. Wallace<sup>2</sup>

The value of mineral production in South Dakota for 1975 was \$101.8 million, a 1% decline from the alltime high record value set in 1974. Metals accounted for about 50%, nonmetals 44%, and petroleum 6% of the total mineral output value in 1975. The State's leading mineral commodity in terms of value was gold, followed in order by cement, stone, sand and gravel, and petroleum.

A decline in gold production of approximately 11% was the major factor contributing to the overall lower level of

value output for the year. An underground mine fire at the Homestake gold mine, Lead, S. Dak., forced the cessation of mining for a 2-week period in May. Nationally, South Dakota ranked second among the States in gold production for the year.

Legislation enacted by the State affecting the mineral industry included: A

<sup>1</sup> State Liaison Officer, Bureau of Mines, Rapid City, S. Dak.

<sup>2</sup> Liaison Program Assistant, Bureau of Mines, Rapid City, S. Dak.

Table 1.—Mineral production in South Dakota<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays <sup>2</sup> .....thousand short tons..	190	\$202	187	\$185
Gem stones.....	NA	42	NA	42
Gold (recoverable content of ores, etc.)...troy ounces..	343,723	54,906	304,935	49,244
Gypsum.....thousand short tons..	32	135	23	60
Lime.....do.....	94	2,059	W	W
Petroleum (crude).....thousand 42-gallon barrels..	494	3,283	472	5,996
Sand and gravel.....thousand short tons..	9,028	9,720	6,481	8,668
Silver (recoverable content of ores, etc.).....thousand troy ounces..	62	294	68	299
Stone.....thousand short tons..	2,968	14,231	2,647	15,350
Value of items that cannot be disclosed:				
Beryllium concentrate (1975), cement, clays (bentonite), feldspar, iron ore, mica (scrap), natural gas liquids, and values indicated by symbol W ..	XX	17,938	XX	21,977
Total.....	XX	102,810	XX	101,821
Total 1967 constant dollars.....	XX	48,609	XX	P 40,321

<sup>2</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes bentonite; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in South Dakota, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Aurora	\$45	\$15	Sand and gravel.
Beadle	W	20	Do.
Bon Homme	17	17	Do.
Brookings	W	488	Do.
Brown	385	473	Do.
Brule	--	37	Do.
Buffalo	W	W	Do.
Butte	2,950	W	Clays, natural gas liquids, sand and gravel.
Campbell	98	38	Sand and gravel.
Charles Mix	87	231	Do.
Clark	47	23	Do.
Clay	25	30	Do.
Codington	555	1,054	Do.
Corson	51	35	Do.
Custer	857	W	Stone, feldspar, petroleum.
Davison	56	30	Sand and gravel.
Day	118	74	Do.
Deuel	554	644	Do.
Dewey	13	W	Petroleum, sand and gravel.
Douglas	122	W	Sand and gravel.
Edmunds	W	--	
Fall River	W	W	Sand and gravel, stone.
Faulk	55	--	
Grant	8,981	W	Stone, sand and gravel.
Gregory	58	81	Sand and gravel.
Haakon	--	9	Do.
Hamlin	109	47	Do.
Hand	72	82	Do.
Hanson	W	W	Stone, sand and gravel.
Harding	35	W	Petroleum, sand and gravel.
Hughes	8	--	
Hutchinson	80	84	Sand and gravel.
Hyde	47	75	Do.
Jerauld	8	17	Do.
Kingsbury	85	34	Do.
Lake	110	145	Do.
Lawrence	W	49,919	Gold, silver, sand and gravel, stone.
Lincoln	82	112	Sand and gravel.
Lyman	W	W	Do.
McCook	55	39	Do.
McPherson	37	--	
Marshall	102	60	Sand and gravel.
Meade	W	W	Sand and gravel, gypsum.
Mellette	228	115	Sand and gravel.
Miner	22	22	Do.
Minnehaha	W	W	Stone, sand and gravel.
Moody	110	102	Sand and gravel.
Pennington	20,714	22,310	Cement, lime, stone, iron ore, sand and gravel, clays, mica, beryllium, feldspar.
Perkins	78	362	Sand and gravel.
Potter	42	45	Do.
Roberts	333	302	Do.
Sanborn	73	W	Do.
Spink	147	W	Do.
Sully	56	45	Do.
Tripp	150	W	Sand and gravel, stone.
Turner	77	--	
Union	56	55	Sand and gravel.
Walworth	8	75	Do.
Washabaugh	W	--	
Yankton	W	W	Sand and gravel, stone.
Ziebach	--	18	Sand and gravel.
Undistributed <sup>2</sup>	64,803	24,455	
Total <sup>3</sup>	102,810	101,821	

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

<sup>1</sup> The following counties are not listed because no production was reported: Bennett, Jackson, Jones, Shannon, Stanley, and Todd.

<sup>2</sup> Includes gem stones, some sand and gravel, and petroleum (1974) that cannot be assigned to specific counties, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

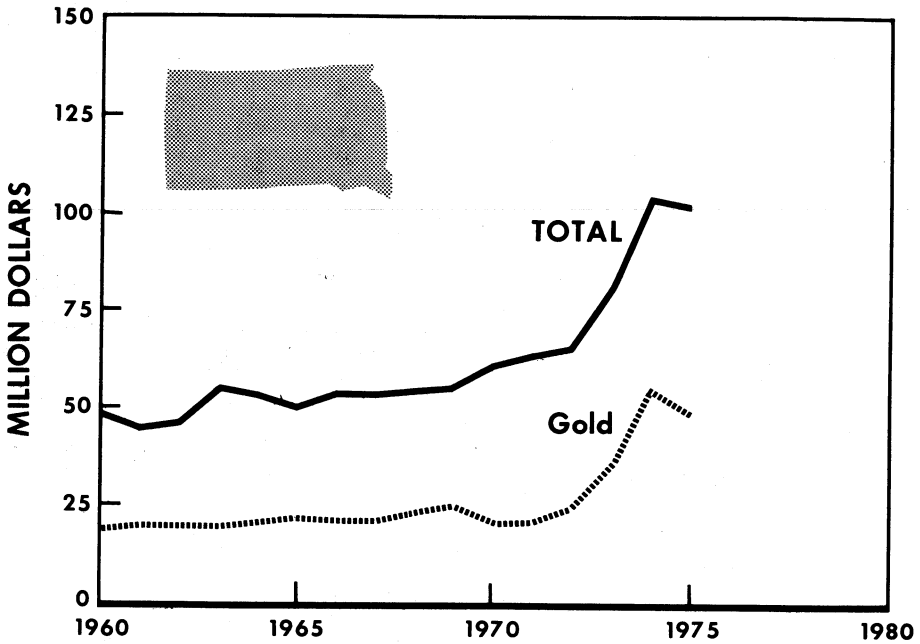


Figure 1.—Value of gold and total value of mineral production in South Dakota.

Table 3.—Indicators of South Dakota business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands .....	305.0	299.2	-1.9
Unemployment ----- do .....	10.8	14.0	+29.6
<b>Employment (nonagricultural):</b>			
Mining ----- do .....	2.5	2.5	--
Manufacturing ----- do .....	20.7	20.0	-3.4
Contract construction ----- do .....	10.8	8.9	-17.6
Transportation and public utilities ----- do .....	12.4	12.1	-2.4
Wholesale and retail trade ----- do .....	53.9	54.3	+7
Finance, insurance, and real estate ----- do .....	8.6	8.9	+3.5
Services ----- do .....	42.9	45.4	+5.8
Government ----- do .....	54.9	56.4	+2.7
Total nonagricultural employment ----- do .....	206.7	208.5	+1.9
<b>Personal income:</b>			
Total ----- millions .....	\$3,311	\$3,365	+1.6
Per capita ----- do .....	\$4,860	\$4,924	+1.3
<b>Construction activity:</b>			
Number of private and public residential units authorized .....	2,806	3,103	+10.6
Value of nonresidential construction ----- millions .....	\$44.5	\$44.8	+7
Value of State road contract awards ----- do .....	\$50.0	\$60.0	+20.0
Shipments of portland and masonry cement to and within South Dakota ----- thousand short tons .....	354	322	-9.0
<b>Mineral production value:</b>			
Total crude mineral production value ----- millions .....	\$102.8	\$101.8	-1.0
Value per capita, resident population ----- do .....	\$150.97	\$149.52	-1.0
Value per square mile ----- do .....	\$1,334.38	\$1,321.54	-1.0

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce; U.S. Department of Labor; Highway and Heavy Construction Magazine; and U.S. Bureau of Mines.



tax of 4% on the net profits of individuals or firms taking in more than \$100,000 from mining operations; stiffening of the former State surface mining and reclamation laws; a moratorium on iron ore mining in selected areas of the Black Hills; and requirements for sealing exploration drill test holes and sharing of the geologic information obtained with the State Department of Natural Resources.

Exploration for oil and gas showed a marked increase and resulted in the greatest amount of drilling in South Dakota since 1971. During the year, 27 test holes were drilled which brought in two new oil discovery wells and five field development oil wells.

Conoco Coal Development Co.'s coal gasification pilot plant, located at Rapid City, successfully demonstrated the production of high-quality pipeline gas with an energy rating of more than 900 Btu's per standard cubic foot by the carbon

dioxide acceptor process. The achievement was significant not only for the fact the plant was operated on a fully integrated basis at an optimum level, but also in that local resources played principal roles in the gasification process. The lignite from which gas was formulated was mined in North Dakota and the limestone used as the acceptor in the process was obtained in Rapid City.

Among the documents published in 1975 dealing with the State's mineral resources and geology were a U.S. Geological Survey report prepared for the Senate Interior and Insular Affairs Committee describing various kinds of mineral deposits in South Dakota and indicating where further deposits might be found,<sup>3</sup> and a U.S. Geological Survey report indicating areas in the Black Hills where mineral exploration might lead to discovery of metals in commercial quantities.<sup>4</sup>

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Production of cement in 1975 declined 12% compared to the previous year. The State-owned cement plant in Rapid City accounted for all of the production. Over 80% of the shipments of finished portland cement during the year went to ready-mix companies and highway contractors.

**Clays.**—Clay production in 1975 declined 7% below that of 1974. Bentonite accounted for the bulk of the value of clays produced in South Dakota. The American Colloid Co. operated the only bentonite-processing plant in the State near Belle Fourche. Principal uses of the bentonite produced were in foundry sands, animal feed, and drilling mud.

Other types of common clay and shale produced were for use in cement manufacturing, lightweight aggregate, and brickmaking.

**Feldspar.**—Production of crude feldspar in 1975 was 30% lower in quantity and 32% higher in value compared with that of the previous year. Mines were operated during the year in Custer and Pennington Counties. A grinding mill at Custer, op-

erated by Pacer Corp., processed the bulk of the crude feldspar output.

**Gypsum.**—The South Dakota Cement Commission operated a small surface mine in Meade County and provided the entire State production. All the gypsum output was used in cement manufacturing. Production of gypsum in 1975 declined 28% in quantity and 56% in value compared with that of the previous year.

**Lime.**—Output of lime in 1975 was lower in quantity but higher in value compared with that of 1974. All production came from the Pete Lien & Sons, Inc., plant in Pennington County.

**Mica.**—A small amount of scrap and flake mica was produced at one mine in Pennington County.

**Sand and Gravel.**—Sand and gravel production decreased 28% in 1975 compared with that of 1974. A total of 155 mines were operated in 54 counties during 1975.

<sup>3</sup> U.S. Geological Survey, Mineral and Water Resources of South Dakota, Committee on Interior and Insular Affairs Print, 94th Cong., 1st sess., July 1975, 313 pp.

<sup>4</sup> Raymond, W. H., R. U. King, and J. J. Norton, Anomalous Concentrations of Several Metals in Iron-Formation of the Blue Lead Mountain Area, Pennington County, South Dakota, U.S. Geol. Survey Circular 707, 1976, 14 pp.

Table 4.—South Dakota: Construction sand and gravel sold or used by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	1,057	1,598	1,000	1,480
Gravel -----	6,501	7,114	4,337	5,416
Unprocessed:				
Sand and gravel -----	1,470	1,010	1,144	1,023
Total -----	9,028	9,722	6,481	7,919

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

Table 5.—South Dakota: Construction aggregate (blended sand and gravel) sold or used commercially by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	736	1,193	729	1,237
Highway and bridge construction -----	406	652	197	342
Other construction (dams, waterworks, airports, etc.) -----	71	101	25	55
Concrete products (cement blocks, brick, pipe, etc.) -----	362	628	124	253
Bituminous paving (asphalt and tar paving) -----	332	462	177	300
Roadbase and subbase -----	1,171	990	809	756
Fill -----	73	69	52	55
Other -----	218	293	32	77
Unprocessed:				
Roadbase and subbase -----	702	439	119	134
Fill -----	555	481	264	223
Other -----	--	--	W	W
Total <sup>1</sup> -----	4,626	5,308	2,529	3,426

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 6.—South Dakota: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	2	W	151	253
Highway and bridge construction -----	691	1,002	460	805
Other construction (dams, waterworks, airports, etc.) -----	--	--	W	W
Concrete products (cement blocks, brick, pipe, etc.) -----	14	31	W	W
Bituminous paving (asphalt and tar paving) -----	981	941	546	1,196
Roadbase and subbase -----	2,211	2,032	1,506	1,839
Fill -----	82	78	547	465
Other -----	209	238	5	5
Unprocessed:				
Roadbase and subbase -----	162	73	553	558
Fill -----	51	17	134	122
Other -----	--	--	W	W
Total -----	4,403	4,412	3,952	5,243

W Withheld to avoid disclosing individual company confidential data; 1974 included with "Highway and bridge construction," 1975 included with "Nonresidential and residential construction."

Counties leading in production were Minnehaha, Codington, Pennington, Brookings, Fall River, and Brown, which together accounted for 40% of the State total.

**Stone.**—Stone production consisting of limestone, granite, quartz, and quartzite was produced from 28 quarries in nine counties. Output in 1975 declined 11% in quantity and rose 8% in value compared with that of the previous year.

Granite dimension stone, produced by five companies operating seven quarries in Grant County, accounted for 67% of the total value of stone produced in the State during 1975. The principal usage was for monumental and architectural purposes.

Crushed and broken stone, used principally for concrete and bituminous aggregate,

cement and lime manufacturing, roadbed materials and railroad ballast, accounted for 98% of the total output quantity.

### METALS

**Gold and Silver.**—At Lead, the Homestake Mining Co., the State's sole producer of gold and silver, produced 304,935 troy ounces of gold and 67,669 troy ounces of silver from 1.47 million tons of ore milled during 1975. Production of gold was down 11% in quantity and 10% in value compared with that of the previous year. Silver output rose 8% in quantity and 2% in value over that of 1974. The average grade recovered was 0.207 ounce per ton in gold content compared with 0.22 ounce per ton in 1974, a 6% drop in grade.

**Table 7.—South Dakota: Stone sold or used by producers, by kind**  
(Thousand short tons and thousand dollars)

Kind of stone	1974		1975	
	Quantity	Value	Quantity	Value
Dimension stone total <sup>1</sup> -----	36	8,881	42	10,270
Crushed and broken:				
Limestone -----	2,019	3,262	1,876	3,120
Other stone <sup>2</sup> -----	914	2,087	729	1,962
Total <sup>3</sup> -----	2,968	14,231	2,647	15,350

<sup>1</sup> Data represent granite.

<sup>2</sup> Data include quartzite, quartz, and granite (1974).

<sup>3</sup> Data may not add to totals shown because of independent rounding.

**Table 8.—South Dakota: Stone sold or used by producers, by use**  
(Thousand short tons and thousand dollars, unless otherwise specified)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough monumental <sup>1</sup> -----thousand cubic feet--	146	2,295	229	3,188
Dressed monumental -----do-----	218	6,442	213	7,080
Total (thousand short tons) -----	36	<sup>2</sup> 8,881	42	<sup>3</sup> 10,270
Crushed and broken stone:				
Bituminous aggregate -----	263	566	234	554
Concrete aggregate -----	971	2,120	906	2,190
Macadam aggregate -----	1	1	1	1
Other construction aggregate and roadstone -----	W	W	121	227
Surface treatment aggregate -----	119	255	98	192
Railroad ballast -----	512	1,007	211	449
Riprap and jetty stone -----	34	62	23	52
Other uses <sup>4</sup> -----	1,033	1,337	1,012	1,416
Total <sup>3</sup> -----	2,933	5,349	2,605	5,082
Grand total <sup>3</sup> -----	2,968	14,231	2,647	15,350

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

<sup>1</sup> Includes rough architectural (1975) and dressed architectural work.

<sup>2</sup> Includes rough architectural work.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

<sup>4</sup> Includes stone used for agricultural limestone, dense graded roadbase stone, cement and lime manufacture and uses not specified.

Table 9.—South Dakota: Dimension granite sold or used by producers, by use

Use	1974			1975		
	Short tons	Cubic feet	Value (thousands)	Short tons	Cubic feet	Value (thousands)
Dressed monumental -----	19,580	217,800	\$6,442	20,590 <sup>(1)</sup>	213,400 <sup>(1)</sup>	\$7,080 <sup>(1)</sup>
Rough monumental -----	7,382	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )
Other uses <sup>2</sup> -----	8,722	146,116	2,295	21,120	229,100	3,188
Total <sup>3</sup> -----	35,680	W	8,881	41,700	442,500	10,270

<sup>1</sup> W Includes rough architectural work; withheld to avoid disclosing individual company confidential data.

<sup>2</sup> Included with "Other uses."

<sup>3</sup> Includes cut, dressed building stone, rough blocks (1975), rough monumental.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

<sup>5</sup> Includes rough architectural work.

Development work in the Homestake mine in 1975 found the No. 6 shaft being sunk from its location at the 4,550-foot level to the 8,251-foot level. Drifting on the 8,000-foot level is to begin in 1976. Late in 1975 a hoist for the sinking of the No. 7 shaft was installed, which will eventually reach the 10,000-foot level. Work on this shaft is a long-range plan expecting to take some 10 to 12 years.

In February, the Ellison shaft caved around the tramway level, damaging the original fan used for ventilation. Two 16-foot-diameter boreholes running from the 3,050 to the 2,300-foot level were added

to bypass the debris which fell to the bottom of the shaft following the cave-in. In repairing the damage, a 7- by 7-foot drift on the 300-foot level was stripped to a larger 12- by 12-foot drift, with two new fans installed.

New ventilation systems, which are a continuation of the present units, were constructed between the 5,900 and the 6,800 levels at 19 ledge near the No. 6 and No. 7 shafts.

Exploration work at Bald Mountain mine, near Lead, by Homestake during the year found the company working in partnership with Taiga Mining Co., Denver,

Table 10.—South Dakota: Mine production (recoverable) of gold and silver

	1973	1974	1975
Mines producing: Lode -----	1	1	1
Material sold or treated: -----			
Gold ore ----- thousand short tons	1,574	1,560	1,473
Production (recoverable): -----			
Quantity: -----			
Gold ----- troy ounces	357,575	343,723	304,935
Silver ----- do	71,939	62,474	67,669
Value: -----			
Gold ----- thousands	\$34,974	\$54,906	\$49,244
Silver ----- do	184	294	299
Total ----- do	35,158	55,201	49,543

<sup>1</sup> Data do not add to total shown because of independent rounding.

Table 11.—South Dakota: Homestake mine ore milled and receipts for gold produced

Year	Ore milled (thousand short tons)	Receipts for gold produced	
		Total (thousands)	Per ton
1971 -----	1,800	\$21,179	\$11.77
1972 -----	1,467	23,875	16.27
1973 -----	1,574	34,974	22.22
1974 -----	1,560	54,906	35.20
1975 -----	1,473	49,244	33.43

and the firm, Canadian Mines, Inc., subcontracting much of the work. At the site, a large shop building, which houses the air compressors and the electrical equipment as well as small offices and a repair shop, was constructed and work began on the main decline which was advanced about 1,600 feet at a 15% grade.

**Iron Ore.**—A small mine was operated by Pete Lien & Sons, Inc., near the community of Nemo in Pennington County. The entire output of iron ore was supplied to the State-owned cement plant for use in cement manufacturing.

#### MINERAL FUELS

**Petroleum.**—Crude oil production in 1975 decreased 4% in quantity and increased 83% in value compared with that of the previous year.

Two new oil discovery wells and five field development wells during 1975 were the result of the greatest amount of drilling in South Dakota since 1971. Six of the new wells are located in Harding County and one is in Dewey County.

The two discoveries in Harding County, plus a third drilled late in 1974 and placed on production in 1975, resulted in the es-

tablishment of three new oilfields in Harding County. This brings the total number of oilfields in the State to 11—9 in Harding County, 1 in Custer County, and 1 undesignated field in Dewey County.

A total of 27 test holes were drilled on as many permits during 1975. The deepest hole drilled was 9,341 feet and the shallowest was 644 feet. The average depth of all holes was 5,347 feet. An average of two drilling rigs were in operation each month during the year. Fourteen of the tests had as their objective the Red River dolomite of Ordovician age, a proven reservoir rock in the nine Harding County oilfields. Five of the holes tested the Minnelusa formation of Pennsylvanian-Permian age, and the remaining eight holes were drilled to shallower Cretaceous formations such as the Muddy sandstone.

The success ratio, or ratio of producing wells to total wells in 1975, was 7 to 27 for 26%. The ratio of producers to wells drilled to the Red River dolomite was 7 to 14 for 50%. This compares with a national success ratio of about 13%.

Natural gas production decreased from 47.8 million cubic feet in 1974 to 38.6 million cubic feet in 1975. All the gas was used locally.

Table 12.—South Dakota: Oil test completions in 1975, by county

County	Total		Status
	Wells	Footage	
Butte -----	1	2,370	Dry and abandoned.
Corson -----	1	6,711	Do.
Dewey -----	1	5,020	Field development well.
Fall River -----	3	8,770	Dry and abandoned.
Haakon -----	2	3,468	Do.
Harding -----	13	100,554	Four field development wells; two discovery wells; seven dry and abandoned.
Lawrence -----	1	644	Dry and abandoned.
Meade -----	1	1,965	Do.
Perkins -----	1	6,455	Do.
Stanley -----	2	5,472	Do.
Tripp -----	1	2,935	Do.
<b>Total -----</b>	<b>27</b>	<b>144,364</b>	

Source: South Dakota Geological Survey, Western Field Office, Rapid City, S. Dak.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Cement: South Dakota Cement Commission.	P.O. Box 360 Rapid City, S.Dak. 57701	Wet-process, 3-rotary-kiln plant.	Pennington.
Clays:			
American Colloid Co -----	5100 Suffield Ct. Skokie, Ill. 60076	Open pit mine and plant.	Butte.
Black Hills Clay Products Co.--	P.O. Box 428 Belle Fourche, S.Dak. 57717	Open pit mine and brick plant.	Do.
Light Aggregates, Inc -----	Box 1922 Rapid City, S.Dak. 57701	Open pit mine and plant.	Pennington.
South Dakota Cement Commission.	P.O. Box 360 Rapid City, S.Dak. 57701	Open pit mine -----	Do.
Feldspar: Pacer Corp -----	Box 311 Custer, S.Dak. 57730	Open pit mines and dry-grinding plant.	Custer.
Gold: Homestake Mining Co -----	Lead, S.Dak. 57754 ----	Underground mine, cyanidation mill and refinery.	Lawrence.
Gypsum: South Dakota Cement Commission.	P.O. Box 360 Rapid City, S.Dak. 57701	Open pit mine -----	Meade.
Lime: Pete Lien & Sons, Inc ----	Box 3124 Rapid City, S.Dak. 57701	1-rotary-kiln, 1-vertical-kiln, continuous- hydrator plant.	Pennington.
Petroleum:			
Depco, Inc -----	1025 Petroleum Club Bldg. Denver, Colo. 80202	Crude oil wells ----	Harding (Yellow Hair and State Line field).
Hanover Planning Co., Inc ---	1236 North 28 St. Billings, Mont. 59102	----do -----	Harding (Harding Springs field).
Kenneth Luff, Inc -----	2180 Colorado State Bank Building Denver, Colo. 80202	----do -----	Harding (Travers Ranch field).
Koch Exploration Co -----	P.O. Box 2256 Wichita, Kans. 67201	----do -----	Harding (Buffalo field).
Phillips Petroleum Co -----	P.O. Box 2920 Casper, Wyo. 82601	----do -----	Do.
Sand and gravel (commercial):			
Birdsall Sand and Gravel Co., Inc.	Box 767 Rapid City, S.Dak. 57701	Pit and plant -----	Fall River and Pennington.
Concrete Materials Co -----	100 South Dakota Ave. Sioux Falls, S.Dak. 57102	Pits -----	Minnehaha and Roberts.
F.J. McLaughlin Co -----	Box 13 Watertown, S.Dak 57201	Pit -----	Codington.
Highway Construction Co ----	Box 511 Rapid City, S.Dak. 57701	Pit -----	Pennington.
L.G. Everist, Inc -----	302 Paulton Building Sioux Falls, S.Dak. 57102	Pit and plant -----	Various.
Mannerud, Inc -----	Box 223 Brookings, S.Dak. 57006	Plant -----	Brookings.
N&M Construction, Inc -----	Box 337 Sturgis, S.Dak. 57785	Pit -----	Meade.
W.E. Bartholow & Sons Construction.	Box 3 Huron, S.Dak. 57350	Pit -----	Various.
Weelborg Brothers, Inc -----	Dell Rapids S.Dak. 57022	Pits and mill -----	Do.
Silver: Homestake Mining Co ----	Lead, S.Dak. 57754 ----	See gold -----	Lawrence.
Stone:			
Cold Spring Granite Co -----	Cold Spring, Minn. 56320	2 quarries -----	Grant.
Concrete Materials Co -----	100 South Dakota Ave. Sioux Falls, S.Dak. 57102	Quarry and plant --	Minnehaha.
Dakota Granite Co -----	Box 269 Milbank, S.Dak. 57252	2 quarries -----	Grant.
Delano Granite Works, Inc ----	Delano, Minn. 55328 ---	Quarry -----	Do.
Hills Materials Co -----	Box 1392 Rapid City, S.Dak. 57701	Quarry and plant --	Pennington.
Robert Hunter Granite Co., Inc.	501 E. Drake St. Milbank, S.Dak. 57252	Quarry -----	Grant.
Lee Construction Co -----	Box 348 Spearfish, S.Dak. 57783	----do -----	Lawrence.

Table 13.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
L.G. Everist, Inc -----	302 Paulton Building Sioux Falls, S.Dak. 57102	Quarry and plant --	Minnehaha and Pennington.
Pete Lien & Sons, Inc -----	Box 3124 Rapid City, S.Dak. 57701	----do -----	Pennington.
Pioneer Lime Co -----	Humboldt, Iowa 50548--	Quarry -----	Yankton.
South Dakota Cement Commission.	P.O. Box 360 Rapid City, S.Dak. 57701	Quarry and plant --	Pennington.
Spencer Quarries, Inc -----	Spencer, S.Dak. 57374 --	Quarry -----	Hanson.

# 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.

By William D. Hardeman<sup>1</sup>

The 1975 value of mineral industry production was \$425 million, an increase of 7% over that of 1974. Tennessee was the leading producing State for zinc ore, pyrites, and ball clay, and ranked third in the production of phosphate rock. Coal was first in value of the mineral commodities produced during the year, followed by stone and zinc ore.

The mineral industry was very active in exploration for coal, zinc ore, and oil during the year. The Elmwood mine in the new middle Tennessee zinc district went into full production and several additional zinc mines were under development in both middle and eastern Tennessee.

#### Legislation and Government Programs.

—The Tennessee Division of Geology continued its statewide program of quadrangle geologic mapping and mineral resources investigations. Seven new geologic maps with mineral resource summaries were published covering the following 7-½-minute quadrangles: Bellwood, Cardwell Mountain, Harpeth Valley, Fork Mountain, Dixon Springs, Lafayette, and New Providence. Six total intensity aeromagnetic maps (each covering eight 7-½-minute quadrangles) were published beginning a new series. Both of these mapping projects were carried on as part of a continuing long-range program of cooperation with the Tennessee Valley Authority (TVA). Other significant publications of the Division included such reports as IC 17, "Coal Mining in Tennessee"; Bulletin 75, "Stratigraphy of the Outcropping Upper Cretaceous, Paleocene, and Lower Eocene in Western

Tennessee"; and Bulletin 76, "Subsurface Information Catalog of Tennessee."

The Geologic Services Branch, TVA, continued its program of airborne magnetic surveying, resulting in additional coverage of 8,800 square miles within the State, mostly in western Tennessee. The Branch continued in its long-range cooperative effort with the U.S. Geological Survey (USGS) to catalogue mineral resource data into the Computer Resources Information Bank (CRIB) system of the Survey. To date the Branch has entered more than 2,000 mineral records into the system. The Branch, in addition, engaged in a wide variety of geological investigations relating to potential and future nuclear, pumped storage, and multipurpose dam sites. Additional studies relevant to existing projects were made, including the Racoon Mountain pumped storage site, Duck River projects (Columbia and Normandy), Tellico Dam site, Johnsonville steam plant, and the Sequoyah, Watts Bar, Hartsville, and Phipps Bend nuclear projects.

Construction continued on four major TVA hydroelectric plants. The Tellico Dam is slated for closure in January 1977, the Columbia Dam in January 1982, and the Normandy Dam was completed in January 1976. The Racoon Mountain pumped storage project is scheduled for completion in February 1978. Construction continued on two nuclear plants—the Sequoyah plant is scheduled for operation in November

<sup>1</sup> State Liaison Officer, Bureau of Mines, Nashville, Tenn.



Table 1.—Mineral production in Tennessee <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite -----thousand short tons--	W	W	13	\$260
Cement:				
Portland -----do-----	1,525	\$43,339	1,136	37,866
Masonry -----do-----	154	4,706	138	4,778
Clays <sup>2</sup> -----do-----	1,638	9,776	1,310	9,008
Coal (bituminous) -----do-----	7,541	135,874	8,206	140,293
Copper (recoverable content of ores, etc.) short tons--	6,304	9,745	10,041	12,893
troy ounces--	18	3	W	W
Lime -----thousand short tons--	136	3,449	106	3,735
Natural gas -----million cubic feet--	17	6	27	12
Petroleum (crude) --thousand 42-gallon barrels--	769	7,256	682	7,849
Phosphate rock -----thousand short tons--	2,411	18,465	2,291	28,803
Pyrites -----thousand long tons--	411	4,101	W	W
Sand and gravel -----thousand short tons--	10,702	19,476	10,909	22,102
Silver (recoverable content of ores, etc.) thousand troy ounces--	20	94	54	238
Stone -----thousand short tons--	41,720	75,547	39,938	83,437
Zinc (recoverable content of ores, etc.) short tons--	85,671	61,512	83,293	64,968
Value of items that cannot be disclosed: Clay (fuller's earth), and values indicated by symbol W -----	XX	2,259	XX	8,526
Total -----	XX	395,608	XX	424,768
Total 1967 constant dollars -----	XX	187,043	XX	<sup>P</sup> 168,208

<sup>P</sup> Preliminary. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes fuller's earth; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Tennessee, by county <sup>1 2</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Anderson -----	W	W	Coal, stone, sand and gravel.
Bedford -----	W	W	Stone.
Benton -----	W	W	Sand and gravel, stone.
Bledsoe -----	W	W	Coal.
Blount -----	\$2,330	W	Stone.
Bradley -----	W	\$1,252	Do.
Campbell -----	30,587	W	Coal, stone, sand and gravel.
Cannon -----	145	W	Stone.
Carroll -----	W	W	Clays.
Carter -----	W	W	Stone.
Claiborne -----	W	W	Coal, stone, petroleum.
Clay -----	W	W	Stone, petroleum.
Cocke -----	219	248	Stone.
Coffee -----	W	W	Sand and gravel, stone.
Cumberland -----	3,026	3,537	Stone, coal, sand and gravel.
Davidson -----	15,851	W	Stone, cement, clays, sand and gravel.
Decatur -----	W	W	Stone, sand and gravel.
De Kalb -----	318	W	Stone.
Dickson -----	W	W	Do.
Dyer -----	41	W	Sand and gravel.
Fayette -----	15	34	Do.
Fentress -----	705	W	Coal, stone, petroleum.
Franklin -----	W	W	Cement, stone, sand and gravel, clays.
Gibson -----	W	W	Clays.
Giles -----	W	W	Phosphate rock, stone.
Grainger -----	53	W	Stone.
Greene -----	W	W	Stone, sand and gravel.
Grundy -----	W	2,070	Coal, stone.
Hamblen -----	W	W	Stone.
Hamilton -----	18,649	16,988	Cement, stone, sand and gravel, clays.
Hardeman -----	217	247	Sand and gravel.
Hardin -----	W	W	Stone, sand and gravel.
Hawkins -----	W	W	Sand and gravel, stone.
Haywood -----	13	--	

See footnotes at end of table.

Table 2.—Value of mineral production in Tennessee, by county<sup>1 2</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Henry	\$4,584	\$6,073	Clays, sand and gravel.
Hickman	W	W	Phosphate rock.
Humphreys	W	W	Sand and gravel, stone.
Jackson	W	W	Stone.
Jefferson	49,337	W	Zinc, stone, silver.
Johnson	W	W	Stone.
Knox	30,402	29,164	Zinc, cement, stone, lime, sand and gravel, clays.
Lauderdale	W	160	Sand and gravel.
Lawrence	824	W	Stone, sand and gravel.
Lincoln	W	W	Stone.
Loudon	1,559	W	Stone, barite, sand and gravel, clays.
McMinn	W	W	Lime, stone, sand and gravel.
McNairy	99	W	Sand and gravel.
Macon	W	W	Stone.
Madison	W	102	Sand and gravel.
Marion	W	W	Coal, cement, stone, sand and gravel.
Marshall	W	W	Stone.
Maury	W	W	Phosphate rock, stone.
Meigs	W	W	Stone.
Monroe	1,105	W	Stone, barite, sand and gravel.
Montgomery	W	W	Stone.
Moore	45	--	
Morgan	W	W	Coal, petroleum, natural gas.
Obion	W	289	Sand and gravel.
Overton	W	1,075	Coal, stone, petroleum, clays.
Perry	W	W	Sand and gravel.
Pickett	W	--	
Polk	W	21,455	Copper, pyrites, zinc, silver, gold.
Putnam	W	W	Coal, stone, sand and gravel.
Rhea	W	W	Stone.
Roane	W	W	Stone, coal, sand and gravel.
Robertson	W	W	Stone.
Rutherford	1,368	1,347	Do.
Scott	W	W	Coal, petroleum, natural gas.
Sequatchie	7,990	W	Coal, stone.
Sevier	W	W	Stone, sand and gravel.
Shelby	6,236	7,636	Sand and gravel.
Smith	69	W	Zinc, stone.
Stewart	676	W	Stone.
Sullivan	11,443	W	Cement, stone, clays.
Sumner	W	W	Stone.
Tipton	115	338	Sand and gravel.
Unicoi	W	W	Sand and gravel, stone.
Union	W	1,846	Stone, sand and gravel.
Van Buren	W	419	Coal.
Warren	W	W	Stone.
Washington	W	W	Sand and gravel, stone, clays.
Wayne	W	W	Sand and gravel.
Weakley	5,602	4,695	Clays.
White	W	W	Coal, stone.
Williamson	W	W	Phosphate rock, stone.
Wilson	W	W	Stone.
Undistributed	201,941	325,803	
Total <sup>3</sup>	395,608	424,768	

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

<sup>1</sup> The following counties are not listed because no production was reported: Cheatham, Chester, Crockett, Hancock, Henderson, Houston, Lake, Lewis, and Trousdale.

<sup>2</sup> The values of petroleum and natural gas are based on an average price per barrel and cubic foot, respectively, for the State.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

1977 and the Watts Bar plant in December 1978.

The USGS was engaged in widespread cooperative programs with various State agencies on geologic mapping, water resources investigations, and topographic mapping.

The Tennessee Div. of Surface Mining

continued its supervision of surface mining operations and the reclamation of lands disturbed by such mining. The State permitted 8,609 acres for surface mining in 1975, an increase of 45% over the preceding year.

The Mining Enforcement and Safety Administration (MESA) operated out of four

Table 3.—Indicators of Tennessee business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	1,828.0	1,812.0	-0.9
Unemployment -----do-----	92.0	151.0	+64.1
<b>Employment (nonagricultural):</b>			
Mining -----do-----	8.1	9.0	+11.1
Manufacturing -----do-----	516.5	454.1	-12.1
Contract construction -----do-----	84.8	72.2	-14.9
Transportation and public utilities -----do-----	74.2	71.2	-4.0
Wholesale and retail trade -----do-----	320.7	314.7	-1.9
Finance, insurance, and real estate -----do-----	70.8	68.1	-3.8
Services -----do-----	235.1	237.0	+3.8
Government -----do-----	256.4	271.0	+5.7
Total nonagricultural employment -----do-----	1,566.6	1,497.3	-4.4
<b>Personal income:</b>			
Total -----millions--	\$18,949	\$20,501	+8.2
Per capita -----do-----	\$4,567	\$4,895	+7.2
<b>Construction activity:</b>			
Number of private and public residential units authorized--	18,032	14,484	-19.7
Value of nonresidential construction -----millions--	\$405.8	\$268.0	-34.0
Value of State road contract awards -----do-----	\$246.0	\$194.0	-21.1
Shipments of portland and masonry cement to and within Tennessee -----thousand short tons--	1,820	1,479	-18.7
<b>Mineral production value:</b>			
Total crude mineral value -----do-----	\$395.6	\$424.8	+7.4
Value per capita, resident population -----do-----	\$95.35	\$101.25	+6.2
Value per square mile -----do-----	\$9,364.83	\$10,001.85	+6.8

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

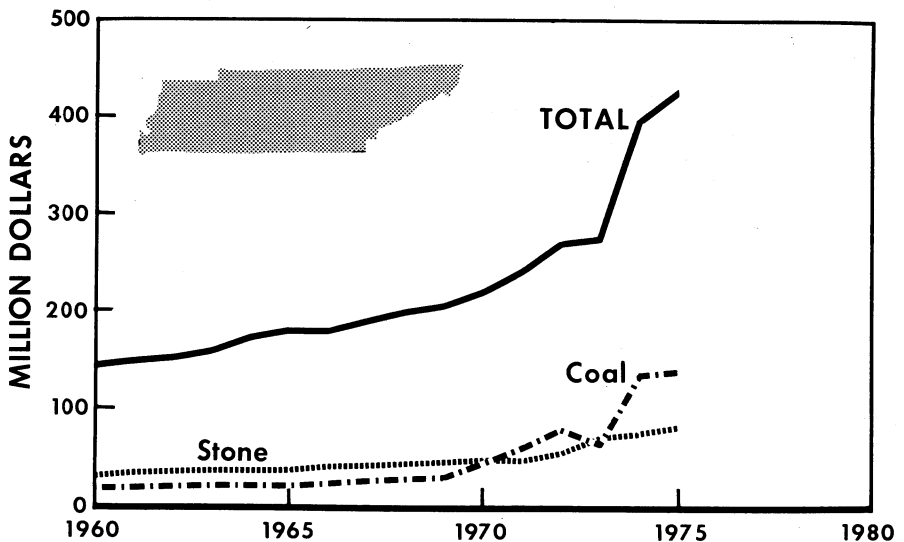


Figure 1.—Value of stone, coal, and total value of mineral production in Tennessee.

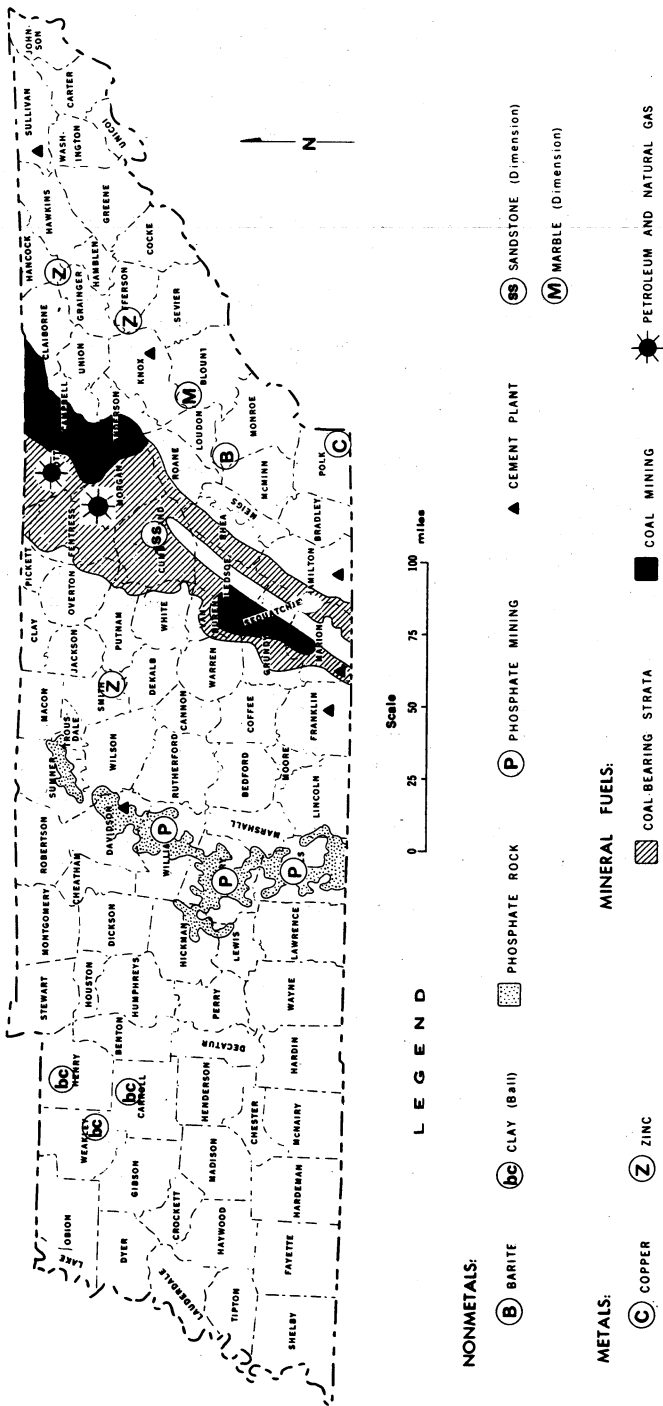


Figure 2.—Generalized map of selected mining areas and industries in Tennessee.

offices in the State (Knoxville, Jellico, Jasper, and Franklin) in carrying out its inspection responsibilities with regard to the health and safety of miners. The Div. of Mines, Tennessee Department of Labor, carried out its inspection responsibilities from a Knoxville office.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

Nonmetals accounted for 48% of the total value of mineral production in 1975. The principal nonmetallic commodities in order of value were stone, cement, phosphate rock, sand and gravel, and clays.

**Barite.**—Three companies operated open pit mines in the Sweetwater district of eastern Tennessee. NL Industries, Inc., shipped concentrates from its Ballard mine and plant in Monroe County to New Orleans to be ground for use as drilling mud. B.C. Wood and C.R. Wood shipped concentrates from the Cedar Fork mine and the C.R. Wood mine and plant in Loudon County to out-of-State purchasers. Production of barite in the State decreased slightly in both tonnage and value in 1975. Surface mining permits covering 4 acres were issued by the State during the year. (See also section on fluorspar.)

**Cement.**—Cement was produced by four companies operating six plants in the State—General Portland, Inc. at Chattanooga; Ideal Basic Industries, Inc. at Knoxville; Marquette Co. at Nashville and Cowan; and Penn-Dixie Industries, Inc. at Kingsport and Richard City. Shipments of portland cement declined for the second successive year, decreasing about 26% in quantity and 13% in value compared with 1974. Masonry cement decreased 10% in quantity with the value remaining about the same as that of the previous year.

Types of portland cement shipped included types I and II (general use and moderate heat), type III (high-early-strength), pozzolan, and waterproof. Purchasers of the portland cement shipped from the plants were: Ready mix companies, 62%; concrete products manufacturers, 20%; building materials dealers, 8%; government agencies, 5%; highway contractors, 3%; and other contractors and miscellaneous customers, 2%.

**Taxes.**—Tennessee has a coal severance tax of 20 cents per ton of coal mined, reports and payments due the 15th of each month. The State also has a production tax of 4.2 cents per barrel of crude oil and 5% of the sales price of any gas sold.

The raw materials used in producing portland cement were limestone, clay, shale, sand, iron ore, fly ash, and gypsum.

Ideal Basic Industries, Inc. was to complete early in 1976 a \$20 million plant improvement project at its Knoxville plant involving the installation of a new raw mill, and two new finish mills. Engineering was underway on the final stage of the modernization program for the planned installation of a single new dry process kiln to replace four old wet process kilns.<sup>2</sup>

Table 4.—Tennessee: Portland cement salient statistics  
(Short tons)

	1974	1975
Number of active plants	6	6
Production	1,557,003	1,197,907
Shipments from mills:		
Quantity	1,524,652	1,136,403
Value	\$43,338,597	\$37,865,945
Stocks at mills, Dec. 31	115,852	111,903

Table 5.—Tennessee: Masonry cement salient statistics  
(Short tons)

	1974	1975
Number of active plants	5	5
Production	174,586	154,353
Shipments from mills:		
Quantity	153,657	138,386
Value	\$4,706,381	\$4,778,473
Stocks, at mills, Dec. 31	12,894	14,954

**Clays.**—Tennessee ranked first in the production of ball clay in 1975, producing 60% of the U.S. total. Production of ball clay was 424,344 tons valued at \$7,849,303, a decrease of 15% in quantity and about 7% in value compared with 1974. Common

<sup>2</sup> Ideal Basic Industries, Inc. 1975 Annual Report. P. 5.

clay and shale production decreased 22% in quantity and about 16% in value compared with 1974. Production of fuller's earth increased about 6% in tonnage but almost doubled in value over 1974.

Ball clay was mined from 35 open pits in Carroll, Gibson, Henry, and Weakley Counties. The major producing companies were Kentucky-Tennessee Clay Co., H. C. Spinks Clay Co., Inc., and Cyprus Industrial Minerals Co. Other producers of ball clay were NL Industries and Old Hickory Clay Co. The principal uses for the ball clay produced were in the manufacture of floor and wall tile, pottery, sanitary ware, electrical porcelain, china dinnerware, and refractory mortar and cement. Other important uses included catalysts (oil refining), firebrick and block, aluminum

refining, ceramics, kiln furniture, asphalt tile, quarry tile, and pesticides. About 14% was exported for uses in ceramics, sanitary ware, and floor and wall tile.

Common clay and shale was produced from 21 open pits by 13 companies. General Shale Corp. was by far the largest producer, operating five mines in four counties. Other significant producers were General Portland, Inc.; Shalite Corp.; Tennlite, Inc.; W. G. Bush and Co.; and Bell Clay Co.

Fuller's earth was produced by Lowe's, Inc. from operations in Henry County. Production increased only slightly, but value almost doubled over that of 1974. The major uses for this clay were for oil and grease absorbent, pesticides, and pet absorbent.

Table 6.—Tennessee: Ball clay sold or used by producers, by kind and use  
(Short tons)

Use	1974			1975		
	Airfloat	Unprocessed	Total	Airfloat	Unprocessed	Total
Ceramic, hobby -----	--	--	--	6,334	--	6,334
Chemical manufacturing -----	--	--	--	441	--	441
Fine china—dinnerware -----	20,059	1,301	21,360	15,520	1,265	16,785
Crockery and other earthenware --	--	1,137	1,137	--	914	914
Electrical porcelain -----	W	W	33,822	W	W	35,551
Firebrick, block, shapes -----	--	W	W	--	9,045	9,045
Glazes, glass, enamels -----	569	--	569	457	--	457
Pottery -----	47,467	49,103	96,570	74,260	5,453	79,713
Sanitary ware -----	82,052	77,905	159,957	14,768	64,052	78,820
Floor and wall tile, ceramic -----	37,666	26,248	63,914	W	W	92,232
Quarry tile -----	--	1,137	1,137	--	914	914
Other uses <sup>1</sup> -----	31,785	68,116	<sup>2</sup> 66,079	92,362	77,927	<sup>2</sup> 42,506
Exports -----	32,438	23,340	55,778	58,845	1,787	60,632
Total -----	252,036	248,287	500,323	262,987	161,357	424,344

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

<sup>1</sup> Includes adhesives (1975), animal feed (1975), asphalt emulsion (1974), common brick, catalysts (oil refining), drilling mud, high alumina refractories, kiln furniture, refractory mortar and cement, paint (1975), pesticides and related products, rubber, asphalt tile, and data indicated by symbol W.

<sup>2</sup> Incomplete total, remainder included with total for each specific use.

Table 7.—Tennessee: Common clay sold or used by producers, by use  
(Short tons)

Use	1974	1975
Brick -----	579,972	480,172
Portland cement -----	258,795	200,829
Concrete block and structural concrete -----	298,836	204,936
Total -----	1,137,603	885,937

**Fluorspar.**—Developments in 1975 indicated that Tennessee may become a significant producer of fluorspar in the not

too distant future. U.S. Borax and Chemical Co. announced the discovery of several potentially economic deposits in McMinn, Monroe, and Loudon Counties in the Sweetwater district where drilling and metallurgical work have been underway since late 1973. Core drilling encountered substantial tonnages of fluorspar mineralization in zones 10 to 160 feet thick with grades varying from 15% to 35% CaF<sub>2</sub>. In addition to these fluorspar zones, there are substantial tonnages of potentially economic barite mineralization. Metallurgical tests show that the ore responds to simple bene-

Table 8.—Tennessee: Production of clay and shale  
(Short tons)

Type	1974			1975		
	Production	Value	Average per ton	Production	Value	Average per ton
Ball clay -----	500,323	\$8,403,994	\$16.80	424,344	\$7,849,303	\$18.50
Common clay and shale--	1,137,603	1,372,210	1.21	885,937	1,159,053	1.31
Total -----	1,637,926	9,776,204	XX	1,310,281	9,008,356	XX

XX Not applicable.

fication methods. Exploration and evaluation for mine development continued throughout the year.

**Graphite.**—Synthetic graphite was produced from petroleum coke by Union Carbide Corp., at its plant near Columbia in Maury County. The chief use of the graphite was in the manufacture of electric furnace electrodes.

**Lime.**—Three companies produced quick and hydrated lime at three plants, all located in eastern Tennessee. Williams Lime Manufacturing Co. (Knoxville plant) and Tennessee Lime Co. (Asbury plant) operated plants in Knox County; and Bowaters Southern Paper Co. operated a plant at Calhoun near Chattanooga. The lime produced had a wide variety of uses; the principal ones being in pulp and paper processing, water purification, and lithium manufacture. Output was 106,358 tons compared with 136,300 tons in 1974.

Tennessee Lime Co.'s Asbury plant ceased operations permanently in the latter part of 1975. The plant had been in operation for 40 years. The shortage of natural gas was the principal factor in the decision to close the plant.

**Perlite.**—Chemrock Corp. produced expanded perlite at its Nashville plant. The product was used as a filter aid, in concrete and plaster aggregates, as insulation, and in horticulture aggregate.

**Phosphate Rock.**—Tennessee ranked third in the Nation in tonnage and value of phosphate rock production in 1975. The ore was recovered by surface mining in four counties in the Columbia—Mt. Pleasant district of south-central Tennessee. In order of tonnage produced and value these counties were Maury, Williamson, Hickman, and Giles. The major producers were the Monsanto Industrial Chemical Co., Hooker Chemical and Plastics Corp. (a subsidiary of Occidental Petroleum Corp.), and

Stauffer Chemical Co. The Tennessee Valley Authority and M.C. West, Inc. also operated mines in the area. Surface mine permits were issued which covered 1,309 acres. Mining operations disturbed 616 acres, and the State approved the reclamation of 290 acres.

Marketable production for the year was 2,291,240 tons of concentrate from a total mine production of 4,052,302 tons of ore. This figure is 119,674 tons, or about 5%, less than the 1974 production. However, the value of production in 1975 rose from \$18,465,000 to \$28,803,000, an increase of 56%.

The average grade of ore mined was 19.9%  $P_2O_5$ , the average weight recovery of the concentrates was 56.5%, and the recovery of  $P_2O_5$  was 72.8%. A small quantity of rock mined was used directly without the benefit of concentration. All of the Tennessee production was reduced to elemental phosphorus in the 14 electric furnaces of the major producers. The elemental phosphorus in turn was converted into a wide variety of industrial chemicals.

The grade of the marketable rock sold or used during the year compared with previous years was as follows:

Grade, BPL content <sup>1</sup>	Percent distribution		
	1973	1974	1975
Less than 60% -----	66.4	19.7	80.9
60%—66% -----	19.8	75.6	17.5
66%—70% -----	12.9	4.7	1.6
70%—72% -----	—	—	—
72%—74% -----	.9	—	—
Over 74% -----	—	—	—

<sup>1</sup> 1.0% BPL (bone phosphate of lime or tricalcium phosphate) = 0.458%  $P_2O_5$ .

Stauffer Chemical Co. began construction of a new \$25 million plant to manufacture a Japanese-developed insecticide from agricultural chemicals already being produced by the company at Mt. Pleasant.

A new company, Mt. Pleasant Chemical Co., owned 50% by Stauffer and 50% by two Japanese companies will operate the plant.

**Table 9.—Tennessee: Production of phosphate rock**  
(Thousand short tons and thousand dollars)

Year	Mine production		Marketable production		Value marketable production	
	Rock	P <sub>2</sub> O <sub>5</sub> content	Rock	P <sub>2</sub> O <sub>5</sub> content	Total	Average per ton
1972	3,824	817	2,154	583	10,732	4.98
1973	4,168	894	2,512	653	12,799	5.10
1974	4,135	821	2,411	648	18,465	7.66
1975	4,052	808	2,291	588	28,803	12.57

**Table 10.—Tennessee: Phosphate rock sold or used by producers**  
(Thousand short tons and thousand dollars)

Year	Rock	P <sub>2</sub> O <sub>5</sub> content	Value	
			Total	Average per ton
1971	2,596	687	12,281	4.73
1972	2,240	587	11,188	4.99
1973	2,665	699	13,812	5.18
1974	2,607	708	20,594	7.90
1975	2,393	617	29,921	12.50

**Pyrite.**—Tennessee led the Nation in pyrite production in 1975. Tonnage and value both increased over 1974 production. The only producer in the State was Cities Service Co. at Copperhill. Pyrite was recovered by flotation from the sulfide ore produced at the company's four underground mines in the area. Processing of these concentrates yielded industrial chemicals (mostly sulfuric acid) and iron sinter.

**Sand and Gravel.**—Production increased slightly (2%) in quantity and about 14% in value compared with 1974. Eighty-six companies operated 96 open pit mines in 37 counties scattered throughout the State. Western Tennessee was, however, the principal producing area. Surface mining operations disturbed about 616 acres during the year.

Shelby County continued to be the leading producer, supplying about 40% of the sand and gravel sold or used during the year, followed by Benton County. The operations in Benton County were mainly for glass and molding sands and accounted for most of the industrial sand produced during the year.

**Silicon Carbide.**—The Carborundum Co. produced silicon carbide in 1975 at its

Jacksboro plant in Campbell County. The product was used for abrasives, refractories, and metallurgical applications.

**Stone.**—Production of all types of stone in 1975 was 39.9 million tons valued at \$83.4 million, a decrease of 4% in tonnage but an increase of 10% in value compared with 1974. Stone was second in value of the mineral commodities in the State, supplying 20% of the total.

Crushed stone continued to be the major product, accounting for more than 99% of the tonnage and 97% of the value. Crushed stone was produced from 130 limestone and two dolomite quarries (see table 16). Dimension stone was produced from five marble and four sandstone operations. A very small byproduct crushed stone was produced from dimension stone operations.

Vulcan Materials Co. (Mid-South) was by far the largest producer (22 quarries) followed by ASARCO Incorporated (5 operations), The Stone Man, Inc. (4 quarries), Mid-South Pavers, Inc. (6 quarries), and Hoover, Inc. (3 quarries). End uses for for the crushed stone were dense-graded roadbase (30%), other construction aggregate (22%), concrete aggregate (16%), bituminous aggregate (6%), agricultural



Table 11.—Tennessee: Sand and gravel sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Anderson	1	56	126	1	20	30
Benton	6	1,331	2,652	4	W	W
Cocke	1	112	83	--	--	--
Coffee	2	451	W	3	635	1,454
Cumberland	3	156	420	3	26	83
Davidson	--	--	--	1	W	6
Dyer	1	92	41	2	W	W
Fayette	1	81	15	3	69	34
Franklin	4	331	1,416	1	86	800
Hardeman	3	130	217	3	212	247
Hardin	1	7	4	2	W	W
Haywood	1	29	13	--	--	--
Henry	3	189	216	3	140	104
Humphreys	1	W	W	2	356	W
Lauderdale	2	W	W	6	147	160
Lawrence	1	197	37	1	17	5
McNairy	1	112	99	1	81	W
Madison	2	W	W	3	86	102
Marion	--	--	--	1	W	5
Obion	2	W	W	5	274	289
Perry	2	W	W	2	518	W
Putnam	2	153	332	2	W	W
Shelby	15	3,900	6,236	19	4,416	7,636
Tipton	1	W	115	7	262	338
Union	1	W	99	1	70	140
Other counties <sup>1</sup>	15	3,367	7,357	20	3,494	10,674
Total <sup>2</sup>	72	10,702	19,476	96	10,909	22,102

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

<sup>1</sup> Includes Campbell, Decatur, Greene (1975), Hamilton, Hawkins, Knox, Loudon, McMinn, Monroe, Roane (1975), Sevier (1974), Unicoi, Washington, and Wayne Counties, and counties indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 12.—Tennessee: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand	4,236	7,703	3,942	7,625
Gravel	3,836	6,501	4,266	7,790
Unprocessed:				
Sand and gravel	1,872	1,335	2,009	1,880
Industrial:				
Sand	758	3,606	693	3,591
Gravel	--	--	--	--
Total	10,702	19,145	<sup>2</sup> 10,909	20,886

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

**Table 13.—Tennessee: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	1,850	3,503	1,906	4,213
Highway and bridge construction ----	426	946	554	1,254
Other construction (dams, waterworks, airports, etc.) ----	311	648	W	W
Concrete products (cement blocks, brick, pipe, etc.) ----	2,029	3,971	1,597	3,651
Bituminous paving (asphalt and tar paving) ----	609	969	767	1,528
Roadbase and subbase ----	733	1,422	493	703
Fill ----	172	229	103	162
Other ----	116	204	117	270
<b>Unprocessed:</b>				
Roadbase and subbase ----	1,139	863	554	607
Fill ----	310	302	266	262
Other ----	---	---	---	---
Industrial sand and gravel ----	758	3,606	693	3,591
<b>Total</b> ----	<b>8,453</b>	<b>16,663</b>	<b>7,050</b>	<b><sup>1</sup>16,240</b>

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>1</sup>Data do not add to total shown because of independent rounding.

**Table 14.—Tennessee: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	450	941	354	813
Highway and bridge construction ----	302	535	519	1,006
Other construction (dams, waterworks, airports, etc.) ----	W	W	20	68
Concrete products (cement blocks, brick, pipe, etc.) ----	W	W	28	W
Bituminous paving (asphalt and tar paving) ----	283	286	669	1,455
Roadbase and subbase ----	791	881	952	1,198
Fill ----	W	W	129	295
Other ----	W	W	W	W
<b>Unprocessed:</b>				
Roadbase and subbase ----	330	129	975	829
Fill ----	92	41	213	198
Other ----	---	---	---	---
<b>Total</b> ----	<b>2,248</b>	<b>2,813</b>	<b>3,859</b>	<b>5,862</b>

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

**Table 15.—Stone in Tennessee**  
(Thousand short tons and thousand dollars)

Type	Quarries	Quantity	Value	Unit value
Dimension ----	9	16	1,998	\$124.87
Crushed and broken ----	132	39,923	81,439	2.04
<b>Total</b> ----	<b>141</b>	<b><sup>1</sup>39,938</b>	<b>83,437</b>	<b>--</b>

<sup>1</sup>Data do not add to total shown because of independent rounding.

limestone (6%), macadam aggregate (5%), cement manufacture (4%), and numerous miscellaneous purposes (11%).

**Sulfuric Acid.**—Cities Service Co. produced sulfuric acid from sulfur gases generated during the roasting and smelting of pyrite and copper concentrates from company mines at Copperhill. Sulfuric acid was the most important chemical product of the Copperhill operations of the company.

Table 16.—Tennessee: Crushed limestone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Campbell -----	3	W	W	4	994	1,850
Cannon -----	1	77	145	1	132	W
Clay -----	1	W	269	1	W	237
Cocke -----	1	104	136	1	124	248
Cumberland -----	3	941	2,204	3	W	W
Davidson -----	8	5,468	8,485	8	4,705	9,180
De Kalb -----	2	W	318	2	266	W
Fentress -----	2	294	452	2	377	650
Franklin -----	4	1,125	W	4	985	2,427
Giles -----	1	261	533	1	W	W
Greene -----	5	W	W	5	413	832
Grundy -----	1	108	W	1	W	198
Jefferson -----	4	1,137	1,477	6	2,023	3,988
Johnson -----	1	W	W	1	245	W
Knox -----	8	2,725	5,492	8	2,607	5,497
Lawrence -----	1	346	737	1	W	W
McMinn -----	2	1,000	1,957	2	423	874
Marion -----	4	1,737	2,946	4	1,486	3,007
Moore -----	1	30	45	--	--	--
Rutherford -----	3	848	1,368	3	702	1,347
Smith -----	1	46	69	2	192	W
Stewart -----	1	338	676	1	W	W
Unicoi -----	1	141	170	1	130	298
Union -----	3	190	346	3	532	1,706
Washington -----	5	147	297	5	221	377
Undistributed <sup>1</sup> -----	53	24,441	44,009	62	23,359	48,664
Total <sup>2</sup> -----	120	41,504	72,178	132	39,915	81,289

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

<sup>1</sup> Includes Anderson, Bedford, Benton, Blount, Bradley, Carter, Claiborne, Coffee, Decatur, Dickson, Hamblen, Hamilton, Hardin, Hawkins, Humphreys, Jackson, Lincoln, Loudon, Macon, Marshall, Maury, Meigs, Monroe, Montgomery, Overton, Putnam, Rhea, Roane, Robertson, Sequatchie (1975), Sevier, Sullivan, Sumner, Warren, White, Williamson, and Wilson Counties, and counties indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 17.—Tennessee: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	2,792	4,864	2,347	4,771
Concrete aggregate -----	5,327	8,911	6,578	13,156
Dense-graded roadbase stone -----	14,395	24,218	12,118	24,168
Macadam aggregate -----	2,820	4,770	2,088	4,272
Other construction aggregate and roadstone -----	5,455	9,288	8,708	17,050
Surface treatment aggregate -----	2,107	3,682	1,434	2,991
Agricultural limestone -----	<sup>1</sup> 2,752	<sup>1</sup> 4,931	2,286	4,774
Poultry grit -----	W	W	334	1,246
Cement manufacture -----	<sup>2</sup> 2,288	<sup>2</sup> 4,671	1,811	3,692
Manufactured fine aggregate (stone sand) -----	718	1,500	430	936
Railroad ballast -----	519	836	234	427
Riprap and jetty stone -----	583	1,142	634	1,328
Other uses <sup>3</sup> -----	1,748	3,366	914	2,477
Total <sup>4</sup> -----	41,504	72,178	39,915	81,289

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

<sup>1</sup> Data include agricultural limestone, poultry grit, and mineral food.

<sup>2</sup> Includes lime manufacture.

<sup>3</sup> Includes asphalt and other fillers, filter stone, flux stone (1975), glass manufacture, mine dusting, drain fields, building products (1974), terrazzo and exposed aggregates (1975), whitening (1974), and lime (1975).

<sup>4</sup> Data may not add to totals shown because of independent rounding.

**Vermiculite.**—Construction Products Div. of W.R. Grace & Co. continued production of expanded vermiculite at its plant in Nashville. The product was used in concrete and plaster aggregate, loose fill insulation, horticulture, and soil conditioning.

#### MINERAL FUELS

Mineral fuels accounted for 35% of the total value of mineral production in 1975, about the same as in 1974.

**Coal (Bituminous).**—Production of coal in 1975 was 8.2 million tons valued at \$140.3 million, an increase in tonnage and value compared with 1974.<sup>3</sup> Prices remained relatively stable during the year. Coal was the major mineral commodity produced in Tennessee. Production was from 166 mines in 16 counties of the Cumberland Plateau and Cumberland Mountain regions of the east-central part of the State. Anderson, Campbell, Claiborne, and Scott were the leading producing counties in that order, each producing more than 1 million tons during 1975. Surface and auger mines accounted for 54% of the total production and underground mines accounted for 46%. The State issued 201 surface mining permits during the year, compared with 96 in 1974.

A large percentage of the surface mined coal was sold to TVA for consumption in

steamplants; however, little of the coal mined by underground methods was sold to TVA. All of the production of the largest operation in the State—the underground mines of Consolidation Coal Co. in Claiborne County—was shipped by unit train to the Georgia Power Co. Most of the coal mined in the State was sold to electric utilities (including TVA) but the Tennessee Consolidation Coal Co. exports to Japan the entire output of metallurgical coal from mines in Marion and Sequatchie Counties.

Widespread exploratory drilling continued in the coal region during the year—both in the search for new deposits and in extending proven reserves.

**Coke.**—The Chattanooga Coke and Chemical Co., Inc., (Mead Corp.) produced all of the State's coke and breeze (under-size coke) at its plant at Alton Park in Hamilton County. Other commodities produced were ammonium sulfate, crude coal tar, naphthalene, crude light oil, and small quantities of benzene and toluene. The plant utilized coking coal from Pennsylvania, West Virginia, and Virginia, at a rate of about 450 tons per day.

<sup>3</sup> The Bureau collects production data on a voluntary basis. Many small operations did not comply with the Bureau's request for production data. Therefore, as in prior years the figure shown is somewhat less than the amount of coal actually produced in 1975.

**Table 18.—Tennessee: Bituminous coal production, by type of mine and county**  
(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines					Production (thousand short tons)					Value (thou- sands)
	Under- ground	Strip	Auger	Strip- auger	Total	Under- ground	Strip	Auger	Strip- auger	Total <sup>2</sup>	
Anderson	20	9	3	--	32	1,132	W	( <sup>1</sup> )	--	1,848	\$29,715
Bledsoe	--	3	--	--	3	--	W	--	--	W	W
Campbell	12	20	2	1	35	435	W	( <sup>1</sup> )	17	1,703	32,905
Claiborne	3	5	--	--	8	W	W	--	--	1,230	W
Cumberland	--	2	--	--	2	--	51	--	--	51	905
Fentress	--	6	--	--	6	--	216	--	--	216	3,399
Grundy	--	7	--	--	7	--	101	--	--	101	1,872
Marion	7	1	--	--	8	W	W	--	--	470	7,331
Morgan	1	10	2	--	13	13	544	19	--	576	9,334
Overton	1	1	--	--	2	W	W	--	--	W	W
Putnam	1	--	--	--	1	W	--	--	--	W	W
Roane	--	--	1	--	1	--	--	( <sup>1</sup> )	--	W	W
Scott	8	25	1	--	34	282	W	( <sup>1</sup> )	--	1,087	18,665
Sequatchie	8	2	--	--	10	W	W	--	--	605	11,905
Van Buren	1	1	--	--	2	1	25	--	--	26	419
White	--	2	--	--	2	--	W	--	--	W	W
Undistributed	--	--	--	--	--	1,944	3,294	133	--	293	23,743
Total <sup>2</sup>	62	94	9	1	166	3,806	4,231	152	17	8,206	140,293

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

<sup>1</sup> Auger production included with strip production figure to avoid disclosing individual company data.

<sup>2</sup> Data may not add to totals shown to avoid disclosing individual company confidential data.

**Nuclear Fuel.**—Nuclear Fuel Services' plant at Erwin, a specialty nuclear fuels fabrication and scrap recovery facility, expanded its services in 1975 to include the cleaning and recertification of uranium hexafluoride cylinders. Nuclear Fuel Services is a division of Getty Oil Co.<sup>4</sup>

**Petroleum and Natural Gas.**—Reported completions of oil and gas tests in Tennessee totaled 203, up 50% from 1974; development drilling increased 20%. Wells were drilled in 12 counties but activity remained concentrated in Morgan, Fentress, and Scott Counties. These counties reported 171 completions, of which 112 were exploratory. Most of these wells were lower Mississippian Fort Payne tests.<sup>5</sup>

Crude oil production for 1975 was 682,000 barrels, a decline of 11% from 1974. Of this total, 673,400 barrels were produced from Fort Payne pools in Scott and Morgan Counties. The average value of the oil at the wellhead was \$11.50. Sales of natural gas remained insignificant, 26.7 million cubic feet, although about 585 million cubic feet was vented or flared from oil producing wells.

Successful exploratory wells in 1975 found 23 new fields (8 oil, 15 gas) and 8 new pools (2 oil, 6 gas). There were 13 extensions (3 oil, 10 gas) to existing pools. None of the 1975 discoveries made significant additions to reserves in Tennessee. However, several extensions and continued development in northern Morgan County resulted in the consolidation of several producing areas into the Burrville field indicating the presence of a sizable Fort Payne reservoir. At yearend of 1975, cumulative

Fort Payne production at Burrville was 102,908 barrels from 32 wells, and 7 gas wells, currently shut-in, had been drilled in the southwestern part of the field.

At Indian Creek field, the Fort Payne reservoir produced 422,100 barrels in 1975 from 36 wells, and cumulative production at yearend was 959,500 barrels. In late 1975, pool operators began recycling gas into the reservoir for pressure maintenance. This program should enhance oil recovery and will eliminate the waste of associated gas which had previously been vented for lack of a pipeline outlet.

The success ratio for exploration and development continued to be outstanding, 30% for exploratory wells and 68% for development wells, 41% overall.

### METALS

Metals accounted for 18% of the total value of mineral production in 1975. Zinc ore was 83% of the value of metal production and copper accounted for nearly all of the remaining 17%.

**Aluminum.**—Tennessee ranked fourth in the Nation in quantity and third in value of aluminum produced in 1975. Production and value were down 26% and 2%, respectively, compared with 1974. The Aluminum Co. of America (Alcoa) in Blount County and Consolidated Aluminum Corp. (Conalco) in Humphreys County produced aluminum metal from alumina imported from outside the United States. Both com-

<sup>4</sup> Getty Oil Co. 1975 Annual Report, P. 27.

<sup>5</sup> Statler, A. T. AAPG Bulletin, August 1976, pp. 1222-1233.

Table 19. Tennessee: Oil and gas well drilling completions, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Foot-age
Campbell -----	--	--	--	1	--	2	3	6,220
Clay -----	--	--	--	--	--	2	2	2,348
Cumberland -----	--	--	--	--	--	4	4	5,261
Fentress -----	--	3	--	4	7	27	41	64,710
Grundy -----	--	--	--	--	1	--	1	2,000
Jackson -----	--	--	--	1	--	4	5	3,676
Morgan -----	29	4	12	6	15	41	107	168,636
Obion -----	--	--	--	--	--	1	1	2,328
Overton -----	--	--	1	1	--	2	4	5,501
Pickett -----	--	--	--	--	5	6	11	12,438
Scott -----	4	1	6	--	2	10	23	38,443
Smith -----	--	--	--	--	--	1	1	145
Total -----	33	8	19	13	30	100	203	311,706

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

panies operated at lesser capacities compared with the near record high 1974 levels.

Alcoa's new scrap processing plant began reclaiming aluminum from recycled beverage cans and fabricating the metal into container sheet aluminum. The company also completed facilities to extract nitrogen from the atmosphere for use in enameling furnaces. The new installations replace facilities which produce nitrogen and other gas through combustion of natural gas.<sup>6</sup>

BJR Archer, Inc., began construction on a \$13 million aluminum casting facility at its plant at Huntington in Carroll County. Output will be in the form of coiled sheet. The plant manufactures a wide range of aluminum products, including aluminum foil and sheet and aluminum tin stock.

**Copper.**—Production of copper metal in 1975 was 10,041 tons valued at about \$12.9 million; a 59% increase in tonnage and a 32% increase in value over 1974. Cities Service Co. in Polk County was the only producer of copper in the State.

The Copperhill operations of the company operated four underground mines at depths of 1,000 to 3,000 feet (the Boyd, Calloway, Cherokee, and Eureka mines) and the London flotation plant where the ore is separated into copper, pyrite (iron), and zinc concentrates. The copper and pyrite (iron) concentrates are further processed by roasting and smelting operations to produce, in order of value, sulfuric acid, copper metal, and iron sinter. The zinc concentrates are sold and shipped out-of-State.

The revamping of processing facilities at the company's industrial chemicals complex

at Copperhill continued and was scheduled to be essentially completed by the end of 1976. Iron roaster performance improved significantly in 1975 as modification of the iron system neared completion.

A new sulfuric acid plant went into production in 1975. This plant, with a capacity of 2,100 tons per day, was designed to meet all emission standards requirements. Two water treatment plants to remove chemicals and suspended solids were scheduled to be completed in 1976. Extraction of several million tons of sulfide ores near the surface, using open pit methods, was planned for startup in late 1976. Mechanization of the underground mines was continuing but reportedly it will require several years to complete.<sup>7</sup>

**Ferrous alloys.**—Tennessee ranked third in the Nation in tonnage and sixth in value of ferrous alloys produced in 1975. Six companies produced 168,278 tons valued at \$61,036,000; a decrease of about 33% in tonnage but a slight increase in value compared with 1974.

The principal uses of ferrous alloys were as additives and alloying elements in the manufacture of carbon steels, stainless steels, other alloy steels, cast irons, and various alloys.

Monsanto Industrial Chemical Co., Stauffer Chemical Co., and Hooker Chemical and Plastics Corp. produced ferrophosphorus as a byproduct of their electric furnace operations in Maury County. Roane Electric Furnace Co. (a subsidiary of Engelhard

<sup>6</sup> Aluminum Co. of America. 1975 Annual Report. Pp. 4-5, 24.

<sup>7</sup> Cities Service Co. 1975 Annual Report. P. 8.

Table 20. Tennessee: Mine production (recoverable) of gold, silver, copper, and zinc

	1973	1974	1975
Mines producing: Lode -----	9	10	11
Material sold or treated:			
Ore -----thousand short tons--	3,458	4,246	4,741
Copper-zinc -----do-----	1,323	1,153	1,635
Zinc -----do-----	2,135	3,093	3,106
Production:			
Quantity:			
Gold -----troy ounces--	68	18	W
Silver -----do-----	73,104	20,053	53,752
Copper -----short tons--	8,500	6,304	10,041
Zinc -----do-----	64,172	85,671	83,293
Value:			
Gold -----thousands--	\$7	\$3	W
Silver -----do-----	187	94	\$238
Copper -----do-----	10,115	9,745	12,893
Zinc -----do-----	26,516	61,512	64,968
Total -----do-----	1 36,824	71,354	W

W Withheld to avoid disclosing individual company confidential data.

<sup>1</sup> Data do not add to total shown because of independent rounding.

Minerals and Chemical Corp.) produced ferrosilicon, ferromanganese, and silicomanganese in an electric furnace at Rockwood in Roane County. Tennessee Metallurgical Corp. (a subsidiary of International Minerals & Chemical Corp.) produced ferrosilicon at Kimball in Marion County, and Chromium Mining and Smelting Co. produced ferrochromium from electric furnace operations at Woodstock in Shelby County.

**Gold.**—A very small amount of gold was produced as a byproduct of refining copper from Cities Service Co.'s Copperhill operations. Production of gold in 1974 was 18 ounces at a value of \$3,000.

**Iron.**—Cities Service Co. produced iron sinter as a byproduct of processing pyrite and copper concentrates at its Copperhill operations in Polk County. The product was sold to the iron and steel industry.

**Magnesium.**—Tennessee Die Casting Co. at Ripley continued producing magnesium die castings from metal shipped in from Texas. The company also produces aluminum and zinc die castings.

**Manganese.**—Foote Mineral Co. continued production of electrolytic manganese metal at its plant in New Johnsonville. The product was sold primarily to the steel and aluminum industries. Demand was high during most of 1975.

**Rare Earths and Thorium.**—W.R. Grace & Co., Davison Chemical Div., processed imported bastnäsite and monazite concentrates for rare earths and thorium at its Chattanooga plant. The company was the only monazite processor in the Nation. Thorium was extracted from monazite during the refining of rare-earth elements and stored. The company stockpile is probably the largest readily available supply of thorium in the United States.

**Silver.**—Silver was also recovered at out-of-State refineries as a byproduct of refining copper concentrates from Cities Service Co.'s Copperhill operations. Production increased from 20,053 troy ounces valued at about \$94,000 in 1974 to 53,752 troy ounces at a value of about \$238,000 in 1975.

**Titanium.**—E.I. du Pont de Nemours & Co., Inc., continued production of titanium dioxide pigment using ilmenite and rutile concentrates from Florida, Georgia, New Jersey, and Australia. Capacity of the New Johnsonville plant is 228,000 tons of pigment per year, making it the largest plant

of this type in the United States. Waste from the plant consisted of an aqueous solution of ferric chloride with a specific gravity of about 1.3, which is produced at a rate of about 500 gallons per minute. This waste is injected into two disposal wells 5,000 to 6,000 feet deep.

Ethyl Corp. announced that it was temporarily abandoning its schedule to develop a \$30 million titanium operation near Paris Landing on Kentucky Lake. However, the company retained and increased its lease holdings and purchased outright a 572-acre tract in the proposed mining area.

**Zinc.**—Tennessee regained first place among zinc producing States in 1975, after ranking third in both 1973 and 1974. Prior to 1973, Tennessee had ranked first for 15 consecutive years. With the rapidly expanding new middle Tennessee district just beginning production the State seems assured of this position for many years to come. In 1975 production decreased slightly to 83,293 tons from 85,671 tons in 1974, but value of production increased to \$65.0 million from \$61.5 million, an increase of about 5%.

Zinc ore was produced from 11 mines during 1975. In the Mascot-Jefferson City zinc district three companies ASARCO, Inc., United States Steel Corp., and New Jersey Zinc Co. operated six mines; the Coy, New Market, Young and Immel (ASARCO), the Zinc Mine Works (United States Steel), and the Jefferson City (New Jersey Zinc). Cities Service produced zinc concentrates from ore produced at its four copper mines in the Ducktown district, and the Elmwood mine of New Jersey Zinc Co. in middle Tennessee began production.

The most significant development during the year was the signing of a major partnership agreement between New Jersey Zinc Co., a subsidiary of Gulf & Western, and Union Miniere S.A. Belgium, which calls for the development of four mines in middle Tennessee including the new Elmwood mine, and a 90,000-ton-per-year electrolytic zinc refinery. The refinery will be the first new zinc refinery to be built in the United States since 1941; it will be located on the Cumberland River near Clarksville, northwest of Nashville. The project will operate as the Jersey Miniere Zinc Co., owned 60% by New Jersey Zinc and 40% by Union Miniere. The total project will represent an investment of \$190

million of which \$67 million will be allocated to mine development, \$97 million to the refinery, and the remainder to working capital.

Jersey Miniere began sinking the shaft for the Gordonsville mine and excavating an incline at the same location to gain access to mineralization north of the river which is not included in the Elmwood mine community lease. This mine is located about 2 miles southwest of the Elmwood and about 1½ miles north of Gordonsville.

In east Tennessee, ASARCO's new mill began operation at the Young mine. The concentrator has a capacity of 8,500 tons per day and has a 20% greater capacity than the old Mascot mill which it replaces. It will process ore from the Immel and Coy mines in addition to the Young mine production. The operation has no environmental problems because the carbonate waste rock and tailings are used for construction aggregate, manufactured sand, and agricultural limestone; and, in addition, all water used in the mill is recycled, and no combustion processes are involved. The zinc concentrate is used mainly for the production of zinc oxide at ASARCO's plants in Ohio and Illinois.

In addition to operating the Jefferson City mine in east Tennessee, New Jersey Zinc was involved in developing three additional mines in the area. After dewatering, the Idol mine was under development during the entire year, a 1,200-ton-per-day mill was under construction, and production was scheduled for early 1977. The main shaft was started in 1975; production at a

rate of 2,400 tons per day is planned with a heavy media plant at the mine. The concentrate from this plant will be trucked to the Jefferson City mill. A shallow incline and underground development was underway at the new Lost Creek mine with a projected production of 700 tons per day. The ore will also be trucked to the mill at Jefferson City.

Very active exploration for zinc ore continued in middle Tennessee during the year. Freeport Sulphur (Minerals) purchased zinc leases on 14,000 acres in central Tennessee from Occidental Minerals Corp. and commenced an active drilling program with an emphasis on the Carthage area. Freeport Zinc Co. requested approval for mining operations within the city limits. Toho Zinc Co. Ltd. and Nichimen Co. Ltd. of Japan entered into a joint venture agreement with Dresser Industries Inc., to explore for zinc on 25,000 acres under lease to Dresser. The Japanese companies are to invest \$1 million in a 3-year program to acquire a 50% interest in the leases.

**Table 21.—Tennessee: Tenor of zinc ore milled and concentrate produced in 1975**

Total material .....	short tons..	3,105,719
Metal content of ore: <sup>1</sup>		
Zinc .....	percent..	2.72
Concentrate produced and average content:		
Zinc .....	short tons..	137,393
Recovery ratio .....	percent..	4.42
Average zinc content ..do....		61.40

<sup>1</sup> Figure represents metal content of crude ore only as contained in the concentrate.



Table 22.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Aluminum smelters:</b>			
Aluminum Company of America.	Box 158 Alcoa, Tenn. 37701	Plant -----	Blount.
Consolidated Aluminum Corp.	1102 Richmond St. Jackson, Tenn. 38301	----do -----	Humphreys.
<b>Barite:</b>			
NL Industries, Inc -----	Box 187 Sweetwater, Tenn. 37874	Open pit mines and plant.	Monroe.
B. C. Wood Co -----	Box 284 Sweetwater, Tenn. 37874	----do -----	Loudon.
<b>Cement:</b>			
General Portland, Inc ---	1300 American National Bank Bldg. Chattanooga, Tenn. 37402	Plant -----	Hamilton.
Ideal Basic Industries, Inc	Box 6238 Knoxville, Tenn. 37914	----do -----	Knox.
Marquette Co -----	First American Center Nashville, Tenn. 37238	Plants -----	Davidson.
Penn-Dixie Industries, Inc.	60 East 42nd St. New York, N.Y. 10017	----do -----	Marion and Sullivan.
<b>Clays:</b>			
Cyprus Industrial Minerals Co.	Box 111 Gleason, Tenn. 38229	Pits and plants ---	Carroll and Weakley.
Kentucky-Tennessee Clay Co.	Box 449 Mayfield, Ky. 42066	----do -----	Carroll, Gibson, Henry, Weakley.
H. C. Spinks Clay Co., Inc	Box 820 Paris, Tenn. 38242	----do -----	Henry and Weakley.
Lowe's, Inc -----	Box 819 Paris, Tenn. 38242	----do -----	Henry.
<b>Coal, bituminous:</b>			
Consolidation Coal Co ---	Box 460 Middlesboro, Ky. 40965	Underground mine and plant.	Claiborne.
Cumberland Coal Corp --	Box 3187 Oak Ridge, Tenn. 37830	Strip mines -----	Scott and Anderson.
Grundy Mining Co., Inc -	Box 878 Jasper, Tenn. 37347	Underground mine.	Marion.
Long Pit Mining Co -----	Box 443 Harriman, Tenn. 37748	Auger and strip mines.	Campbell.
Royal Dean Coal Co., Inc	Box 428 Oneida, Tenn. 37841	Underground mine.	Scott.
Shemco, Inc -----	Route 1, Box 86-A Oliver Springs, Tenn. 37840	Strip mine -----	Morgan.
Volunteer Mining Corp --	Cody, Ky. 41808 -----	Underground mine.	Anderson.
<b>Coke:</b>			
The Mead Corp. <sup>1</sup> -----	4800 Central Ave. Chattanooga, Tenn. 37410	Plant -----	Hamilton.
<b>Copper:</b>			
Cities Service Co. <sup>2</sup> -----	Copperhill, Tenn. 37317 ---	Underground mines and plant.	Polk.
<b>Ferroalloys:</b>			
Chromium Mining & Smelting Corp.	Box 28538 Memphis, Tenn. 38128	Plant -----	Shelby.
Tennessee Metallurgical Corp.	818 Hamilton Bank Bldg. Chattanooga, Tenn. 37402	----do -----	Marion.
<b>Graphite, artificial:</b>			
Union Carbide Corp -----	Box 513 Columbia, Tenn. 38401	----do -----	Maury.
<b>Lime:</b>			
Tennessee Lime Co -----	Route 8, Asbury Rd. Knoxville, Tenn. 37914	----do -----	Knox.
Williams Lime Mfg. Co --	Box 2286 Knoxville, Tenn. 37901	----do -----	Do.
<b>Perlite, expanded:</b>			
Chemrock Corp -----	Osage St. Nashville, Tenn. 37208	----do -----	Davidson.
<b>Petroleum refinery:</b>			
Delta Refinery Co -----	543 West Mallory Ave. Memphis, Tenn. 38106	----do -----	Shelby.
<b>Phosphate rock:</b>			
Hooker Chemical and Plastics Corp. <sup>1</sup>	Box 591 Columbia, Tenn. 38401	----do -----	Maury.
Monsanto Industrial Chemical Co. <sup>1</sup>	Columbia, Tenn. 38401 ---	----do -----	Do.
Stauffer Chemical Co. <sup>1</sup> ---	Box 472 Mt. Pleasant, Tenn. 38474	----do -----	Do.
Tennessee Valley Authority.	Box 73 Columbia, Tenn. 38401	Open pit mines and plant.	Maury and Williamson.

See footnotes at end of table.

Table 22.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Sand and gravel:</b>			
Camden Gravel Co -----	Box 207 Camden, Tenn. 38320	Pit -----	Benton.
Clyde Owen Sand and Gravel, Inc.	10636 Shelton Rd. Collierville, Tenn. 38017	Pit -----	Shelby.
<b>Stone:</b>			
Hoover, Inc -----	Box 7201 Nashville, Tenn. 37210	Quarries -----	Davidson, Greene, Rutherford.
Mid-South Pavers Inc ---	720 Argyle Ave. Nashville, Tenn. 37203	----do -----	Jackson and Putnam.
The Stone Man, Inc ----	Box 2098 Chattanooga, Tenn. 37409	----do -----	Bedford, Hamilton, Rutherford, Warren.
Vulcan Materials Co ----	Box 7 Knoxville, Tenn. 37901	----do -----	Various.
Watauga Stone Co -----	Box 2389 Knoxville, Tenn. 37901	Quarry -----	Carter.
Webb Stone Co -----	Box 806 Athens, Tenn. 37303	----do -----	McMinn.
<b>Vermiculite, exfoliated:</b>			
W. R. Grace & Co -----	4061 Powell Ave. Nashville, Tenn. 37204	Plant -----	Davidson.
<b>Zinc:</b>			
ASARCO Inc. <sup>3</sup> -----	Mascot, Tenn. 37806 -----	Underground mines and plant.	Jefferson and Knox.
United States Steel Corp.	Jefferson City, Tenn. 37760.	----do -----	Jefferson.

<sup>1</sup> Also ferroalloys.<sup>2</sup> Also gold, silver, zinc, and pyrites.<sup>3</sup> Also silver and stone.



# 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 Murphy E. Hawkins<sup>1</sup> and Thomas J. Evans<sup>2</sup>

A record mineral value of over \$15.5 billion was established in 1975, an increase of 13% above the 1974 output. The mineral industry of Texas maintained its importance in the economy of the Nation by producing about 25% of the total national mineral output, thus retaining its first place ranking for the 41st consecutive year. The greatest value was in fuels, worth \$14,712 million or 94.7% of the total output. The relative proportion of nonmetals and metals to the total mineral value declined for the second straight year, reflecting the large growth in value of mineral fuels. Non-

metallic minerals were valued at \$709 million or 4.6% of the total, and metals contributed less than 1% of the total value.

Texas continued as the Nation's leader in the production of crude petroleum, natural gas, natural gas liquids, natural graphite, natural asphaltic rock, magnesium, sulfur, and carbon black. In 1975, production of minerals was reported in 238 of the State's 254 counties.

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<sup>1</sup>State Liaison Officer, Bureau of Mines, Austin, Tex.

<sup>2</sup>Geologist, Bureau of Economic Geology, The University of Texas at Austin, Austin, Tex.

Table 1.—Mineral production in Texas <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>Cement:</b>				
Masonry -----thousand short tons--	195	\$6,438	181	\$7,089
Portland -----do-----	7,739	207,706	7,195	224,804
Clays -----do-----	5,315	13,677	4,248	13,411
Coal (lignite) -----do-----	7,684	W	11,002	W
Gem stones -----do-----	NA	160	NA	160
Gypsum -----thousand short tons--	1,365	5,276	1,094	4,277
Helium, crude -----million cubic feet--	35	420	36	432
Iron ore -----thousand long tons--	W	W	601	W
Lime -----thousand short tons--	1,835	39,644	1,735	46,179
Natural gas -----million cubic feet--	8,170,798	2,541,118	7,485,764	3,885,112
<b>Natural gas liquids:</b>				
Natural gasoline and cycle products				
thousand 42-gallon barrels--	88,316	629,529	78,835	479,700
LP gases -----do-----	213,756	1,004,653	212,635	965,363
Petroleum (crude) -----do-----	1,262,126	8,773,003	1,221,929	9,336,570
Salt -----thousand short tons--	11,379	51,296	8,560	42,119
Sand and gravel -----do-----	42,466	81,364	38,649	87,106
Stone -----do-----	<sup>2</sup> 63,074	<sup>2</sup> 109,758	57,985	106,554
Sulfur (Frasch) -----thousand long tons--	4,473	W	3,406	W
Talc and soapstone -----short tons--	<sup>r</sup> 188,262	1,310	129,626	795
<b>Value of items that cannot be disclosed:</b>				
Asphalt, fluorspar, graphite, magnesium chloride, magnesium compounds, sodium sulfate, stone (dimension, 1974), uranium, and values indicated by symbol W -----				
	XX	245,792	XX	330,260
Total -----	XX	13,711,144	XX	15,529,931
Total 1967 constant dollars -----	XX	6,482,629	XX	<sup>p</sup> 6,149,853

<sup>p</sup> Preliminary. <sup>r</sup> 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.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes values of dimension stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Texas, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Anderson	\$63,880	\$159,955	Petroleum, natural gas.
Andrews	424,472	448,875	Petroleum, natural gas, natural gas liquids.
Angelina	156	596	Clays, natural gas, petroleum.
Aransas	13,067	17,804	Natural gas, petroleum, natural gas liquids.
Archer	24,612	24,992	Petroleum, natural gas.
Armstrong	W	W	Sand and gravel.
Atascosa	35,903	42,740	Natural gas, petroleum, natural gas liquids.
Austin	16,325	23,607	Petroleum, natural gas.
Bailey	W	W	Stone.
Bastrop	1,750	1,256	Petroleum, clays, natural gas.
Baylor	W	W	Petroleum, natural gas.
Bee	28,823	38,675	Natural gas, petroleum, natural gas liquids, stone.
Bell	W	3,043	Stone, sand and gravel.
Bexar	48,499	51,141	Cement, stone, natural gas liquids, petroleum, lime, sand and gravel, clays, natural gas.
Blanco	6	11	Stone.
Borden	79,282	89,239	Petroleum, natural gas, sand and gravel.
Bosque	W	W	Lime, stone.
Bowie	868	1,477	Natural gas, petroleum, sand and gravel.
Brazoria	450,073	522,410	Petroleum, natural gas, magnesium chloride, natural gas liquids, salt, lime, magnesium compounds, sand and gravel.
Brazos	2,607	2,602	Sand and gravel, natural gas, petroleum.
Brewster	W	W	Fluorspar, sand and gravel.
Brooks	85,667	98,239	Natural gas, petroleum, natural gas liquids.
Brown	4,812	5,771	Stone, petroleum, natural gas, clays.
Burleson	993	1,128	Petroleum, natural gas.
Burnet	W	W	Stone, graphite.
Caldwell	15,631	19,052	Petroleum, natural gas.
Calhoun	33,344	36,477	Natural gas, petroleum, stone, natural gas liquids, lime.
Callahan	5,495	7,231	Petroleum, natural gas, natural gas liquids, stone.
Cameron	4,018	5,950	Natural gas, petroleum.
Camp	6,226	6,862	Petroleum, natural gas.
Carson	66,354	88,402	Natural gas, natural gas liquids, petroleum.
Cass	43,961	43,940	Natural gas liquids, natural gas, petroleum, iron ore.
Chambers	201,810	225,807	Petroleum, natural gas, natural gas liquids, salt, clays.
Cherokee	23,259	8,126	Natural gas liquids, petroleum, natural gas, clays.
Childress	287	156	Petroleum, natural gas.
Clay	14,523	14,636	Petroleum, natural gas, sand and gravel.
Cochran	83,098	149,633	Petroleum, natural gas, natural gas liquids.
Coke	36,689	37,371	Petroleum, natural gas liquids, natural gas, sand and gravel.
Coleman	5,044	6,201	Petroleum, natural gas, clays.
Collin	286	W	Stone.
Collingsworth	2,315	3,392	Natural gas, petroleum.
Colorado	77,716	91,447	Natural gas, natural gas liquids, sand and gravel, petroleum.
Comal	9,559	W	Stone, lime, sand and gravel.
Comanche	407	995	Natural gas, petroleum, stone, clays.
Concho	2,554	2,932	Petroleum, natural gas, natural gas liquids.
Cooke	65,041	59,319	Petroleum, natural gas liquids, natural gas, sand and gravel, stone.
Coryell	153	W	Stone.
Cottle	251	716	Petroleum, natural gas.
Crane	363,270	378,604	Petroleum, natural gas, natural gas liquids.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by county<sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Crockett -----	\$89,440	\$109,833	Natural gas, petroleum, natural gas liquids, stone.
Crosby -----	2,138	2,304	Sand and gravel, petroleum, natural gas.
Culberson -----	W	79,594	Sulfur (Frasch), petroleum, talc, natural gas, sand and gravel.
Dallam -----	W	W	Natural gas.
Dallas -----	18,407	W	Cement, sand and gravel, stone, clays.
Dawson -----	76,573	88,518	Petroleum, natural gas, natural gas liquids, stone.
Deaf Smith -----	W	W	Lime, stone.
Denton -----	1,798	2,093	Natural gas, sand and gravel, clays, petroleum.
De Witt -----	19,124	29,473	Natural gas, petroleum, natural gas liquids.
Dickens -----	2,639	2,540	Petroleum, natural gas.
Dimmit -----	50,135	54,263	Petroleum, natural gas, natural gas liquids.
Donley -----	W	W	Sand and gravel, natural gas.
Duval -----	67,312	79,077	Petroleum, natural gas, natural gas liquids, salt, sand and gravel.
Eastland -----	6,454	8,249	Natural gas, petroleum, natural gas liquids, clays.
Ector -----	660,873	693,458	Petroleum, natural gas liquids, natural gas, cement, sand and gravel, stone.
Edwards -----	703	4,672	Natural gas, natural gas liquids, petroleum.
Ellis -----	51,987	51,535	Cement, stone, clays, petroleum, natural gas.
El Paso -----	W	W	Cement, stone, sand and gravel.
Erath -----	747	1,101	Natural gas, petroleum.
Falls -----	249	597	Stone, natural gas, petroleum.
Fannin -----	--	W	Sand and gravel.
Fayette -----	3,112	3,436	Petroleum, clays, natural gas.
Fisher -----	74,355	83,527	Petroleum, natural gas, natural gas liquids, gypsum, clays, sand and gravel.
Floyd -----	W	--	
Foard -----	2,020	2,168	Petroleum, natural gas.
Fort Bend -----	152,700	158,401	Petroleum, natural gas, sulfur (Frasch), salt, natural gas liquids, clays.
Franklin -----	30,326	34,103	Petroleum, natural gas, natural gas liquids.
Freestone -----	15,972	22,647	Coal, natural gas, stone, petroleum, clays.
Frio -----	7,872	12,826	Petroleum, natural gas, natural gas liquids.
Gaines -----	422,347	404,674	Petroleum, natural gas, natural gas liquids, sodium sulfate.
Galveston -----	87,690	115,513	Petroleum, natural gas, natural gas liquids, clays, sand and gravel.
Garza -----	67,678	52,477	Petroleum, natural gas.
Gillespie -----	1,124	W	Stone, gypsum, sand and gravel.
Glasscock -----	17,602	29,502	Petroleum, natural gas.
Goliad -----	15,030	20,344	Natural gas, petroleum.
Gonzales -----	4,038	3,562	Natural gas, clays, petroleum.
Gray -----	69,158	78,893	Petroleum, natural gas, natural gas liquids, sand and gravel.
Grayson -----	50,392	51,434	Petroleum, natural gas, natural gas liquids, stone.
Gregg -----	398,483	419,308	Petroleum, natural gas liquids, natural gas, stone.
Grimes -----	75	224	Natural gas, petroleum.
Guadalupe -----	16,192	13,781	Petroleum, sand and gravel, clays, natural gas.
Hale -----	48,140	59,142	Petroleum, natural gas liquids, natural gas.
Hamilton -----	244	567	Natural gas, petroleum.
Hansford -----	27,730	44,906	Do.
Hardeman -----	8,730	7,735	Petroleum, gypsum, natural gas liquids, natural gas, sand and gravel.
Hardin -----	40,110	40,304	Petroleum, natural gas, natural gas liquids.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by county <sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Harris -----	\$361,088	\$420,112	Petroleum, natural gas liquids, cement, natural gas, sand and gravel, salt, lime, clays.
Harrison -----	22,906	25,925	Natural gas, petroleum, natural gas liquids, coal, clays, sand and gravel.
Hartley -----	W	W	Natural gas.
Haskell -----	20,031	19,677	Petroleum, natural gas, stone.
Hays -----	W	1,573	Sand and gravel, stone.
Hemphill -----	72,330	113,214	Natural gas, petroleum, natural gas liquids.
Henderson -----	108,866	31,200	Natural gas liquids, natural gas, petroleum, clays, sand and gravel.
Hidalgo -----	52,442	78,804	Natural gas, petroleum, natural gas liquids, sand and gravel, stone.
Hill -----	W	W	Lime, stone, petroleum, natural gas.
Hockley -----	380,027	375,152	Petroleum, natural gas liquids, natural gas.
Hood -----	W	W	Natural gas, stone.
Hopkins -----	19,227	19,311	Petroleum, natural gas, natural gas liquids, clays.
Houston -----	13,866	17,763	Petroleum, natural gas, natural gas liquids.
Howard -----	134,241	138,946	Petroleum, natural gas liquids, natural gas, stone.
Hudspeth -----	1,710	1,224	Talc, stone, sand and gravel, gypsum.
Hunt -----	243	361	Natural gas, petroleum.
Hutchinson -----	158,849	162,148	Natural gas liquids, natural gas, petroleum, sand and gravel, salt.
Irion -----	18,038	23,734	Petroleum, natural gas, natural gas liquids.
Jack -----	22,381	29,282	Petroleum, natural gas, natural gas liquids, stone.
Jackson -----	168,150	181,100	Petroleum, natural gas, natural gas liquids.
Jasper -----	1,886	3,359	Petroleum, natural gas.
Jeff Davis -----	--	W	Stone.
Jefferson -----	98,030	104,133	Natural gas, petroleum, sulfur (Frasch), natural gas liquids, salt, clays, sand and gravel, stone.
Jim Hogg -----	15,229	19,832	Natural gas, petroleum, natural gas liquids.
Jim Wells -----	131,792	168,463	Natural gas, petroleum, natural gas liquids, stone.
Johnson -----	7,067	W	Lime, sand and gravel, stone.
Jones -----	14,121	14,526	Petroleum, natural gas, sand and gravel.
Karnes -----	42,303	53,565	Natural gas, uranium, petroleum, natural gas liquids.
Kaufman -----	4,285	3,949	Petroleum, stone, natural gas.
Kenedy -----	36,548	50,585	Natural gas, natural gas liquids, petroleum.
Kent -----	135,064	105,800	Petroleum, natural gas, sand and gravel.
Kerr -----	839	155	Sand and gravel.
Kimble -----	899	941	Natural gas, sand and gravel, petroleum.
King -----	17,876	26,325	Petroleum, natural gas, stone.
Kleberg -----	321,807	335,730	Natural gas, natural gas liquids, petroleum, stone.
Knox -----	5,383	5,304	Petroleum, natural gas.
Lamb -----	W	1,039	Petroleum, stone, natural gas.
Lampasas -----	310	89	Sand and gravel.
La Salle -----	3,259	3,937	Natural gas, petroleum.
Lavaca -----	22,440	34,383	Natural gas, petroleum, natural gas liquids.
Lee -----	1,051	1,266	Petroleum, natural gas.
Leon -----	3,946	3,941	Natural gas, petroleum.
Liberty -----	53,619	61,899	Petroleum, sulfur (Frasch), natural gas, natural gas liquids, sand and gravel.
Limestone -----	7,760	9,210	Natural gas, clays, sand and gravel, petroleum, stone.

See footnotes at end of table.



Table 2.—Value of mineral production in Texas, by county <sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Lipscomb -----	\$19,135	\$28,985	Natural gas, petroleum.
Live Oak -----	26,336	37,349	Natural gas, petroleum, natural gas liquids, uranium, sand and gravel.
Llano -----	382	576	Stone.
Loving -----	13,832	25,249	Natural gas, petroleum.
Lubbock -----	5,979	4,657	Petroleum, stone, natural gas, natural gas liquids.
Lynn -----	1,676	1,567	Petroleum, natural gas.
McCulloch -----	W	5,787	Sand and gravel, natural gas, stone, petroleum.
McLennan -----	15,942	15,222	Cement, sand and gravel, stone, natural gas liquids, clays, petroleum, natural gas.
McMullen -----	18,030	24,855	Natural gas, petroleum, stone.
Madison -----	3,909	6,682	Natural gas, petroleum.
Marion -----	6,060	5,589	Petroleum, natural gas, clays, natural gas liquids.
Martin -----	87,249	94,771	Petroleum, natural gas, stone, natural gas liquids.
Mason -----	--	W	Stone.
Matagorda -----	96,158	112,515	Natural gas, petroleum, natural gas liquids, stone, salt.
Maverick -----	7,879	11,994	Petroleum, natural gas, natural gas liquids, sand and gravel.
Medina -----	1,717	2,085	Petroleum, sand and gravel, natural gas, clays.
Menard -----	1,676	1,702	Petroleum, natural gas.
Midland -----	111,359	126,102	Petroleum, natural gas, natural gas liquids, stone.
Milam -----	W	7,032	Coal, petroleum, natural gas.
Mitchell -----	35,692	36,432	Petroleum, natural gas, stone, sand and gravel.
Montague -----	21,440	22,973	Do.
Montgomery -----	414,388	201,661	Petroleum, natural gas, natural gas liquids.
Moore -----	124,477	171,732	Natural gas, natural gas liquids, petroleum, helium.
Morris -----	9,141	W	Iron ore.
Motley -----	2,921	2,965	Petroleum, sand and gravel, natural gas.
Nacogdoches -----	6,366	11,088	Natural gas, iron ore, petroleum, clays.
Navarro -----	13,022	18,980	Petroleum, natural gas, clays, stone.
Newton -----	7,007	6,865	Petroleum, natural gas.
Nolan -----	57,224	57,833	Petroleum, cement, natural gas, natural gas liquids, gypsum, stone, sand and gravel.
Nueces -----	155,674	174,977	Natural gas, petroleum, natural gas liquids, lime, cement, sand and gravel.
Ochiltree -----	53,845	62,968	Petroleum, natural gas, natural gas liquids.
Oldham -----	3,622	4,389	Petroleum, sand and gravel, natural gas.
Orange -----	17,847	17,255	Petroleum, cement, natural gas, sand and gravel, clays.
Palo Pinto -----	15,150	22,232	Natural gas liquids, natural gas, petroleum, sand and gravel, clays.
Panola -----	48,059	66,501	Natural gas, natural gas liquids, petroleum.
Parker -----	15,259	15,724	Natural gas liquids, natural gas, stone, petroleum, sand and gravel, clays.
Parmer -----	--	W	Stone.
Pecos -----	436,159	583,435	Natural gas, petroleum, natural gas liquids, sulfur (Frasch), stone, sand and gravel.
Polk -----	11,250	21,031	Petroleum, natural gas, natural gas liquids.
Potter -----	46,043	61,800	Natural gas, natural gas liquids, cement, stone, petroleum, sand and gravel, clays.
Rains -----	2,141	2,671	Natural gas, petroleum.
Randall -----	491	525	Stone.
Reagan -----	84,213	98,604	Petroleum, natural gas liquids, natural gas, stone.
Red River -----	111	115	Petroleum, natural gas.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by county <sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Reeves -----	\$72,444	\$103,025	Natural gas, petroleum, natural gas liquids, sand and gravel, stone.
Refugio -----	295,070	326,795	Petroleum, natural gas, natural gas liquids.
Roberts -----	18,239	32,932	Natural gas, petroleum.
Robertson -----	35	38	Petroleum, natural gas.
Runnels -----	10,492	12,201	Petroleum, natural gas, sand and gravel.
Rusk -----	155,728	164,030	Petroleum, natural gas liquids, natural gas, clays.
San Jacinto -----	1,371	2,273	Natural gas, petroleum.
San Patricio -----	56,621	74,363	Petroleum, natural gas, natural gas liquids, stone, clays.
Schleicher -----	16,746	20,396	Natural gas, petroleum, natural gas liquids.
Scurry -----	809,059	905,308	Petroleum, natural gas liquids, natural gas, magnesium chloride, stone.
Shackelford -----	21,081	25,435	Petroleum, natural gas, natural gas liquids, stone.
Shelby -----	1,290	2,010	Natural gas, petroleum.
Sherman -----	19,088	31,190	Do.
Smith -----	31,989	32,131	Petroleum, natural gas, natural gas liquids, clays, stone.
Somervell -----	1,095	1,620	Sand and gravel.
Starr -----	71,657	83,297	Natural gas, petroleum, natural gas liquids, sand and gravel.
Stephens -----	24,206	31,063	Petroleum, natural gas, natural gas liquids, stone.
Sterling -----	7,498	12,963	Petroleum, natural gas.
Stonewall -----	40,733	42,038	Petroleum, natural gas liquids, natural gas, gypsum.
Sutton -----	18,860	40,835	Natural gas, natural gas liquids, petroleum.
Tarrant -----	19,542	W	Cement, sand and gravel, stone, natural gas.
Taylor -----	21,244	22,345	Petroleum, stone, natural gas, sand and gravel, natural gas liquids, clays.
Terrell -----	12,345	18,623	Natural gas, petroleum.
Terry -----	91,507	86,448	Petroleum, natural gas, sodium sulfate, natural gas liquids.
Throckmorton -----	10,678	11,821	Petroleum, natural gas.
Titus -----	W	24,654	Petroleum, coal, natural gas.
Tom Green -----	16,876	18,139	Petroleum, natural gas, natural gas liquids, sand and gravel.
Travis -----	9,634	W	Lime, stone, sand and gravel, petroleum, natural gas.
Trinity -----	46	91	Petroleum, natural gas.
Tyler -----	5,100	6,709	Do.
Upshur -----	19,499	26,102	Petroleum, natural gas, sand and gravel.
Upton -----	110,850	151,471	Petroleum, natural gas, natural gas liquids.
Uvalde -----	15,628	19,687	Asphalt, stone, sand and gravel, petroleum, natural gas.
Val Verde -----	W	2,296	Natural gas, petroleum.
Van Zandt -----	144,221	154,394	Petroleum, natural gas liquids, natural gas, salt, clays.
Victoria -----	41,770	53,606	Petroleum, natural gas, sand and gravel, natural gas liquids.
Walker -----	192	600	Stone, natural gas, clays, petroleum.
Waller -----	176,983	185,655	Natural gas, natural gas liquids, petroleum, sand and gravel.
Ward -----	190,070	262,892	Natural gas, petroleum, natural gas liquids, sand and gravel.
Washington -----	1,275	1,650	Petroleum, stone, natural gas.
Webb -----	17,531	41,831	Natural gas, petroleum, natural gas liquids, sand and gravel, stone.
Wharton -----	96,332	113,839	Sulfur (Frasch), petroleum, natural gas, natural gas liquids, clays.
Wheeler -----	21,650	36,129	Natural gas, petroleum, natural gas liquids.
Wichita -----	46,305	48,597	Petroleum, natural gas, sand and gravel, natural gas liquids, stone.

See footnotes at end of table.

Table 2.—Value of mineral production in Texas, by county<sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Wilbarger -----	\$25,005	\$26,851	Petroleum, natural gas liquids, natural gas, sand and gravel.
Willacy -----	20,386	24,212	Petroleum, natural gas.
Williamson -----	W	9,449	Stone, lime, petroleum, natural gas.
Wilson -----	4,496	4,166	Petroleum, natural gas.
Winkler -----	184,363	236,175	Natural gas, petroleum, natural gas liquids.
Wise -----	86,399	102,688	Natural gas, natural gas liquids, petroleum, stone, sand and gravel, clays.
Wood -----	358,966	398,638	Petroleum, natural gas liquids, natural gas, clays, sand and gravel.
Yoakum -----	606,304	796,715	Petroleum, natural gas liquids, natural gas, salt.
Young -----	16,721	21,072	Petroleum, natural gas, natural gas liquids, stone, sand and gravel.
Zapata -----	7,053	14,335	Natural gas, petroleum.
Zavala -----	5,175	5,470	Petroleum, natural gas.
Undistributed <sup>2</sup> -----	216,585	247,165	
Total -----	<sup>3</sup> 13,711,144	15,529,931	

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

<sup>1</sup> The following counties are not listed because no production was reported: Bandera, Briscoe, Castro, Delta, Hall, Kendall, Kinney, Lamar, Mills, Presidio, Real, Rockwall, Sabine, San Augustine, San Saba, and Swisher. Value of petroleum and natural gas is based on an average price per barrel and cubic foot, respectively, for the State.

<sup>2</sup> Includes some petroleum, natural gas, and natural gas liquids that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

<sup>3</sup> Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Texas business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	5,141.0	5,292.0	+2.9
Unemployment -----do-----	220.0	295.0	+34.1
<b>Employment (nonagricultural):</b>			
Mining -----do-----	120.3	129.1	+7.3
Manufacturing -----do-----	830.5	800.2	-3.6
Contract construction -----do-----	292.3	280.4	-4.1
Transportation and public utilities -----do-----	294.5	288.3	-2.1
Wholesale and retail trade -----do-----	1,055.3	1,077.0	+2.1
Finance, insurance, real estate -----do-----	247.5	256.3	+3.6
Services -----do-----	736.5	766.2	+4.0
Government -----do-----	775.7	815.6	+5.1
Total nonagricultural employment -----do-----	4,352.6	4,413.1	+1.4
<b>Personal income:</b>			
Total -----millions--	\$61,362	\$68,903	+12.3
Per capita -----do-----	\$5,106	\$5,631	+10.3
<b>Construction activity:</b>			
Number of private and public residential units authorized	69,943	62,749	-10.3
Value of nonresidential construction -----millions--	\$1,432.0	\$1,247.2	-12.9
Value of State road contract awards -----do-----	\$600.0	\$386.0	-35.7
Shipments of portland and masonry cement to and within Texas -----thousand short tons--	6,524	6,288	-3.6
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$13,711.1	\$15,529.9	+13.3
Value per capita, resident population -----do-----	\$1,140.98	\$1,265.99	+11.2
Value per square mile -----do-----	\$51,287.67	\$58,091.00	+13.3

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

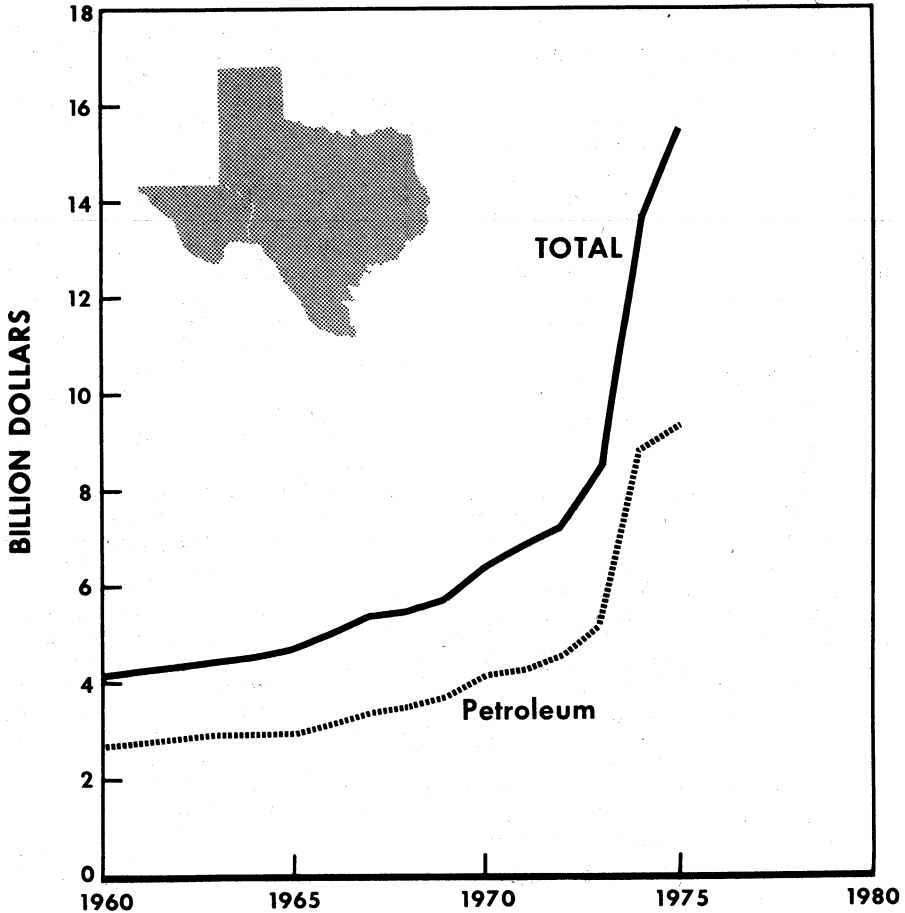


Figure 1.—Value of petroleum and total value of mineral production in Texas.

**Trends and Developments.**—The Texas mineral industry had its ups and downs in 1975. The production and proved reserves of crude oil and natural gas continued their downward slide, but the unit price of each commodity rose sufficiently to push the total value to alltime record highs. Production and proved reserves of natural gas liquids continued to decline. Unit value dropped sharply below 1974 levels because of price-regulating actions of the Federal Energy Administration (FEA).

Texas again led the Nation in exploratory and development drilling for oil and gas, employing about 40% of the working rigs in the United States. A total of 12,086

wells were drilled in Texas compared with 9,529 wells drilled in 1974. Of this total, 3,203 were wildcat wells which resulted in the discovery of 311 oil and 571 gas pools.

Demand for natural gas remained strong with the wellhead prices approaching \$2.00 per thousand cubic feet in the unregulated intrastate market. This price provided operators with added incentives to drill new prospects and to reevaluate areas that were uneconomical at lower prices. Consequently, more gas wells were drilled in 1975 than in any year since 1962.

Along with the completion of numerous low-capacity gas wells, drillers also found the world's largest productive gas well in Pecos County. This record-setting well was

completed with a calculated absolute open-flow potential of 4.3 billion cubic feet per day, surpassing the previous record for a gas well of 2.75 billion cubic feet per day in Hemphill County.

On the negative side, geophysical activity was below 1974 levels in most areas of the State and was particularly lower, by about 50%, in the upper gulf coast offshore area.

Companies and individual operators continued to acquire new leases, especially in gas potential areas, although overall competition was not as spirited as in late 1973 and in 1974.

In October, the University of Texas leased 133,941 acres of university lands in west Texas for \$9,687,500. About 43,500 acres of this total was in Terrell County (Val Verde Basin), which has promising gas potential. The highest bonus was paid for a 320-acre tract in Winkler County that brought an average of \$1,436 per acre.

The Texas General Land Office conducted three statewide lease sales in 1975. At these sales, a total of 216,433 acres were leased for \$9,686,019 yielding an average bonus of \$44.75 per acre.

There were three Federal Outer Continental Shelf (OCS) lease sales during the year. In February 1975, the U.S. Department of the Interior offered for lease nearly 3 million acres of Federal OCS acreage off the Texas coast. Bidding was disappointing with only one-third of the tracts drawing bids. A total of \$300.6 million was offered for the tracts, which is less than one-fourth of the total of winning bids in each of the last six sales held in the Gulf since 1972. The highest bid for a single tract was \$18,190,000. The last two OCS lease sales were held on May 28, 1975 and July 29, 1975. The bidding at both of these sales also proved disappointing. For example, at the July sale, total bidding plunged to a record low of \$171.4 million when only 80 of the 347 tracts tendered received offers. The highest bid was \$13,659,000 or \$2,732 per acre for a West Cameron tract.

In 1975, leasing for lignite and coal continued strong but at a less feverish pace than in earlier years. The slowdown may suggest that companies and individuals have acquired the most favorable or easily attainable acreage. At yearend, there were

several new mines under development or in the advanced planning stages that should push the State's output of lignite upward in future years. Lignite production was over 11 million tons in 1975, an increase of 43% over 1974 and 172% over 1972.

Interest continued in the possibility of gasifying Texas lignites, particularly in situ gasification of the deep-basin beds. Texas Utilities Generating Co. was planning a pilot in situ gasification project in east Texas. The company plans to employ Russian technology in the test.

An investigation of the potential geothermal sources in Texas was completed by researchers at The University of Texas at Austin. The results of the study, published in early 1975, identifies two areas with potential geothermal resources; one is an extensive area of the Gulf Coastal Plain and adjacent offshore area and the other is the Rio Grande rift systems in the Trans-Pecos Region in far west Texas.<sup>3</sup>

As expected, the demand for the non-metallic or industrial minerals was affected adversely by the extended slowdown in the Texas construction industry that began in 1974. In 1975, declines in production were noted for cement, common clay and shale, fire clay, fluorspar, graphite, gypsum, kaolin clay, lime, salt, sand and gravel, stone, sulfur, talc, and vermiculite. Barite, ball clay, bentonite, fuller's earth, natural sodium sulfate, and perlite managed to register increases over last year's output. Despite production declines, value increases were noted for cement, fluorspar, lime, sand and gravel, sulfur (both Frasch and recovered), and vermiculite.

Notable development in the nonmetallic sector includes the completion of Texasgulf, Inc.'s new Comanche Creek Frasch sulfur mine. Output from the Comanche Creek mine was expected to increase the State's sulfur production from 400,000 to 600,000 long tons per year.

Kaiser Cement & Gypsum Corp. installed a new kiln at the San Antonio Longhorn cement plant upping the productive capacity to 785,000 tons per year.

Output from the primary metal sector moved lower as the State's three aluminum smelters were hit by a sharp drop in metal

<sup>3</sup> Dorfman, M., and R. Kehle. Potential Geothermal Resources of Texas. Bureau of Economic Geology, University of Texas, Austin, Tex., Geol. Circ. 74-4, 1974.

demand. Other primary metals produced, such as copper, iron, magnesium, and zinc, were also below the 1974 output. ASARCO, Inc. closed permanently its Amarillo zinc smelter because of air pollution problems. ASARCO completed construction of the company's new \$190 million refinery in Amarillo and began production of refined copper. The company also announced plans to construct an anti-mony recovery unit at its El Paso metallurgical facilities.

Other developments include the completion of Chaparral Steel Co.'s new 250,000-ton-per-year mill near Midlothian. The company plans to add another 100-ton electric furnace raising the annual capacity to about 500,000 tons per year. Texas Reduction Corp. was building a new 44-million-ton-per-year aluminum recycling and smelting plant south of Houston. The plant should be onstream in early 1976.

The south Texas uranium district continued as the proving ground for perfecting in situ solution mining techniques. During the year, Atlantic Richfield Co. converted the Clay West pilot project into the Nation's first commercial-scale in situ uranium-solution mine. Five other pilot projects were in various stages of development ranging from early evaluation to near commercial production.

#### Legislation and Government Programs.

—The 64th legislature passed a law regulating surface mining of coal, lignite, and uranium. The bill, entitled "Texas Surface Mining and Reclamation Act," was signed into law by Governor Dolph Briscoe in June 1975; however, the law was not effective until January 1, 1976. The new act will be administered by the Texas Railroad Commission (TRRC). Although the statute is comprehensive, it does provide for the commission to promulgate some rules of practice and procedure. The commission conducted public hearings in late 1975, and will publish procedures and substantive rules for surface mining of coal, lignite, and uranium in early 1976.

Following legislative approval, the State of Texas became the 12th State to join the Interstate Mining Compact Commission. Governor Briscoe appointed six individuals to the Texas Mining Council. The purpose of the council is to advise the Governor on mining problems.

The Texas Legislature enacted a law creating the State's first public utility commission. The new law gives the commission the authority to set all intrastate utility rates with the exception of natural gas. The TRRC will continue to regulate gas utilities and supervise ratemaking by the cities and gas utilities. The commission will be composed of three members appointed by the Governor.

Reflecting the growing concern over the dwindling supply of natural gas, the legislature passed a law giving Texans first chance to purchase natural gas produced from wells drilled on State-owned lands under future lease agreements. The law provides that, hereafter, any natural gas sold from leases on State-owned land for use outside of Texas will require a permit from the TRRC.

The TRRC established new regulations aimed at reducing consumption of natural gas for boiler fuel. After December 17, 1975, no gas supplier shall deliver for use as boiler fuel any additional gas over existing contracted volumes or the average daily volume delivered during 1974 and 1975, or whichever is greater. Furthermore, users of 100,000 cubic feet per day or more will be subject to a 10% reduction in gas deliveries in January 1981 and a 25% reduction 4 years later.

The TRRC held public hearings and issued rules governing exploration, development, and production of geothermal energy in Texas. The final rules and regulations adopted generally follow those that are currently in effect for oil and gas exploration, development, and production.

ASARCO agreed to install from \$40 to \$50 million worth of new pollution control equipment at its El Paso smelter to meet the State's clean air requirements. This agreement, in the form of an amended judgment and order of injunction by the State district court, concludes a 3-year litigation involving ASARCO, the attorney general's office, and the city of El Paso. As part of this final accord, ASARCO will pay the city of El Paso and the State of Texas \$250,000 in civil penalties in four installments of \$62,500 during the next 4 years. The city and El Paso County governments have endorsed an ASARCO proposal to finance these pollution improvements through municipal bond issues of from \$40 to \$80 million.

Under the original judgment of May 1972, ASARCO has already installed about \$23 million in pollution control equipment and agreed to pay medical expenses for children living near the smelter who allegedly were suffering from lead poisoning.

Armco Steel Co. received approval from the Texas Air Control Board to continue operating coke ovens that the company had earlier agreed to shutdown at its

Houston works. In 1973, the company had agreed to stop using the ovens by 1976 as settlement of an air pollution suit brought by the State. As part of the same suit, Armco paid a \$250,000 air pollution fine. The shortage of natural gas and coke plus development of new coke oven pollution control technology caused the company to reconsider its earlier decision to close the Houston coke facilities and to install pollution control equipment.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Asphalt (Native).**—A cutback in highway construction contributed to a drop of about 4% in the production of naturally occurring asphaltic-impregnated limestone. Unit value however increased 40% over that in 1974. The commodity, mined by two Uvalde County producers, was used primarily in road surfacing.

**Carbon Black.**—Output from the State's carbon black industry, consisting of 1 channel and 12 furnace plants, declined for the second year in a row. Production was 1,228 million pounds, down from 1,435 million pounds for 1974. Average price was 10.98 cents per pound, essentially unchanged from an average value of 10.84 cents per pound last year. A total of 238 million gallons of liquid hydrocarbons and 7,669 million cubic feet of natural gas was consumed in the production of carbon black. Average yield was 5.08 pounds of carbon black per gallon of liquid hydrocarbon.

**Coal (Lignite).**—Production of lignite from the State's four strip mines was 11,002,000 tons, an increase of 43% over the output of 7,684,000 tons in 1974. The Texas Utilities Generating Co. operated two mines, the Big Brown (Freestone County) and the Monticello (Titus County), that produced over 80% of the State's total. The Big Brown mine continued as the State's largest producer.

The remaining production was from the Aluminum Co. of America's (Alcoa) Sandow strip mine (Milam County) and ICI United States, Inc.'s Darco strip mine (Harrison County). All of the lignite production was utilized within the State in mine-mouth steam-electric powerplants or for the production of activated carbon.

Texas Utilities Generating Co. continued construction of mining facilities at the Martin Lake strip mine near Beckville (Panola County). The mine is scheduled to begin production in late 1976. When fully developed, the Martin Lake mine will have a productive capacity exceeding this year's total State output of lignite.

**Helium.**—Texas output of helium in 1975 was 36 million cubic feet, up 1 million cubic feet or 3% above 1974 production. The unit value was unchanged.

**Natural Gas.**—Marketed production of natural gas was 7,486 billion cubic feet valued at \$3,885 million, a decrease of 685 million cubic feet under the 1974 marketed production. Average wellhead price for marketed gas was 51.9 cents per thousand cubic feet, up from 31.1 cents per thousand cubic feet in 1974. Texas again ranked first in the production of natural gas, producing 37% of the Nation's total.

Production was reported in 210 of the State's 254 counties. The 10 leading gas-productive counties were Pecos, Kleberg, Ward, Waller, Winkler, Moore, Hemphill, Brazoria, Nueces, and Reeves. As of December 31, 1975, the State had a total of 39,281 gas wells, an increase of 2,038 wells over yearend 1974.

As of December 31, 1975, the American Gas Association (AGA) reported the State's total proved natural gas reserves to be 71,037 billion cubic feet, down from last year's reserves of 78,541 billion cubic feet. The 10% decline represents the eighth consecutive year the State has shown a loss in natural gas reserves.

The price of new gas for consumption in Texas remained in the \$1.80 to \$2.00 per thousand cubic feet range providing

drillers with an incentive to explore for gas. An active exploration drilling program resulted in the discovery of 571 new fields compared with 562 new gas pools discovered in 1974.

Noteworthy additions to the State's proved gas reserves from new gas discoveries were made in railroad district 10 (panhandle) and in districts 2, 3, and 4 (gulf coast and offshore). Significant reserve additions by extensions and revisions were registered in districts 3 (upper gulf coast), 8 (west Texas), and 10 (panhandle); however, unusually large losses were experienced in districts 2 and 4 (lower gulf coast), 6 (east Texas), and 8A (west Texas). It should be noted that large reserve losses in the latter four districts totaled a staggering 2,674 billion cubic feet which erased the total reserve additions in all categories. Consequently, when this reserve loss is added to the net withdrawal (production), the State ended 1975 with the second largest loss in proved natural gas reserves in its history.

**Natural Gas Liquids.**—Production of natural gas liquids was 291.5 million barrels, down 10.6 million barrels from 1974. Average value dropped sharply from \$5.41 to \$4.96 per barrel yielding a total value of \$1,445 million. Texas again ranked first in the production of natural gas liquids with 49% of the U.S. total.

The chief components of natural gas liquids were propane and butane, 52%; natural gasoline, 23%; ethane, 21%; and others, 4%.

As of December 31, 1975, natural gas liquid reserves were 2,661 million barrels, a decrease of 136 million barrels or 5% below yearend 1974. Although the State's natural gas liquid reserves decreased for the eighth successive year, the State continued to rank first with 42% of the Nation's total.

The most significant additions to the natural gas liquid reserves from new fields

and new pools in old fields were in railroad districts 2, 3, and 4 (gulf coast), and in district 10 (panhandle). The most notable additions to the reserves from extension and revision were in railroad district 8 and 8A (west Texas), district 4 (south Texas), and districts 9 and 10 (north Texas and panhandle).

According to the Oil and Gas Journal's annual survey of natural gas processing plants, Texas had 357 plants, 1 less than a year ago. Daily capacity on December 31, 1975, was 29.02 billion cubic feet, down from 29.45 billion cubic feet in 1974 and 29.88 billion cubic feet in 1973.

**Petroleum.**—Texas 1975 production of crude oil declined for the third consecutive year from a record high in 1972. Output was 1,222 million barrels, a decrease of 40 million barrels or 3% below 1974 production. The average price of crude oil rose from \$6.95 to \$7.64 per barrel yielding a total value of \$9,337 million, a new record.

Production was reported from 205 counties, 4 counties more than in 1974. The 10 leading counties, in order of output in million barrels, were Scurry, 91.6; Yoakum, 82.8; Ector, 69.0; Gaines, 60.7; Hockley, 52.6; Andrews, 52.3; Gregg, 49.7; Wood, 46.9; Refugio, 36.4; and Crane, 36.2. The combined output of these 10 counties was 578.2 million barrels or 47% of the State's total production.

According to the TRRC, the State had 160,603 oil-productive wells at yearend. Average daily production per well was 20.9 barrels compared with 21.7 barrels in 1974 and 21.7 barrels in 1973.

Crude oil stocks above the ground were 79.5 million barrels, up about 150,000 barrels from yearend 1974. Of this total, 18.6 million barrels were at refineries, 4.2 million barrels on leases, and 56.7 million barrels at tank farms and in pipelines. Refinery product stocks were 116.2 million barrels at yearend 1975, up 1.3 million barrels from 1974.



Table 4.—Texas: Production and value of petroleum, natural gas, and natural gas liquids

Year	Crude petroleum		Natural gas <sup>1</sup>			
	Thousand 42-gallon barrels	Value (thousands)	Million cubic feet	Value (thousands)		
1971 -----	1,222,926	\$4,261,775	8,550,705	\$1,376,664		
1972 -----	1,301,685	4,536,077	8,657,840	1,419,886		
1973 -----	1,294,671	5,157,623	8,513,850	1,785,221		
1974 -----	1,262,126	8,773,003	8,170,798	2,541,118		
1975 -----	1,221,929	9,386,570	7,485,764	3,885,112		
Natural gas liquids						
	Natural gasoline and cycle products		LP gases and ethane		Total	
	Thousand 42-gallon barrels	Value (thousands)	Thousand 42-gallon barrels	Value (thousands)	Thousand 42-gallon barrels	Value (thousands)
1971 -----	96,286	\$299,981	210,435	\$380,887	306,721	\$680,868
1972 -----	92,437	294,163	226,624	428,319	319,061	722,482
1973 -----	92,743	347,393	221,686	589,685	314,429	937,078
1974 -----	88,316	629,529	213,756	1,004,653	302,072	1,634,182
1975 -----	78,835	479,700	212,635	965,363	291,470	1,445,063

<sup>1</sup> Marketed production, gas either sold or consumed by producers including losses in transmission, amounts added to storage, and increases in gas pipelines.

Table 5.—Texas: Comparison of crude oil, natural gas, and natural gas liquids production in Texas and the United States  
(Million barrels of crude oil equivalent)

Commodity	Production as oil equivalent <sup>1</sup>				Change from 1974 (percent)				Distribution percentage				Texas as percent of United States			
	Texas		United States		Texas		United States		Texas		United States		Texas		United States	
	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975
Crude oil	1,262	1,222	3,203	3,057	-3.2	-4.6	42.9	44.1	42.6	43.2	39.4	40.0	37.2	37.2	37.8	40.0
Natural gas (marketed)	1,459	1,337	3,357	3,591	-8.4	-6.9	49.6	48.2	51.4	50.7	60.7	57.2	57.2	57.8	57.8	57.2
Natural gas liquids	220	213	449	485	-3.2	-3.1	7.5	7.7	6.0	6.1	49.0	49.0	49.0	49.0	49.0	49.0
Total equivalent	2,941	2,772	7,009	7,033	-5.8	-5.7	100.0	100.0	100.0	100.0	89.2	89.1	89.2	89.1	89.2	89.1

<sup>1</sup> One barrel of crude oil is equivalent to 5,600 cubic feet of natural gas or 57.6 gallons of natural gas liquids.

Table 6.—Texas: Crude oil, natural gas, and natural gas liquids reserves to production ratio in Texas and the United States<sup>1</sup>  
(Million barrels of crude oil equivalent)

Commodity	Reserves				Reserve percentage				Reserve to production ratio			
	Texas		United States		Texas as percent of United States		Change from 1974 (percent)		Texas		United States	
	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975
Crude oil	11,002	10,080	34,250	32,682	32.1	30.8	-8.4	-4.6	8.7	8.2	10.7	10.7
Natural gas	14,025	12,686	42,345	40,750	33.1	31.1	-9.6	-3.8	9.6	9.5	11.0	11.3
Natural gas liquids	2,039	1,940	4,631	4,570	44.0	42.5	-4.9	-1.3	9.3	9.1	10.3	10.5
Total oil equivalent	27,066	24,705	81,226	78,002	33.3	31.7	-8.7	-4.0	9.2	8.9	10.8	11.0

<sup>1</sup> Estimated proved reserves and production from American Gas Association and American Petroleum Institute. One barrel of crude oil is equivalent to 5,600 cubic feet of natural gas or 57.6 gallons of natural gas liquids.

**Table 7.—Texas: Production trends of crude oil, natural gas, and natural gas liquids**  
(Million barrels of crude oil equivalent)

Year	Percentage of—										
	Production <sup>1</sup>					Annual total					
	Oil	Gas <sup>2</sup>	Liquids	Total	Oil	Gas	Liquids	Oil	Gas	Liquids	Total
1971	1,223	1,527	224	2,974	41.1	51.4	7.5	-2.2	+2.3	+4.0	+0.4
1972	1,302	1,546	233	3,081	42.2	50.2	7.6	+6.5	+1.2	+4.0	+3.6
1973	1,295	1,520	229	3,044	42.5	50.0	7.5	-0.5	-1.7	-1.7	-1.2
1974	1,262	1,459	220	2,941	42.9	49.6	7.5	-2.5	-4.0	-3.9	-3.4
1975	1,222	1,337	213	2,772	44.1	48.2	7.7	-3.2	-8.4	-3.2	-5.8

<sup>1</sup> One barrel of crude oil is equivalent to 5,600 cubic feet of natural gas or 57.6 gallons of natural gas liquids.

<sup>2</sup> Marketed gas.

Table 8.—Texas: Crude petroleum production, indicated demand, and stocks in 1975, by month  
(Thousand 42-gallon barrels)

Month	Production	Indicated demand	End-of-month stocks originating within Texas
January -----	104,838	104,875	94,914
February -----	94,652	92,414	97,120
March -----	105,385	102,947	99,518
April -----	101,545	97,375	100,569
May -----	104,224	110,224	97,617
June -----	100,204	102,183	95,599
July -----	103,046	108,622	90,040
August -----	102,904	106,209	86,692
September -----	99,658	99,261	87,044
October -----	103,017	100,297	89,721
November -----	99,535	97,648	91,567
December -----	102,921	102,556	91,883
Total:			
1975 -----	1,221,929	1,224,611	XX
1974 -----	1,262,126	1,258,534	XX

XX Not applicable.

In 1975, 49 refineries processed 1,210 million barrels of crude oil. Refinery capacity in the State at yearend was 4,005,550 barrels of crude oil per calendar day or 26% of the total U.S. refining capacity. On January 1, 1976, there was 414,000 barrels per day of additional or replacement refining capacity under construction in Texas.

Estimated proved recoverable reserves of crude oil in Texas declined 8% to 10,080 million barrels as of December 31, 1975, according to the American Petroleum Institute (API). Texas had 31% of the total crude oil reserves in the

United States, down 1% from 1974. Notable additions of crude oil reserves from discoveries of new fields and new pools in old fields occurred in railroad districts 3 and 4 (gulf coastal area including offshore) and districts 7B, 8, and 8A (west Texas). Significant reserve additions from extensions and revisions were added in railroad districts 8 and 8A (west Texas), and in district 3 (gulf coast). Negative revisions in railroad districts 9 (north Texas), 4 (south Texas), and 5 (east Texas) partially offset some of the reserve gains registered in this category in the other districts.

Table 9.—Texas: Stocks of crude petroleum at refineries, tank farms, and gathering systems in Texas as of the last day of each month, 1975  
(Thousand 42-gallon barrels)

Month	Refineries	Tank farms and pipelines	Lease tanks	Total
January -----	18,963	56,598	4,479	80,040
February -----	22,939	59,133	4,490	86,562
March -----	21,049	58,569	4,512	84,120
April -----	21,516	59,905	4,604	86,025
May -----	21,947	58,700	4,618	85,265
June -----	20,872	58,634	4,440	83,946
July -----	20,026	55,339	4,095	79,460
August -----	18,097	54,357	4,256	76,710
September -----	20,542	55,476	4,197	80,215
October -----	20,197	55,981	4,197	80,375
November -----	19,697	57,037	4,366	81,100
December -----	18,551	56,743	4,248	79,542

Table 10.—Texas: Stocks of refined products held by refining and pipeline companies in 1975, by month  
(Thousand 42-gallon barrels)

Month	Naphthas	Gasoline	Kerosine	Fuel oil		Jet fuel	Miscel- laneous products	Total refined products
				Distillate	Residual			
January	2,321	37,682	2,003	21,403	6,947	4,766	36,629	111,751
February	2,076	37,848	1,589	20,036	5,693	4,712	37,589	109,043
March	2,233	37,298	1,742	18,856	5,979	4,561	36,915	107,584
April	2,151	34,228	1,907	19,299	5,841	5,010	36,792	105,228
May	2,102	31,159	2,371	17,921	6,360	4,725	39,984	104,622
June	1,854	29,726	2,057	18,784	5,905	4,996	38,107	101,429
July	1,703	32,650	2,108	19,349	5,802	4,651	37,485	103,753
August	1,637	33,550	2,502	21,562	5,292	5,008	40,531	110,082
September	1,666	35,337	2,255	24,437	5,296	4,987	37,713	111,631
October	1,848	34,806	2,199	26,048	5,901	4,935	39,141	114,138
November	1,857	34,935	2,231	28,992	6,524	4,408	39,171	117,718
December	1,482	36,731	2,384	27,920	5,440	4,173	39,040	116,170

Table 11.—Texas: Runs to stills and output of refineries in 1975, by month  
(Thousand 42-gallon barrels)

Month	Input				Output					
	Crude	Products	Lubri- cating oil	Gasoline	Kerosine	Fuel oil		Jet fuel	Petro- chemical feed- stocks	Miscel- laneous
						Dis- tillate	Residual			
January	98,132	9,481	1,997	50,184	2,234	22,806	9,785	5,765	6,678	10,962
February	86,055	7,298	1,628	44,247	2,266	20,299	8,185	5,266	4,681	9,525
March	98,249	8,844	2,042	51,008	1,927	22,181	8,326	6,679	5,822	11,602
April	95,953	9,395	1,879	50,368	1,798	22,968	8,172	5,928	5,471	11,354
May	100,476	5,750	1,850	50,927	1,708	22,150	8,201	5,959	5,563	12,253
June	100,092	8,180	1,998	52,873	1,381	22,166	8,071	5,739	6,154	12,314
July	108,620	8,047	2,137	58,992	1,341	22,395	8,668	6,804	6,713	12,704
August	110,248	5,974	2,316	56,297	1,784	23,061	8,586	7,132	7,073	12,681
September	100,914	11,389	2,107	53,677	1,655	24,057	8,059	6,293	6,956	12,766
October	104,593	6,200	2,228	53,166	1,931	23,597	8,236	6,517	7,438	11,824
November	100,691	8,194	2,125	51,718	1,736	23,594	8,209	6,544	7,658	11,803
December	106,353	9,135	2,125	55,233	2,640	23,330	8,558	6,409	7,604	12,446
Total	1,210,366	97,883	24,522	628,390	22,321	270,914	101,856	75,065	77,821	142,834

Table 12.—Texas: Estimated proved reserves of natural gas, natural gas liquids, and crude oil, by railroad district

Railroad district	Proved reserves Dec. 31, 1974	Extensions and revisions	New fields and new pools	Proved reserves Dec. 31, 1975	Change from Dec. 31, 1974
NATURAL GAS (MILLION CUBIC FEET)					
1 -----	1,419,878	24,376	21,417	1,363,529	- 56,344
2 -----	7,386,745	-857,764	111,411	6,186,901	-1,199,844
3 -----	17,078,244	296,195	298,079	16,426,950	- 651,294
4 -----	17,291,294	-837,462	374,999	15,461,167	-1,830,127
5 -----	986,821	27,224	17,112	950,557	- 36,264
6 -----	5,026,683	-576,743	16,226	4,203,032	-823,651
7B -----	659,615	24,950	19,454	620,212	- 39,403
7C -----	2,303,591	31,893	10,830	2,086,401	-217,190
8 -----	13,962,887	206,338	79,780	12,541,137	-1,421,750
8A -----	1,953,860	-401,945	423	1,389,787	- 564,073
9 -----	1,416,465	20,953	14,771	1,316,277	-100,188
10 -----	9,054,639	451,003	152,781	8,490,904	- 563,735
Total -----	78,540,717	-1,590,982	1,116,783	71,036,854	- 7,503,863
NATURAL GAS LIQUIDS (THOUSAND BARRELS)					
1 -----	25,388	3,861	382	25,494	+ 106
2 -----	131,877	- 3,303	1,999	118,273	-13,604
3 -----	396,871	- 3,891	2,237	350,274	-46,597
4 -----	441,941	25,381	9,803	420,310	-21,631
5 -----	74,363	- 790	98	69,049	- 5,314
6 -----	361,334	7,647	366	342,086	-19,248
7B -----	64,987	2,498	924	58,397	- 6,590
7C -----	136,572	5,008	--	123,683	-12,889
8 -----	524,299	78,640	313	545,384	+21,085
8A -----	277,820	29,887	--	263,338	-14,482
9 -----	69,693	12,671	723	73,313	+ 3,620
10 -----	291,843	11,806	4,784	271,067	-20,776
Total -----	2,796,988	169,415	21,629	2,660,668	-136,320
CRUDE OIL (THOUSAND BARRELS)					
1 -----	133,369	9,077	1,410	126,457	- 6,932
2 -----	622,886	2,956	2,336	563,204	- 59,682
3 -----	1,352,103	43,785	9,775	1,244,579	-107,524
4 -----	237,192	-12,369	3,989	193,370	-43,822
5 -----	110,892	- 380	55	91,267	-19,625
6 -----	1,913,653	7,176	235	1,773,893	-139,765
7B -----	250,387	8,119	3,593	227,772	-22,615
7C -----	199,587	11,303	1,952	185,234	-14,353
8 -----	3,064,516	99,706	5,114	2,922,387	-142,129
8A -----	2,578,203	75,496	5,087	2,292,651	-285,552
9 -----	369,822	-29,641	2,186	304,510	- 65,312
10 -----	168,871	3,048	817	154,711	-14,160
Total -----	11,001,506	218,276	36,499	10,080,035	- 921,471

Sources: American Gas Association and American Petroleum Institute.

Table 13.—Texas: Oil and gas well drilling completions, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Anderson	27	1	4	1	--	7	40	86,251
Andrews	148	2	9	5	1	5	170	1,108,229
Angelina	--	3	2	--	--	2	7	60,719
Aransas	2	2	3	1	2	4	14	134,028
Archer	160	1	63	4	1	18	247	444,878
Atascosa	11	--	1	3	--	10	25	120,599
Austin	18	4	1	--	3	10	36	233,597
Bastrop	--	--	1	--	--	7	8	23,798
Baylor	3	--	5	--	--	6	14	51,278
Bee	8	27	14	1	18	14	82	493,349
Bexar	3	--	--	--	--	2	5	4,580
Borden	20	--	4	2	--	8	34	258,011
Bosque	--	--	--	--	--	6	6	44,788
Bowie	1	--	1	1	--	--	3	24,791
Brazoria	28	11	12	7	9	21	88	661,615
Brazos	--	--	--	--	--	1	1	4,320
Brooks	5	12	12	1	4	10	44	306,441
Brown	23	21	21	1	--	5	71	135,059
Burleson	7	--	1	1	--	--	9	31,232
Caldwell	50	--	3	--	--	2	55	130,664
Calhoun	--	3	7	2	6	17	35	295,661
Callahan	30	9	21	2	1	41	104	253,808
Cameron	--	1	1	--	1	2	11	81,707
Camp	1	--	1	--	--	2	4	20,139
Carson	78	4	7	--	--	2	91	302,539
Cass	2	--	2	--	1	6	11	96,957
Chambers	21	5	10	6	5	16	63	551,216
Cherokee	1	--	2	--	--	16	20	121,836
Childress	--	--	--	--	--	2	2	10,833
Clay	35	--	10	5	--	14	64	256,623
Cochran	50	6	1	--	--	1	58	299,519
Coke	20	2	9	4	--	17	52	278,907
Coleman	18	11	13	--	--	19	61	149,674
Colorado	1	12	4	2	33	32	84	511,524
Comanche	3	2	3	--	4	16	28	78,988
Concho	7	4	9	1	3	17	41	144,627
Cooke	55	--	27	2	--	19	103	245,889
Coryell	--	--	--	--	--	1	1	2,866
Cottle	3	5	3	1	1	9	22	121,690
Crane	159	--	3	2	--	4	168	656,629
Crockett	13	42	15	4	5	28	107	724,665
Crosby	11	--	--	--	--	13	24	76,160
Culberson	1	--	1	--	--	1	3	7,305
Dallam	--	--	--	--	--	2	2	9,638
Dawson	65	--	4	1	--	11	81	640,920
Delta	--	--	--	--	--	2	2	11,849
Denton	--	9	--	--	--	5	14	88,076
De Witt	7	8	8	1	10	25	59	447,911
Dickens	--	--	2	--	--	5	7	27,052
Dimmit	59	24	18	3	14	22	140	592,321
Duval	46	28	29	5	11	26	145	542,932
Eastland	15	11	5	2	--	18	51	164,097
Ector	209	3	3	--	--	--	215	1,062,502
Edwards	--	38	16	--	--	4	58	300,215
Ellis	--	--	--	--	--	2	2	1,340
Erath	--	--	--	--	--	7	7	25,705
Falls	--	--	--	--	--	2	2	15,194
Fayette	--	--	2	1	--	5	8	44,469
Fisher	12	2	11	--	--	18	43	230,536
Floyd	--	--	1	--	--	2	2	7,480
Foard	--	3	1	--	--	2	6	18,171
Fort Bend	18	5	8	--	5	8	44	223,041
Franklin	4	--	1	1	--	4	10	58,578
Freestone	--	8	2	--	1	8	19	185,842
Frio	52	--	--	8	--	1	61	340,253
Gaines	44	2	11	3	1	8	69	504,628
Galveston	9	4	6	3	8	8	38	368,463
Garza	68	--	11	2	--	18	99	513,827
Glasscock	130	--	6	2	--	9	147	988,721
Goliad	9	16	14	--	22	16	77	404,864
Gonzales	--	--	--	1	--	7	8	44,648
Gray	18	2	13	--	--	2	35	120,773
Grayson	7	--	2	4	--	7	20	108,446
Grexx	6	1	1	--	1	1	10	57,748
Grimes	--	--	1	--	2	3	6	44,876

See footnote at end of table.

Table 13.—Texas: Oil and gas well drilling completions, by county—Continued

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Guadalupe	34	--	2	--	--	2	38	78,225
Hale	11	--	--	--	--	2	13	70,571
Hall	--	1	--	--	--	1	1	5,985
Hamilton	--	1	--	--	1	5	7	25,750
Hansford	4	26	13	1	--	6	50	302,094
Hardeman	3	--	3	1	--	3	10	83,434
Hardin	76	1	12	1	1	6	97	302,955
Harris	50	6	13	2	3	10	84	479,427
Harrison	10	13	3	--	--	12	38	241,450
Hartley	--	1	--	--	--	2	3	20,275
Haskell	18	1	9	2	--	18	48	213,063
Hemphill	12	69	14	3	3	16	117	1,212,174
Henderson	3	--	2	1	--	2	8	87,669
Hidalgo	--	15	7	--	11	13	46	483,514
Hill	--	--	--	--	--	4	4	31,899
Hockley	245	--	8	1	--	3	257	1,313,782
Hood	--	1	--	--	2	10	13	65,096
Hopkins	6	--	--	--	--	6	12	66,455
Houston	6	3	3	--	--	5	17	152,684
Howard	143	--	9	1	--	11	164	569,876
Hudspeth	--	--	--	--	--	1	1	5,053
Hunt	--	--	1	--	--	3	4	12,749
Hutchinson	9	5	3	--	1	3	21	82,877
Irion	96	--	7	2	--	7	112	656,994
Jack	63	36	30	5	4	33	171	659,125
Jackson	6	26	25	6	16	39	118	658,999
Jasper	3	--	1	2	--	4	10	84,277
Jefferson	14	5	6	1	5	4	35	242,567
Jim Hogg	19	4	12	3	4	11	53	220,020
Jim Wells	13	22	15	1	4	16	71	353,733
Johnson	--	--	--	--	--	7	7	41,370
Jones	27	--	23	4	--	36	90	262,715
Karnes	--	2	2	--	4	9	17	140,822
Kaufman	--	--	2	--	--	4	6	50,896
Kendall	--	--	--	--	--	1	1	1,200
Kenedy	1	4	5	--	3	11	24	240,683
Kent	16	--	5	3	--	25	49	323,948
Kerr	--	--	--	--	--	2	2	5,785
Kimble	1	3	6	1	2	14	27	54,716
King	44	--	8	1	1	22	76	364,074
Kleberg	3	19	7	4	4	--	37	275,975
Knox	32	--	18	1	--	10	61	139,848
Lamar	--	--	--	--	--	1	1	18,780
Lamb	--	--	--	--	--	4	4	19,104
La Salle	--	1	4	3	4	16	28	173,380
Lavaca	4	30	9	4	40	36	123	710,832
Lee	--	--	--	2	--	2	4	26,118
Leon	--	5	--	--	1	2	8	57,058
Liberty	52	2	12	--	5	5	76	352,176
Limestone	1	3	5	--	3	6	18	117,345
Lipscomb	5	25	8	--	1	7	46	420,054
Live Oak	5	9	13	3	11	27	68	460,324
Loving	--	4	--	--	2	3	9	183,121
Lubbock	2	--	2	--	--	6	10	73,024
Lynn	2	--	--	--	--	11	13	111,603
McCulloch	1	--	--	--	1	--	2	1,543
McMullen	2	8	11	2	6	21	50	263,099
Madison	--	1	2	5	2	1	11	94,389
Marion	8	--	--	--	--	3	11	48,711
Martin	166	--	7	4	--	5	182	1,596,565
Matagorda	3	3	7	3	8	30	54	439,596
Maverick	193	5	7	--	3	12	220	384,085
Medina	53	1	3	1	--	1	59	55,697
Menard	--	--	--	1	--	1	8	21,790
Midland	62	1	3	2	1	6	69	557,022
Milam	7	--	3	1	--	6	17	46,785
Mitchell	114	1	5	6	--	17	143	436,056
Montague	47	1	10	3	--	16	77	312,524
Montgomery	7	1	1	--	1	4	14	95,163
Moore	15	6	3	--	--	--	24	64,208
Morris	--	--	--	--	--	1	1	4,195
Motley	--	--	1	--	--	3	4	19,536
Nacogdoches	2	7	1	--	--	2	12	83,941
Navarro	13	--	9	1	--	8	31	79,992
Newton	3	--	--	1	--	5	9	75,629

See footnote at end of table.



Table 13.—Texas: Oil and gas well drilling completions, by county—Continued

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Nolan	22	1	9	2	--	8	42	255,075
Nueces	21	17	11	3	2	16	70	518,537
Ochiltree	48	9	17	--	--	1	75	570,610
Oldham	--	--	--	--	--	1	1	750
Orange	3	--	4	--	--	5	12	88,413
Palo Pinto	20	74	18	4	5	53	174	713,558
Panola	7	7	2	1	3	4	24	159,388
Parker	3	32	4	--	12	29	80	415,233
Pecos	163	50	18	11	11	34	287	1,195,467
Polk	2	3	4	1	4	11	25	245,592
Potter	16	9	7	--	--	2	34	82,475
Rains	--	--	--	--	--	1	1	13,803
Randall	--	--	--	--	--	2	2	16,632
Reagan	216	--	6	1	1	2	226	1,371,723
Real	--	--	--	--	--	1	1	6,400
Red River	--	--	1	--	1	3	5	20,711
Reeves	21	7	2	--	5	7	42	336,652
Refugio	29	16	15	8	6	13	87	537,166
Roberts	6	27	9	1	4	12	59	605,472
Robertson	--	1	--	--	1	--	2	14,438
Runnels	19	2	8	14	2	40	85	355,525
Rusk	24	10	4	--	1	12	51	309,444
San Augustine	--	--	--	--	--	1	1	15,361
San Jacinto	--	3	--	--	4	14	21	176,520
San Patricio	13	29	22	--	9	27	105	791,710
San Saba	--	--	--	--	--	1	1	2,220
Schleicher	4	10	3	1	6	13	37	221,631
Scurry	186	--	7	1	--	8	202	993,934
Shackelford	119	8	47	7	3	29	213	442,955
Shelby	1	1	--	--	2	4	6	57,812
Sherman	--	2	--	1	1	2	6	30,339
Smith	7	4	3	1	--	13	23	242,030
Somervell	--	--	--	--	--	2	2	5,982
Starr	15	27	19	2	5	15	83	288,885
Stephens	95	20	12	11	1	30	169	532,546
Sterling	23	27	5	9	4	8	76	533,356
Stonewall	25	--	8	5	1	49	88	429,617
Sutton	--	184	46	--	13	14	257	1,726,419
Tarrant	--	--	--	--	--	2	2	12,380
Taylor	56	--	20	2	--	26	104	353,293
Terrell	--	5	5	--	3	8	21	235,974
Terry	24	--	2	2	--	5	33	239,703
Throckmorton	40	1	34	2	2	7	86	220,111
Titus	6	--	2	--	--	2	10	39,576
Tom Green	3	--	8	5	--	15	31	137,574
Trinity	--	--	1	1	3	2	6	51,129
Tyler	--	--	1	2	2	6	11	108,095
Upshur	--	8	2	--	--	2	12	117,324
Upton	98	1	9	4	3	2	117	618,619
Val Verde	--	1	1	--	2	3	7	86,410
Van Zandt	15	2	1	--	--	3	21	114,358
Victoria	11	25	16	4	28	28	112	598,772
Walker	--	--	--	--	--	2	2	24,589
Waller	--	8	1	--	1	1	11	95,264
Ward	52	19	8	4	7	5	95	761,693
Washington	2	--	--	--	1	2	5	29,786
Webb	18	92	30	1	39	34	214	1,334,504
Wharton	20	20	26	--	14	39	119	612,764
Wheeler	1	7	3	--	2	5	18	295,504
Wichita	397	--	82	--	--	--	479	689,113
Wilbarger	23	--	12	1	--	6	47	122,607
Willacy	1	--	1	--	--	2	4	28,566
Williamson	--	--	--	--	--	3	3	3,057
Wilson	3	--	2	--	--	2	7	17,166
Winkler	55	2	8	1	4	3	73	439,294
Wise	12	21	4	2	--	9	48	309,924
Wood	34	2	6	--	--	5	47	291,891
Yoakum	122	--	2	1	--	8	133	756,810
Young	106	8	63	6	--	50	233	572,420
Zapata	4	24	3	--	14	15	60	446,038
Zavala	--	5	7	4	--	13	32	122,885
Offshore area	6	2	5	--	7	155	172	1,509,497
Total	5,763	1,564	1,556	311	571	2,321	12,086	61,652,425

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

The oil and gas industry drilled 12,086 wells in search of crude oil and natural gas. There were 3,203 wildcat wells drilled resulting in the discovery of 311 oil and 571 gas pools for a success ratio of 28%. A total of 8,883 development wells were drilled; 5,763 were oil productive and 1,564 were gas productive for a statewide success ratio of 82%.

**Petrochemicals.**—The petrochemical industry in Texas continued to expand and contribute to the economic welfare of the State. A major portion of the industry was along the gulf coast and, in 1975, most of the new facilities and expansions of existing plants were in this area of the State.

Union Carbide Corp. completed an expansion of its Seadrift plant to increase ethanolamine-productive capacity to 200 million pounds per year. At Texas City, Union Carbide completed an expansion to increase production of propionic acid and propionaldehyde to 150 million pounds per year. Chemetron Corp. began production at its new phosgene plant at La Porte. The new facility has an annual capacity of about 67 million pounds of phosgene or its derivatives.

The Dow Chemical Co. was expanding its Freeport high-density polyethylene plant from 450 to 600 million pounds per year. Pearsall Chemical Co. announced plans to double the capacity of its La Porte plant that produces chlorinated paraffins.

Phillips Petroleum Co. increased the output of its polyethylene plant on the Houston ship channel from 462 to 550 million pounds per year. Phillips also completed a \$50 million expansion of its Philtex plant near Borger to increase production of various petro-sulfur compounds and expanded its Copolymer plant's capacity to 8,000 tons per year of Cis-4 polybutadiene.

#### NONMETALS

**Barite.**—No barite mines operated in Texas during 1975. Seven grinding plants processed crude barite shipped into the State. Grinding plants were located in Brownsville (two plants), Corpus Christi (one plant), Galveston (one plant), Houston (two plants), and Wallisville (one plant). Over 98% of the processed barite was used as a drilling-mud additive, with

the remainder used mainly as a filler or extender.

In 1975, output of ground barite in Texas was nearly 5% more than 1974 levels. However, total value of processed barite decreased nearly 3% in 1975 compared with 1974.

**Cement.**—Though leading the Nation in cement output, 1975 shipments of portland cement in Texas declined for the second straight year from the record output in 1973. Declines reflected the continuing economic recession. Portland cement shipments were down 7% from 1974. However, average unit values increased over 16% in 1975 resulting in a record total value for portland cement shipments of \$225 million, an increase of 8% over the previous year. Average value of cement per short ton was \$31.24 compared with \$26.84 in 1974.

The cement was prepared by 13 companies at 18 plants in Bexar, Dallas, Ector, Ellis, El Paso, Harris, McLennan, Nolan, Nueces, Orange, Potter, and Tarrant Counties. Harris County, with four plants, led the State in output. Most of the plants used limestone as the chief raw material; however, four plants (three in Harris County and one in Orange County) used oystershell dredged from shallow bays along the gulf coast. Other principal raw materials included cement rock, clay and shale, sand, and iron ore.

In addition to portland cement, 12 of the plants also produced masonry cement. Masonry cement shipments declined over 7% from the previous year, but total value of masonry cement shipped increased over 10%. Average value per short ton increased almost 19% in 1975 compared with 1974.

All 18 plants produced gray portland cement with 3 plants also producing white cement and 12 plants producing masonry cement. Production of portland and masonry cement in 1975 was over 75% of apparent cement production capacity. Forty-eight kilns (37 wet process and 11 dry process) were operating during the year. Texas cement plants consumed over 44 billion cubic feet of natural gas. Fuel oil and coal were utilized to a lesser extent at some plants. Consumption of electrical energy exceeded 866 million kilowatt-hours.

Ready-mix concrete companies accounted for the bulk of finished portland

cement shipments (over 55%). Other primary consumers and their share of Texas portland cement production included concrete-products manufacturers (9%), building-materials dealers (8%), highway contractors (5%), other contractors (8%), government agencies (1%), and miscellaneous customers (13%).

Longhorn in San Antonio, a division of Kaiser Cement & Gypsum Corp., announced the completion of its expansion program which increased annual production capacity to 785,000 tons. This program included the most recent kiln to come onstream in Texas—a 190-foot, dry-process kiln with a daily production capacity of 1,400 tons. Ideal Basic Industries, located along the Houston ship channel, announced plans for installation of air-pollution control equipment by July 1, 1977, to bring the plant into compliance with the Texas Clean Air Act.

**Table 14.—Texas: Portland cement salient statistics**  
(Short tons)

	1974	1975
Number of active plants -----	18	18
Production -----	7,889,147	7,074,017
Shipments from mills:		
Quantity -----	<sup>r</sup> 7,738,935	7,195,380
Value -----	\$207,705,706	\$224,803,785
Stocks at mills, Dec. 31 -----	644,096	470,715

<sup>r</sup> Revised.

**Table 15.—Texas: Masonry cement salient statistics**  
(Short tons)

	1974	1975
Number of active plants--	12	12
Production -----	216,122	189,495
Shipments from mills:		
Quantity -----	195,337	180,965
Value -----	\$6,438,178	\$7,089,015
Stocks at mills, Dec. 31--	23,793	21,156

**Clays.**—Production of clay and shale was reported by 48 companies from 115 operations located in 43 Texas counties during 1975. Total output in 1975 declined 20% compared with 1974, but total value decreased only 2% because average unit value of Texas clays in 1975 increased 23% to \$3.16 per short ton. The decline in total production was due to the sharp drop in output of common clay and shale.

Declines were also registered for fire clay and kaolin; however, increases in output occurred for ball clay, bentonite, and fuller's earth.

Common clay and shale constituted 94% of the total clay mined in Texas in 1975. Output was reported from 92 pits operated by 40 companies. Common clay and shale production was reported in 37 counties, with Eastland, Navarro, Fort Bend, Rusk, and Chambers Counties leading in output. Thirty-six percent of the 1975 output was used to make building brick and other heavy clay products, such as sewer pipe and tile. Over 27% of the common clay and shale production was used to make portland cement. Other important uses included manufacture of concrete block, structural concrete, highway surfacing material, and lightweight aggregate.

Bentonite production increased in 1975, and total value jumped dramatically as the average unit value more than doubled. Three producers operated 15 pits in Angelina and Fayette Counties. The bentonite was used principally as a drilling-mud additive, an ingredient in animal feed, a filtering and decolorizing agent, and as a binding substance for foundry sand.

Kaolin, mined by two companies in Limestone County, was used principally as a filler in fertilizer, paint, and rubber. A significant amount was also used to manufacture cement. Production of kaolin in 1975 declined nearly 30% compared with 1974 output.

Ball clay production increased by more than 34% in 1975. Three companies, operating in Cherokee, Henderson, and Rusk Counties, produced ball clay for facebrick, firebrick, and other uses.

Fire clay output dropped almost 17% below the 1974 level. Fire clay, used for firebrick and similar refractory materials, was mined by four companies at eight pits in Bastrop, Henderson, Hopkins, and Wood Counties.

One operator produced fuller's earth in Texas in 1975. Output from this one pit was up almost 7% with total value increasing over 23%. Attapulgite fuller's earth was used to manufacture absorbent granules.

**Fluorspar.**—Metallurgical-grade fluorspar was produced by D & F Minerals Co. at one location in Texas in 1975. Output from La Mina Paisano, located in the

Table 16.—Texas: Clays sold or used by producers, by kind  
(Thousand short tons and thousand dollars)

Year	Ball		Bentonite		Fire clay		Common clay and shale		Total <sup>1</sup>	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1971	W	W	W	W	W	W	4,374	7,098	4,615	10,432
1972	W	W	88	1,128	89	684	4,894	7,872	5,175	11,554
1973	W	W	85	802	87	689	5,330	8,951	5,667	13,115
1974	41	329	69	881	41	316	5,046	8,365	5,315	13,477
1975	55	467	W	W	34	271	3,995	7,594	4,248	13,411

W Withheld to avoid disclosing individual company confidential data; included in "Total."

<sup>1</sup> Includes fuller's earth, kaolin, and data indicated by symbol W.

Christmas Mountains northwest of Big Bend National Park in Brewster County, dropped 7%, although the total value rose nearly 13% above the previous year's level.

Fluorspar was processed in Brownsville, Eagle Pass, and Marathon from shipments into the United States from the Republic of Mexico. Texas fluorspar was processed in Marathon.

**Gem Stones.**—Value of gem stones and specimens of rocks and minerals found in the State during the year was estimated at \$160,000. No gem stone mines were in operation, but one Texas-based company, Grillos Mining Co. in Lubbock, operated a turquoise mine in Nevada. In Texas, dealers and hobbyists collected specimens that included agate, calcite, celestite, jasper, cinnabar, feldspar, fluorite, fossiliferous limestone, obsidian, opal, petrified wood, quartz, topaz, and tourmaline.

**Graphite.**—The Nation's only production of natural graphite came from the open pit mine of Southwestern Graphite Co., a division of Joseph Dixon Crucible Co. Output of small-flake crystalline graphite from the mine, which was located in Burnet County in central Texas, was approximately equal to that in 1974. Natural crystalline flake graphite was used chiefly in crucibles, foundry facings and pencils.

**Gypsum.**—Production of crude gypsum was 1,094,000 short tons, a decrease of 271,000 tons or 20% below the 1974 production. Decline in output reflected the continuing economic slump, which resulted in a construction slowdown and less demand for the raw materials needed in the construction industry. Average price in 1975 was \$3.91 per short ton compared with the \$4 average price in 1973—the record year for crude gypsum production and total value. Total value in 1975 was \$4,277,000.

Production of crude gypsum was reported by seven companies operating open pit mines in Fisher, Gillespie, Hardeman, Hudspeth, Nolan, and Stonewall Counties. Texas ranked fourth in the Nation in output of crude gypsum. Crude gypsum produced in Texas was used primarily as a retarder in portland cement and as a soil conditioner.

Seventy-seven percent of the crude gypsum mined in Texas during the year was calcined before use. Seven calcining plants, operated by six companies, were

located in five counties—Dallas (one plant), Fisher (two plants), Hardeman (one plant), Harris (one plant), and Nolan (two plants). The calcined gypsum was used for the manufacture of gypsum wallboard, building plasters, and other construction related products. Output of calcined gypsum declined more than 23% in 1975, and average price per ton experienced a sharp increase to \$23.07 compared with the 1974 price of \$20.67. Texas ranked third in the Nation in production of calcined gypsum.

**Lime.**—Twelve companies prepared lime at 13 plants in 12 counties in 1975. Nueces, Johnson, Comal, and Travis Counties led in production. The total output of hydrated lime and quicklime in Texas was down more than 5% from the 1974 record production. Despite the decline in output, total value increased 16% as average value per ton rose from \$21.60 in 1974 to \$26.62 in 1975. Quicklime accounted for 60% of the total lime produced and average value was \$29.52. Hydrated lime average value was \$22.26 in 1975.

Raw materials used to prepare lime were limestone, shell, and dolomite. The lime was used chiefly for alkalies, water purification, paper and pulp, soil stabilization, aluminum and bauxite, construction, chemical processing, and many other uses. Leading producers were PPG Industries, Inc. (Corpus Christi), Texas Lime Co. (near Cleburne), and United States Gypsum Co. (New Braunfels).

**Perlite.**—No perlite was mined in Texas in 1975. Out-of-State perlite was expanded at six plants in Bexar, Dallas, Harris, and Nolan Counties. Output for 1975 was up nearly 75% and total value of the processed perlite increased over 57%.

Expanded perlite was used primarily as a filter aid, but also as cement and asphalt binder, plaster aggregate, horticulture, insulation, and filler.

**Salt.**—After two successive record years of salt production, Texas output declined nearly 25% in 1975. Accordingly, despite an average unit value increase of 9%, the total value of salt produced in Texas dropped 18%. Output decline was related to a depressed chemical industry—the prime source of salt consumption.

Salt was produced by 9 companies operating at 11 localities in 10 counties. Production included salt brine, rock salt, and

**Table 17.—Texas: Lime sold or used by producers, by use**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Soil stabilization .....	545	9,472	518	11,940
Aluminum and bauxite .....	159	3,726	W	W
Water purification .....	115	2,693	124	3,508
Sewage treatment .....	8	185	114	3,201
Steel, electric .....	112	2,623	107	3,009
Paper and pulp .....	149	3,503	101	2,834
Mason's lime .....	17	298	14	331
Oil well drilling .....	11	260	13	378
Petroleum refining .....	13	301	9	243
Other uses <sup>1</sup> .....	707	16,580	736	20,740
Total <sup>2</sup> .....	1,835	39,644	1,735	46,179

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

<sup>1</sup> Includes alkalis, other chemical uses, petrochemicals, chrome, steel, open-hearth, BOF steel furnaces, sugar refining, magnesium metal, other metallurgy, glass, insecticides, paint, other construction lime, rubber, fertilizer (1974), agriculture, food and food byproducts, wire drawing, and items indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

evaporated salt. Nine companies produced salt brine, which accounted for 95% of the salt output and 68% of total salt value. Brine was produced using wells drilled into salt domes along the Texas Coastal Plain (Brazoria, Chambers, Duval, Fort Bend, Harris, Jefferson, and Matagorda Counties) and wells drilled into subsurface salt beds of Permian age in west Texas (Hutchinson and Yoakum Counties).

Rock salt was mined underground in salt domes by two companies. Grand Saline salt dome in Van Zandt County was mined by Morton Salt Co., and the Hockley dome in Harris County was mined by United Salt Corp. United Salt and Morton Salt also produced evaporated salt (vacuum pan process) at two localities in Fort Bend and Van Zandt Counties.

Salt produced in Texas was used in preparation of chlorine, caustic soda, and other chemicals, as well as for table and household use, food preservation and preparation, water softeners, and other purposes.

**Table 18.—Texas: Salt sold or used by producers**

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1971 .....	9,217	40,838
1972 .....	9,744	36,544
1973 .....	10,354	45,350
1974 .....	11,379	51,296
1975 .....	8,560	42,119

**Sand and Gravel.**—Following the previous year's record output of over 42 million tons, sand and gravel production declined 9% in 1975, but a 17% increase in average value per ton to \$2.25 raised total value of sand and gravel to over \$87 million (up 7% over 1974). Construction aggregate (blended sand and gravel) and industrial sand and gravel sold commercially accounted for 83% of the State's output. Publicly funded projects used the remainder of the output which consisted wholly of construction aggregate. Output of processed sand and processed gravel declined 20% and 11%, respectively. Unprocessed sand and gravel output, however, rose by over 47% in 1975 and accounted for over 16% of the total sand and gravel output. Industrial sand and gravel production declined slightly, but overall value rose 28% as the average price for industrial sand and gravel rose over 35% to \$8.35 per ton in 1975.

A total of 183 operations were active in 1975. Seventy-nine counties reported production with the following counties, ranked by order of production, leading in output: Colorado, Dallas, Victoria, Tarrant, Harris, and McLennan. These six counties produced over 56% of the State's sand and gravel from 53 operations or 29% of the total number of operations active during the year.

Construction aggregate was used for concrete aggregate (primarily residential

construction), bituminous paving, roadbase and subbase, fill, and other similar purposes. Industrial sand was used for glass, molding, blast, and other special-purpose

sands. The silica sand reserves and processing plant owned by Chemical Express Co. was sold in 1975 to Texas Mining Co., a subsidiary of Olgebay Norton Co.

**Table 19.—Texas: 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
1971	29,607	48,831	3,181	2,983	32,788	51,814
1972	33,036	54,658	2,115	1,670	35,151	56,328
1973	35,739	58,098	2,807	2,608	38,546	60,706
1974	33,467	64,920	8,999	16,445	42,466	<sup>1</sup> 81,364
1975	32,036	72,912	6,613	14,194	38,649	87,106

<sup>1</sup> Data do not add to total shown because of independent rounding.

**Table 20.—Texas: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand	19,009	31,075	15,145	27,842
Gravel	17,762	38,335	15,843	37,300
Unprocessed:				
Sand and gravel	4,304	2,618	6,343	4,834
Industrial:				
Sand	1,391	8,595	1,318	11,009
Gravel	--	--	W	W
Total	42,466	80,623	38,649	<sup>2</sup> 80,986

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used in construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

**Table 21.—Texas: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction--	17,348	34,044	16,523	37,539
Highway and bridge construction -----	975	2,008	1,884	4,058
Other construction (dams, waterworks, airports, etc.) -----	669	1,215	886	1,881
Concrete products (cement blocks, brick, pipe, etc.) -----	3,113	5,528	3,332	7,644
Bituminous paving (asphalt and tar paving) ---	2,482	4,817	775	2,028
Roadbase and subbase -----	2,451	4,599	1,111	2,372
Fill -----	581	780	511	722
Other -----	368	782	87	188
<b>Unprocessed:</b>				
Roadbase and subbase -----	353	298	2,090	2,605
Fill -----	3,736	2,254	3,505	2,806
Other -----	--	--	13	60
Other -----	--	--	13	60
Industrial sand and gravel -----	1,391	8,595	1,318	11,009
<b>Total -----</b>	<b>33,467</b>	<b>64,920</b>	<b>32,036</b>	<b>72,912</b>

<sup>1</sup> Unit value of construction aggregate may be higher than the unit value of sand and gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

**Table 22.—Texas: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction--	401	670	576	1,161
Highway and bridge construction -----	4,340	8,385	2,632	6,008
Other construction (dams, waterworks, airports, etc.) -----	229	432	475	1,139
Concrete products (cement blocks, brick, pipe, etc.) -----	66	88	171	233
Bituminous paving (asphalt and tar paving) ---	2,589	4,908	1,482	3,389
Roadbase and subbase -----	1,121	1,816	504	1,064
Fill -----	30	47	39	61
Other -----	9	33	--	--
<b>Unprocessed:</b>				
Roadbase and subbase -----	158	35	454	879
Fill -----	56	31	163	147
Other -----	--	--	118	114
<b>Total <sup>2</sup> -----</b>	<b>8,999</b>	<b>16,445</b>	<b>6,613</b>	<b>14,194</b>

<sup>1</sup> Unit value of construction aggregate may be higher than the unit value of sand and gravel.

<sup>2</sup> Data may not add to totals shown because of independent rounding.



Table 23.—Texas: Industrial sand and gravel sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Sand:</b>				
Abrasives -----	W	W	W	W
Blast -----	316	1,954	243	3,017
Chemicals -----	W	W	W	W
Engine -----	10	75	9	72
Filler -----	W	W	W	W
Filtration -----	11	138	10	127
Foundry -----	W	W	W	W
Glass -----	404	1,997	426	2,498
Molding -----	201	869	162	851
Oil (hydrofrac) -----	W	W	W	W
Pottery, porcelain, and tile -----	8	73	W	W
Other uses -----	442	3,490	468	4,443
<b>Gravel:</b>				
Other -----	--	--	W	W
Total <sup>1</sup> -----	1,391	8,595	1,318	11,009

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

**Sodium Sulfate (Natural).**—Natural sodium sulfate was extracted from subterranean brines in west Texas. Saturated brines occur in strata underlying playas or former saline lakes, and are recovered through shallow (100 feet or less) wells. Sodium sulfate production in 1975 increased 0.4% over 1974 output and value rose sharply to 69% more than the 1974 total value.

Sodium sulfate was used to manufacture kraft paper pulp, detergents, glass, and other products.

**Stone.**—Crushed stone was produced at 206 quarries and dimension stone was produced at 10 quarries. Seventy-seven counties were indicated to have stone production; Bexar, Wise, Williamson, and Comal Counties led the State in production, accounting for over 46% of the total stone output in 1975. Crushed and broken stone production in Texas was down 8% and value declined almost 5%. Dimension stone output increased slightly in 1975, but value dropped due to a sharp decline in the average value per ton. Leading producers in rank of output were Texas Crushed Stone Co.; McDonough Bros., Inc.; and Parker & Co., Inc. The Texas State Highway Department operated in 33

counties in 1975. Traditionally a leader in crushed and broken stone output, the Texas State Highway Department ranked only ninth among crushed and broken stone producers in 1975 compared with ranking first in 1971.

Limestone production accounted for 89.7% of the total stone production. Other stone production included dolomite, granite, marble, marl, sandstone, shell, and traprock. Principal uses of limestone were for roadbase stone, cement manufacture, concrete aggregate, bituminous aggregate, other aggregate uses, and lime manufacture. Limestone represented most of the dimension stone output in 1975, with granite and marble also produced for dimension stone.

Texas Crushed Stone Co., near Georgetown in Williamson County, was the largest crushed stone producer in the State. Texas Crushed Stone had devised a new "hourglass tunnel" system for blending aggregate mixes to meet customer's specifications.

Shell dredging was restricted to two operations in Matagorda Bay during most of 1975. By yearend, however, only Parker Bros. & Co., Inc., continued dredging shell from Matagorda Bay.

Table 24.—Texas: Crushed stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	6,370	16,069	4,274	14,562
Concrete aggregate -----	8,199	15,455	6,890	13,282
Dense-graded roadbase stone -----	23,465	29,534	23,705	31,982
Macadam aggregate -----	566	787	404	616
Other construction aggregate and roadstone -----	3,434	6,217	3,623	6,010
Surface treatment aggregate -----	2,834	9,004	3,014	8,077
Agricultural limestone -----	1 415	1 928	222	381
Poultry grit -----			W	204
Cement manufacture -----	11,234	18,581	9,215	15,073
Filter stone -----	28	74	W	W
Flux stone -----	560	1,598	362	1,242
Glass manufacture -----			19	90
Lime manufacture -----	2,620	4,106	1,918	3,435
Manufactured fine aggregate (stone sand) -----	160	354	130	294
Railroad ballast -----	863	1,695	941	1,678
Riprap and jetty stone -----	1,005	2,075	826	1,954
Terrazzo and exposed aggregate -----	W	W	76	424
Mineral fillers, extenders, and whiting <sup>2</sup> -----	30	W	227	1,485
Other uses <sup>3</sup> -----	1,292	3,280	2,096	3,601
Total <sup>4</sup> -----	63,074	109,758	57,964	104,390

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

<sup>1</sup> Data combined to avoid disclosing confidential data.

<sup>2</sup> Includes asphalt filler; 1974 data represent other filler only.

<sup>3</sup> Includes asphalt filler (1974), bedding material (1974), building products (1975), chemicals (1975), dead-burned dolomite, paper manufacture (1974), roofing aggregates, sugar refining, whiting (1974), chemical stone for alkali works (1975), and uses indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

**Sulfur.**—Production of native sulfur in Texas declined nearly 10% in 1975, and sales dropped below the previous year's volume. Total value and price per ton, however, rose sharply, continuing the upward trend begun a few years ago. Eighty-two percent of the 1975 output was sold; producer inventories were up markedly at yearend. For the fourth year in a row, Texas led the Nation in the production of sulfur in its native form from Frasch mines.

Table 25.—Texas: Sulfur produced and shipped from Frasch mines

(Thousand long tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value <sup>1</sup>
1971 -----	3,408	3,092	W
1972 -----	3,755	3,847	W
1973 -----	4,294	4,109	W
1974 -----	4,593	4,473	W
1975 -----	4,141	3,406	W

W Withheld to avoid disclosing individual company confidential data.

<sup>1</sup> F.o.b. mine plant.

Four companies produced the sulfur at eight Frasch operations in six Texas counties. Three of the operations were in west Texas (Pecos and Culberson Counties), where the sulfur was produced through wells drilled into sulfur deposits in subsurface Permian strata. Five of the operations were on the Texas gulf coast, where the sulfur was obtained through wells drilled into the caprock of subsurface salt domes—Long Point in Fort Bend County, Fannet and Spindletop in Jefferson County, Moss Bluff in Liberty County, and Boling in Wharton County. Texasgulf, Inc.'s Comanche Creek Frasch sulfur mine came onstream in late 1975. Located 17 miles northeast of Fort Stockton on university lands in Pecos County, the Comanche Creek operation is expected to produce 400,000 to 600,000 long tons per year from Permian sulfur-bearing strata.

Recovered sulfur was also produced in Texas during the year. Fifty operations extracted sulfur from sour natural gas and oil in 29 Texas counties. Output totaled 801,408 long tons, a decrease of 6% from 1974. Sales totaled 796,253 long tons, a decrease of 8% for the year. Total value

of sales, however, rose by over 47% as the average price per long ton increased nearly 60% from \$22.93 in 1974 to \$36.51 in 1975.

**Talc and Soapstone.**—Four operators obtained production from seven mines—one in Culberson County and six in Hudspeth County. Output from these open pit mines was 129,626 tons, down from 188,262 tons last year. Average value of crude mined material was \$6.13 per ton (down 12% from 1974); average value after grinding was \$26.55 per ton. Talc and soapstone were used in the manufacture of ceramic products, roofing material, insecticides, paint, and textile products.

**Vermiculite.**—Vermiculite was not mined in Texas in 1975, but exfoliated vermiculite was produced from out-of-State vermiculite shipments in Bexar, Dallas, and Harris Counties. Exfoliated vermiculite production declined 18% in 1975 and value of production increased 17%. Average value per ton increased 43%. The expanded material was used principally for concrete aggregate; other uses included horticulture, fireproofing, insulation, and miscellaneous purposes.

## METALS

Raw metallic minerals mined in Texas were limited to uranium, iron, magnesium, and sodium. Complementing the output of the metal mining industry, however, was a large, diversified metal-extractive industry that continued to make a significant contribution to the local, State, and national economies. The extractive industry included aluminum from imported bauxite; antimony, cadmium, copper, iron, lead, manganese, silver, gold, tin, tungsten, tellurium, selenium, nickel, and zinc from domestic and foreign ores and concentrates; uranium and sodium from domestic ores; and magnesium from brines and seawater.

**Aluminum.**—Texas again ranked second in production of primary aluminum although output was 43% below a year ago. Lower metal demand and soaring energy costs resulted in sharply reduced operating levels at the Reynolds Metals Co.'s San Patricio Works and at the Aluminum Co. of America's (Alcoa) Point Comfort and Rockdale reduction facilities.

Table 26.—Texas: Smelters, refineries, and reduction plants in 1975

Product, company, and plant	Location (county)	Material treated
<b>Aluminum:</b>		
Aluminum Co. of America:		
Point Comfort (alumina) -----	Calhoun -----	Bauxite.
Point Comfort (reduction) -----	do -----	Alumina.
Rockdale (reduction) -----	Milam -----	Do.
Reynolds Metals Co.:		
Sherwin works (alumina) -----	San Patricio -----	Bauxite.
San Patricio (reduction) -----	do -----	Alumina.
<b>Antimony:</b>		
NL Industries, Inc.:		
Laredo smelter -----	Webb -----	Ore.
<b>Cadmium:</b>		
ASARCO, Inc.:		
Electrolytic -----	Nueces -----	Flue dust.
<b>Copper:</b>		
ASARCO, Inc.:		
Amarillo refinery -----	Potter -----	Blister and anode.
El Paso smelter -----	El Paso -----	Ore and concentrates.
Phelps Dodge Refining Corp.:		
Nichols refinery -----	do -----	Blister and anode.
<b>Iron:</b>		
Lone Star Steel Co.:		
Daingerfield plant -----	Morris -----	Ore and scrap.
Armco Steel Corp.:		
Houston plant -----	Harris -----	Do.
United States Steel Corp.:		
Cedar Point plant -----	Chambers -----	Do.
<b>Lead:</b>		
ASARCO, Inc.:		
El Paso smelter -----	El Paso -----	Ore and concentrates.
<b>Magnesium:</b>		
The Dow Chemical Co.:		
Freeport plants, electrolytic -----	Brazoria -----	Seawater.
American Magnesium Co.:		
Snyder plant, electrolytic -----	Scurry -----	Brine.
<b>Manganese:</b>		
Tenn-Tex Alloy Corp -----	Harris -----	Ore.
<b>Sodium:</b>		
Ethyl Corp -----	do -----	Brine.
<b>Tin:</b>		
Gulf Chemical & Metallurgical Co.:		
Texas City smelter -----	Galveston -----	Ore.
<b>Tungsten:</b>		
Gulf Chemical & Metallurgical Co.:		
Texas City smelter -----	do -----	Do.
NL Industries, Inc.:		
Laredo plant -----	Webb -----	Do.
<b>Zinc:</b>		
ASARCO, Inc.:		
Amarillo retort smelter -----	Potter -----	Ore and concentrates.
Corpus Christi electrolytic -----	Nueces -----	Do.
El Paso fuming plant -----	El Paso -----	Dusts and residues.

Table 27.—Texas: Secondary metal recovery plants

County and company	Material	Products
<b>Austin:</b>		
Schindler Bros. Steel Co -----	Steel scrap -----	Reinforced steel bars.
<b>Dallas:</b>		
Abasco, Inc -----	Aluminum scrap -----	Aluminum ingots, dioxiding bars and shot.
ASARCO, Inc -----	Lead and zinc scrap ----	Lead and zinc ingots, pigs, alloys.
Dixie Industries, Inc -----	Lead scrap -----	Lead pigs, alloys, chemicals.
NL Industries, Inc., Metals Div.	Battery plates -----	Lead products.
Southern Lead Co -----	----do -----	Lead pigs and alloys.
<b>El Paso:</b>		
Border Steel Mills, Inc -----	Steel scrap -----	Steel shapes and reinforcing bars.
<b>Gregg:</b>		
Marathon-LeTourneau Co ----	----do -----	Heavy mobile equipment.
<b>Guadalupe:</b>		
Structural Metals, Inc -----	----do -----	Structural-steel reinforcing bars.
<b>Harris:</b>		
A&B Metal & Smelting Co ---	Aluminum and 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 and zinc scrap-	Aluminum and zinc ingots, alloys.
Houston Fishing Tackle Co ---	Soft lead scrap -----	Lead products.
Houston Lead Co -----	Lead scrap -----	Lead pigs, ingots, alloys.
Lead Products, Inc -----	----do -----	Do.
Proler International Corp ----	Aluminum and zinc scrap-	Aluminum and zinc ingots.
Southwest Saw Corp -----	Steel scrap -----	Steel alloys.
Sterling Type, Rule and Metals Co.	Type metal -----	Type metal.
Vulcan Materials Co.-----	Tinned scrap -----	Refined tin and baled detinned steel.
<b>Tarrant:</b>		
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.

Alcoa continued construction of the company's new Anderson County works near Palestine in east Texas. Startup for the 15,000-ton-per-year smelter, which will employ a new smelting process developed by Alcoa, is mid-1976.

**Antimony.**—Primary antimony metal was produced at the Laredo smelter of NL Industries, Inc. The smelter operated at reduced capacity during 1975 and output was down about 22%.

**Cadmium.**—Production of cadmium metal declined 81% and value fell 86% from 1974. Cadmium metal was recovered as a byproduct at ASARCO's electrolytic zinc smelter in Corpus Christi.

**Copper.**—Blister and anode copper was produced at ASARCO's El Paso metallurgical smelter from ores and concentrates mined outside of Texas. In the last quarter of 1975, ASARCO began production of refined copper at the company's new 420,000-ton-per-year Amarillo refinery. Phelps Dodge Refining Corp. continued to refine copper at its Nichols refinery in El Paso.

**Gold and Silver.**—ASARCO completed and put into operation a precious metal recovery facility at the company's new copper refinery near Amarillo. Gold and silver, along with nickel, selenium, and tellurium, were recovered as byproducts of the copper electrolytic refining process. The silver recovery unit had the capacity to produce 60 million ounces of refined silver per year making it the largest such facility in the world. Gold and silver contained in the copper treated at the Amarillo refinery were smelted from ores and concentrates produced in other States and foreign countries.

Changes in governmental policies and improved prices for gold and silver in recent years has renewed interest in potential precious metal deposits in Texas. In response to this heightened interest, the Bureau of Economic Geology, The University of Texas at Austin, published a report which summarizes the information on known occurrences of gold and silver.<sup>4</sup>

Although numerous occurrences of gold and silver are known to exist in the State, the only areas where sustained mining has occurred is in the Trans-Pecos Texas and, to a very limited extent, in the central mineral region. The last notable production of gold or silver ores was from a Presidio County mine in the early 1950's.

**Iron Ore.**—The production of iron ore (siderite and limonite) decreased but value increased above 1974 levels. Iron ore was recovered from open pit mines in the counties of Cass, Morris, and Nacogdoches in the northeastern part of the State. Iron ore was used in the production of pig iron at the Lone Star Steel Co.'s steel mill and in the production of cement.

**Lead.**—Primary lead was recovered from domestic and imported ores and concentrates at ASARCO's smelter in El Paso.

**Magnesium.**—The Dow Chemical Co. and the American Magnesium Co. continued to recover magnesium from seawater and from brine to produce magnesium metal and compounds. Output of metal and compounds was down but value was up slightly over 1974.

**Manganese.**—Tenn-Tex Alloy Corp. of Houston continued production of ferrous manganese and silicomanganese from imported ores.

**Sodium.**—Metallic sodium was recovered from salt by the Ethyl Corp.'s Houston ship channel plant. The output was used principally to produce tetraethyl or tetramethyl lead.

**Tin.**—Production of tin at the Gulf Chemical & Metallurgical Co.'s Texas City smelter was about 7% above the 1974 output. The ore feedstock for the smelter, the only tin smelter in the United States, was from Bolivia.

**Tungsten.**—In July, NL Industries, Inc.'s tungsten mill was closed because of reduced demand and prices. The Laredo mill employed a chemical process to recover sheelite from ore concentrates that were imported from Guatemala.

**Uranium.**—Output of uranium U<sub>3</sub>O<sub>8</sub> was essentially unchanged from 1974, but unit value was up about 17%. Over 90% of the yellowcake production was from the 1,750-ton-per-day Conquista mill, jointly owned by the Continental Oil Co. and the Pioneer Nuclear Corp. Ore feed for the Conquista solvent-extraction mill was trucked from 10 open pit mines in Karnes and Live Oak Counties.

The Atlantic Richfield Co. completed construction of the Clay West uranium recovery plant and expanded what had been a pilot test into the Nation's first commer-

<sup>4</sup>Evans, T. J. Gold and Silver in Texas. Bureau of Economic Geology, The University of Texas, Austin, Tex., Miner. Res. Circ. No. 56, 1975.

cial in situ uranium-solution mine. The first shipment of 30,000 pounds of  $U_3O_8$  concentrate was made in October. The Wyoming Minerals Corp. (Westinghouse) continued to operate pilot in situ solution mines near Bruni (Webb County) and near Three Rivers (Live Oak County). Dalco Oil Co. and United States Steel Corp. were negotiating with an electric utility and a foreign concern regarding sales of their Burns in situ leach facilities and uranium reserves in south Texas. The Burns pilot project is near George West (Live Oak County). Union Carbide Corp. was completing development wells and constructing uranium recovery facilities at the Palangana in situ leach project north of Benavides (Duval County). Mobil Oil Corp. continued experimental work at the O'Hern in situ leach project near Bruni (Webb County).

Total exploration and development drilling was 3,316,000 feet, ranking the State third in the Nation. Improved uranium prices were responsible for the 11% in-

crease in drilling activity. Land held for uranium exploration and mining was 622,000 acres, down less than 1% from 1974.

The Energy Research and Development Administration (ERDA) provides estimates of proved reserves of uranium ( $U_3O_8$ ) based on \$10, \$15, and \$30 per pound prices. As of December 31, 1975, Texas proved uranium reserves were 15,000 tons of  $U_3O_8$  in 53 deposits. Reserve estimate at \$15 per pound was 23,000 tons in 110 deposits and reserve estimate at \$30 per pound was 43,900 tons in 130 deposits. The State ranked third in proved reserves in 1975, up from fourth in 1974.

**Zinc.**—Zinc output was sharply lower because of a drop in metal demand and the shutdown of one of the State's two smelters. On May 31, ASARCO closed permanently its horizontal retort smelter in Amarillo. The smelter had been operating under a variance from the Texas Air Control Board.

Table 28.—Texas: Principal producers

Commodity and company	Address	Type of activity	County
<b>Asphalt (native):</b>			
Uvalde Rock Asphalt Co --	Box 531 San Antonio, Tex. 78206	Mine -----	Uvalde.
White's Uvalde Mines, Inc.	Box 499 San Antonio, Tex. 78206	---do -----	Do.
<b>Barite:</b>			
Dresser Minerals Div ----	Box 6504 Houston, Tex. 77005	Grinding plant ----	Cameron.
The Milwhite Co., Inc ----	Box 15038 Houston, Tex. 77020	---do -----	Harris.
NL Industries, Inc -----	Box 1675 Houston, Tex. 77001	---do -----	Nueces.
<b>Carbon black:</b>			
Ashland Chemical Co ----	Box 1503 Houston, Tex. 77005	Furnace plant ----	Aransas and Wheeler.
Cabot Corp -----	125 High St. Boston, Mass. 02110	---do -----	Gray and Howard.
Columbian Carbon Co., Div. of Cities Service Co.	3200 West Market Akron, Ohio 44313	---do -----	Montgomery.
Do -----	-----	Channel plant ----	Gaines.
Continental Carbon Co ---	Box 22085 Houston, Tex. 77027	Furnace plant ----	Moore.
J. M. Huber Corp -----	Box 831 Borger, Tex. 79066	---do -----	Harris and Hutchinson.
Phillips Petroleum Co ----	Adams Bldg. Bartlesville, Okla. 74004	---do -----	Hutchinson and Orange.
Sid Richardson Carbon & Gasoline Co.	1105 Fort Worth National Bank Bldg. Fort Worth, Tex. 76102	---do -----	Howard.
<b>Cement:</b>			
Alpha Portland Cement Co.	15 South 3d St. Easton, Pa. 18042	Quarry and plant.	Orange.
Capitol Aggregates, Inc --	Rte. 13, Box 412 San Antonio, Tex. 78209	Plant -----	Bexar.
Centex Cement Corp ----	Box 9294 Corpus Christi, Tex. 78408	Quarry and plant.	Nueces.
General Portland, Inc ----	2800 Republic Bank Tower Dallas, Tex. 75201	---do -----	Dallas, Harris, Tarrant.
Gifford-Hill Portland Cement Co.	Box 520 Midlothian, Tex. 76065	---do -----	Ellis.
Gulf Coast Portland Cement Co., Div. of McDonough Co.	Box 262 Houston, Tex. 77001	---do -----	Harris.
Ideal Cement Co., Div. of Ideal Basic Industries.	420 Ideal Cement Bldg. Denver, Colo. 80202	---do -----	Do.
Lone Star Industries, Inc.--	Box 47327 Dallas, Tex. 75247	---do -----	Harris and Nolan.
Longhorn Div., Kaiser Cement & Gypsum Corp.	Kaiser Center 300 Lakeside Dr. Oakland, Calif. 94612	Plant -----	Bexar.
San Antonio Portland Cement Co.	Box 6925 San Antonio, Tex. 78209	Quarry and plant -	Do.
Southwestern Portland Cement Co.	Box 392 El Paso, Tex. 79943	---do -----	Ector, El Paso, Ellis, Potter.
Texas Industries, Inc ----	Box 146 Midlothian, Tex. 76065	---do -----	Ellis.
Universal Atlas Cement Div., United States Steel Corp.	600 Grant St. U.S. Steel Bldg. Pittsburgh, Pa. 15230	---do -----	McLennan.
<b>Clay and shale:</b>			
Acme Brick Co., Div. of Justin Industries, Inc.	Box 425 Fort Worth, Tex. 76101	Mine and plant ---	Denton, Nacog- doches, Parker, Van Zandt, Wise, Fayette.
Balcones Mineral Corp ---	Box B Flatonia, Tex. 78941	---do -----	Angelina and Limestone.
Dresser Minerals Div ----	601 Jefferson Houston, Tex. 77002	---do -----	Bastrop.
Elgin Butler Brick Co ----	Box 1947 Austin, Tex. 78767	---do -----	Bexar and Eastland.
Featherlite Corp -----	Box 141 Ranger, Tex. 76470	---do -----	Dallas and Limestone.
General Portland Inc ----	Box 2698 Dallas, Tex. 75201	---do -----	Cherokee.
General Refractories Co --	1520 Locust St. Philadelphia, Pa. 19102	---do -----	Chambers.
Gulf Coast Portland Cement Co., Div. of McDonough Co.	Box 262 Houston, Tex. 77001	---do -----	



Table 28.—Texas: Principal producers—Continued

Commodity and company	Address	Type of activity	County
Clay and shale—Continued			
Henderson Clay Products Co.	Box 1251 Henderson, Tex. 75652	Mine and plant	Rusk.
Lone Star Industries, Inc.	Box 47327 Dallas, Tex. 75247	----do	Fisher and Harris.
The Milwhite Co., Inc.	Box 15038 Houston, Tex. 77020	----do	Fayette and Walker.
Southern Clay Products, Inc.	Box 44 Gonzales, Tex. 78629	----do	Angelina, Cherokee, Gonzales.
Texas Clay Products, Inc.	Box T Malakoff, Tex. 75148	----do	Henderson.
Texas Industries, Inc.	3100 Carpenter Freeway Dallas, Tex. 75247	----do	Comanche, Dallas, Ellis, Fort Bend, Henderson, Marion, Van Zandt.
Coal (lignite):			
Aluminum Co. of America	Box 1111 Rockdale, Tex. 76567	Strip mine	Milam.
ICI United States, Inc.	Box 790 Marshall, Tex. 75670	----do	Harrison.
Texas Utilities Generating Co.	Box 948 Fairfield, Tex. 75840	----do	Freestone.
Do	Box 1266 Mt. Pleasant, Tex. 75455	----do	Titus.
Fluorspar:			
D & F Minerals Co.	Box 75 Terlingua, Tex. 79852	Mine	Brewster.
Graphite:			
Southwestern Graphite Co.	Burnet, Tex. 78611	Open pit mine	Burnet.
Gypsum:			
The Celotex Corp.	1500 North Dale Tampa, Fla. 33607	Open pit mine and calcining plant.	Fisher.
The Flintkote Co.	400 Westchester Ave. White Plains, N.Y. 10604	----do	Nolan.
Georgia-Pacific Corp.	900 S.W. 5th Ave. Portland, Oreg. 97204	----do	Hardeman.
National Gypsum Co.	325 Delaware Ave. Buffalo, N.Y. 14202	----do	Fisher.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	----do	Nolan.
Do	----do	Plant	Harris.
Iron ore:			
Lone Star Steel Co.	Box 12226 Dallas, Tex. 75225	Open pit mine	Cass and Morris.
Tex-Iron, Inc.	Cushing, Tex. 75760	----do	Nacogdoches.
Lime:			
Aluminum Co. of America	1028 Alcoa Bldg. Pittsburgh, Pa. 15219	Plant	Calhoun.
Armco Steel Corp.	Box 1367 Houston, Tex. 77001	----do	Harris.
Austin White Lime Co.	General Delivery McNeil, Tex. 78651	----do	Travis.
Champion Papers, Inc.	Box 872 Pasadena, Tex. 77501	----do	Harris.
The Dow Chemical Co.	2020 Dow Center Midland, Mich. 48640	----do	Brazoria.
McDonough Bros., Inc.	Fredericksburg Rd. Rt. 8, Box 22 San Antonio, Tex. 78228	----do	Bexar.
PPG Industries, Inc.	Box 4026 Corpus Christi, Tex. 78408	----do	Nueces
Round Rock Lime Co.	Box 218 Round Rock, Tex. 78664	----do	Hill and Williamson.
Texas Lime Co.	Box 851 Cleburne, Tex. 76031	----do	Johnson.
United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	----do	Comal and Harris.
Magnesium:			
American Magnesium Co.	Snyder, Tex. 79549	----do	Scurry.
The Dow Chemical Co.	2020 Dow Center Midland, Mich. 48640	----do	Brazoria.
Magnesium compounds:			
The Dow Chemical Co.	2020 Dow Center Midland, Mich. 48640	----do	Do.
A. P. Green Refractories Co.	Freeport, Tex. 77541	----do	Do.

Table 28.—Texas: Principal producers—Continued

Commodity and company	Address	Type of activity	County
Mica:			
Western Mica Co., Div. of United States Gypsum Co.	101 South Wacker Dr. Chicago, Ill. 60606	Plant -----	Tarrant.
Perlite:			
Filter Media, Inc -----	Box 19156 Houston, Tex. 77024	Expanding plant --	Harris.
Perlite of Houston, Inc ---	Box 8386 Houston, Tex. 77004	----do -----	Do.
Sil-Flo Corp -----	3405 North Sylvania Ave. Box 7086 Fort Worth, Tex. 76111	----do -----	Dallas.
South Texas Perlite Co ---	Judson Rd. San Antonio, Tex. 78233	----do -----	Bexar.
Texas Vermiculite Co ----	2651 Manila Dallas, Tex. 75212	----do -----	Dallas.
United States Gypsum Co..	101 South Wacker Dr. Chicago, Ill. 60606	----do -----	Nolan.
Roofing granules:			
H. E. Reed & Co., Inc ---	8149 Kennedy Ave. Highland, Ind. 46322	Plant -----	Milam.
Salt:			
Diamond Shamrock Corp --	300 Union Commerce Bldg. Cleveland, Ohio 44115	Brine wells -----	Chambers.
The Dow Chemical Co ----	Midland, Mich. 48640	----do -----	Brazoria.
Morton Salt Co -----	110 North Wacker Dr. Chicago, Ill. 60606	Underground mine and brine wells.	Van Zandt.
PPG Industries, Inc ----	Box 4026 Corpus Christi, Tex. 77704	Brine wells -----	Duval.
Phillips Petroleum Co ---	Bartlesville, Okla. 74003	----do -----	Hutchinson.
Texas Brine Corp -----	2000 West Loop South Houston, Tex. 77027	----do -----	Harris, Jefferson, Matagorda.
United Salt Corp -----	----do -----	Underground mine and brine wells.	Fort Bend and Harris.
Vulcan Materials Co ----	Box 1060 Denver City, Tex. 79323	Brine wells -----	Yoakum.
Sand and gravel:			
Capitol Aggregates, Inc --	Rt. 13, Box 412 San Antonio, Tex. 78209	Stationary -----	Guadalupe and Travis.
Dresser Minerals Div ---	Kosse, Tex. 76653	----do -----	Limestone.
The Fordyce Co -----	Box 1981 San Antonio, Tex. 78206	----do -----	Hidalgo and Victoria.
Fort Worth Sand & Gravel Co.	Box 400 Arlington, Tex. 76010	----do -----	Dallas, Denton, Tarrant.
Gifford-Hill & Co., Inc ---	Box 47127 Dallas, Tex. 75247	----do -----	Brazos, Colorado, Dallas, McLennan, Tarrant, Wichita.
Horton & Horton -----	Box 1669 Houston, Tex. 77001	Portable and dredge.	Colorado, Harris, Victoria, Crosby.
Janes-Prentice, Inc -----	Box 2155 Austin, Tex. 78767	Stationary -----	
Lone Star Industries, Inc -	Box 47327 Dallas, Tex. 75247	----do -----	Colorado, Denton, Nolan.
Parker Bros. & Co., Inc --	Box 107 Houston, Tex. 77001	Stationary and dredge.	Colorado and Harris.
Thorstenberg Materials Co.	1435 Bank of the Southwest Bldg. Houston, Tex. 77002	----do -----	Do.
Shell:			
Lone Star Industries, Inc..	Box 86 Houston, Tex. 77001	Dredge -----	Calhoun.
Parker Bros. & Co., Inc ---	5303 Navigation Bldg. Box 107 Houston, Tex. 77001	----do -----	Do.
Sodium (metallic):			
Ethyl Corp -----	Box 472 Pasadena, Tex. 77501	Plant -----	Harris.
Sodium sulfate (natural):			
Ozark-Mahoning Co -----	1870 South Boulder Tulsa, Okla. 74119	----do -----	Gaines and Terry.
Stone:			
Barrett Industries -----	2718 SW. Military Dr. Box 21070 San Antonio, Tex. 78221	Quarry -----	Bexar.

Table 28.—Texas: Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Stone—Continued</b>			
General Portland, Inc ----	2800 Republic Bank Tower Dallas, Tex. 75201	Quarry -----	Dallas and Tarrant.
Gifford-Hill & Co., Inc ---	Box 47127 Dallas, Tex. 75247	----do -----	Wise.
Lone Star Industries, Inc--	Box 47327 Dallas, Tex. 75247	----do -----	Burnet, Calhoun, Ellis, Hudspeth, Nolan, Wise.
Parker Bros. & Co., Inc --	Box 107 Houston, Tex. 77001	----do -----	Comal and Matagorda.
Texas Crushed Stone Co --	Box 9345 Austin, Tex. 78717	----do -----	Llano and Williamson.
Texas Industries, Inc -----	Box 146 Midlothian, Tex. 76065	----do -----	Ellis and Wise.
Trinity Concrete Products Co.	Box 47524 Dallas, Tex. 75247	----do -----	Johnson and Wise.
White's Mines, Inc -----	Box 500 Brownwood, Tex. 76801	----do -----	Brown, Taylor, Uvalde.
<b>Sulfur (native):</b>			
Atlantic Richfield Co -----	Box 2819 Dallas, Tex. 75221	Frasch process ---	Pecos.
Duval Corp -----	1906 First City National Bank Bldg. Houston, Tex. 77002	----do -----	Culberson.
Jefferson Lake Sulphur Co.	Box 1185 Houston, Tex. 77001	----do -----	Fort Bend.
Texasgulf, Inc -----	200 Park Ave. New York, N.Y. 10017	----do -----	Jefferson, Liberty, Pecos, Wharton.
<b>Sulfur (byproduct):</b>			
Amoco Production Co ----	Box 591 Tulsa, Okla. 74102	Secondary recovery	Andrews, Ector, Hockley, Van Zandt, Wood.
Cities Service Oil Co -----	Box 300 Tulsa, Okla. 74102	----do -----	Cochran, Dawson, Gaines, Van Zandt.
Getty Oil Co -----	Box 8 Seroggins, Tex. 75480	----do -----	Franklin and Freestone.
Gulf Oil Corp -----	Box 701 Port Arthur, Tex. 77640	----do -----	Jefferson.
Phillips Petroleum Co ---	Bartlesville, Okla. 74003	----do -----	Brazoria, Crane, Ector, Hutchinson.
Shell Oil Co -----	Box 2099 Houston, Tex. 77001	----do -----	Cass, Harris, Karnes.
Warren Petroleum Corp --	Box 1589 Tulsa, Okla. 74101	----do -----	Crane, Hopkins, Karnes.
<b>Talc and soapstone:</b>			
Cyprus Industrial Minerals Co.	Box 1201 Trenton, N.J. 08606	Mine -----	Hudspeth.
Pioneer Talc Co., Inc -----	Chatsworth, Ga. 30705	Mine and plant ---	Do.
Southern Clay Products, Inc.	Box 44 Gonzales, Tex. 78629	----do -----	Do.
Texas Talc Co., Inc -----	Allamoore, Tex. 79829	----do -----	Do.
Westex Talc Co -----	Box 15088 Houston, Tex. 77020	----do -----	Culberson and Hudspeth.
<b>Uranium:</b>			
Atlantic Richfield Co -----	515 South Flower St. Los Angeles, Calif. 90071	Solution mines and plant.	Live Oak.
Continental Oil Co.- Pioneer Nuclear Corp.	Box 300 Falls City, Tex. 78113	Open pit mines and mill.	Karnes and Live Oak.
<b>Vermiculite:</b>			
Texas Vermiculite Co ----	2651 Manila Rd. Dallas, Tex. 75200	Exfoliating plant -	Bexar and Dallas.
Vermiculite Products, Inc.-	Box 7327 Houston, Tex. 77008	----do -----	Harris.

# The Mineral Industry of Utah

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

By Stephen R. Wilson<sup>1</sup>

Minerals produced in Utah during 1975 were valued at \$966 million, a 2% increase over that of 1974 and an alltime high. A substantial gain was recorded in the mineral fuels group, with a modest increase in nonmetals. Valuation of the metals group was down.

The mineral fuels group increased 35% in value. Coal, natural gas, and crude petroleum accounted for most of the gain. Only natural gasoline and LP gases decreased in value. During the year, 194 wells were completed in the State. Sixty percent of the wells—103 oil and 13 gas wells, developed into producers.

Increases in values were noted for 10 of the 14 commodities in the nonmetals group. Clays, lime, and stone showed decreases. Total value of the group was 15% above that of 1974.

The dollar value of the metals group dropped 28%. A large part of the decrease was the result of lower prices for copper and a cutback in copper ore production in the Bingham district. Gold and silver production and value were also less because of decreased copper production. Copper accounted for 66% of the value of the metals group and 24% of the value of all minerals produced in the State. In 1974, the corresponding figures were 74% and 37%.

Material handled in the metals and nonmetals industries during 1975 totaled 160 million tons. Crude ore mined was 46.5 million tons or 29% of the total. Waste from stripping operations totaled 97.7 million tons, and other waste from surface and

underground operations amounted to 7.0 million tons. Material mined and moved at the surface was 159 million tons. One hundred and fifty-nine surface and 44 underground mines reported activity in the State during the year.

A new oilfield was discovered in the Pineview area, Summit County, 12 miles east of Coalville. American Quasar Petroleum Co. completed the discovery well, the Newton Sheep Co. No. 1, in December 1974. The well is flowing approximately 500 barrels of oil per day from the Nugget Formation. A second well, American Quasar 3-1UPRR has also been completed and is producing approximately 1,050 barrels of oil daily from the Nugget and Twin Creek Formations. This well is 3,450 feet northeast of the discovery well. Other wells were being drilled in the new field at the end of the year.

During February, Phillips Petroleum Co. announced plans for geothermal drilling in the Roosevelt Hot Springs area, Beaver County. Initially three "observation wells" were drilled to depths in excess of 2,200 feet. Additional drilling to an approximate depth of 2,700 feet has disclosed a favorable high-temperature water zone. More drilling will be necessary to establish the importance of the area, but tentative appraisals indicate considerable potential for power-plant construction.

Construction of a new building to house Utah Geological and Mineral Survey personnel was started during the year. The

<sup>1</sup> State Liaison Officer, Bureau of Mines, Salt Lake City, Utah.

site is within the University of Utah Research Park. Estimated cost of the new facility is \$375,000. It is expected that construction will be completed early in 1976. The Utah Geological and Mineral Survey has recently been transferred from the jurisdiction of the University of Utah to the Utah Department of Natural Resources.

#### Legislation and Government Programs.

—Two grants were awarded to the Utah Geological and Mineral Survey during the year. One involved an amount of \$25,350 to develop data on lead and zinc in Utah for the Minerals Availability System (MAS). The second grant permits an expenditure of \$18,800 to define the iron ore occurrences in Utah.

The Bureau of Mines awarded two contracts to the University of Utah during June. The first involved an expenditure of \$25,820 to identify research and development needs for advancing mining technology and for improving the health and safety of mining in the western U.S. and to develop a list of suggested priorities for these needs. The second contract, in an amount of \$102,252, concerned research to determine adsorption-desorption reactions in the desulfurization of coal by pyrite flotation technique.

The National Science Foundation also awarded \$101,500 to the University of Utah for research in conversion of coal to liquid and gaseous fuels. The work has been planned to cover 3 years.

Table 1.—Mineral production in Utah<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Carbon dioxide, natural -----thousand cubic feet..	93,751	\$6	108,941	\$8
Clays -----thousand short tons..	232	953	220	548
Coal (bituminous) -----do-----	5,858	71,699	6,961	138,134
Copper (recoverable content of ores, etc.) ----- short tons..	230,593	356,497	177,155	227,467
Fluorspar -----do-----	2,967	98	9,542	389
Gem stones -----do-----	NA	100	NA	100
Gold (recoverable content of ores, etc.) ----- troy ounces..	254,909	40,719	189,620	30,622
Gypsum -----thousand short tons..	248	1,076	247	1,457
Iron ore (usable) -----thousand long tons, gross weight..	1,808	14,016	1,334	10,399
Lead (recoverable content of ores, etc.) ----- short tons..	10,510	4,729	12,679	5,452
Lime -----thousand short tons..	176	4,911	161	4,540
Natural gas -----million cubic feet..	50,522	20,815	55,354	26,570
Petroleum (crude) -----thousand 42-gallon barrels..	39,363	279,858	42,301	348,181
Pumice -----thousand short tons..	15	19	17	23
Salt -----do-----	771	7,321	631	7,717
Sand and gravel -----do-----	11,578	12,985	10,159	14,342
Silver (recoverable content of ores, etc.) ----- thousand troy ounces..	3,208	15,109	2,822	12,472
Stone -----thousand short tons..	2,869	6,410	2,486	6,167
Zinc (recoverable content of ores, etc.) short tons..	12,619	9,060	19,640	15,319
Value of items that cannot be disclosed:				
Asphalt, beryllium, cement, clays (kaolin, 1975), magnesium chloride, magnesium compounds, molybdenum, natural gas liquids, phosphate rock, potassium salts, sodium sulfate, tungsten concentrates, uranium, and vanadium..	XX	105,664	XX	116,550
Total .....	XX	952,045	XX	966,407
Total 1967 constant dollars .....	XX	450,127	XX	<sup>p</sup> 383,568

<sup>p</sup> Preliminary. NA Not available. XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes kaolin; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Utah, by county <sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Beaver -----	W	\$176	Sand and gravel.
Box Elder -----	\$1,975	2,116	Stone, sand and gravel, lime, salt, tungsten.
Cache -----	W	W	Sand and gravel, stone.
Carbon -----	W	81,694	Coal, petroleum, natural gas, carbon dioxide, sand and gravel.
Daggett -----	W	1,077	Natural gas, petroleum.
Davis -----	1,412	1,340	Sand and gravel, stone.
Duchesne -----	164,985	209,341	Petroleum, natural gas, natural gas liquids, sand and gravel.
Emery -----	W	W	Coal, uranium, natural gas, sand and gravel.
Garfield -----	12,154	W	Petroleum, sand and gravel, stone.
Grand -----	12,194	11,500	Potassium salts, natural gas, petroleum, uranium, copper, salt, sand and gravel.
Iron -----	14,727	W	Iron ore, sand and gravel.
Juab -----	411	627	Fluorspar, clays, gypsum, sand and gravel, copper, gold, silver.
Kane -----	300	251	Sand and gravel.
Millard -----	W	W	Gypsum, stone, pumice, beryllium, sand and gravel.
Morgan -----	W	W	Cement, stone, sand and gravel.
Piute -----	2	W	Sand and gravel, clays.
Rich -----	W	W	Phosphate rock.
Salt Lake -----	434,108	297,375	Copper, gold, molybdenum, silver, cement, sand and gravel, salt, lime, stone, clays.
San Juan -----	112,755	130,721	Petroleum, uranium, natural gas, natural gas liquids, vanadium, copper.
Sanpete -----	W	1,601	Sand and gravel, gypsum, salt, clays.
Sevier -----	4,372	10,875	Coal, gypsum, clays, salt, sand and gravel.
Summit -----	6,748	17,258	Petroleum, zinc, lead, silver, natural gas, clays, copper, gold, stone.
Tooele -----	12,262	12,110	Potassium salts, salt, lime, stone, sand and gravel, tungsten, magnesium compounds, clays.
Uintah -----	48,097	63,571	Petroleum, phosphate rock, asphalt, natural gas, sand and gravel, natural gas liquids.
Utah -----	22,099	W	Zinc, silver, lead, stone, sand and gravel, gold, clays, copper, lime.
Wasatch -----	W	W	Sand and gravel, stone.
Washington -----	W	W	Sand and gravel, petroleum, pumice, stone.
Wayne -----	W	W	Sand and gravel.
Weber -----	9,140	13,720	Potassium salts, salt, sodium sulfate, sand and gravel, magnesium compounds, clays, stone.
Undistributed <sup>2</sup> -----	94,304	111,056	
Total <sup>3</sup> -----	952,045	966,407	

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

<sup>1</sup> Values of petroleum and natural gas (1975) are based on an average price per barrel and cubic foot, respectively, for the State.

<sup>2</sup> Includes some sand and gravel that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Utah business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	496.6	505.1	+1.7
Unemployment -----do-----	29.8	35.0	+17.4
<b>Employment (nonagricultural) : <sup>1</sup></b>			
Mining -----do-----	13.4	13.3	-.7
Manufacturing -----do-----	69.5	67.8	-2.4
Contract construction -----do-----	24.0	26.6	+10.8
Transportation and public utilities -----do-----	26.9	27.3	+1.5
Wholesale and retail trade -----do-----	102.3	103.9	+1.6
Finance, insurance, real estate -----do-----	20.1	20.3	+1.0
Services -----do-----	73.7	76.3	+3.5
Government -----do-----	108.2	106.7	-1.4
Total nonagricultural employment -----do-----	438.1	442.2	+ .9
<b>Personal income:</b>			
Total -----millions--	\$5,351	\$5,937	+11.0
Per capita -----do-----	\$4,539	\$4,923	+8.5
<b>Construction activity:</b>			
Number of private and public residential units authorized	11,808	12,960	+9.8
Value of nonresidential construction -----millions--	\$147.7	\$126.8	-14.2
Value of State road contract awards -----do-----	\$32.7	\$76.0	+132.4
Shipments of portland and masonry cement to and within Utah -----thousand short tons--	685	692	+1.0
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$952.0	\$966.4	+1.5
Value per capita, resident population -----do-----	\$807.50	\$803.33	-.5
Value per square mile -----do-----	\$11,211.61	\$11,380.74	+1.5

<sup>P</sup> Preliminary.<sup>1</sup> Annual average for 1975 not available, data for July 1975 provided in lieu of 1975 average.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

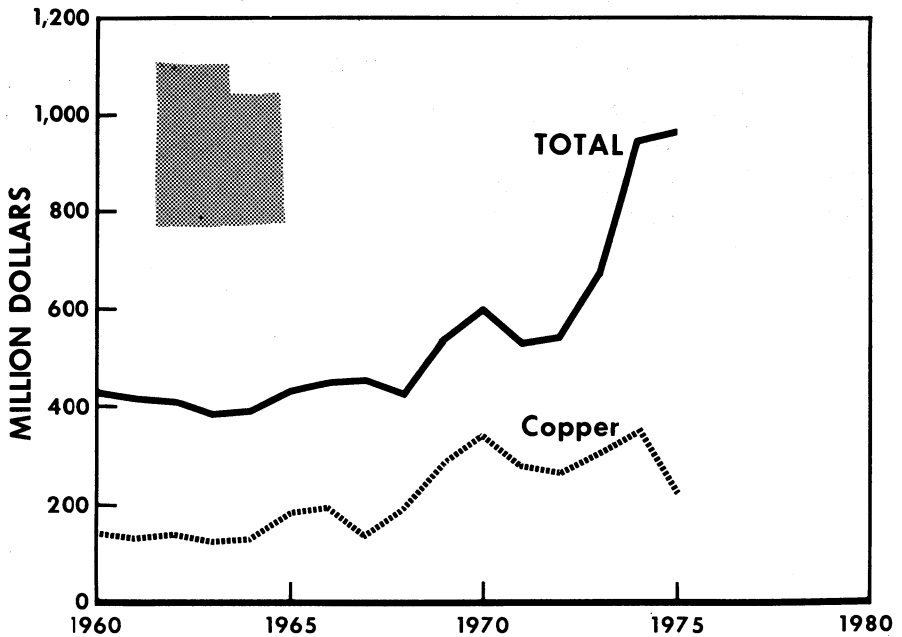


Figure 1.—Value of mine production of copper and total value of mineral production in Utah.

## REVIEW BY MINERAL COMMODITIES

## METALS

**Beryllium.**—Brush Wellman, Inc., continued mining operations on bertrandite ores at Spor Mountain. Production was down compared with that of the previous year. Ores are mined from several pits during a brief period of the year during the most favorable weather and temperature conditions. The ores were stockpiled and later transported by truck to the company processing plant in Millard County, 48 miles east of the mine site. A 2-year ore supply is generally maintained in the stockpile at the mine site.

**Copper.**—Copper production in Utah decreased 23% during 1975 because of the cutback in operations at the Bingham mine of Kennecott Copper Corp. Total value of production dropped 36% as a result of decreased ore tonnage and lower copper prices during the year. The Bingham mine was again the largest single copper producer in the United States. Other producers in Utah included Park City Ventures in the Park City area, Kennecott Copper Corp. at the Burgin and Trixie mines in the East Tintic district, Atlas Corp. from ores treated in the uranium mill at Moab, and Empire Mines Co. in the Tintic district. Copper was produced from eight mines in six counties exclusive of the properties supplying ores to the Atlas uranium mill.

Kennecott Copper Corp. announced early in February that approximately 1,200 workers would be terminated at the Utah Copper Div. in Utah. The action was necessary because of the large stock of copper on hand. Under normal conditions the Bingham mine operates on a 7-day schedule, but under the new arrangement workers are on the job 10 days straight followed by 4 nonworking days every 2 weeks. This reduced schedule was continued throughout the year, with the result that copper production was considerably less than during 1974.

In August, The Anaconda Company disclosed plans for a cutback in development at the Carr Fork copper project, Bingham district. Original plans included sinking four shafts—a production shaft, an operating shaft, and two air shafts. Work was suspended on the production and air intake shafts. The copper market situation apparently influenced the decision for changes in development. Initial plans called for production to begin in 1979 at a rate of 10,000 tons of ore per day. It appears likely that current scheduling will permit production to begin in 1979 but with reduced ore tonnage, probably in the range of 5,000 tons daily. Perhaps by 1983, production of 10,000 tons of ore per day will be achieved.



Table 4.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing <sup>1</sup> (lode)	Material sold or treated (short tons)	Gold		Silver		Total value
			Troy ounces	Value	Troy ounces	Value	
1973 total	6	39,207,402	307,080	\$30,035,495	3,619,038	\$9,257,499	
1974 total	8	35,824,728	254,909	40,719,164	3,207,923	15,109,317	
1975:							
Grand	—	—	—	—	—	—	—
Salt Lake	1	27,424,540	W	W	W	W	W
Utah	2	231,464	5,257	848,953	734,478	3,246,393	
Undistributed <sup>2</sup>	3	95,496	184,363	29,772,781	2,087,252	9,225,655	
Total	6	27,751,500	189,620	30,621,734	2,821,730	12,472,048	
Copper							
Lead							
Zinc							
	Short tons	Value	Short tons	Value	Short tons	Value	Total value
1973 total	256,589	\$305,340,886	13,733	\$4,474,325	16,800	\$6,941,787	\$356,049,992
1974 total	230,593	356,496,595	10,510	4,729,457	12,619	9,060,307	426,114,840
1975:							
Grand	59	75,226	--	--	--	--	75,226
Salt Lake	176,836	227,057,958	--	--	--	--	W
Utah	121	155,910	7,479	3,215,788	12,989	10,131,656	17,598,700
Undistributed <sup>2</sup>	139	178,348	5,201	2,236,311	6,651	5,187,487	273,658,540
Total	177,155	227,467,442 <sup>3</sup>	12,679	5,452,099	19,640	15,319,143	291,332,466

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

<sup>1</sup> Operations at old mill or miscellaneous cleanups not counted as producing mines, nor are various uranium mines counted from which byproducts were recovered.

<sup>2</sup> Includes Juab, San Juan, and Summit Counties combined to avoid disclosing individual company confidential data, and items indicated by symbol W.

<sup>3</sup> Data do not add to total shown because of independent rounding.

Table 5.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by class of ore or other source material

Source	Number of mines <sup>1</sup>	Material sold or treated (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode ore:							
Gold and gold-silver <sup>2</sup>	2	35,229	<sup>3</sup> 188,813	<sup>3</sup> 2,010,664	85	--	--
Copper	2	27,379,556	W	W	139,691	--	--
Lead and lead-zinc <sup>2</sup>	2	290,718	807	811,066	148	12,679	19,640
Total <sup>4</sup>	4	27,670,274	807	811,066	139,838	12,679	19,640
Other lode material:							
Copper precipitates	2	45,997	--	--	37,174	--	--
Uranium	--	--	--	--	59	--	--
Total <sup>4</sup>	2	45,997	--	--	37,232	--	--
Grand total	6	27,751,500	189,620	2,821,730	177,155	12,679	19,640

W Withheld to avoid disclosing individual company confidential data; included in gold and gold-silver ores.

<sup>1</sup> Detail will not add to total because some mines produce more than one class of material.

<sup>2</sup> Combined to avoid disclosing individual company confidential data.

<sup>3</sup> Includes gold and silver from copper ore.

<sup>4</sup> Data may not add to total shown because of independent rounding.

Table 6.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1975, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
Lode:					
Smelting of concentrates -----	184,025	2,500,024	139,753	12,578	19,624
Leaching -----	--	--	7	--	--
Direct smelting of—					
Ore -----	5,595	321,706	229	101	16
Copper precipitates -----	--	--	37,166	--	--
Total -----	189,620	2,821,730	177,155	12,679	19,640

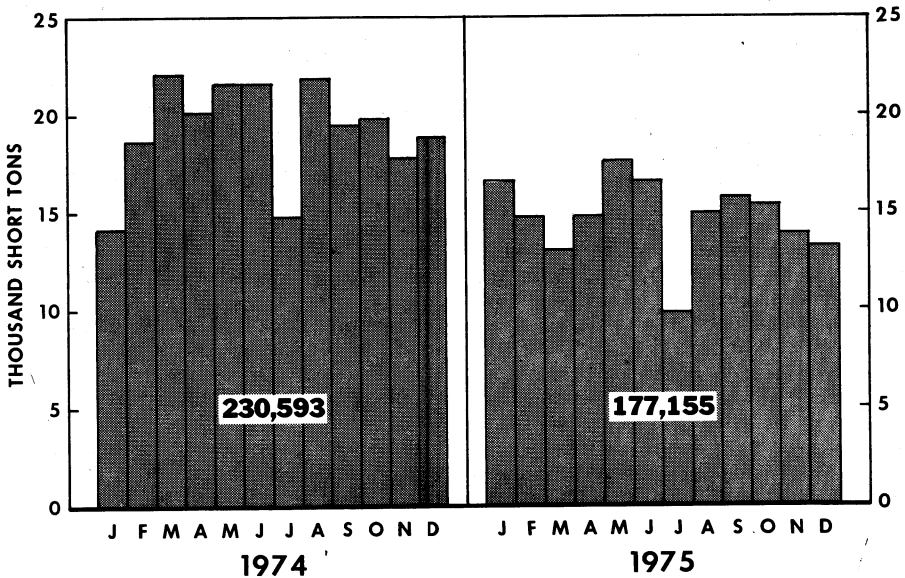


Figure 2.—Mine production of copper in Utah, by months in terms of recoverable metals.

**Gold.**—Gold was produced in Utah principally as a byproduct of base metal ores. Total yield was 26% less than that of the previous year. Value of the gold dropped 25%. The major gold producer was the Bingham mine of Kennecott Copper Corp. The Trixie mine in the East Tintic district, Utah County, was second in gold production. Six mines in four counties yielded gold.

**Iron Ore.**—All iron ores produced in the State were mined in the Iron Springs and Iron Mountain areas in Iron County. CF&I Steel Corp. and United States Steel

Corp. extracted most of their ores from the Comstock and Mountain Lion ore bodies. Utah International, Inc., mined low-grade alluvial ores and open pit ores from the Thompson and other deposits near Iron Springs. Upgrading of the alluvial ores was accomplished at the mine site, and final beneficiation was completed in the company plant at Iron Springs. Total tonnage of direct shipping ores and concentrates produced in the State decreased 26%. Value was also down 26%. The average iron content of all ores and concentrates was 56.99%. Nearly all pro-

duction was utilized in the iron and steel industry. A minor tonnage of concentrate was consumed for miscellaneous purposes.

**Lead.**—Two mines produced lead in 1975. The Burgin mine in Utah County, operated by Kennecott Copper Corp., was the largest lead producer in the State. Significant lead production was also recorded by Park City Ventures at the Ontario mine in Summit County. The output of lead increased 21% over that of the previous year. Total value of production was 15% greater.

A new 750-ton flotation concentrator was completed in April by Park City Ventures, operating on property of United Park City Mines Co., Summit and Wasatch Counties. Park City Ventures is a partnership of The Anaconda Company and Asarco, Inc. Ore reserves disclosed by exploration since 1970 are indicated to average 9% lead, 11% zinc, and 5 ounces of silver per ton. It is expected that the operation will annually yield 30,000 tons of lead concentrate with an average content of 70% lead, and 45,000 tons of zinc concentrate containing 60% zinc. The silver content of the lead concentrate will range from 30 to 40 ounces per ton.

**Molybdenum.**—As in past years, all molybdenum produced in the State was recovered as a byproduct from concentration of copper ore mined in the Bingham open pit by Kennecott Copper Corp. Molybdenum production decreased 20% because of a cutback in ore production during the year. Total value of the molybdenum was only 3% less than that produced in 1974.

**Selenium.**—All selenium produced in Utah was recovered as a byproduct of copper ore mined in the Bingham district by Kennecott Copper Corp. The 1975 production declined 61%, in part as a result of a cutback at Kennecott's open pit operation and changes in the smelter during the year to satisfy pollution standards.

**Silver.**—Six mines in four counties produced silver during 1975. The leading property was the Bingham mine of Kennecott Copper Corp., followed by the Burgin mine in the East Tintic district, the Ontario mine in the Park City area, and the Trixie mine in the East Tintic district. Silver yield during the year was 12% less than that during 1974. Total value decreased 17%.

**Tungsten.**—Tungsten ores were mined from four properties during 1975, two in

Tooele County, and two in Box Elder County. Timm Tungsten Co. and C&P Leasing produced scheelite ores from Dutch Mountain, 3 miles northwest of Gold Hill, Tooele County. Blair Sorenson mined scheelite ore in the Newfoundland Range in Box Elder County, 7 miles south of the north end of the range. Themco, Inc., extracted ore from the Glory Vein property in Box Elder County, 7 miles southeast of Yost. State production was slightly more than double that of the previous year. The total value of production rose 123%.

**Uranium.**—Production of uranium declined 5% in 1975, but total value increased 11% as a result of greater average unit price. The average price was \$12.30 per pound  $U_3O_8$  in 1975 as compared with \$10.50 per pound in 1974.

**Vanadium.**—All vanadium produced in the State was derived from ores mined in San Juan County. Production was 16% less than that of the previous year, but total value increased 15%. Ores were treated in mills at Rifle and Uravan, Colo.

**Zinc.**—Two mines reported production of zinc ores during 1975. The largest producer was the Burgin mine in Utah County. Park City Ventures in Summit County started ore production from the Ontario mine in April, after completion of a new flotation concentrator. Zinc production was 56% higher than that of the previous year because of the new Ontario operation. Total value of the zinc was 69% greater.

## MINERAL FUELS

**Asphalt and Related Bitumens.**—Two companies produced gilsonite from properties in Uintah County. Total production was 19% less than that during 1974, but as a result of higher average price for the product, total value was 2% greater.

**Carbon Dioxide.**—Production of carbon dioxide continued from one well in the Farnham Dome Field, Carbon County. Yield during the year was 16% greater than that during the previous year. Total value rose 33%.

**Coal (Bituminous).**—Coal production during 1975 was derived from 20 underground mines in 3 counties. As in past years, the major tonnage was mined in Carbon and Emery Counties with a lesser production from Sevier County. Coal ton-

nage increased 19% over that of the prior year, and the value was almost double the 1974 production.

Braztah Corp., a subsidiary of McCulloch Oil Corp., completed negotiation of a coal mining contract with Indiana and Michigan Electric Power Co., a wholly owned subsidiary of American Electric Power Co. Under the agreement, Braztah will develop and operate McCulloch's coal mines in Carbon County, with financing provided by Indiana and Michigan Electric Power Co. During the year Braztah started rehabilitation at several properties in preparation for establishing coal mining operations. Coal will be shipped to powerplants in the Midwest.

The U.S. Geological Survey and Utah Geological and Mineral Survey arranged a cooperative agreement covering exploration

of coal deposits in the Wasatch Plateau, Emery County. Drilling was started in July under the direction of geologists of the Utah Geological and Mineral Survey. The exploration provided considerable information on the thickness, quality, and continuity of coalbeds in the area. In addition, tests were made on the methane content of the coal in cooperation with the Bureau of Mines. The investigations included assemblage of data for possible commercial utilization of the methane.

Inspiration Consolidated Copper Co. completed exploration on a tract of coal land in Ferron Canyon, Sanpete County. A reserve of approximately 18 million tons of coal was indicated in seams 5 to 12 feet in thickness. Tentative mining plans have been submitted to Federal agencies for approval.

Table 7.—Utah: Bituminous coal production, by type of mine and county  
(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines				Production (thousand short tons)				Value (thousands)
	Under-ground	Strip	Auger	Total	Under-ground	Strip	Auger	Total	
Carbon -----	12	--	--	12	3,089	--	--	3,089	\$81,405
Emery -----	7	--	--	7	W	--	--	W	W
Sevier -----	1	--	--	1	W	--	--	W	W
Undistributed ---	--	--	--	--	3,872	--	--	3,872	56,729
Total -----	20	--	--	20	6,961	--	--	6,961	138,134

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

**Natural Gas.**—The quantity of marketed natural gas was 55.4 billion cubic feet, an increase of 10% over that marketed in 1974. The average wellhead price increased from 41.2 cents per thousand cubic feet in 1974 to 48.0 cents per thousand in 1975, equivalent to a total of \$26.6 million.

The State Division of Oil, Gas, and Mining<sup>2</sup> reported production of 76.2 billion cubic feet of natural gas, of which 21.6 billion cubic feet was injected into reservoirs for storage. San Juan County was the largest producer, with Duchesne and Uintah Counties in second and third place, respectively. The three counties accounted for 83% of the State's natural gas output.

Natural gas reserves estimated by the American Petroleum Institute (API) and the American Gas Association (AGA) totaled 0.917 trillion cubic feet. During 1975,

reserves were decreased by 114 billion cubic feet.

Thirteen productive gas wells were completed during the year—8 in Grand County, 4 in Uintah County, and 1 in San Juan County.

**Natural Gas Liquids.**—Production of natural gas liquids decreased 4% in quantity and 10% in value. Reserves of natural gas liquids estimated by API and AGA totaled 49.4 million barrels at the end of 1975, a decrease of 3.0 million barrels over 1974.

**Petroleum.**—Crude petroleum production showed a 7% increase over that of 1974. Although exploratory activity in Uinta Basin's Tertiary trend slackened

<sup>2</sup> Utah Department of Natural Resources, Division of Oil, Gas and Mining. Monthly Oil and Gas Production Report, December 1975.

somewhat as compared with that of the previous year, total value of production in the State rose 24%. Duchesne County again was the leading producing county, accounting for 56% of the total yield. In second place was San Juan County with 26% of the production. Third and fourth places were held by Uintah County with 12% and Garfield County with 3% of the State total, respectively. Total crude petroleum production includes condensate recovered from gas in Duchesne and San Juan County oil wells.

The Altamont field in Duchesne County was the principal producing field, with 11.5 million barrels of oil. The Bluebell field in Duchesne and Uintah Counties ranked second with 11.2 million barrels of oil, followed by Greater Aneth field in San Juan County with 8.9 million barrels, Red Wash Unit, Uintah County, 2 million barrels, Cedar Rim in Duchesne County, 1.7 million barrels Upper Valley field in Garfield County, 1.4 million barrels Wonsits Valley field, Uintah County, 1.3 million barrels, and the Lisbon field in San Juan County, 1 million barrels of oil. These eight fields accounted for 93% of the oil produced in the State.

Proved crude oil reserves in Utah at yearend 1975 totaled 208.3 million barrels, a decrease of 42.3 million barrels over that

of the previous year. However 33.2 million barrels are considered available by fluid injection. Extensions added 16.5 million barrels but revisions decreased the reserves by 20.2 million barrels.

A total of 194 wells was completed in the State during 1975, essentially the same number that were drilled in the previous year. Sixty percent of the wells are producers—103 oil and 13 gas wells. Drilling was active in 18 counties, but as in previous years, the greatest number of new producing wells are in Duchesne County. In this county 57 wells were completed, with 50 new producing oil wells. Drilling in San Juan County resulted in 34 new oil producers and 1 gas producing well.

Eight oil refineries in Utah processed 42.8 million barrels of crude oil. Oilfields in the State supplied 17.7 million barrels. A total of 25.1 barrels of crude oil was received from Colorado, Montana, and Wyoming, with Colorado providing 17.4 million barrels, Montana 0.8 million barrels, and Wyoming 6.9 million barrels. Shipments of crude oil to out-of-State points totaled 21.1 million barrels. California received 11.6 million, Texas 3.3 million, and Colorado 2.8 million barrels of the total. Other States receiving smaller quantities included Illinois, Kansas, Oklahoma, and Wyoming.

Table 8.—Utah: Oil and gas well drilling completions in 1975, by county

County	Proved field wells <sup>1</sup>			Exploratory			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Wells	Footage
Beaver	--	--	--	--	--	1	1	8,540
Carbon	1	--	--	--	1	4	6	26,543
Daggett	--	--	--	--	1	1	2	14,085
Duchesne	50	--	3	1	--	3	57	747,832
Emery	--	--	--	--	--	10	10	48,585
Garfield	--	--	--	--	1	2	2	25,718
Grand	--	8	7	--	1	6	22	81,857
Iron	--	--	--	--	--	1	1	11,700
Kane	--	--	--	--	--	1	1	5,239
Millard	--	--	--	--	--	1	1	985
Salt Lake	--	--	--	--	--	2	2	6,472
San Juan	34	1	1	--	--	9	45	257,521
Sanpete	--	--	--	--	--	1	1	20,450
Summit	--	--	--	2	--	2	4	56,858
Uintah	16	4	--	4	3	5	32	309,809
Wasatch	--	--	--	--	--	1	1	17,002
Washington	2	--	1	--	--	1	4	2,484
Wayne	--	--	--	--	--	2	2	6,435
<b>Total</b>	<b>103</b>	<b>13</b>	<b>12</b>	<b>7</b>	<b>6</b>	<b>53</b>	<b>194</b>	<b>1,648,115</b>

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.

## NONMETALS

**Barite.**—No barite was mined in the State during 1975. However, ores from out-of-State mines were ground and prepared for well drilling mud by five companies in the Salt Lake City area. Companies engaged in processing the barite ores are All Minerals Corp., Custom Milling & Supply Co., Eisenman Chemical Co., Rocky Mountain Refractories, and Westemco, Inc.

**Cement.**—Portland cement output increased 7% in quantity and 24% in total value. The quantity of masonry cement produced was 50% less than that of the previous year but the total value increased 70%. Production and sales were made by Ideal Cement Co., Div. of Ideal Basic Industries, Inc., and Portland Cement Co. of Utah. Portland and masonry cement consumed in Utah totaled 521,300 and 1,400 tons, respectively. Seventy-eight percent of the portland cement was used by ready-mix concrete companies, 8% by concrete product manufacturers, 7% by building materials dealers, 3% by highway contractors, and 4% by other contractors and miscellaneous customers. Cement rock, gypsum, limestone, and sandstone were the principal raw materials used in making portland cement.

**Clays.**—Output of clays during 1975 was essentially the same as 1974, tonnage-wise. However total value declined 20%. Mining was conducted on 14 properties in 9 counties. The principal producing companies were Filtrol Corp., Interpace Corp., Mountain Fuel Supply Co., and Utelite Corp. Commodities classed as clays included common clay, shale, bentonite, fire clay, fuller's earth, and kaolin. The majority of the clays were utilized in expanding materials for lightweight aggregates, as catalysts in oil refining, and in the manufacture of building bricks.

**Fluorspar.**—Production of fluorspar was substantially greater during the year. Quantity increased 222% and total value rose 297%. All production was classed as metallurgical-grade fluorspar. Two companies, U.S. Energy Corp. and Willden Fluorspar Co., operating in the Spor Mountain area, Juab County, accounted for the total ore tonnage.

**Gypsum.**—Five properties in four counties accounted for all gypsum production in the State during 1975. Active companies were Cox Enterprises, Inc., Georgia-Pacific

Corp., Thomas J. Peck & Sons, Inc., United States Gypsum Co., and White Mountain Gypsum Co. Production of crude gypsum decreased approximately 1%, while total value of the product rose 35%. Georgia-Pacific Corp., and U.S. Gypsum Co., calcined gypsum mined near Sigurd, Sevier County. Tonnage of calcined gypsum increased 2% but was 9% below that of 1972, the record year.

**Lime.**—Lime mining and processing were conducted in four counties by five operating companies, The Flintkote Co., Kennecott Copper Corp., Mountain States Lime Co., Utah-Idaho Sugar Co., and Utah Marblehead Lime Co. The lime products were utilized primarily in refractories, mason's lime, and flotation of copper sulfide ores. Miscellaneous uses consumed a minor tonnage. Lime output was 9% less than that in 1974. A total of 95,456 tons of lime was consumed in Utah. Other tonnages were exported to Missouri, Nevada, Ohio, and South Dakota.

**Magnesium Compounds.**—Production of magnesium compounds was reported by two companies that process brines from Great Salt Lake and adjacent areas. Great Salt Lake Minerals & Chemicals Corp., operating west of Ogden in Weber County, and Kaiser Aluminum & Chemical Corp., near Wendover, Tooele County, are the active companies. Production during 1975 was 8% less, but total value increased approximately 7% over that of the prior year.

Magnesium operations of NL Industries, Inc., at Rowley, Tooele County, on the west shore of Great Salt Lake, were conducted at low level. A series of problems in the plant has prevented attainment of rated production. During the latter part of the year, a study was underway in an attempt to develop alternative methods to handle magnesium production. Norsk Hydro, a Norwegian magnesium producer, assisted in the study.

**Perlite.**—Two companies, Georgia-Pacific Corp. at Sigurd, Sevier County, and Lehi Block & Perlite Products Co., at Lehi, Utah County, expanded perlite during the year. The source material was mined out of State. The expanded perlite was used principally as plaster aggregate. Minor quantities were used for masonry and horticultural purposes.

**Phosphate Rock.**—Phosphate rock production in Utah during 1975 was limited to one company, Stauffer Chemical Co.

This company operated two mines, an open pit mine 10 miles north of Vernal in Uintah County and an underground mine in the Crawford Mountains, Rich County. Production was down 6%, but total value increased 3% as a result of higher average prices.

**Potash.**—Production of potash salts was recorded by Kaiser Aluminum & Chemical Corp., at Wendover, Tooele County, by Great Salt Lake Minerals & Chemicals Corp. in Weber County, and by Texasgulf, Inc., near Moab, Grand County. Output was 13% less in quantity but 32% greater in total value.

**Pumice.**—Production of pumice and other volcanic materials increased slightly during the year. Two operators were active, the Utah State Road Commission in Millard County and the Washington County Road Department in Washington County. All production was utilized in road construction. Tonnage mined increased 13% with a total value 21% greater than that of the previous year.

**Salt.**—A total of nine salt companies operated in seven counties in Utah during 1975. Salt production was down 18% below that of the previous year, but because of greater unit price, the total value of production was 5% higher. Two companies, one in Sanpete County and the other in Sevier County, produced rock salt. Evaporated salt was recovered by seven companies operating in five counties, Box Elder, Grand, Salt Lake, Tooele, and Weber. The salt was sold for use in many industrial applications, including the chemical and animal feed processing industries.

A large percentage of the salt was sold for road salt.

**Sand and Gravel.**—Production of sand and gravel in the State declined 12% during 1975, but because of an increase in the average unit price to \$1.41, the total value was 10% greater. Sand and gravel retained number three rank among the commodities of the nonmetallic group. Only potassium salts and portland cement had greater total values. A total of 90 mining operations were active in 25 of the 29 counties in the State. Salt Lake County was the leading producer followed by Davis and Sanpete Counties. Sand and gravel operations in the three counties accounted for 55% of the State's sand and gravel production.

**Sodium Sulfate.**—Production of sodium sulfate was reported by one company, Great Salt Lake Minerals & Chemical Corp. The company plant is on Great Salt Lake in Weber County, west of Ogden. Tonnage produced was 41% less than that of 1974, but total value rose 16%.

**Stone.**—Production of stone was recorded from 13 counties in the State during 1975. Mining operations were conducted in 30 quarries. Total yield was 13% less than that of the previous year, with a 4% drop in value. The principal producing counties were Box Elder, Morgan, and Utah. The three counties accounted for 76% of the total stone tonnage mined. The largest producers were Ideal Basic Industries, Inc., Portland Cement Co. of Utah, Southern Pacific Railroad Co., and United States Steel Corp.

Table 9.—Utah: Crushed stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	( <sup>1</sup> )	2	--	--
Dense-graded roadbase stone -----	W	W	3	6
Other construction aggregate and roadstone -----	W	W	3	5
Agricultural limestone <sup>2</sup> -----	W	W	36	234
Cement manufacture <sup>3</sup> -----	<sup>3</sup> 833	<sup>3</sup> 1,724	941	2,123
Fill -----	--	--	3	3
Lime manufacture -----	<sup>4</sup> W	<sup>4</sup> W	17	50
Metallurgical purposes <sup>5</sup> -----	W	W	828	2,054
Mine dusting -----	14	91	18	154
Riprap and jetty stone -----	777	1,080	582	875
Other uses <sup>6</sup> -----	1,239	3,221	52	413
Total <sup>7</sup> -----	2,864	6,118	2,482	5,916

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

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Includes poultry grit and mineral food.

<sup>3</sup> Includes lime manufacture.

<sup>4</sup> Included with cement.

<sup>5</sup> Includes dead-burned dolomite, flux stone, ferrosilicon (1975), and refractory stone (1974).

<sup>6</sup> Includes manufactured fine aggregate (stone sand), railroad ballast (1975), surface treatment aggregate, terrazzo and exposed aggregate, and uses indicated by symbol W.

<sup>7</sup> Data may not add to totals shown because of independent rounding.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt: American Gilsonite Co.	Suite 1150, Kennecott Bldg. Salt Lake City, Utah 84110	Underground mine and plant.	Mesa and Uintah.
Beryllium: Brush Wellman Inc.	67 W. 2950 S. Salt Lake City, Utah 84115	Open pit mine and plant.	Millard.
Carbon dioxide, natural: Equity Oil Co -----	806 American Oil Bldg. Salt Lake City, Utah 84101	Well and plant--	Carbon.
Cement: Ideal Basic Industries, Inc. <sup>1</sup>	420 Ideal Cement Bldg. Denver, Colo. 80202	Plant -----	Morgan.
Portland Cement Co. of Utah <sup>1</sup>	Box 1469 Salt Lake City, Utah 84110	----do -----	Salt Lake.
Clays: Filtrol Corp -----	3250 E. Washington Blvd. Los Angeles, Calif. 90023	Open pit and underground mine.	Juab.
Utelite Corp -----	RFD Coalville, Utah 84017	Open pit mine and plant.	Summit.
Coal: American Coal Co -----	190 N. Main Huntington, Utah 84528	Underground mine.	Emery.
Kaiser Steel Corp -----	Sunnyside Coal Mines Sunnyside, Utah 84539	Underground mine and plant.	Carbon.
Peabody Coal Co -----	301 N. Memorial Dr. St. Louis, Mo. 36102	Underground mine.	Emery.
Copper: Kennecott Copper Corp. <sup>2</sup>	Box 11299 Salt Lake City, Utah 84111	Open pit mine, mills, plant, smelter refinery.	Salt Lake and Utah.
Fluorspar: Spor Brothers -----	Box 276 Delta, Utah 84624	Open pit and underground mines.	Juab.
U.S. Energy Corp -----	625 East Madison Suite 1 Riverton, Wyo. 82501	Open pit mine --	Do.
Willden Fluorspar Co -----	Box 536 Delta, Utah 84624	Underground mine.	Do.
Gypsum: Georgia Pacific Corp -----	P.O. Box 311 Portland, Ore. 97204	Open pit mine and plant.	Sevier.
United States Gypsum Co --	101 S. Wacker Dr. Chicago, Ill. 60606	----do -----	Do.

See footnotes at end of table.



Table 10.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Iron ore:</b>			
CF&I Steel Corp -----	Box 1920 Pueblo, Colo. 80201	Open pit mines -	Iron.
United States Steel Corp. <sup>3</sup> -	600 Grant St. Pittsburgh, Pa. 15230	Open pit mine --	Do.
Utah International Inc ---	Box 649 Cedar City, Utah 84720	Open pit mines and plants.	Do.
<b>Lime:</b>			
The Flintkote Co -----	2244 Beverly Blvd. Los Angeles, Calif. 90057	Plant -----	Tooele.
Utah-Marblehead Lime Co. <sup>1</sup> -	300 W. Washington St. Chicago, Ill. 60606	----do -----	Do.
<b>Petroleum and natural gas:<sup>4</sup></b>			
<b>Potassium salts:</b>			
Great Salt Lake Minerals & Chemicals Corp. <sup>5</sup>	Box 1190 Ogden, Utah 84402	----do -----	Weber.
Kaiser Aluminum & Chemical Corp. <sup>6</sup>	300 Lakeside Dr. Oakland, Calif. 94604	----do -----	Tooele.
Texasgulf, Inc -----	200 Park Ave. New York, N.Y. 10017	Underground mine and refinery.	Grand.
<b>Salt:</b>			
American Salt Co -----	3142 Broadway Kansas City, Mo. 64111	Plant -----	Tooele.
Morton International Inc -	110 N. Wacker Drive Chicago, Ill. 60606	----do -----	Salt Lake.
<b>Sand and gravel:</b>			
Cox Construction Co., Inc -	270 North First E. Manti, Utah 84642	----do -----	Sanpete.
Gibbons & Reed Co -----	41 W. Central Ave. Murray, Utah 84107	Pits and plants -	Davis, Salt Lake, Weber.
Utah Sand and Gravel Products Corp.	Box 537 Salt Lake City, Utah 84110	----do -----	Salt Lake.
<b>Stone:</b>			
General Dynamics -----	300 West Washington St. Chicago, Ill. 60606	Quarry -----	Tooele.
Southern Pacific Railroad Co.	65 Market St. San Francisco, Calif. 94105	----do -----	Box Elder.
Utah Calcium Co., Inc ----	2150 S 2 DW Salt Lake City, Utah 84115	----do -----	Tooele.
<b>Uranium:</b>			
Atlas Corp. <sup>7</sup> -----	Box 1207 Moab, Utah 84532	Underground mines.	San Juan.
Rio Algom Corp. <sup>7</sup> -----	Box 610 Moab, Utah 84532	Underground mine.	Do.

<sup>1</sup> Also stone.<sup>2</sup> Also stone, gold, silver, lead, zinc, molybdenum, selenium, and lime.<sup>3</sup> Also stone and salt.<sup>4</sup> Many of the major oil companies and some of the smaller companies operate in Utah and several commercial directories contain lists of them.<sup>5</sup> Also salt and magnesium compounds.<sup>6</sup> Also magnesium compounds.<sup>7</sup> Also vanadium.

# The Mineral Industry of Vermont

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 Vermont, for collecting information on all minerals except fuels.

By William R. Barton <sup>1</sup> and Charles G. Doll <sup>2</sup>

Mineral production in Vermont in 1975 decreased 15% in value to \$28.8 million. Stone was the principal mineral commodity in value, followed by asbestos, sand and gravel, talc, and a small production of peat and gem stones. The Vermont mineral industry is significant nationally as a producer of dimension granite, dimension marble, dimension slate, asbestos, talc, and ground marble. Some of the Vermont dimension stones are exported and recognized worldwide. The Vermont mineral industry is of critical importance to Vermont railroads—the Vermont Northern Railroad (formerly St. Johnsbury and Lamoille County) normally generates about one-half of its revenue from mineral products, 20% of the total traffic over Vermont Railway is in Vermont minerals, the Green Mountain Railroad depends upon minerals for about 75% of its traffic, and the Montpelier and Barre

Railroad is dependent upon shipments of granite for profitable operation.

A land use planning bill, milder than the one in 1974, was introduced to the legislature in 1975; again it failed to pass.

The Vermont Geological Survey environmental mapping project was dropped from the budget on July 1, even though the extremely valuable work was within 2 years of completion. At yearend the status of the Vermont Geological Survey and the position of the State Geologist were in doubt as a result of proposed Government economy moves.

Vermont energy director Forrest Orr was selected by the Federal Energy Administration (FEA) to head a combined Federal-State task force to draw up a nationwide energy conservation program.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Newmarket, N.H.

<sup>2</sup> State Geologist, Burlington, Vt.

Table 1.—Mineral production in Vermont <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Peat -----thousand short tons..	( <sup>2</sup> )	\$4	( <sup>2</sup> )	W
Sand and gravel -----do-----	2,394	3,588	2,356	\$3,693
Stone -----do-----	1,932	21,630	1,224	15,718
Talc -----short tons-----	W	W	230,973	1,918
Value of items that cannot be disclosed:				
Other nonmetals and values indicated by symbol W	XX	<sup>r</sup> 8,723	XX	7,450
Total -----	XX	<sup>r</sup> 33,945	XX	28,779
Total 1967 constant dollars -----	XX	16,049	XX	<sup>p</sup> 11,396

<sup>p</sup> Preliminary. <sup>r</sup> Revised. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Less than 1/2 unit.

Table 2.—Value of mineral production in Vermont, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Addison	W	W	Stone, sand and gravel.
Bennington	\$473	\$305	Sand and gravel, stone.
Caledonia	W	W	Stone, sand and gravel.
Chittenden	W	1,562	Sand and gravel, stone.
Essex	W	W	Do.
Franklin	W	W	Stone, sand and gravel.
Grand Isle	W	1	Sand and gravel.
Lamoille	W	W	Talc, sand and gravel, stone.
Orange	W	W	Stone, sand and gravel.
Orleans	W	W	Asbestos, sand and gravel, stone.
Rutland	8,857	5,299	Stone, sand and gravel.
Washington	W	5,293	Do.
Windham	256	475	Talc, sand and gravel, stone.
Windsor	W	W	Talc, sand and gravel, stone, peat.
Undistributed <sup>1</sup>	r 24,360	15,842	
Total <sup>2</sup>	r 33,945	28,779	

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

<sup>1</sup> Includes gem stones and values indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Vermont business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	201.3	201.7	+0.2
Unemployment -----do-----	14.1	19.4	+37.6
<b>Employment (nonagricultural):</b>			
Mining -----do-----	.8	.7	-12.5
Manufacturing -----do-----	42.8	39.1	-8.6
Contract construction -----do-----	8.6	6.6	-23.3
Transportation and public utilities -----do-----	8.4	8.1	-3.6
Wholesale and retail trade -----do-----	33.0	33.2	+6
Finance, insurance, and real estate -----do-----	6.6	6.6	--
Services -----do-----	33.2	34.7	+4.5
Government -----do-----	29.3	30.5	+4.1
Total nonagricultural employment -----do-----	162.7	159.5	-2.0
<b>Personal income:</b>			
Total -----millions--	\$2,152	\$2,336	+8.6
Per capita -----do-----	\$4,602	\$4,960	+7.8
<b>Construction activity:</b>			
Number of private and public residential units authorized	1,549	1,768	+14.1
Value of nonresidential construction -----millions--	\$12.3	\$12.6	+2.4
Value of State road contract awards -----do-----	\$25.0	\$27.0	+8.0
Shipments of portland and masonry cement to and within Vermont -----thousand short tons--	126	114	-9.5
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$33.9	\$28.8	-15.0
Value per capita, resident population -----do-----	\$72.53	\$60.97	-15.9
Value per square mile -----do-----	\$3,532.63	\$2,995.00	-15.2

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Table 4.—Worktime and injury experience in the Vermont nonmetal mineral industry in 1975 <sup>1 2</sup>

	Men	Man-hours	Fatal injuries	Fatal frequency rate	Non-fatal disabling injuries	Non-fatal disabling frequency rate	Nondisabling injuries	Nondisabling frequency rate
<b>Sand and gravel:</b>								
Surface -----	159	156,066	--	--	6	32.04	3	12.82
Office -----	35	45,945	--	--	1	21.77	--	--
Total -----	194	202,011	--	--	7	29.70	3	9.90
<b>Stone:</b>								
Underground -----	53	95,086	--	--	7	73.62	3	31.55
Surface -----	399	669,968	--	--	22	30.00	3	2.86
Mill -----	485	903,167	--	--	19	21.04	6	6.64
Office -----	133	222,453	--	--	--	--	--	--
Total -----	1,070	1,890,674	--	--	48	24.86	12	5.82
<b>Talc:</b>								
Underground -----	60	119,410	--	--	13	108.87	3	25.12
Mill -----	76	160,611	--	--	12	74.71	5	31.13
Office -----	35	65,521	--	--	--	--	--	--
Total -----	171	345,542	--	--	25	72.35	8	23.15
<b>Peat:</b>								
Surface -----	2	433	--	--	--	--	--	--
<b>Miscellaneous nonmetals (including asbestos):</b>								
Surface -----	44	93,818	--	--	1	10.66	--	--
Mill -----	111	185,405	--	--	2	10.79	--	--
Office -----	18	35,511	--	--	--	--	--	--
Total -----	173	314,734	--	--	3	9.53	--	--
<b>State totals:</b>								
Underground -----	113	214,496	--	--	20	93.24	6	27.97
Surface -----	604	920,285	--	--	29	29.34	6	4.35
Mill -----	672	1,249,183	--	--	33	26.42	11	8.81
Office -----	221	369,430	--	--	1	2.71	--	--
Total or average -----	1,610	2,753,394	--	--	83	29.42	23	7.63

<sup>1</sup> All data are preliminary.<sup>2</sup> Data supplied by Mining Enforcement & Safety Administration.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Asbestos.**—The Lowell asbestos mine and mill was purchased from GAF Corp., by an employees cooperative known as Vermont Asbestos Group, Inc. (VAG). The new firm continued operations while working to bring the plant up to Environmental Protection Agency (EPA) standards for ambient air quality.

The workers raised \$150,000 among themselves for the purchase, and raised the balance of the \$400,000 price through a Small Business Administration-backed loan. A \$1.5 million bank loan to finance environmental controls was guaranteed by the Vermont Industrial Development Authority. Subsequent to the March 1975 purchase, additional ore reserves were located by core drilling, and in the first 5 months of operation net profits were

reported to exceed \$500,000. It was anticipated by VAG President John Lupien that all debts would be paid off in 1976 and a sizeable dividend paid to the workers.

**Cement.**—Vermont has no cement producing plants, importing all of the commodity it needs. Preliminary Bureau of Mines data indicated that 109,000 tons of portland cement and 5,000 tons of prepared masonry cement were shipped to Vermont destinations in 1975. These compared, respectively, with 120,000 tons and 6,000 tons in 1974.

**Gem Stones.**—The value of gem stones and mineral specimens collected was estimated at several thousand dollars. The most popular collecting localities were listed in Vermont Geological Survey Special Publication No. 2, "Mineral Collect-

ing in Vermont," by R. W. Grant. The report can be purchased for \$5 from the Vermont Department of Libraries, Montpelier, Vt.

**Mica, Reconstituted.**—At Rutland, Samica Corp. processed delaminated scrap mica in the manufacture of reconstituted sheet mica for use in electrical insulation.

**Sand and Gravel.**—Sand and gravel production decreased 2% in quantity and increased 3% in value. Average value per ton was \$1.57 (\$1.50 in 1974). Production by 47 sand and gravel companies totaled 2.4 million tons with a value of \$3.7 million. Government-and-contractor operations produced less than 1 million tons with an average value of \$1.16 per ton. Leading counties were Chittenden, Rutland, Caledonia, Bennington, and Orleans. Leading commercial producers were Hinesburg Sand and Gravel Co., Calkins Construction, Inc., J. P. Carrara & Sons, Inc., and Burgess Brothers, Inc.

The Vermont Department of Highways purchased sand and gravel from commercial producers and contracted for production as part of construction and maintenance projects. Its own crews produced sand for ice control and gravel for routine paving and maintenance.

**Stone.**—Compared with 1974, tonnage and value of stone production decreased 37% and 27%, respectively. Production of dimension stone decreased from 145,107 tons to 120,214 tons, and value decreased from \$12.3 million to \$10.9 million. Average value per ton increased from \$84.97 in 1974 to \$90.96 in 1975.

Production of crushed stone decreased from 1.8 million tons in quantity and \$9.3 million in value to 1.1 million tons and \$4.8 million. Average value per ton decreased from \$5.20 in 1974 to \$4.33 in 1975.

Leading stone producers included White Pigment Corp. (partly owned by Vermont Marble Co.); Swanton Lime Works, Inc.; Rock of Ages Corp.; Vermont Marble Co.; Wells-Lamson Quarry Co., Inc.; and the State Highway Department, which contracted for crushed stone in all counties except Essex and Grand Isle. Dimension stone was produced at 29 quarries. Crushed stone was mined at 46 operations. Leading counties were Rutland, Chittenden, and Caledonia. Principal kinds of stone were marble (some marketed under the terminology of crushed or ground limestone or dolomite), granite, and slate.

Vermont Marble Co. operated three dimension stone quarries during the year: Danby (white), Isle La Motte (black), and Roxburg (verde antique). Ground marble (including limestone) production increased substantially. The product was used principally for filler in items such as plastics, synthetic rubber, and chewing gum. As prices of plastic feedstocks increased, fabricators were tending to increase percentages of filler in their products.

Rock of Ages Corp. operated five quarries (in gray granite), a finishing plant at Barre, and a sixth quarry (in white granite) at Bethel. A new operation, the Adams quarry, was opened at Barre in

**Table 5.—Vermont: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	775	1,421	668	1,170
Gravel -----	825	1,564	980	1,920
Unprocessed:				
Sand and gravel -----	794	597	709	370
Industrial:				
Sand -----	W	W	W	W
Total -----	2,394	3,582	<sup>2</sup> 2,356	3,460

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand and gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

Table 6.—Vermont: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction	552	1,034	418	891
Highway and bridge construction -----	56	197	67	134
Other construction (dams, waterworks, airports, etc.) -----	44	153	W	W
Concrete products (cement blocks, brick, pipe, etc.) -----	146	324	156	351
Bituminous paving (asphalt and tar paving) -	232	454	210	558
Roadbase and subbase -----	156	316	164	322
Fill -----	18	18	20	20
Other -----	W	W	45	93
<b>Unprocessed:</b>				
Roadbase and subbase -----	238	183	190	129
Fill -----	468	382	165	126
Other -----	--	--	11	13
Industrial sand and gravel -----	W	W	W	W
<b>Total</b> <sup>1</sup> -----	<b>1,910</b>	<b>3,062</b>	<b>1,444</b>	<b>2,638</b>

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."  
<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 7.—Vermont: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction	W	W	55	90
Highway and bridge construction -----	90	114	96	155
Other construction (dams, waterworks, airports, etc.) -----	8	16	12	26
Concrete products (cement blocks, brick, pipe, etc.) -----	16	34	--	--
Bituminous paving (asphalt and tar paving) -	137	170	171	376
Roadbase and subbase -----	101	99	95	149
Fill -----	--	--	W	W
Other -----	44	62	139	110
<b>Unprocessed:</b>				
Roadbase and subbase -----	84	28	279	121
Fill -----	4	3	64	27
<b>Total</b> <sup>1</sup> -----	<b>484</b>	<b>526</b>	<b>912</b>	<b>1,055</b>

W Withheld to avoid disclosing individual company confidential data; included with "Other."  
<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 8.—Vermont: Stone production, by type

	Dimension stone		Crushed and broken stone		Total stone	
	1974	1975	1974	1975	1974	1975
Quantity ---short tons---	145,107	120,214	1,787,050	1,104,082	1,932,157	1,224,296
Value -----	\$12,329,086	\$10,934,944	\$9,301,276	\$4,782,912	\$21,630,312	\$15,717,856
Unit value ----per ton---	\$84.97	\$90.96	\$5.20	\$4.33	\$11.19	\$12.84
Number of operations ---	30	29	47	46	77	75

1975. This quarry featured inclined haulage entries so trucks can be loaded directly in the pit. Areas of waste rock were not quarried but instead were mined by drilling and blasting and sent to a crusher. The result was a salable crushed stone product instead of new grout piles. Dimension granite shipments were restrained in 1975 because of effects from the general economic recession. Producers were caught in a cost-crunch with oxygen up 58%, oil up 55%, and abrasives up 50% from 1974. Coupled with lessened demand for some granite products, the result was widespread layoffs or shorter work weeks in the Barre granite memorial industry.

The Vermont Tax Appeal Board ruled that Rock of Ages Corp. had been overtaxed by Barre town \$585,000 during the period 1972-74. Jones Bros. (Wells-Lamson Quarry Co., Inc.) sold their finishing plant to Beck and Beck Granite Co. The Vermont Occupational Safety and Health Administration (VOSHA) announced plans to lower dust standards at Barre granite sheds from 100 micrograms of quartz per cubic meter of air to 50 micrograms. It was announced that the Communist Party headquarters in East Berlin would use Vermont Bethel white granite for its front steps.

The Bureau of Mines conducted research at Tuscaloosa, Ala. to make useful products from silicon carbide recovered from New England granite processing waste sludges.<sup>3</sup>

Dolomite (marble), quartzite, and traprock were quarried for road surface treatment, roadbase stone, and construction aggregate.

Dimension slate production, exclusive to Rutland County, decreased in quantity and value, compared with 1974. Seventeen quarries were active. Mill stock for flagging, the principal product, was worth an average of \$33.86 per ton in 1975. Other products included mill stock for structural and sanitary uses (\$360.85 per ton), roofing slate (\$227.57 per ton), and flooring slate (\$139.33 per ton).

A quantity of crushed slate was expanded in a rotary kiln near Castleton by Vermont Light Aggregate Corp. to produce lightweight concrete aggregate.

Talc.—The talc industry was being expanded in 1975. Windsor Minerals, Inc.'s

(subsidiary of Johnson and Johnson, Inc.) two new mines near Ludlow began to supply a new \$3 million mill at Ludlow.

Three companies mined and ground talc in 1975. Value of production increased over that of 1974. The ground talc was sold and used for toilet preparations, plastics, rubber, paper, paint, insecticides, asphalt filler, refractories, foundry facings, and for export. Vermont Soapstone Co., Inc. fabricated soapstone stoves, griddles, and other products at its Perkinsville plant.

#### MINERAL FUELS

Statistics on Vermont fuel consumption are published annually in the New England Fuel Institute (NEFI) Statistical Fact Book. The book appears as the March issue of "Yankee Oilman" magazine published by NEFI, Boston, Mass. Data for 1973 were published in March 1975.

Peat.—A small quantity of humus peat was produced from a bog near Barnard. The material was sold both in bulk and in bags for general soil improvement.

Petroleum and Natural Gas.—Natural gas has been known to exist in the Champlain Valley of Vermont for many years. It is present in some water wells and has been encountered in drilling for water. Some gas-producing wells with reportedly commercial possibilities have been located to the north, in the St. Lawrence Lowlands of Canada.

Several attempts have been made to locate gas or oil in the Champlain Valley of Vermont since the mid-1950's. Several holes were drilled to 3,500-5,000 feet, pockets of gas were encountered, but the wells were abandoned. Some geologists feel the drilling was not deep enough, and the energy crisis has resulted in a revival of interest in the area. The thickness, extent, and type of rocks beneath the Champlain thrust is not known, nor have they been adequately tested for oil and gas potential. The Energy Research and Development Administration (ERDA) laboratory at Bartlesville, Okla., detected soil gas anomalies from northwestern Vermont samples that suggested petroleum or gas concentrations at depth. At yearend the State said

<sup>3</sup> Llewellyn, T. O., G. V. Sullivan, and E. Martin. Recovery of Silicon Carbide From Granite Sludge. BuMines RI 8074, 1975, 8 pp.

it would seek Federal assistance to further investigate the gas potential of the area.

### METALS

**Copper.**—Prospecting for copper and other base metals continued during 1975. Possibilities for uranium associated with the copper mineralization at the old Udall mine were suggested. Other areas of interest were located in the eastern Vermont

copper belt (the so-called "New Brunswick-Connecticut Valley Trend").

**Uranium.**—During 1975, Dexter Mining Co. continued exploring for uranium and possible associated hydrocarbons near Highgate Springs and Milton. ERDA completed airborne scintillation surveys over the State. Dolomite breccias, areas of copper mineralization, and gneissic complexes seemed to receive the most attention from several private firms prospecting in the State.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos: VAG, Inc. <sup>1</sup> -----	P.O. Box 70 Hyde Park, Vt. 05655	Pit -----	Orleans.
Peat: Kirk's Green Mountain Peat ----	P.O. Box 456 Woodstock, Vt. 05091	Bog -----	Windsor.
<b>Sand and gravel:</b>			
Burgess Brothers, Inc -----	Bennington, Vt. 05201 -	Pit -----	Bennington.
Caledonia, Inc -----	Box 428 St. Johnsbury, Vt. 05819	Pit -----	Caledonia.
Calkins Construction, Inc -----	Lyndonville, Vt. 05851-	Pit -----	Orleans.
J. P. Carrara & Sons, Inc -----	Rutland, Vt. 05701 ----	Pit -----	Rutland.
S. T. Griswold, Inc -----	Williston, Vt. 05495 -	Pit -----	Chittenden.
Hinesburg Sand and Gravel Co ---	Hinesburg, Vt. 05461 --	Pit -----	Do.
<b>Stone:</b>			
Granite (dimension):			
Rock of Ages Corp -----	Barre, Vt. 05641 ----	Quarries ----	Orange, Washington, Windsor.
Wells-Lamson Quarry Co., Inc. <sup>2</sup> ----	do -----	Quarry ----	Washington.
Limestone, dolomite, and marble (crushed, ground, and broken):			
Swanton Lime Works, Inc ----	Swanton, Vt. 05488 ---	do -----	Franklin.
White Pigment Corp -----	Proctor, Vt. 05765 ----	Quarries ----	Addison and Rutland.
Marble (dimension):			
Vermont Marble Co. <sup>3</sup> -----	do -----	do -----	Grand Isle, Rutland, Windsor.
Slate (dimension):			
John G. Hadeka -----	Poultney, Vt. 05764 --	Quarry -----	Rutland.
Hilltop Slate Co -----	Middle Granville, N.Y. 12849	do -----	Do.
Taran Bros., Inc -----	North Poultney, Vt. 05764	do -----	Do.
Tatko Bros. Slate Co -----	Middle Granville, N.Y. 12849	do -----	Do.
Vermont Structural Slate Co., Inc -----	Fair Haven, Vt. 05743 -	do -----	Do.
<b>Talc:</b>			
Eastern Magnesia Talc Co -----	Johnston, Vt. 05656 ---	Underground mines.	Lamoille.
Vermont Talc, Inc -----	Chester, Vt. 05143 ----	do -----	Windham.
Windsor Minerals, Inc -----	Windsor, Vt. 05089 ---	do -----	Windsor.

<sup>1</sup> Also miscellaneous stone.

<sup>2</sup> Also crushed and broken granite.

<sup>3</sup> Also crushed and broken limestone and dolomite.





# 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 Lawrence E. Shirley<sup>1</sup> and D. C. LeVan<sup>2</sup>

Virginia's total mineral production in 1975 was valued at \$1,262 million, an increase of \$205 million, or 19%, above that of 1974. This was the 13th consecutive year that the value of mineral production has shown an increase, primarily owing to increased production and value of bituminous coal.

The economy of Virginia, like that of most other states, suffered its sharpest post-war decline in the first half of 1975. Although the economy began to improve during the last half of the year, the mineral industry experienced some of the greatest decreases in output that it had undergone in many years. Except for increases in value for coal, lime, aplite, and petroleum, decreases were recorded in both output and value for all mineral commodities produced in the State. Those commodities closely allied to the building and construction industries such as stone, sand and gravel, clays, gypsum, and cement showed the greatest decreases in output and value.

Bituminous coal, as in the past, was the State's leading mineral commodity and accounted for 86% of the total mineral production value of the State. Coal production value coupled with that of stone, cement (masonry and portland), sand and gravel, and lime was responsible for 98% of Virginia's total mineral production value.

Virginia led the Nation in kyanite production and was the only State that produced aplite.

## Legislation and Government Programs.

—The Division of Mineral Resources, Virginia Department of Conservation and Economic Development, continued its functions of geologic and geophysical mapping, conducting studies related to economic geology, and providing a wide variety of services to the public including the preliminary evaluation of rock and mineral samples and examination and evaluation of resource occurrences. One of its publications was a directory of the mineral industry prepared and issued annually.<sup>3</sup> The 1975 directory contains a list of 269 companies and individuals on record as of April 1, 1975, exclusive of coal mine operators. The listing includes portable plants, some captive and intermittent operations, and some processors of out-of-State or imported materials. The names of producers and processors are arranged by county or city under the appropriate raw material or commodity.

Other 1975 publications by the Division of Mineral Resources included an aeroradioactivity survey covering approximately 1,980 square miles of east-central Virginia,<sup>4</sup> a geologic quadrangle study

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<sup>2</sup> Geologist, Virginia Division of Mineral Resources, Charlottesville, Va.

<sup>3</sup> LeVan, D. C. Directory of the Mineral Industry in Virginia—1975. Va. Div. Miner. Res. (Charlottesville, Va.), 1975, 53 pp.

<sup>4</sup> Johnson, S. S. Bouguer Gravity in South-eastern Virginia. Va. Div. Miner. Res. (Charlottesville, Va.), RI 39, 1975, 42 pp.

Table 1.—Mineral production in Virginia <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays -----thousand short tons--	1,957	\$2,614	819	\$1,152
Coal (bituminous) -----do-----	34,326	856,099	35,510	1,081,587
Gem stones -----	NA	13	NA	13
Lead (recoverable content of ores, etc.)				
-----short tons--	3,106	1,398	2,551	1,097
Lime -----thousand short tons--	895	18,929	705	20,192
Natural gas -----million cubic feet--	7,096	3,619	6,723	3,462
Petroleum (crude)				
-----thousand 42-gallon barrels--	3	W	3	W
Sand and gravel -----thousand short tons--	14,314	29,270	9,895	24,776
Silver -----thousand troy ounces--			W	W
Stone -----thousand short tons--	44,176	95,988	35,384	84,204
Zinc (recoverable content of ores, etc.)				
-----short tons--	17,195	12,346	15,151	11,818
Value of items that cannot be disclosed:				
Aplite, cement, gypsum, kyanite, silver (1975), soapstone, and values indicated by symbol W -----	XX	† 36,293	XX	33,673
Total -----	XX	† 1,056,569	XX	1,261,974
Total 1967 constant dollars -----	XX	499,546	XX	† 499,742

<sup>P</sup> Preliminary. <sup>†</sup> 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.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Virginia, by county <sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Accomack -----	\$135	\$121	Sand and gravel.
Albemarle -----	W	W	Stone, sand and gravel.
Amherst -----	W	W	Do.
Appomattox -----	W	W	Stone.
Augusta -----	W	W	Stone, sand and gravel.
Bedford -----	W	W	Do.
Bland -----	1,610	778	Stone.
Botetourt -----	20,997	W	Cement, stone, clays.
Brunswick -----	W	W	Stone, clays.
Buchanan -----	385,552	452,912	Coal, natural gas, stone.
Buckingham -----	W	W	Kyanite, stone.
Campbell -----	W	2,341	Stone, sand and gravel.
Caroline -----	950	705	Sand and gravel.
Charles City -----	W	W	Do.
Charlottesville (city) -----	W	1	Do.
Chesapeake (city) -----	W	W	Cement, sand and gravel.
Chesterfield -----	8,450	W	Sand and gravel, stone, clays.
Clarke -----	W	W	Stone.
Colonial Heights (city) -----	W	--	Sand and gravel.
Craig -----	185	162	Do.
Culpeper -----	W	W	Stone.
Dickenson -----	W	182,739	Coal, natural gas.
Dinwiddie -----	W	W	Stone.
Essex -----	W	--	Sand and gravel.
Fairfax -----	5,424	W	Stone, sand and gravel.
Fauquier -----	W	W	Stone.
Floyd -----	14	23	Do.
Franklin -----	W	W	Stone, soapstone.
Frederick -----	9,983	W	Stone, lime, sand and gravel.
Giles -----	W	W	Lime, stone.
Gloucester -----	W	32	Sand and gravel.
Goochland -----	5,043	3,882	Stone.
Grayson -----	W	W	Stone, sand and gravel.
Greene -----	W	W	Stone.
Greensville -----	W	W	Stone, clays.
Halifax -----	W	W	Stone, sand and gravel.
Hampton (city) -----	W	--	Sand and gravel, stone.
Hanover -----	† 3,603	W	Stone, aplite, sand and gravel.

See footnotes at end of table.

Table 2.—Value of mineral production in Virginia, by county <sup>1</sup>—Continued  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Henrico -----	\$6,074	\$6,009	Sand and gravel, stone.
Henry -----	W	W	Stone.
Highland -----	--	128	Do.
Isle of Wight -----	W	W	Lime, sand and gravel, stone.
James City -----	36	15	Sand and gravel.
King and Queen -----	8	W	Do.
King George -----	W	W	Do.
King William -----	64	W	Do.
Lancaster -----	W	W	Do.
Lee -----	W	31,261	Coal, stone, petroleum.
Loudoun -----	6,980	5,145	Stone.
Madison -----	W	W	Sand and gravel.
Middlesex -----	4	2	Do.
Montgomery -----	1,006	W	Stone, clays.
Nansemond -----	W	W	Clays, sand and gravel.
Nelson -----	W	W	Stone, apfite.
New Kent -----	W	W	Sand and gravel.
Newport News (city) -----	W	W	Do.
Northampton -----	17	13	Do.
Northumberland -----	19	W	Do.
Nottoway -----	W	W	Stone.
Orange -----	W	W	Clays.
Page -----	W	W	Stone.
Patrick -----	--	W	Do.
Pittsylvania -----	W	W	Stone, sand and gravel.
Portsmouth (city) -----	242	52	Sand and gravel.
Powhatan -----	W	W	Stone.
Prince Edward -----	W	W	Kyanite, stone.
Prince George -----	1,938	W	Sand and gravel.
Prince William -----	W	W	Stone, clays.
Pulaski -----	W	W	Stone.
Rappahannock -----	W	W	Do.
Richmond (city) -----	W	W	Stone, clays.
Roanoke -----	W	2,692	Stone, sand and gravel, clays.
Rockbridge -----	873	W	Do.
Rockingham -----	2,950	W	Sand and gravel, stone.
Russell -----	W	74,853	Coal, stone, natural gas.
Scott -----	W	1,550	Stone.
Shenandoah -----	W	W	Lime, stone.
Smyth -----	W	W	Sand and gravel, stone, clays, gypsum.
Spotsylvania -----	1,950	805	Stone, sand and gravel.
Stafford -----	W	W	Sand and gravel.
Suffolk (city) -----	--	1	Do.
Surry -----	W	W	Do.
Sussex -----	W	W	Do.
Tazewell -----	47,099	W	Coal, stone, natural gas, clays.
Virginia Beach (city) -----	1,983	1,186	Sand and gravel.
Warren -----	4,430	W	Cement, stone, sand and gravel.
Washington -----	W	W	Stone, gypsum.
Westmoreland -----	68	70	Sand and gravel.
Wise -----	W	W	Coal, stone, natural gas.
Wythe -----	15,890	W	Zinc, stone, lead, silver.
York -----	W	95	Sand and gravel.
Undistributed <sup>2</sup> -----	<sup>r</sup> 522,999	494,393	
Total <sup>3</sup> -----	<sup>r</sup> 1,056,569	1,261,974	

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

<sup>1</sup> The following counties are not listed because no production was reported: Alleghany, Amelia, Arlington, Bath, Carroll, Charlotte, Cumberland, Fluvanna, Louisa, Lunenburg, Lynchburg (city), Mathews, Mecklenburg, Richmond, and Southampton.

<sup>2</sup> Includes gem stones and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

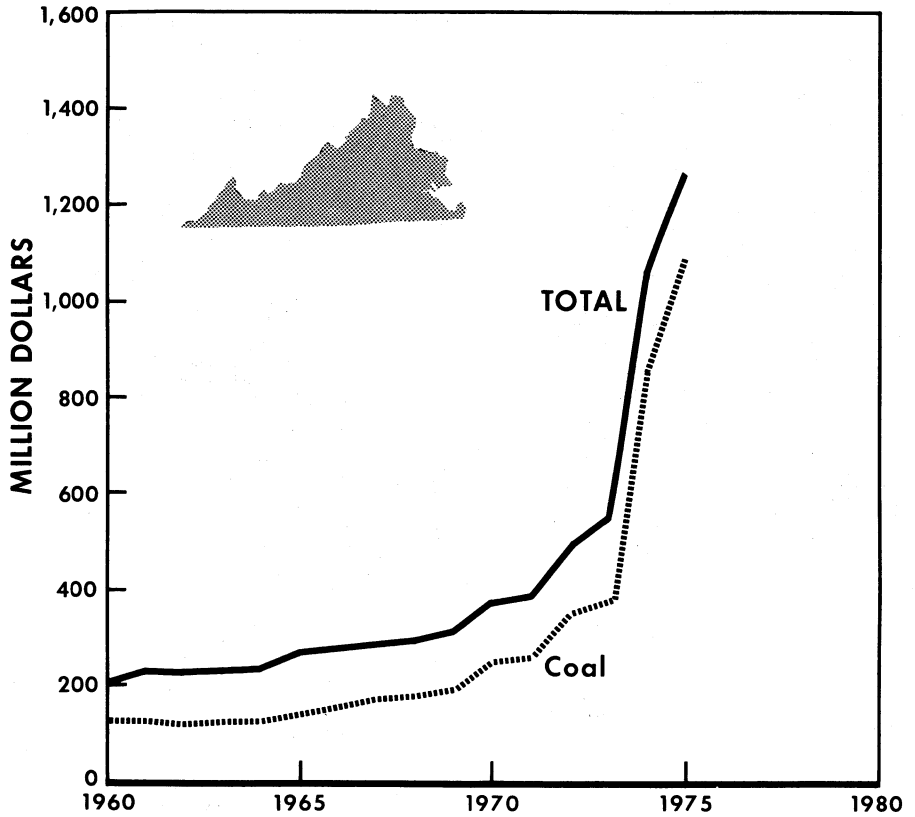


Figure 1.—Value of coal, and total value of all mineral production in Virginia.

Table 3.—Indicators of Virginia business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	2,159.0	2,247.0	+4.1
Unemployment -----do-----	98.0	144.0	+46.9
<b>Employment (nonagricultural):</b>			
Mining -----do-----	18.1	20.3	+12.2
Manufacturing -----do-----	399.4	366.3	-8.3
Contract construction -----do-----	128.7	104.9	-18.5
Transportation and public utilities -----do-----	107.4	102.7	-4.4
Wholesale and retail trade -----do-----	368.0	360.3	-2.1
Finance, insurance, and real estate -----do-----	88.1	87.0	-1.2
Services -----do-----	286.9	291.3	+1.5
Government -----do-----	404.7	422.2	+4.3
Total nonagricultural employment -----do-----	1,801.3	1,755.0	-2.6
<b>Personal income:</b>			
Total -----millions--	\$26,399	\$28,732	+8.8
Per capita -----do-----	\$5,377	\$5,785	+7.6
<b>Construction activity:</b>			
Number of private and public residential units authorized -----do-----	41,892	38,210	-20.7
Value of nonresidential construction -----millions--	\$592.8	\$440.9	-25.6
Value of State road contract awards -----do-----	\$300.0	\$168.0	-44.0
Shipments of portland and masonry cement to and within Virginia -----thousand short tons--	2,371	1,756	-25.9
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$1,056.6	\$1,262.0	+19.4
Value per capita, resident population -----do-----	\$215.19	\$253.93	+18.0
Value per square mile -----do-----	\$25,885.51	\$30,988.22	+19.7

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

with a section on hydrogeology,<sup>5</sup> and a description of 1,181 new or previously reported caves in the State;<sup>6</sup> detailed maps accompany 148 of the cave descriptions. The Division of Mineral Resources also publishes Virginia Minerals quarterly; this publication contains articles on mineral resources, various items of interest to the mineral industry, and an index to the status of topographic mapping in the State.

The Division of Mined Land Reclamation, headquartered in Big Stone Gap, continued its land reclamation activities during the year both in surface mining of coal and for all minerals other than coal. An Assistant Commissioner of the Division is located in Lynchburg to give assistance to mineral operations located in the eastern part of the State. Considerable progress was made by the Division during the year as follows:

1. For coal strip mining operations, 321 operating permits were issued in 7 southwestern Virginia counties, and 182 operating permits were released. Over 9,000 acres were disturbed by mining and 7,490 acres were reclaimed. Over 4 million tree seedlings were set out, and 649,000 pounds

of grass and legumes were planted, requiring 3.4 million pounds of fertilizer, 82,000 pounds of mulch, and 3.4 million pounds of lime. There were 16 bond forfeitures during the year.

2. For minerals other than coal, 19 operating permits were issued, 10 permits were released, and there were 4 bond forfeitures. Acres disturbed by surface mining totaled 10,310, and total acres reclaimed were 1,482. About 28,000 tree seedlings were put out, and 14,000 pounds of grass and legumes were planted, requiring 189,000 pounds of fertilizer and 508,000 pounds of lime.

The Division of Mines and Quarries, Virginia Department of Labor and Industry, located in Big Stone Gap, is responsible for executing and enforcing the laws enacted for the safety of persons employed within or at mines in Virginia, in the operation of quarries, and in the protection of mine property. The Chief

<sup>5</sup> Rader, E. K., and T. H. Biggs. Geology of the Front Royal Quadrangle, with a section on Hydrogeology by R. H. DeKay. Va. Div. Miner. Res. (Charlottesville, Va.), RI 40, 1975. 91 pp.

<sup>6</sup> Holsinger, J. R. Descriptions of Virginia Caves. Va. Div. Miner. Res. (Charlottesville, Va.), Bull. 85, 1975. 450 pp.

Mine Inspector of the Division is also charged with the enforcement of oil and gas laws. Virginia has a State Plan Agreement with the U.S. Mining Enforcement and Safety Administration (MESA) covering the metal and nonmetallic mining industry. The plan provides for joint effort of the two agencies in promoting health and safety programs for the industry and its employees in Virginia. Under the terms of the agreement, the State assumes the responsibility of conducting and controlling all joint inspections and, where necessary, requires compliance if violations are found during inspections.

New regulations were adopted by the Division in 1975 to cover blasting at surface operations and the drilling of vertical ventilation holes; these are designed to provide methane control in mined-out areas.

**Trends and Developments.**—Industrial activity in Virginia continued to reflect the effects of the nationwide recession, with announced employment down 11% from that in 1974 and the number of new and expanding firms down 9.5% from the 1974 total of 116. Even with this decline, however, industry in Virginia continued to expand in a well-rounded way with 19 out of the 20 major industrial classifications reporting new and/or expanding industry, according to the State Division of Industrial Development. As in 1974, there continued to be considerable activity by companies that produce various types of mining equipment. Many of the announcements in the nonelectrical machinery and fabricated metal products categories, accounting for 1,485 employees and 10 facilities, were by firms manufacturing mining equipment.

Virginia continued to attract foreign-based firms with seven new and five expanding manufacturing facilities for 1975. At yearend 14 foreign countries had about 75 affiliations in Virginia. Leading countries listed in order of the largest number

of companies in the State were the United Kingdom, West Germany, Sweden, Japan, and France.

New plant facilities announced during 1975 included Hampton Roads Energy Co. with plans to build a \$350 million refinery near Portsmouth and Mixing Equipment Co. with a \$5 million operation to be constructed at Wytheville. Expansions during the year included Lynchburg Foundry Co. at Radford with an investment of \$11.6 million; Bristol Steel Co. at Bristol, \$5 million; and Ingersoll-Rand Co. at Roanoke, \$2.5 million.

**Employment and Injuries.**—The Virginia Department of Labor and Industry Annual Report for 1975, Division of Mine and Quarries section, reported only nine fatalities in coal mining, the lowest total since 1921. Five of the nine fatalities had 10 years or more total mining experience. The fatality rate for 1975 was 0.25 per million tons of coal mined. The number of nonfatal accidents involving lost workdays rose from 579 in 1974 to 745 in 1975 with a total of 20,806 workdays missed during the year. The injury frequency rate for these nonfatal cases was 27.2 per million man-hours of exposure, and the severity rate equaled 760 lost days per million man-hours of exposure. Virginia's 981 coal mines employed 3,837 surface and 10,394 underground production workers in 1975, compared with 2,991 surface and 9,311 underground workers in 1974.

There were 4,543 mining and plant workers employed in 323 operations classified under mining or quarrying of nonmetallic minerals and metal mining in 1975. There was only one fatality reported in nonmetal and metal mining and quarrying in 1975. The number of nonfatal lost-workday injuries decreased from 168 in 1974 to 152 in 1975. However, the injury frequency rate per million man-hours of exposure increased from 16.7 to 17.5, and the severity rate per million man-hours of exposure jumped from 313 lost days in 1974 to 398 in 1975.

## REVIEW BY MINERAL COMMODITIES

## MINERAL FUELS

**Coal (Bituminous).**—Coal continued to be the most important mineral commodity produced in the State, in terms of mineral production value. Total coal output was 35.5 million tons valued at \$1,084.5 million, an increase of 3% in quantity and 27% in value above that of 1974. The average value per short ton was \$30.54, compared with \$24.94 in 1974.

When comparing coal production figures released by the State of Virginia with those released by the Federal Bureau of Mines, the following should be pointed out: Bureau of Mines production data include coal produced from deposits within the State boundaries, 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 Bureau of Mines may differ somewhat from those published by the Virginia Division of Mines and Quarries, Department of Labor and Industry.

Buchanan, Wise, and Dickenson Counties were the principal coal-producing counties in the State and were responsible for 84% of the total State production. Buchanan County accounted for 39% of the State production and was the leading producing county in both underground and auger production. Wise County, with 29% of the State's production, led in strip mine output. Dickenson County accounted for 15% of the State's total production.

Of the total coal production, 65% was from underground mines, 26% was from strip mines, 1.5% was from auger mines, and the remainder was from strip-auger mines.

The total output from underground mines was 23,181 million tons from 374 mines, compared with 22,767 million tons from 350 mines in 1974.

Total strip mine output from 305 mines totaled 9,145 million tons, compared with 7,874 million tons from 258 mines in 1974.

Auger mine production came from 30 mines and totaled 536,000 tons, compared with 34 mines and 767,000 tons in 1974. Strip-auger production came from 36 mines and totaled 2,648 million tons, com-

pared with 40 mines and 2,918 tons in 1974.

**Coke.**—Owing to gradual closures of all other plants over the past few years, there was only one producing coke plant in Virginia in 1975. Jewell Coal and Coke Co. with headquarters in Knoxville, Tenn., operated a plant near Vansant, Buchanan County. Total coke output decreased about 8%, but value increased 38% above that of 1974. The major use of the coke was for blast furnaces. Most of the coke consumed in Virginia came from out-of-State sources and was used principally by foundries, with a small percentage used by other industrial plants.

**Natural Gas and Petroleum.**—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.

According to a report by the Virginia Department of Labor and Industry, Division of Mines and Quarries, the total amount of natural gas produced in five southwestern Virginia counties was as follows: Buchanan, 4,321 million cubic feet; Dickenson, 1,368 million cubic feet; Tazewell, 1,028 million cubic feet; Wise, 4 million cubic feet; and Russell, 1 million cubic feet. Total production by 7 companies from 186 wells in the 5 counties was 6,723 million cubic feet. This total was 5.3% below that of 1974. The report added that Columbia Gas Transmission Corp. (Columbia Gas) produced gas from 86 wells into its own pipeline, as well as purchasing and transporting gas produced from 15 wells of Consol-Ray Resources, for a total of 5,789 million cubic feet of gas delivered to Columbia's pipeline from 101 wells during 1975. Columbia tied 12 new wells into its pipeline during the year. Consolidated Gas Supply Corp. purchased gas produced from 35 wells of Ashland Oil, Inc., 6 wells of P & S Oil and Gas Corp., and 1 well of Cabot Corp., for a total of 621 million cubic feet of gas from 42 wells in 1975. Kentucky-West Virginia Gas Co. purchased gas produced from 40 wells of Clinchfield Coal Co. during 1975 for a total of 303 million cubic feet. In addition, Clinchfield Coal Co. used 5 million cubic feet from its Dickenson County pro-



Table 4.—Virginia: Bituminous coal production, by type of mine and county  
(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines					Production (thousand short tons)					Value (thousands)
	Under-ground	Strip	Auger	Strip-auger	Total	Under-ground	Strip	Auger	Strip-auger	Total	
Buchanan -----	225	69	25	10	329	10,126	2,656	502	731	14,016	\$450,662
Dickenson -----	56	42	--	2	100	4,115	W	--	W	5,357	182,034
Lee -----	18	9	--	8	35	W	W	--	418	1,077	30,310
Russell -----	6	9	--	5	20	W	474	--	W	2,085	71,630
Tazewell -----	22	10	4	2	38	2,177	218	W	W	2,542	71,871
Wise -----	47	166	1	9	223	4,854	4,649	W	W	10,433	275,080
Undistributed -----	--	--	--	--	--	1,909	1,149	33	1,498	--	--
Total <sup>1</sup> -----	374	305	30	36	745	23,181	9,145	536	2,648	35,510	1,081,587

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

duction and 1 million cubic feet from a well in Russell County for local use during the year.

There were 36 wells drilled in 1975, compared with 39 drilled in 1974. Total footage drilled was 168,765 feet. Eight of the 36 wells drilled were exploratory tests, indicating a continued interest by oil and gas companies in new development. Of the 36 wells drilled, 28 were completed as producers, and the remainder were dry holes. Dickenson County again had the most drilling activity with 22 wells drilled, Buchanan County followed with 5 wells, Wise County with 4 wells, Lee County with 3 wells, and Scott County with 2 wells. Philadelphia Oil Co. drilled 17 wells, Columbia Gas drilled 16 wells, Tamik Oil Co. drilled 2 wells, and 1 well was drilled by Lee Oil Drilling Co. The majority of the productive gas wells drilled in 1975 were completed in the Berea Sandstone and Greenbrier Limestone (Big Lime) of Mississippian Age, with one well completed in the Devonian Shale. Natural gas pipeline construction increased during the year. Two companies, Columbia Gas and Berea Gathering Co., laid a total of 132,264 feet of line to two fields.

Lease acreage for oil and gas continued to increase during 1975 with 31,438 acres added to the total area during the year. At yearend 14 companies had 862,761 acres in undeveloped lease and 75,172 acres in developed lease for a total of 937,933 acres.

Crude oil production came from seven wells of two companies and totaled about 3,000 barrels. Tamik Oil Co. and Lee Oil Drilling Co. each completed one pro-

ducing well in the Rose Hill field during 1975. The two wells were completed with production in the middle Ordovician Trenton and Moccasin Limestone. American Oil Co. continued to operate the only refinery in the State at Yorktown. Hampton Roads Energy Co., a subsidiary of Cox Enterprises, Inc., Atlanta, Ga., announced early in the year its proposal to build a \$350 million oil refinery, with a capacity of 250,000 barrels of oil per day, near Portsmouth. At yearend the proposal was meeting opposition from several environmental groups.

#### NONMETALS

**Aplite.**—The only domestic production of aplite comes from Virginia. Total quantity and value declined below those of 1974. The Feldspar Corp. operated a plant at Montpelier, Hanover County, where the ore is first treated by passing over spirals and then, after drying, by magnetic separation to reduce the iron content. Sobin Chemicals, Inc., operated a plant in Nelson County, where aplite was produced by dry grinding and magnetic treatment. The product is an excellent ingredient for the manufacture of container and flat glass.

**Cement.**—Virginia's cement production in 1975 followed the national trend and decreased owing to the recession and reduced demand by the construction industry. Citadel Cement Corp. operated its Roanoke plant near Cloverdale and produced portland and masonry cement and quarried limestone for use in cement manufacture. Citadel Cement also operated its Norfolk grinding plant in Chesapeake and

ground imported cement clinker for use in its operations. Riverton Corp. produced masonry cement only at its Riverton plant and quarried limestone for use in cement manufacture.

Raw materials used in the manufacture of cement, in addition to limestone, included gypsum, sand, clay, and shale. Finished portland cement transported in bulk was 47% by rail and 53% by truck. Container shipments of portland cement were 40% by rail and 60% by truck. The disposition of the portland cement by type of customer or user was 73% to ready-mix companies, 17% to concrete products manufacturers, 6% to building materials dealers, and the remaining 4% to highway contractors, government agencies, and miscellaneous customers.

According to the 1975 Annual Report of Lone Star Industries, Lone Star's joint venture with Canada Cement Lafarge, Ltd., known as Citadel Cement Corp., virtually completed its plant construction program at Roanoke (formerly a Lone Star plant), doubling the productive capacity of that facility to a total of 1.2 million tons per year, and is well underway with construction of a new 750,000-ton cement plant in Demopolis, Ala., to be completed later this year. Together these two major projects represent an investment by Citadel of \$110 million. Lone Star provided supervision of engineering and construction for the Roanoke facility. Upon completion of the expansion program, Citadel will have more than twice the productive capacity of the original Lone Star plants, and the new operations will be considerably more modern, with lower operating cost and longer life. Citadel Cement Corp. serves the Southeast U.S. market with headquarters in Atlanta, Ga.

**Clays.**—Common clay and shale production in 1975 showed a significant decrease compared with that in 1974. Total output was under 1 million tons, and value was slightly over \$1 million. Production came from 15 mines in 13 counties by 8 companies. The clay and shale were used principally in the manufacture of face brick and were unprocessed. Other uses were for lightweight aggregate in the manufacture of concrete block, in structural concrete, and for other aggregate uses. Leading companies were Webster

Brick Co., Inc. (three mines), General Shale Products Corp. (three mines), Brick and Tile Corp. (two mines), and Weblite Corp. These four companies accounted for 85% of the total tonnage and 86% of the total value of all common clay and shale produced in the State in 1975.

**Table 5.—Virginia: Clays sold or used by producers**

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1971	1,710	1,800
1972	1,634	1,733
1973	1,646	1,886
1974	1,957	2,614
1975	819	1,152

**Gem Stones.**—Amateur collectors and rockhounds collected a variety of semi-precious gems and mineral specimens in various areas of the State. People interested in collecting Virginia rocks and minerals may contact the Virginia Division of Mineral Resources, Box 3667, Charlottesville, Va., 22903, for information on current localities and fees charged for collecting. Because entering private property without permission violates trespass laws and is punishable under law, the permission of the property owner should always be obtained before attempting to collect any material on private property.

**Gypsum.**—United States Gypsum Co., the only gypsum producer in the State, mined gypsum at its Locust Cove mine in Smyth County and at its Plasterco mine in Washington County. Output declined 48% below that of 1974 and was 72% below that of 1970, the record year. The firm also calcined Virginia gypsum at its Plasterco plant in Washington County and imported gypsum at its Berkeley plant in the city of Norfolk. Output declined 21% below that calcined in 1974 and was 28% below that of 1973, the record year. Most of the calcined gypsum was manufactured into plasterboard and other products by U.S. Gypsum at its Plasterco plant.

**Kyanite.**—Virginia again led the Nation in kyanite production in 1975. Kyanite Mining Corp. produced and processed kyanite at a mine and plant near Sprouses Corner and operated a processing plant near Dillwyn, all in Buckingham County. Kyanite Mining also mined and processed kyanite near Darlington Heights in Prince

Edward County and operated a processing plant at Pamplin City, all in Prince Edward County. Total output and value decreased below those of 1974.

During 1975, according to an annual review,<sup>7</sup> Kyanite Mining Corp. conducted a drilling program on ore bodies adjacent to its current mining operations and in this manner further increased its large proven ore reserves. In 1975, Kyanite Mining Corp. also began construction of its third concentrating plant at its deposit immediately east of Willis Mountain. This new plant is scheduled for completion by the fall of 1976 and will produce a 56%  $Al_2O_3$  (minimum) grade of concentrate with superior iron levels. This new plant will exceed 100,000 short tons per year in productive capacity and, by itself, can satisfy the total current kyanite demand in the United States. An important development took place in 1975 with the news that Kyanite Mining Corp. had purchased the Crocan Lake kyanite deposit near North Bay, Ontario. This deposit has at least 50 million short tons occurring to an explored depth of 100 feet.

**Lime.**—Total lime production in 1975 was 705,410 tons valued at \$20.2 million, compared with 895,000 tons valued at \$18.9 million in 1974. Of the total tonnage produced, 94.6% was quicklime and the remainder was hydrated. Six companies produced lime in Giles, Shenandoah, Frederick, and Isle of Wight Counties, listed in order of output. The major producing companies were National Gypsum Co., Chemstone Corp., and Virginia Lime Co.

Principal uses for Virginia lime were as a metallurgical flux in the basic oxygen

furnace (BOF) steelmaking process, in pulp and paper manufacture, in electric furnace production of steel, and in water purification.

**Mica.**—Imported mica was processed by two adjacent plants in the Newport News area. Asheville Mica Co. operated a mica-fabricating plant, and Mica Co. of Canada Inc. operated a plate-mica facility. There were no new developments in either operation during 1975.

**Nitrogen Compounds.**—Allied Chemical Corp., Nitrogen Div., near Hopewell, produced ammonia, urea, ammonium nitrate, and ammonium sulfate using reformed natural gas as feed. The materials produced were used chiefly for ingredients in fertilizers. Allied's plant capacity is rated at 350,000 short tons annually of ammonia.

**Sand and Gravel.**—Total sand and gravel production and value decreased in 1975 for the first time in several years, owing to decreased construction activity. Total production was 9.9 million tons valued at \$24.8 million, decreases of 31% in quantity and 15% in value below the 1974 figures. Sand and gravel was produced by 98 companies at 106 operations in 45 counties. Leading counties listed in order of descending rank of production were Chesterfield, Henrico, King George, and Stafford. These four counties produced 62% of the total State output of sand and gravel. There were 58 operations throughout the State with production of less than 25,000 tons, 33 operations between 25,000 and 300,000 tons, 7 opera-

<sup>7</sup> Radcliffe, D. Kyanite in Mining Engineering Annual Review/'75. Min. Eng., V. 28, No. 3, March 1976, pp. 39-40.

Table 6.—Virginia: Lime sold or used by producers, by use

Use	1974		1975	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, BOF -----	432,000	\$8,920	331,800	\$9,244
Paper and pulp -----	107,000	2,218	97,970	2,729
Steel, electric -----	71,440	1,474	60,050	1,673
Steel, open-hearth -----	61,040	1,260	47,970	1,336
Water purification -----	98,970	2,043	61,930	1,725
Sewage treatment -----	48,780	1,007	39,970	1,114
Construction -----	14,190	759	8,870	241
Agriculture -----	12,000	211	7,590	264
Other <sup>1</sup> -----	49,830	1,037	49,260	1,864
Total <sup>2</sup> -----	895,250	18,929	705,400	20,192

<sup>1</sup> Includes refractory dolomite, metallurgy (other), miscellaneous chemicals, tanning, and sugar refining.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

tions between 300,000 and 600,000 tons, and 3 operations with 1 million tons and over.

Construction sand and gravel comprised the bulk of the material produced. Output for construction purposes totaled 9.4 million tons valued at \$21 million.

Industrial sand and gravel was produced at five operations; output was 478,000 tons valued at \$2.8 million.

Transportation of sand and gravel in Virginia was 56% by truck, 32% by waterway, and 11% by railroad; the remainder was used at the pit site.

According to a survey of sand and gravel operations made during the year on sources of water for sand and gravel processing in Virginia, 15 operations used water from rivers, 3 from lakes, 6 from pits created by the operation, and 2 from wells; 9 used no water in processing. It was also determined that 488 gallons of water was needed to process 1 ton of sand and gravel, and that 192 pounds of waste was generated in producing 1 ton of sand and gravel. Waste is defined as all undersized material, silt, or clay.

**Table 7.—Virginia: Construction and industrial sand and gravel sold or used by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	8,425	15,842	5,072	10,131
Gravel -----	3,974	9,588	3,269	9,774
Unprocessed: Sand and gravel -----	1,510	1,446	1,076	1,058
Industrial:				
Sand -----	405	2,072	478	2,757
Total -----	14,314	28,948	9,895	23,720

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

**Table 8.—Virginia: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	3,902	8,374	2,857	7,577
Highway and bridge construction -----	866	1,623	441	907
Other construction (dams, waterworks, airports, etc.) -----	100	232	42	106
Concrete products (cement blocks, brick, pipe, etc.) -----	1,755	4,555	1,549	4,169
Bituminous paving (asphalt and tar paving -----	520	984	270	513
Roadbase and subbase -----	1,064	1,995	192	472
Fill -----	1,263	1,075	623	538
Other -----	28	38	83	196
Unprocessed:				
Roadbase and subbase -----	109	59	332	298
Fill -----	1,401	1,387	698	734
Other -----	—	—	11	9
Industrial sand and gravel -----	405	2,072	478	2,757
Total -----	11,413	22,394	7,576	18,276

Table 9.—Virginia: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential				
construction	1,018	2,035	1,480	4,385
Highway and bridge construction	622	1,713	626	1,681
Other construction (dams, waterworks, airports, etc.)	W	W	W	W
Concrete products (cement blocks, brick, pipe, etc.)	547	1,526	W	W
Bituminous paving (asphalt and tar paving)	159	281	133	300
Roadbase and subbase	555	1,321	W	W
Fill	--	--	--	--
Other	W	W	43	109
<b>Unprocessed:</b>				
Roadbase and subbase	--	--	19	17
Fill	--	--	16	7
Other	--	--	( <sup>1</sup> )	W
Total <sup>2</sup>	2,901	6,876	2,318	6,500

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>1</sup> Less than 1/2 unit.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

**Soapstone.**—Blue Ridge Talc Co. produced soapstone from its quarry in Franklin County and ground the soapstone in its plant near Henry, Henry County. Output and value decreased slightly below those of 1974. The ground material was used principally in insecticides and for foundry facings.

Dimension soapstone was produced in Albemarle and Nelson Counties by the Alberene Stone Division of Georgia Marble Co. at its plant near Schuyler. Dimension soapstone production and value are included in the Stone section of this chapter.

**Stone.**—Stone was the second leading mineral commodity produced in the State in 1975, surpassed only by bituminous coal. Total stone output, consisting of crushed and dimension stone, was 35.4 million tons valued at \$84.2 million, decreases of 20% in output and 12% in value below those of 1974, the record year. Crushed and broken stone accounted for most of the production; only a small tonnage of dimension stone was produced. Production was reported from 139 quarries in 58 counties. Fauquier, Loudoun, Montgomery, Nelson, and Wythe Counties had five quarries each; nine other counties had four quarries each; and nine other counties had three quarries each. Leading individual

counties in output were Loudoun, Goochland, and Fairfax. There were 6 crushed stone quarries that produced over 900,000 tons, 15 quarries that produced over 500,000 tons, and 67 quarries that produced over 100,000 tons.

Leading producing companies were Vulcan Materials Co. with 10 quarries, Luck Quarries, Inc., with 7 quarries, and Lone Star Industries, Inc., with 3 quarries. Companies with two quarries each included Pounding Mill Quarry Corp., Blue Ridge Stone Corp., and Chantilly Crushed Stone, Inc. These 6 companies with 26 quarries accounted for 39% of the total State stone production and 37% of the total value.

Crushed stone was used primarily for dense roadbase, construction aggregate, concrete aggregate, and bituminous aggregate. There were decreases in both quantity and value for most end use categories. Principal crushed stone output came from 95 limestone and granite quarries. Other crushed stone produced was dolomite, marble, marl, quartz, quartzite, traprock, and slate.

Dimension stone was produced at 13 quarries; total output was 14,265 short tons valued at \$2.1 million. Dimension limestone, granite, dolomite, quartzite, traprock, soapstone, and slate were produced.

Table 10.—Virginia: Crushed stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	3,408	7,342	2,630	6,140
Concrete aggregate -----	5,954	11,904	4,634	10,450
Dense-graded roadbase stone -----	14,917	28,644	12,299	26,168
Macadam aggregate -----	861	1,655	464	998
Other construction aggregate and roadstone -----	8,543	17,961	6,466	14,050
Surface treatment aggregate -----	2,151	4,460	1,396	3,159
Agricultural purposes <sup>1</sup> -----	1,347	3,109	1,616	4,709
Cement manufacture -----	<sup>2</sup> 2,779	<sup>2</sup> 5,553	1,226	2,257
Lime manufacture -----	( <sup>2</sup> )		1,524	3,442
Flux stone -----	462	829	211	430
Manufactured fine aggregate (stone sand) -----	842	1,835	721	1,883
Mine dusting -----	384	2,224	425	1,262
Railroad ballast -----	763	1,277	697	1,343
Riprap and jetty stone -----	275	665	124	439
Other uses <sup>3</sup> -----	1,467	6,382	944	5,327
Total <sup>4</sup> -----	44,152	93,839	35,369	82,058

<sup>1</sup> Data includes stone used in agricultural limestone and marl (1975), poultry grit, and mineral food.

<sup>2</sup> Combined with cement manufacture to avoid disclosing confidential data.

<sup>3</sup> Includes stone used in asphalt and other fillers, chemicals, fill, filter stone, glass, lightweight aggregate, paper manufacture, roofing aggregate, terrazzo and exposed aggregate (1975), and floor (slate).

<sup>4</sup> Data may not add to totals shown because of independent rounding.

Shipments of crushed stone were transported 79% by truck and 18% by railroad, a small amount by water, and the remainder unspecified.

**Sulfur.**—Hydrogen sulfide, recovered from fuel gas, was converted to elemental sulfur by the American Oil Co. at its Yorktown refinery. Total output decreased 10% and value 29%, compared with the 1974 figures. Production and sales were approximately identical.

## METALS

**Iron Ore.**—Huff Coal and Oil Co., Pulaski County, recovered byproduct iron ore in the form of iron cinder from Allied Chemical Corp.'s pyrrhotite processing plant. Most of the material was used in cement manufacture.

**Iron Ore (Pigment Material).**—Hoover Color Corp., near Hiwassee, Pulaski County, produced natural iron oxide pigments from local deposits of earthy forms of hydrous and anhydrous iron oxides including ocher, sienna, and umber. Manufactured iron oxides for use in pigment manufacture and other purposes were produced at the company's Pulaski plant. Blue Ridge Talc Co., Inc., near Henry, Henry County, produced natural iron

oxide pigments from hematite obtained from out-of-State. Finished iron oxide pigments are used in cement manufacture, printing inks, paint manufacture, and other products.

**Lead and Zinc.**—Lead and zinc ores were mined by a single company in Wythe County. Lead production declined 18% and zinc production 12% below those in 1974. The ratio of zinc recovery to that of lead was about 6 to 1.

**Magnetite.**—Virginia Lime Co., a subsidiary of the Rangaire Corp., processed out-of-State magnetite at a plant near Kimballton, Giles County. The material was ground for use in coal preparation.

**Manganese.**—Union Carbide Corp., Consumer Products Division, operated a manganese ore processing plant near Newport News. The plant processed imported ore for use in company products.

**Pyrrhotite.**—Allied Chemical Corp., Industrial Chemicals Division, mined pyrrhotite near Galax intermittently during the year for use in its plant near Pulaski.

**Silver.**—A small amount of byproduct silver from the smelting of lead and zinc ores was mined by a metals-producing company in Wythe County. No recovery of silver was reported in 1974.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Aplite (crude):</b>			
The Feldspar Corp -----	Route 1, Box 23 Montpelier, Va. 23192	Quarry and plant -	Hanover.
Sobin Chemicals, Inc -----	Box 38 Piney River, Va. 22964	----do -----	Nelson.
<b>Cement:</b>			
Citadel Cement Corp. <sup>1</sup> ----	Box 27 Cloverdale, Va. 24077	Plant and quarry-	Botetourt.
Do -----	Box 5128 Chesapeake, Va. 23320	Plant -----	Chesapeake (city).
Riverton Corp. <sup>2</sup> -----	Riverton, Va. 22651 -----	Quarry and plant -	Warren.
<b>Clays (miscellaneous and shale):</b>			
Brick and Tile Corp. of Lawrenceville.	Box 45 Lawrenceville, Va. 23868	Pits and plant ----	Brunswick and Greensville.
General Shale Products Corp.	Box 3547 Johnson City, Tenn. 37601	Pits and plants ---	Rockbridge, Smyth, Tazewell.
Old Virginia Brick Co., Inc.	Box 508 Salem, Va. 24153	Pits and plant ----	Roanoke and Mont- gomery.
Weblite Corp -----	Box 12887 Roanoke, Va. 24004	Pit and plant ----	Botetourt.
Webster Brick Co., Inc ---	----do -----	Pits and plants ---	Botetourt and Orange.
<b>Coal (bituminous):</b>			
Clinchfield Coal Co. <sup>3</sup> -----	Dante, Va. 24237 -----	Underground mines	Buchanan, Dickenson, Russell.
Island Creek Coal Co ---	Box 113 Keen Mountain, Va. 24264	----do -----	Buchanan.
Westmoreland Coal Co ---	Box 229 Big Stone Gap, Va. 24219	----do -----	Wise.
Coke: Jewell Coal & Coke Co -	D'smal Route, Box 1 Vansant, Va. 24656	Plant -----	Buchanan.
<b>Gypsum:</b>			
United States Gypsum Co.	101 South Wacker Drive Chicago, Ill. 60606	----do -----	Norfolk (city).
Do -----	----do -----	Mines and plant --	Washington and Smyth.
<b>Iron oxide pigments (crude):</b>			
Blue Ridge Talc Co., Inc. <sup>4</sup>	Box 39 Henry, Va. 24102	Plant -----	Henry.
Hoover Color Corp -----	Box 218 Hiwassee, Va. 24347	Mines and plant --	Pulaski.
<b>Lime:</b>			
Battery Park Fish and Oyster Co.	Box 57 Battery Park, Va. 23304	Plant -----	Isle of Wight.
Chemstone Corp -----	Box 71 Strasburg, Va. 22657	----do -----	Shenandoah.
The Flintkote Co -----	Box 8 Stephens City, Va. 22655	----do -----	Do.
W. S. Frey Co., Inc -----	Box 65 Clearbrook, Va. 22624	----do -----	Frederick.
National Gypsum Co -----	Box 635 Star Route 635 Ripplemead, Va. 24150	----do -----	Giles.
Virginia Lime Co -----	Star Route Ripplemead, Va. 24150	----do -----	Do.
<b>Sand and gravel:</b>			
Lone Star Industries Inc..	Box 3778 Richmond, Va. 23229	Pits and dredges--	Charles City, Chesterfield, Henrico, New Kent, Prince George.
Sadler Sand & Gravel Corp-	Box 5607 Virginia Beach, Va. 23455	Pit -----	Henrico.
Solite Corp -----	Box 883 Fredericksburg, Va. 22401	Pit -----	King George.
West Sand & Gravel Co., Inc.	Box 6008 Richmond, Va. 23222	Pits -----	Henrico and Rocking- ham.
E. V. Williams Co., Inc --	Box 938 Norfolk, Va. 23501	Pit -----	Virginia Beach (city).

See footnotes at end of table.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Soapstone:			
Blue Ridge Talc Co., Inc. <sup>5</sup>	Box 39 Henry, Va. 24102	Mine and plant ---	Franklin.
Georgia Marble Co -----	Schuyler, Va. 22969	Mines -----	Albemarle and Nelson.
Stone:			
Blue Ridge Stone Corp ---	Box 2459 Roanoke, Va. 24010	Quarries -----	Bedford and Campbell.
Lone Star Industries, Inc.--	977 Norfolk Square Norfolk, Va. 23501	----do -----	Brunswick, Chesterfield, Dinwiddie.
Luck Quarries, Inc -----	Box 4682 Richmond, Va. 23229	----do -----	Albemarle, Augusta, Fairfax, Goochland, Loudoun, Nottoway.
Pounding Mill Quarry Corp.	Box 2459 Roanoke, Va. 24010	----do -----	Tazewell.
Vulcan Materials Co -----	Box 7506, Reynolds Sta. Winston-Salem, N.C. 27109	----do -----	Brunswick, Chesterfield, Fairfax, Goochland, Halifax, Pittsylvania, Prince William, Washington.

<sup>1</sup> Also clay, sand and gravel, and stone.<sup>2</sup> Masonry cement only; also produces limestone.<sup>3</sup> Also clay.<sup>4</sup> Also talc (soapstone).<sup>5</sup> Also finished oxide pigments.





# 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 Geology and Earth Resources for collecting information on all minerals.

By John R. Welch<sup>1</sup>

The total value of mineral production increased 10% over that of 1974. Metals, principally gold, with an average value of \$161.50 per ounce and uranium, with its upward price trend, accounted for a substantial part of the increase in value. Lead and zinc production also showed a significant increase over that of 1974. Some of the increase was offset by a decrease in the production of silver. The value of non-metals greatly exceeded that of metallic minerals and fossil fuels; cement value showed a 12% increase over that of 1974.

The mineral industry contributed greatly to the economy of the State and the Nation. Primary aluminum produced at seven plants in the State of Washington was about the same as that of 1974. However, the value increased about 19%, amounting to \$848,000. This was 28% of the Nation's total. Similarly, six petroleum refineries with a total capacity of more than 350,000 barrels per day produced petroleum products for the State and Nation. During 1974, the gross income of these refineries was about \$458 million. American Smelting and Refining Co.'s (ASARCO) big nonferrous smelter in Tacoma, which turns out about 7% of the Nation's copper, refined ores from all over the world, adding in excess of \$200 million to the economy of the State.

**Legislation and Government Programs.**—H.B. 527, an Act relating to water pollution from petroleum spills, passed the

legislature May 21, 1975. This bill provides, among other things, safety standards for oil tankers and other precautionary measures for the prevention of major oil spills in Puget Sound and adjacent waters.

By passing this bill, the legislature has decided that at least in the near future, oil tankers exceeding 125,000 deadweight tons should not be permitted to enter these waters. In addition, the bill requires all oil tankers above a certain size to employ Washington State licensed pilots and, if lacking certain safety and maneuvering capability requirements, to be escorted by a tug or tugs while navigating certain areas of Puget Sound. Any tanker of 50,000 deadweight tons or greater shall be required to take on a Washington State licensed pilot while navigating Puget Sound waters. Other restrictions include twin screws, double bottoms, and two radar systems.

Shortly after enactment of the law, the Atlantic Richfield Co., which operates one of the State's larger petroleum refineries, filed suit in Federal Court seeking to overturn the law. The company believes that it conflicts with Federal laws and the issue of State versus Federal jurisdiction over interstate and foreign commerce.

**Environment.**—ASARCO's smelter at Tacoma is one of the few copper smelters in the world refining ores with up to

<sup>1</sup> State Liaison Officer, Bureau of Mines, Olympia, Wash.

Table 1.—Mineral production in Washington<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
<b>Cement:</b>				
Masonry -----thousand short tons--	6	\$193	5	\$209
Portland -----do-----	1,377	36,347	1,147	40,666
Clays <sup>2</sup> -----do-----	269	698	290	778
Coal (bituminous) -----do-----	3,913	W	3,743	W
Gem stones -----do-----	NA	160	NA	160
Lead (recoverable content of ores, etc.)				
-----short tons--	1,299	585	W	W
-----thousand short tons--	14	85	13	98
Peat -----do-----	( <sup>3</sup> )	1	--	--
Pumice -----do-----	22,842	35,030	19,069	32,990
Sand and gravel -----do-----	15,095	24,483	7,920	18,764
Stone -----do-----				
Zinc (recoverable content of ores, etc.)	6,909	4,960	W	W
<b>Value of items that cannot be disclosed:</b>				
Fire clay, copper, diatomite, gold, gypsum, lime, olivine, silver, talc, tungsten, uranium, and values indicated by symbol W --	XX	41,388	XX	64,850
Total -----do-----	XX	143,930	XX	158,505
Total 1967 constant dollars -----do-----	XX	680,501	XX	P 627,680

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

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes fire clay; included with "Value of items that cannot be disclosed."

<sup>3</sup> Less than 1/2 unit.

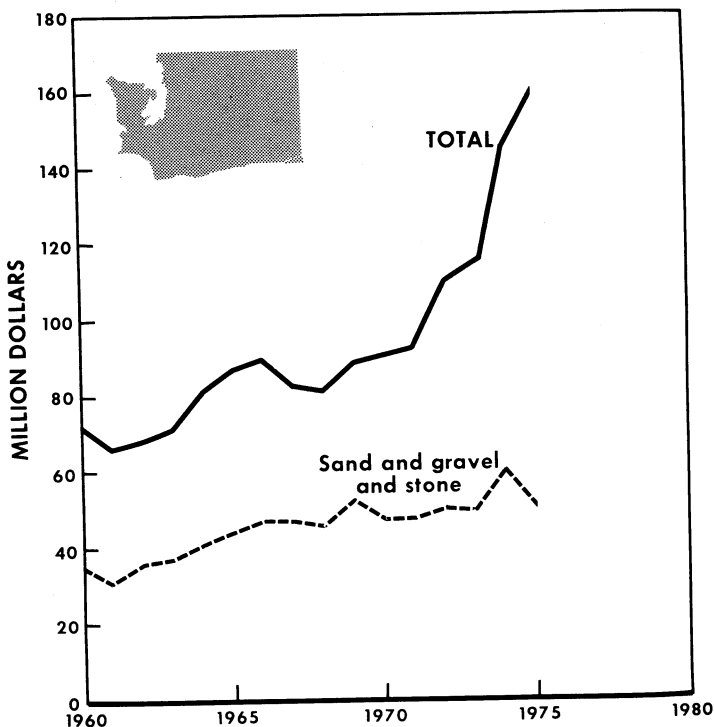


Figure 1.—Value of sand and gravel and stone, and total value of mineral production in Washington.

Table 2.—Value of mineral production in Washington, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams -----	W	W	Sand and gravel, stone.
Asotin -----	\$5,997	\$67	Stone, sand and gravel.
Benton -----	W	W	Sand and gravel, stone.
Chelan -----	W	359	Do.
Clallam -----	W	W	Stone, clays, sand and gravel.
Clark -----	W	W	Sand and gravel, stone, clays.
Columbia -----	111	101	Stone.
Cowlitz -----	W	1,023	Stone, sand and gravel.
Douglas -----	173	W	Stone, sand and gravel, clays.
Ferry -----	W	4,350	Gold, silver, stone, zinc, copper, lead, sand and gravel.
Franklin -----	524	129	Sand and gravel, stone.
Garfield -----	115	51	Stone.
Grant -----	W	W	Diatomite, lime, stone, sand and gravel.
Grays Harbor -----	1,546	1,023	Sand and gravel, stone.
Island -----	622	428	Do.
Jefferson -----	W	832	Stone, sand and gravel.
King -----	31,840	W	Cement, sand and gravel, stone, coal, clays, peat, talc.
Kitsap -----	W	W	Sand and gravel, stone, peat.
Kittitas -----	W	W	Stone, sand and gravel, clays.
Klickitat -----	710	248	Stone, sand and gravel.
Lewis -----	W	W	Coal, sand and gravel, stone, clays.
Lincoln -----	539	175	Stone.
Mason -----	130	W	Sand and gravel, stone.
Okanogan -----	112	302	Stone, sand and gravel, gypsum, silver, gold, copper, lead, zinc.
Pacific -----	598	252	Stone.
Pend Oreille -----	10,166	14,009	Zinc, cement, lead, stone, silver, sand and gravel, copper, gold.
Pierce -----	11,420	W	Sand and gravel, lime, stone, clays.
San Juan -----	W	W	Sand and gravel.
Skagit -----	2,553	2,886	Olivine, sand and gravel, stone, talc.
Skamania -----	224	445	Stone, sand and gravel.
Snohomish -----	W	W	Sand and gravel, stone, clays, peat.
Spokane -----	3,911	W	Do.
Stevens -----	10,178	9,502	Uranium, stone, zinc, sand and gravel, clays, tungsten, silver, lead, gold, copper.
Thurston -----	W	16,263	Coal, sand and gravel, stone, peat.
Wahkiakum -----	W	W	Stone.
Walla Walla -----	W	W	Sand and gravel, stone.
Whatcom -----	10,070	W	Cement, sand and gravel, stone, clays.
Whitman -----	W	239	Stone, sand and gravel.
Yakima -----	W	W	Sand and gravel, stone, lime.
Undistributed <sup>1</sup> -----	52,383	105,816	
Total <sup>2</sup> -----	143,930	158,505	

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

<sup>1</sup> Includes value of mineral production that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Washington business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force ----- thousands--	1,509.0	1,532.0	+ 1.5
Unemployment ----- do-----	108.0	146.0	+35.2
<b>Employment (nonagricultural):</b>			
Mining ----- do-----	2.0	1.9	- 5.0
Manufacturing ----- do-----	253.6	241.8	- 4.7
Contract construction ----- do-----	55.0	55.0	--
Transportation and public utilities ----- do-----	74.1	71.0	- 4.2
Wholesale and retail trade ----- do-----	273.4	281.7	+ 3.0
Finance, insurance, and real estate ----- do-----	65.2	66.2	+ 1.5
Services ----- do-----	209.5	219.1	+ 4.6
Government ----- do-----	267.2	272.7	+ 2.1
Total nonagricultural employment ----- do-----	1,200.0	1,209.4	+ .8
<b>Personal income:</b>			
Total ----- millions--	\$19,761	\$22,158	+12.1
Per capita ----- do-----	\$5,646	\$6,247	+10.6
<b>Construction activity:</b>			
Number of private and public residential units authorized--	27,111	35,209	+29.9
Value of nonresidential construction ----- millions--	\$385.3	\$349.8	- 9.2
Value of State road contract awards ----- do-----	\$99.5	\$119.0	+19.6
Shipments of portland and masonry cement to and within Washington ----- thousand short tons--	1,174	1,039	-11.5
<b>Mineral production value:</b>			
Total crude mineral value ----- millions--	\$143.9	\$158.5	+10.1
Value per capita, resident population ----- do-----	\$41.19	\$44.54	+ 8.1
Value per square mile ----- do-----	\$2,110.66	\$2,324.39	+10.1

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

15% arsenic content. As a result, various groups of people have been concerned with the lack of emission controls for arsenic as well as for sulfur dioxide and particulate matter. Hearings were held throughout the year to determine action to be taken. ASARCO's proposed program to further reduce emissions, after already spending more than \$20 million since 1971, was an important effort to improve air quality and to keep the Tacoma smelter in operation. The additional cost of the proposed pollution control program is \$4.7 million to be spent over the next 32 months. That figure represents approximately five times the smelter's average annual earnings for the past 10 years.

The amount of sulfurous fumes spewing out of Mt. Baker has increased sharply in recent months and there are indications of an increasing buildup of heat within the heretofore dormant volcano. Instruments placed in the mountain's Sherman Crater to measure earth movement and gaseous fumes indicated 2,800 pounds of sulfur were emitted each hour on March 27. The devices showed emissions of 10,000 pounds of sulfur per hour in a June 30 reading. Scientists in recent weeks have feared that it was potentially possible for old lava and ash deposits to break loose from the mountain, as a result of increased thermal activity, and create a huge mudslide, possibly extending down into Baker Lake.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Cement.**—Shipments of portland cement in 1975 declined 17% in quantity from that shipped in 1974 to 1.15 million short tons, but increased in value 12% to \$40.67 million. Shipments of 5,325 tons of masonry cement valued at \$208,592 represented a 6% decline in quantity and an 8% increase in value. Output originated at four plants,

each producing both portland and masonry cement. Shipments of portland cement included general use, moderate heat, and high-early-strength. Concrete product manufacturers, ready-mix companies, building material dealers, and contractors were the major consumers.

**Clays.**—Total production of clays increased in 1975. The quantity produced in 1975 increased 4%, but value remained the

same as that in 1974. Clay was produced in 11 counties, the majority came from Clallam, King, and Snohomish Counties. Fire clay was produced in three counties.

**Gypsum.**—Agro Minerals, Inc. mined gypsum in Okanogan County. Output was 17% below the 1972 record. Kaiser Gypsum Co., Inc. calcined gypsum at Seattle, in King County; output declined 38% below that calcined in 1974.

**Lime.**—Domtar Chemicals, Inc., and Utah-Idaho Sugar Co. produced lime in Grant, Pierce, and Yakima Counties for sugar refining, paper, and pulp processing, calcium carbide production, sewage treatment, and other uses. Output increased slightly over that of 1974, and value remained about the same.

**Sand and Gravel.**—Sand and gravel was produced in 34 counties. Production decreased 17% in quantity from that of 1974. Counties leading in output were Pierce, King, and Snohomish which collectively supplied 52.5% of the total. Commercial operations provided 72% of the production;

the remainder was provided by local contractor's crews.

**Stone.**—The production of crushed and broken stone declined 48% in quantity and 23% in value from that of 1974. The decline in production was due to a decrease in road construction in the State.

There were 254 operating quarries in 38 counties, but the quarries in 5 of the largest producing counties accounted for 28% of the stone reported. There were three counties whose production was valued in excess of \$1 million. Four uses—roadbase, surface treatment, riprap and jetty, and aggregate—consumed 63% of the available crushed stone.

Traprock was produced at 202 quarries and constituted 70% of the stone quarried. Most of it was used for riprap, road material and aggregate. Granite was produced at 55 quarries and amounted to 5% of the total available stone, and limestone was produced at 12 quarries constituting 10% of the total stone. Most of the limestone production was used to make cement and lime.

Table 4.—Washington: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	4,453	7,259	3,559	6,777
Gravel -----	11,743	19,712	10,031	18,353
Unprocessed: Sand and gravel -----	6,407	5,669	5,479	5,847
Industrial:				
Sand -----	239	1,966	W	W
Gravel -----	--	--	--	--
Total -----	22,842	34,606	19,069	30,982

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant for blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

**Table 5.—Washington: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction				
Highway and bridge construction	5,265	8,366	4,704	9,004
Other construction (dams, waterworks, airports, etc.)	399	732	878	1,526
Concrete products (cement blocks, brick, pipe, etc.)	647	896	544	807
Bituminous paving (asphalt and tar paving)	1,305	2,505	905	2,346
Roadbase and subbase	1,682	2,837	1,199	2,248
Fill	2,253	3,994	1,136	2,372
Other	482	655	464	773
Other	284	565	120	327
<b>Unprocessed:</b>				
Roadbase and subbase	1,340	1,061	1,351	1,224
Fill	4,982	4,573	2,347	3,208
Other	--	--	W	W
Industrial sand and gravel	239	1,966	W	W
<b>Total</b>	<b><sup>1</sup>18,877</b>	<b>28,150</b>	<b>13,648</b>	<b>23,835</b>

W Withheld to avoid disclosing individual company confidential data; included with "Non-residential and residential construction."

<sup>1</sup>Data do not add to total shown because of independent rounding.

**Table 6.—Washington: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers**  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction				
Highway and bridge construction	185	323	142	341
Other construction (dams, waterworks, airports, etc.)	320	707	1,024	2,134
Concrete products (cement blocks, brick, pipe, etc.)	194	473	148	366
Bituminous paving (asphalt and tar paving)	114	168	212	388
Roadbase and subbase	1,669	2,905	676	1,290
Fill	1,284	2,122	1,319	2,656
Other	115	148	154	272
Other	W	W	9	13
<b>Unprocessed:</b>				
Roadbase and subbase	15	8	964	909
Fill	69	26	761	779
Other	--	--	12	8
<b>Total <sup>1</sup></b>	<b>3,965</b>	<b>6,880</b>	<b>5,420</b>	<b>9,155</b>

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

<sup>1</sup>Data may not add to totals shown because of independent rounding.

Table 7.—Washington: Crushed stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	730	1,374	621	1,393
Concrete aggregate -----	275	W	86	173
Dense-graded roadbase stone -----	1,212	1,934	1,043	2,091
Macadam aggregate -----	256	546	54	148
Surface treatment aggregate -----	1,723	2,720	2,167	4,480
Other construction aggregate and roadstone -----	2,048	3,717	1,686	3,958
Agricultural limestone <sup>1</sup> -----	22	143	10	W
Fill -----	5,488	5,587	18	36
Flux stone <sup>2</sup> -----	35	108	W	W
Glass -----	W	W	134	1,098
Manufactured fine aggregate (stone sand) -----	31	206	--	--
Railroad ballast -----	364	625	185	372
Riprap and jetty stone -----	1,729	3,159	1,055	2,287
Other uses <sup>3</sup> -----	1,177	4,070	858	2,391
Total <sup>4</sup> -----	15,091	24,188	7,915	18,428

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

<sup>1</sup> 1974 data include poultry grit and mineral food.

<sup>2</sup> 1974 data include ferrosilicon.

<sup>3</sup> Includes abrasives, asphalt filler, bedding material (1974), cement manufacture, drain fields (1974), filter stone (1974), paper manufacture, porcelain, refractory stone (1975), roofing aggregates, sugar refining (1974), terrazzo, waste material (1974), and uses indicated by symbol W.

<sup>4</sup> Data may not add to totals shown because of independent rounding.

### METALS

**Aluminum.**—Production of primary aluminum declined less than 1% from that of 1974. However, value increased 19% during the same period. Washington's share of national production was 28%, an increase of 19% over that of 1974. Five firms operated seven plants in the State. These plants imported alumina from Australia, Surinam, Jamaica, and Guinea, which was used in the production of the primary aluminum. Most of the alumina was processed from bauxite in those countries before shipment to the United States.

**Copper.**—Production of copper rose sharply in 1975. Most of the production came from Ferry and Pend Oreille Counties. The average value of copper produced in 1975 was \$0.64 per pound.

With unsold refined copper piling up, ASARCO announced a 5% cut in the primary copper price. By June the price of copper cathode was \$0.60 per pound, down from \$0.63. ASARCO's Tacoma plant had an inventory of 35,000 tons of refined copper waiting for processing into finished goods.

The southern Cascades continued to be an active area with Exxon Co. and Amoco Minerals Co. staking large blocks of claims in 1975. Amoco core drilled throughout the year at its Copper Creek property in southwestern Skamania County, while in the northwestern part of the county, Duval drilled throughout the summer on its Ryan Lake deposit.

In north-central Ferry County near Danville, Coastal Mining Co. continued to ex-

Table 8.—Washington: Primary aluminum production data

Year	Production			Average U.S. ingot price per pound (cents)
	Quantity (thousand short tons)	Percent of national total	Value (thousands)	
1970 -----	1,023	26	\$569,377	27.3
1971 -----	934	24	516,407	27.6
1972 -----	1,049	25	532,678	25.3
1973 -----	1,048	23	513,732	24.5
1974 -----	1,178	24	713,175	30.3
1975 -----	1,075	28	847,908	39.4

<sup>r</sup> Revised.



plore the Lone Star mine for copper. In western Okanogan County near Mazama, Quintana Minerals Corp. undertook further drilling at its property on Goat Creek.

**Gold-Silver.**—Production and value of gold and silver declined below that produced in 1974. Most of the production came from Ferry and Pend Oreille Counties. The average price for gold and silver produced in 1975 was \$161.50 and \$4.43 per troy ounce, respectively.

By the end of 1976, Cyprus Mines Co. should know whether its current exploration work at the L-D Gold mine near Wenatchee, in central Washington, will uncover sufficient new gold values to justify returning the mine to production. Exploration work began in mid-1975. The Wenatchee mine is being studied under a joint venture between Cyprus and Azcon Corp.

In the Republic district of Ferry County, the Knob Hill mine continued to operate as the State's only gold producer.<sup>2</sup>

**Lead-Zinc.**—Production of lead exceeded that of 1974 and value increased. Zinc production and value also increased over those of 1974. Most production came from Pend Oreille, Ferry, and Stevens Counties.

Pend Oreille mine, located in Pend Oreille County, was the State's largest producer of lead and zinc. This operation is now owned and operated by The Bunker Hill Co., a wholly owned subsidiary of Gulf Resources and Chemical Co.

Exploration for lead and zinc decreased in 1975, compared with 1974. General reconnaissance for these metals was carried out in parts of the Cascade Mountains and Okanogan Highlands, but the lead-zinc districts of Pend Oreille and Stevens Counties continued to receive the most attention.

**Magnesium.**—About 800 people were employed on construction crews completing the \$50 million magnesium and silicon plant for Northwest Alloys, Inc., near Addy, 55 miles northwest of Spokane. Silicon production will start this year with nearly full plant operation scheduled early in 1976. Northwest Alloys, a subsidiary of Aluminum Co. of America, will use the magnesium and silicon as alloying materials for aluminum.

**Uranium.**—In northeastern Washington, mining companies have triggered a uranium rush in an area where major exploration efforts are being made, probing the geological strata with core drills and using

more sophisticated equipment to find new resources. Bendix Field Engineering Corp. was mapping one area for the Energy Research and Development Administration (ERDA). In addition, other companies prospecting included Exxon, Continental Oil, Getty Oil, Reserve Oil, Burlington Northern, and Western Nuclear.

Midnite Mines, Inc. has been the most successful firm at the Spokane Indian Reservation uranium group, supplying eastern utilities with uranium oxide for the past several years. Midnite Mines, Inc. of Spokane has a 49% interest in the Dawn Mining Co. uranium mill at Ford. Newmont Mining Corp. owns the other 51%. Altogether, Midnite's ore reserves and stockpiles total about 284,000 tons averaging 0.235% uranium oxide. The mine has already produced a total of 2.5 million tons of uranium ore.

Besides the heightened interest in Midnite Mines, Western Nuclear, Inc., of Denver, Colo., is pushing ahead with its large ore plant (2,000 tons per day) and open pit Sherwood mine, also located on the Spokane Indian Reservation.

Exploration for uranium increased in 1975. Although several parts of the State were under investigation, exploration for uranium was confined mainly to Pend Oreille, Spokane, Stevens, and Ferry Counties.

#### MINERAL FUELS

**Coal.**—Bituminous coal production decreased 4% from that produced in 1974. Three mines contributed to the total production, but the bulk of the coal came from one strip mine which extends into Thurston and Lewis Counties. Because of increased costs the two smaller mines have shut down operations. These were underground mines producing coal from relatively thin seams.

The main producer of bituminous coal was the Washington Irrigation and Development Co.'s strip mine in Lewis County. The coal is used exclusively at the 1,400-megawatt coal-fired generating plant in Centralia.

**Geothermal Energy.**—The State's first program to explore for geothermal energy has yielded discouraging results. The area explored in a \$96,000 drilling program funded by the National Science Foundation

<sup>2</sup> Moen, W. S. Silver Occurrences of Washington. Washington Div. of Geology and Earth Resources. Bull. 69, 1976.

was the Big Lava Bed-Steamboat Mountain Region, a place of geologically recent lava flows extending from the Columbia River north to between Mt. Adams and Mt. St. Helens. A preliminary analysis of heat flow measurements made in six holes showed that the increase in temperature with greater depth was uniform from hole to hole. It had been hoped to find some places where the heat flow was greater than others and to concentrate on those hot spots.

**Peat.**—Peat production decreased 7% in quantity below that of 1974, but increased 15% in value during the same period. Production was reported in five counties. King County was the largest producing county. The average value of the peat sold was \$7.70 per ton. The material was sold for use in soil improvement.

**Petroleum and Natural Gas.**—While the State of Washington has not been considered the most desirable area for oil exploration, some oil companies are now willing to investigate the possibilities. In eastern Washington, one of the more likely spots, the drill bit must penetrate through 5,000 feet of basalt before reaching the possible location of oil. Even so, 114 applications have been received from companies planning to drill on the State's public lands. As an example of costs, Shell Oil Co. has paid \$1 per acre to explore on 124,000 acres of private land in Grant, Kittitas, Benton, and Yakima Counties. The Shell exploration work is not far from where a group of Arab investors has purchased property.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
<b>NONMETALS</b>			
<b>Cement:</b>			
Filtrol Corp. <sup>1</sup> -----	Marietta Rd., P.O. Box 37 Bellingham, Wash. 98225	Plant -----	Whatcom.
Ideal Basic Industries Inc. <sup>1 2</sup> -----	420 Ideal Cement Bldg. Denver, Colo. 80202	----do -----	King.
Lehigh Portland Cement Co. <sup>1</sup> -----	718 Hamilton St. Allentown, Pa. 18105	----do -----	Pend Oreille.
Lone Star Industries, Inc ---	One Greenwich Plaza Greenwich, Conn. 06830	----do -----	King.
<b>Clays:</b>			
Interpace Corp -----	2901 Los Feliz Blvd. Los Angeles, Calif. 90039	Pit and plant ---	King and Spokane.
Mutual Materials Co -----	P.O. Box 3547 Seattle, Wash. 98124	----do -----	King and Pierce.
Diatomite: Witco Chemical Corp.-----	277 Park Ave. New York, N.Y. 10017	Mine and plant ..	Grant.
Gypsum: Agro Minerals, Inc ----	P.O. Box Call Tonasket, Wash. 98855	Plant -----	Okanogan.
Lime: Domtar Chemicals, Inc --	1220 Alexander Ave. Tacoma, Wash. 98431	----do -----	Pierce.
Olivine: Northwest International.-----	329 Kincaid Mount Vernon, Wash. 98273	Mine and plant ..	Skagit.
Pumice: W.L. Marenakos Co ---	Route 1, Box 921 Issaquah, Wash. 98027	Plant -----	Kittitas.
<b>Sand and gravel:</b>			
Associated Sand and Gravel Co., Inc. -----	P.O. Box 2037 Everett, Wash. 98201	Pit and plant ----	Snohomish.
B&L Trucking & Construction Co. -----	1621 Marineview Dr. Tacoma, Wash. 98422	----do -----	Pierce.
Central Pre-Mix Concrete ---	805 North Division St. Spokane, Wash. 99202	----do -----	Adams, Frank- lin, Spokane
Glacier Sand & Gravel Co ---	5975 E. Marginal Way Seattle, Wash. 98134	----do -----	King and Pierce.
Lakeside Gravel Co -----	Box 46 Issaquah, Wash. 98027	----do -----	King.
Stoneway Concrete, Inc -----	Box 509 Renton, Wash. 98055	----do -----	Do.
Woodworth & Co., Inc -----	1200 East D St. Tacoma, Wash. 98421	----do -----	Pierce.
Silicon carbide: The Carborundum Co. -----	P.O. Box 423 Niagara Falls, N.Y. 14302	Plant -----	Clark.
<b>Stone:</b>			
Black River Quarry, Inc ----	6808 South 140th Seattle, Wash. 98178	Quarry -----	King.
Friend & Rikals, Inc -----	Box 3 Aberdeen, Wash. 98520	----do -----	Grays Harbor.
General Construction Co ----	Box 3845 Seattle, Wash. 98124	Quarry and plant	Jefferson.
Lane Mountain Silica Inc --	Route 1 Valley, Wash. 99181	Quarry -----	Stevens.

See footnotes at end of table.

Table 9.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
NONMETALS—Continued			
Stone—Continued			
Stoen Construction Co -----	P.O. Box 488 Monroe, Wash. 98272	Quarry -----	Snohomish.
Woodworth & Co., Inc -----	1200 East D St. Tacoma, Wash. 98421	----do -----	Pierce.
Sulfuric acid, smelter:			
American Smelting and Refining Co.	Box 1605 Tacoma, Wash. 98401	Plant -----	Do.
Talc and soapstone:			
Cascade Minerals, Inc -----	3314 Harbor Ave. SW. Seattle, Wash. 98126	Quarry -----	Skagit.
Skagit Talc Co -----	220 Reed St. Sedro Wooley, Wash. 98284	----do -----	Do.
Vermiculite (exfoliated):			
Vermiculite-Northwestern, Inc.	P.O. Box A Auburn, Wash. 98002	Plant -----	Spokane.
METALS			
Aluminum:			
Aluminum Co. of America --	Vancouver, Wash. 98600 --	----do -----	Chelan and Clark.
	Wenatchee, Wash. 98801 --	----do -----	Whatcom.
Intalco Aluminum Corp ----	Bellingham, Wash. 98225 --	----do -----	Pierce and Spokane.
Kaiser Aluminum & Chemical Corp.	Spokane, Wash. 99200 --	----do -----	Klickitat.
Martin Marietta Corp -----	Tacoma, Wash. 98400 -----	----do -----	
	11300 Rockville Pike Rockville, Md. 20852	----do -----	Cowlitz.
Reynolds Metals Co -----	Longview, Wash. 98620 --	----do -----	
Ferroalloys:			
Hanna Mining Co -----	Wenatchee, Wash. 98801 --	----do -----	Douglas.
Ohio Ferro-Alloys Corp -----	Tacoma, Wash. 98400 -----	----do -----	Pierce.
Gold: Knob Hill Mines, Inc. <sup>3</sup> -----	160 Sansome St. San Francisco, Calif. 94104	Mine and mill ---	Ferry.
Lead-zinc: The Bunker Hill Co. (Pend Oreille Mine).	Kellogg, Idaho 83837	----do -----	Pend Oreille.
Steel:			
Bethlehem Steel Co -----	Bethlehem, Pa. 18016 ----	Plant -----	King.
Northwest Steel Rolling Mills, Inc.	Seattle, Wash. 98107	----do -----	Do.
Uranium: Dawn Mining Co -----	Box 25 Ford, Wash. 99013	Mine and mill ---	Stevens.
MINERAL FUELS			
Coal: Washington Irrigation and Development Co.	R.R. 2, Box 41 Centralia, Wash. 98531	Strip mine -----	Lewis.
Peat:			
Maple Valley Humus -----	18805 SE 170th St. Renton, Wash. 98055	Bog -----	King.
Plant Food Co -----	14515 35th Ave. Bothell, Wash. 98011	Bog -----	Snohomish.
Petroleum refineries:			
Atlantic Richfield Co -----	Ferndale, Wash. 98248 ---	Plant -----	Whatcom.
Mobile Oil Corp -----	----do -----	----do -----	Do.
Shell Oil Co -----	Anacortes, Wash. 98221 --	----do -----	Skagit.
Sound Refining, Inc -----	Tacoma, Wash. 98400 -----	----do -----	Pierce.
Texaco, Inc -----	Anacortes, Wash. 98221 --	----do -----	Skagit.
U.S. Oil & Refining Co -----	Tacoma, Wash. 98400 -----	----do -----	Pierce.

<sup>1</sup> Also stone.<sup>2</sup> Also clays.<sup>3</sup> Also silver, copper, lead and zinc.

# The Mineral Industry of West Virginia

This chapter has been prepared under a cooperative agreement between the Bureau of Mines and the West Virginia Geological and Economic Survey.

By James E. Gilley <sup>1</sup>

The total value of mineral production in West Virginia increased \$987 million, a gain of 41% above that in 1974. Increased coal activity contributed 95% of the total value of mineral production in the State. As a group, mineral fuels production value rose owing to increased coal production in spite of declines in both natural gas and petroleum production. The total value of

all other minerals declined slightly more than 1% because of decreased demand.

Counties leading in value of mineral production, in declining order, were McDowell, Wyoming, Boone, Raleigh, and Logan. Mineral production in excess of \$100 million in value occurred in 10 counties during the year.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Charleston, W. Va.

Table 1.—Mineral production in West Virginia <sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays <sup>2</sup> .....thousand short tons..	339	\$520	278	\$439
Coal (bituminous) .....do.....	102,462	2,218,418	109,283	3,206,951
Gem stones .....do.....	NA	2	NA	2
Lime .....thousand short tons.....	128	2,315	W	W
Natural gas .....million cubic feet..	202,306	66,356	154,484	57,005
Petroleum (crude) .....thousand 42-gallon barrels..	2,665	27,058	2,479	29,712
Salt .....thousand short tons.....	1,201	6,296	972	4,671
Sand and gravel .....do.....	5,382	16,018	5,068	17,872
Stone .....do.....	10,954	22,308	<sup>3</sup> 10,583	24,333
Value of items that cannot be disclosed:				
Cement, clays (fire), natural gas liquids, and values indicated by symbol W .....do.....	XX	43,886	XX	49,226
Total .....do.....	XX	2,403,177	XX	3,390,211
Total 1967 constant dollars .....do.....	XX	1,136,222	XX	<sup>p</sup> 1,342,524

<sup>p</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes fire clay; included with "Value of items that cannot be disclosed."

<sup>3</sup> Excludes dimension stone.

Table 2.—Value of mineral production in West Virginia, by county<sup>1</sup>  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Barbour -----	\$65,971	\$81,988	Coal.
Berkeley -----	W	20,135	Cement, stone, clays, lime.
Boone -----	W	299,417	Coal, sand and gravel.
Braxton -----	W	1,928	Coal.
Brooke -----	W	W	Do.
Cabell -----	W	W	Clays.
Clay -----	1,707	1,951	Coal, sand and gravel.
Fayette -----	W	W	Coal, stone.
Gilmer -----	W	2,894	Do.
Grant -----	W	W	Do.
Greenbrier -----	21,935	W	Do.
Hampshire -----	W	W	Stone.
Hancock -----	W	W	Sand and gravel, clays.
Hardy -----	W	W	Do.
Harrison -----	50,760	78,112	Coal, stone.
Jefferson -----	W	W	Stone.
Kanawha -----	W	W	Coal, natural gas liquids, stone, sand and gravel.
Lewis -----	W	W	Coal, stone.
Lincoln -----	W	W	Coal, clays.
Logan -----	W	W	Coal, stone, sand and gravel.
McDowell -----	300,944	483,939	Coal.
Marion -----	W	W	Coal, stone.
Marshall -----	W	W	Coal, salt.
Mason -----	W	W	Coal.
Mercer -----	W	W	Coal, stone.
Mineral -----	W	W	Do.
Mingo -----	76,536	123,315	Coal.
Monongalia -----	142,878	W	Coal, stone.
Morgan -----	W	W	Sand and gravel.
Nicholas -----	126,036	W	Coal, stone.
Ohio -----	W	W	Coal.
Pendleton -----	W	W	Lime, stone.
Pocahontas -----	181	316	Stone.
Preston -----	48,970	W	Coal, stone.
Raleigh -----	W	W	Do.
Randolph -----	34,870	22,673	Do.
Summers -----	942	1,436	Coal.
Taylor -----	1,398	3,168	Do.
Tucker -----	W	W	Coal, stone.
Tyler -----	W	W	Salt, sand and gravel.
Upshur -----	38,366	49,497	Coal.
Wayne -----	W	W	Coal, natural gas liquids.
Webster -----	7,258	10,996	Coal, sand and gravel.
Wetzel -----	W	W	Natural gas liquids, sand and gravel.
Wirt -----	--	W	Stone.
Wood -----	--	W	Sand and gravel.
Wyoming -----	219,902	W	Coal, sand and gravel, stone.
Undistributed <sup>2</sup> -----	1,264,525	2,208,447	
Total <sup>3</sup> -----	2,403,177	3,390,211	

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

<sup>1</sup> Calhoun, Doddridge, Jackson, Monroe, Putnam, Pleasants, Ritchie, and Roane Counties are not listed because no production was reported.

<sup>2</sup> Includes natural gas, petroleum, gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of West Virginia business activity

	1974	1975 <sup>P</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	657.0	649.8	-1.1
Unemployment -----do-----	39.0	45.5	+16.7
<b>Employment (nonagricultural):</b>			
Mining -----do-----	55.6	61.5	+10.6
Manufacturing -----do-----	130.0	119.5	-8.1
Contract construction -----do-----	31.2	26.2	-16.0
Transportation and public utilities -----do-----	40.4	39.2	-3.0
Wholesale and retail trade -----do-----	111.0	109.2	-1.6
Finance, insurance, and real estate -----do-----	17.8	18.1	+1.7
Services -----do-----	78.7	79.7	+1.3
Government -----do-----	106.4	107.8	+1.3
Total nonagricultural employment -----do-----	571.1	561.2	-1.7
<b>Personal income:</b>			
Total -----millions--	\$7,994	\$8,867	+10.9
Per capita -----do-----	\$4,480	\$4,918	+9.8
<b>Construction activity:</b>			
Number of private and public residential units authorized--	1,910	2,072	+8.5
Value of nonresidential construction -----millions--	\$63.2	\$64.6	+2.2
Value of State road contract awards -----do-----	\$103.0	\$232.0	+125.2
Shipments of portland and masonry cement to and within West Virginia -----thousand short tons--	710	609	-14.2
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$2,403.2	\$3,390.2	+41.1
Value per capita, resident population -----do-----	\$1,347.07	\$1,887.50	+40.1
Value per square mile -----do-----	\$99,382	\$140,201	+41.1

<sup>P</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

**Trends and Developments.**—At the annual stockholder's meeting the president of the Chessie System, Inc., announced plans for spending \$525 million during 1976 for new equipment. This expenditure would include purchases of new rolling stock, construction of additional supporting yards and pier facilities at Tidewater, and additional track construction. The promising long-term outlook for increased coal shipments within the area served by the lines in the system was cited as justification for these additional capital expenditures.

Completion of the comprehensive Dents Run Watershed mine reclamation project was announced by Consolidation Coal Co. This tripartite project with the Environmental Protection Agency (EPA) and the West Virginia Department of Natural Resources involved a 14.6-square-mile area that contained 28 abandoned surface mines, 13 abandoned underground mines, and burning gob piles in addition to acid-water discharges from active mines. The abandoned stripped areas were reclaimed, abandoned underground openings were sealed, and gob piles were leveled, graded, and vegetated. Two acid-mine drainage

treatment plants were constructed to process effluent from active underground mines.

The West Virginia Surface Mining and Reclamation Association started the operational phase of the EPA-grant-supported longwall surface mining project in Boone County near Julian. The first phase consisted of an environmental inventory on the mine site by Hittman Associates of Columbia, Md. A second EPA grant to the association was announced near yearend for an evaluation of the effectiveness of the haulback method of surface mining in minimizing the environmental effects of surface mining on steep slopes. Comparative water quality analyses and other data will be collected as indicators of effectiveness. Hobet Mining and Construction Co., Inc., will be conducting the mining operation in Boone County. A third reclamation project announced by the association will study and develop techniques for converting surface-mined lands to effective wildlife habitat. Three mined sites in the State will be reclaimed under this tripartite project between the association, the West Virginia Department of Natural Resources, and the Ruffed Grouse Society of North America.

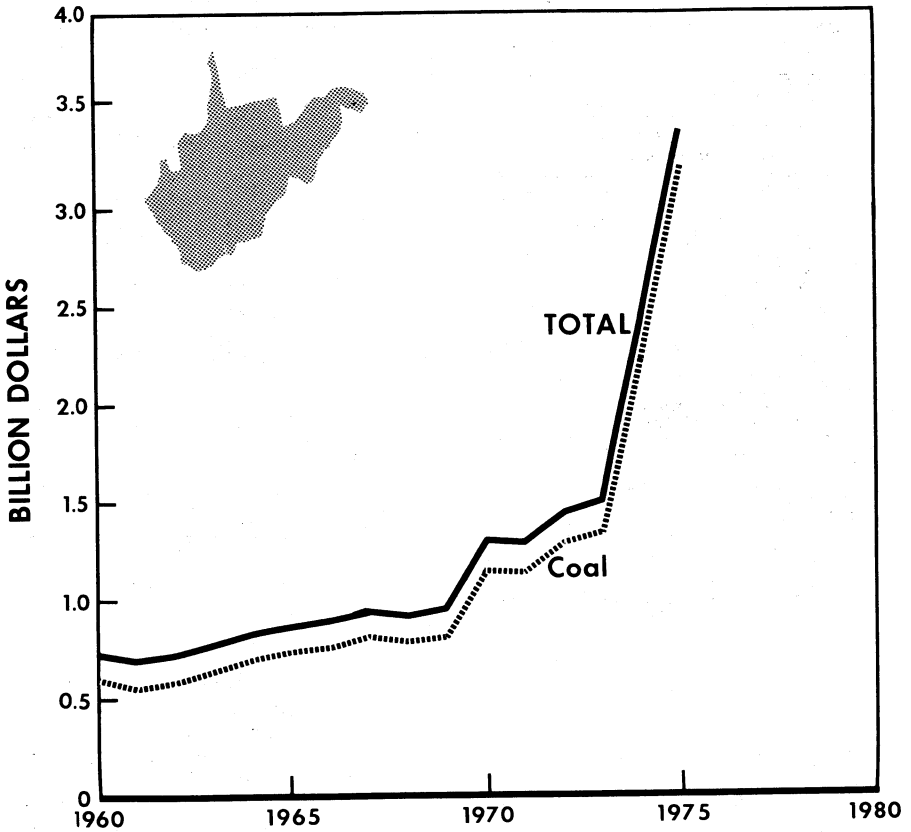


Figure 1.—Value of coal and total value of mineral production in West Virginia.

Construction began on a new consolidated high school in McDowell County on reclaimed surface-mined land. Pocahontas Land Corp. donated the 53-acre mountaintop site to the McDowell County Board of Education after the property had been mined and reclaimed for Cannelton Industries by Tracy Hylton. A similar high school construction project was underway in Raleigh County on land mined and reclaimed by Starling Smokeless Coal Co.

Union Carbide Corp.'s system for converting trash to gas promised a solution to problems of municipal waste disposal as well as supplying gas that is increasingly in short supply. The 200-ton-per-day unit at the company's South Charleston plant is now considered viable and has attracted the interest of several cities now

faced with conventional land disposal constraints. Economics of the system reportedly improve as natural gas prices increase, as costs of land for disposal sites increase, and as the distances to gas consumers decline.

One of three deep wildcat wells drilled in West Virginia by Exxon Corp. reportedly represented a commercial discovery. The Walter McCoy No. 1 well near Ripley in Jackson County reached a depth of 17,675 feet after striking a gas zone at 14,300 feet. Leasing activity in the State has increased during the past 2 years, and completion of this well was expected to accelerate interest in gas development in West Virginia.

The month-long wildcat coal mine strike that idled an estimated 80,000 miners by

the end of August subsided as most miners returned to work by September 10. Estimates by the West Virginia Coal Association placed the strike cost at about 5.1 million tons of production, \$26 million in wages, \$4 million in State business and occupation taxes, and \$7.1 million in union health and retirement funds. To alleviate future interruptions in the economy and energy supply from such strikes, the United Mine Workers of America (UMWA) and the Bituminous Coal Operators' Association formed a joint commission to investigate grievance procedures in District 17 where grievance handling had been identified as a major contributor to wildcat strikes.

First result of a reappraisal of property by county tax assessors indicated increases in property tax revenues from coal lands in the State. Reportedly some assessments on individual tracts climbed to more than three times the previous level. The increases resulted from a program initiated by the State Tax Department to provide counties with more complete data on which to base mineral land tax assessments.

Wheeling-Pittsburgh Steel Corp. developed a plan acceptable to the West Virginia Air Pollution Control Commission for complying with State air pollution control standards. Over a 19-month period, a new coke battery would be constructed, new coke handling and quenching equipment would be installed, existing coke batteries would be upgraded, and the gas collection system would be refurbished. Costing an estimated \$87 million, the program is scheduled to be completed by December 31, 1978.

Criteria for training prospective underground coal miners were developed by the State Board of Miner Training, Education and Certification. The criteria set forth the training course content as well as the standards that any training center, public or private, must meet before certification can be given by the Board. Under provisions of a law enacted by the State Legislature in 1974, all new applicants for underground mining jobs must complete 80 hours of preemployment training before they can be certified as apprentice miners. By yearend, criteria were being prepared by the Board for training prospective surface miners, who must have 40 hours of training before they can be certified.

Eastern Associated Coal Corp. announced the beginning of an experimental tunnel-boring project at the company's Federal No. 2 Mine in Monongalia County. The tunnel borer will develop an 18-foot-diameter, 6,000-foot-long tunnel to join existing mine workings with a down-cast shaft. Underground construction of the boring machine began during the year, and tunneling operations were expected to begin early in 1976. Advantages of the tunneling development technique have been cited as improved mine safety, increased coal recovery, and faster mine development. The project is jointly supported by the company and the Federal Bureau of Mines.

The first class of emergency medical technicians (EMT) completed an 81-hour training course designed to provide early emergency medical treatment to injured miners in underground coal mines. Twenty-one Westmoreland Coal Co. employees were trained under a joint program supported by the UMWA, the coal company, and the State Health Department. The ultimate goal of the program will be to have at least one miner trained in emergency medical treatment on each operating mine section.

West Virginia was one of the six States whose combined consumption of explosives and blasting agents totaled more than 52% of the total national consumption in 1975. West Virginia was fourth behind Kentucky, Pennsylvania, and Alabama while leading Ohio and Virginia. Consumption of all types of explosives and blasting agents in the State increased 22.9% to 183.6 million pounds in 1975, compared with 149.4 million pounds in 1974. On a percentage basis, the largest increase, 105.3%, occurred in quarrying and non-metal mining, the largest increase on a quantity basis took place in coal mining, where consumption increased by 34.9 million pounds, or 36.9%. Coal mining used 70.6% of the total explosives consumed in the State during the year, quarrying and nonmetal mining used 4.9%, construction projects used 20.0%, and other applications used 4.5%.

**Employment, Wages, and Injuries.**—According to the West Virginia Department of Mines annual report, mine employment in the State during 1975 totaled 56,717 versus 47,570 during 1974 for a 19.2% in-



crease. Of the total mine employment in 1975, 55,256 persons were employed in coal mining, 48,293 were underground mine workers, and 6,963 were surface mine workers. Comparable coal mine employment for 1974 was 46,024 persons, 41,596 at underground mines and 4,428 at surface mines. The greatest percentage increase occurred in surface mine workers, who increased 57.2%; underground mine workers increased 16.1%. In contrast with coal mine workers, who increased 20.1% in 1975, the number of non-coal mine workers declined 5.5%, from 1,546 to 1,461.

Reflecting the growing interest in coal mine employment, the number of miners certified by the West Virginia Department of Mines increased 81.1%, from 4,361 in 1974 to 7,896 in 1975. The number of mine foreman and/or fire boss certificates issued declined 8.7%, however, from 1,155 in 1974 to 1,054 in 1975.

According to the West Virginia Coal Association, the average weekly wages for coal miners rose during 1975 to \$274.15. This amounted to an increase of 23.0% above the \$222.87 average weekly wage in 1974.

Fatal injuries at all mines improved slightly during 1975 with the number of deaths declining from 37 in 1974 to 36. The number of fatal injuries to coal miners dropped from 36 in 1974 to 34, and the number of fatal injuries to non-coal miners increased from 1 to 2. The fatal frequency rate for coal miners continued to decline, dropping from 0.46 fatality per million man-hours in 1974 to 0.36 per million man-hours in 1975. While the fatal frequency rate for underground coal miners declined from 0.49 to 0.36 fatality per million man-hours, the fatal frequency rate for surface coal miners worsened from 0.15 to 0.32 fatality per million man-hours.

The number of nonfatal injuries increased 21% from 4,129 in 1974 to 4,996 in 1975. The number of underground mine injuries increased 21.1% from 3,942 to 4,772, while surface mine injuries increased 19.8% from 187 to 224. The non-fatal frequency rate at coal mines, however, improved with a drop from 53.55 injuries per million man-hours in 1974 to 52.58 in 1975. The greatest improvement was made in surface mines, where the non-fatal frequency rate dropped from 29.29 to

23.74 injuries per million man-hours. The rate at underground mines rose slightly, from 55.74 in 1974 to 55.76 in 1975.

The number of fatal accidents due to roof falls declined from 14 in 1974 to 12 in 1975, but fatalities due to haulage accidents increased from 5 to 9. Comparative distributions of total fatalities due to these two causes were 44.5% and 13.9% in 1974 and 35.3% and 26.5%, respectively, in 1975. Fatal injuries due to machinery accidents increased from three to five during the same period. Two accidents occurred in which three or more persons were fatally injured during 1975; both involved falls of rib or roof, and three persons died in each incident.

#### Legislation and Government Programs.—

The 62d Legislature overrode the Governor's veto of a bill that called for a business and occupation tax increase on coal. Provisions of the bill, which became effective on July 1, 1975, called for a 10% increase in the \$3.50 business and occupation tax rate on each \$100 in gross sales of coal for a total rate of \$3.85. The coal-producing counties would receive 75% of the increase based on tonnage produced, and the balance of 25% would be distributed equally to all 55 counties. The increase would result in more than \$7 million in increased tax revenues for the counties, based on the 1974 rate of production.

Bills to ban surface mining and to extend the 22-county moratorium to a total of 26 counties were introduced in the legislature but were not passed. However, the existing moratorium on surface mining in 22 counties was extended for another 2-year period. Modifications to existing surface mine reclamation laws were proposed in unsuccessful bills that called for elimination of highwalls, prohibition of spoil deposition on 20° or steeper slopes, and backfilling to approximate original contour. Bills submitted to prohibit shift rotation in coal mines and to permit the use of diesel-powered haulage equipment in underground coal mines on a test basis were also unsuccessful. Program expansion at the West Virginia University Coal Research Bureau was authorized in a successful bill that called for a study of the economics of environmental and legal aspects of increased coal development; in-

creased research in sulfur removal before, during, and after the use of coal in generating plants; and completion of a geological and geochemical study of coal in the State.

Several Public Service Commission decisions made during the year affected the operation of energy consuming public utilities in the State. The Commission terminated the use of fuel adjustment clauses by which electric power utilities automatically pass the higher costs of fuels on to customers. A three-phased natural gas curtailment plan was set forth by the Commission to provide a smooth transition from previous pro rata plans designed by natural gas suppliers to a final end-use plan for coping with growing shortages. Customer power rate surcharges proposed by a major electric utility to pay for installing pollution control equipment at the company's coal-fired generating plant in Mason County were denied by the Commission. Rate increases collected by the same electric utility over a 30-month period from July 1, 1971, through December 31, 1973, were ordered refunded by the Commission pending a decision by the State Supreme Court.

The Department of Natural Resources formed two new units to aid in its mission of protecting natural resources in the State. A remote-sensing unit will coordinate the application of aircraft and satellite imagery to various inventory needs of the divisions in the Department. A project supported by a National Aeronautics and Space Administration contract will apply LANDSAT-2 resource data acquisition and monitoring capabilities along with complementary aircraft imagery to land-use inventory needs to meet future recreational and economic development. A Division of Coal Refuse and Dam Control was formed to administer provisions of the Coal Waste Disposal Control Act and the Dam Control Act. Onsite inspections and inventories of coal waste impoundments and dams in the State have identified those requiring improvements to alleviate existing or potentially hazardous conditions. Guidelines have been developed for construction of nonimpounding coal waste areas.

The Division of Reclamation, Department of Natural Resources, announced that 272 surface mining permits to mine a total of 16,965.5 acres were issued in 1975,

compared with 255 permits issued in 1974 to mine 18,919.49 acres. The 10.3% decrease in acreage under permit in spite of the larger number of permits issued in 1975 is due primarily to the increased adoption of the "haulback" method of mining in which spoil is controlled and less surface acreage is affected downslope. Acreage reclaimed during the year totaled 15,540 acres, a 25% decline from the 1974 level of 20,618 acres. This reduction also reflected the smaller acreage affected by using the haulback method of mining as well as the decided reduction in surface mining permits issued during the years since 1970, when 616 permits to surface mine were issued on 31,802 acres.

The West Virginia Geological and Economic Survey initiated a study of landslides and landslide-prone areas in urban regions of West Virginia with the support of the Appalachian Regional Commission. Study regions include Morgantown, Fairmont, Clarksburg, Charleston, Wheeling, Parkersburg, Huntington, and critical areas along the Ohio River. Interpretative maps for each region will depict unstable areas inferred from geologic data, field mapping, and aerial photographs. A statewide land-use mapping program commenced as a part of the nationwide Land Use Data Analysis program under the auspices of the U.S. Geological Survey. In addition to maps depicting land-use patterns, computerized data by county, region, and State will be categorized by land-use classifications. The long-term investigation of coal resources and their pollution potential that was initiated in 1973 continued with delineation of abandoned underground and surface mines by coalbed and with gathering, collation, and interpretation of basic engineering and geologic data on the physical and chemical characteristics of the remaining coal reserves in the State.

A grant from the U.S. Geological Survey was awarded that enabled participation in the National Coal-Data System which consists of a computerized system for analyzing the U.S. coal resource data base. Phase 1 will consist of collecting existing coal resource and analytical data and compiling the data by county, State, and coalfield. Phase 2 will develop a compilation of detailed information for determining coal quantity and quality based on geodetically located point data.

Separate maps of oil and gas fields were completed, and data sheets on individual oil and gas fields were prepared for the West Virginia portion of the nationwide Data Bank Project sponsored by the American Association of Petroleum Geologists. Cooperative river basin studies were completed on the Coal and Elk Rivers with the U.S. Geological Survey to determine the quality and quantity of water resources in each area. Because of increased interest in the gas-producing potential of Silurian formations in the State, a study of the paleoenvironment of deposition of Upper Silurian formations was initiated as the first step in determining their economic potential. The cooperative topographic mapping program with the U.S. Geological Survey that began in 1955 continued, and 31 new 7.5-minute maps were published during the year. The economic evaluation of West Virginia clays and shales continued under a cooperative program with the Federal Bureau of Mines.

A joint Bureau of Mines and U.S. Geological Survey mineral evaluation of the New River Gorge between Hinton and Gauley Bridge was announced in December for those lands proposed in the wild and scenic river and national park alternatives. Upon enactment of Public Law 93-622, the Eastern Wilderness Act, the Otter Creek and Dolly Sods wilderness areas were placed in the National Wilderness Preservation System, while a portion of the Cranberry Backcountry was designated as a Wilderness Study Area. The Bureau of Mines began the legally required mineral resource investigations of the three areas in cooperation with the U.S. Geological Survey. Meanwhile, the U.S. Forest Service published results of an evaluation of privately held coal reserves in three sensitive areas of Government-owned land in the Monongahela National Forest. Two of the three areas, Cranberry Backcountry and Shavers Fork, overlie approximately 202 million tons of coal; geologic information on the third area, Otter Creek, was considered inadequate for a definitive reserve evaluation.

Subjects of Federal Bureau of Mines grants and contracts with universities and companies ranged from mineral supply data enhancement to a broad spectrum of mining research efforts in the State. Grants

to West Virginia University included a pilot study in Monongalia County of coal ownership, a rock mechanics study on shortwall mining panels, a study of manpower needs in the coal mining industry, development and testing of a mine monitoring system, and analysis and safety testing of mine electrical power systems. Research contracts with companies in the State included a demonstration of an underground coal mine environmental monitoring system, development of a secondary ventilation system for reducing respirable dust on continuous-mining machines, development of a new conventional mining system, demonstration of the use of tunnel-boring machines for underground coal mine development, development of automatic fire protection systems for surface mine coal augers, performance tests of a deep-cutting continuous miner, development of an area dust-sampling technique, and assessing the feasibility of modified longwall mining in shallow coalbeds.

The first joint Federal-State mine subsidence control project to be conducted in the State under authority of Section 205 of the Appalachian Regional Development Act commenced during the year. The two-phase project is designed to backfill abandoned underground mine voids in the Pittsburgh coalbed underlying the Marion County town of Farmington. Phase 1 consists of drilling and casing exploratory boreholes that will serve later as injection and monitoring boreholes during Phase 2, when mine refuse will be injected into the voids to provide overburden support.

The Mining Enforcement and Safety Administration (MESA) released a series of reports on coal mine refuse dumps and impoundments that included detailed individual studies at 49 sites in West Virginia. Federal regulations to be enforced by MESA for construction, maintenance, and abandonment of coal refuse piles and impoundments were promulgated during the year as amendments to Title 30, Code of Federal Regulations, Part 77. New safety standards were proposed by MESA for metal and nonmetal mines to revise regulations that had been previously promulgated and enforced under authority of the Federal Metal and Nonmetallic Mine Safety Act of 1966.

## REVIEW BY MINERAL COMMODITIES

## MINERAL FUELS

**Carbon Black.**—Production of carbon black during 1975 decreased 19.5% in comparison with the level of production in 1974. The total value of production decreased 21.9%. Carbon black was produced at two furnace process plants, one south of Moundsville, Marshall County, and the other north of Waverly, Pleasants County. The rubber industry and ink manufacturers are the major consumers of carbon black.

**Coal (Bituminous).**—Production of bituminous coal in West Virginia increased 6.7% to slightly more than 109 million short tons during 1975. The total value of this production increased 44.6% to \$3,207 million, compared with \$2,218 million in 1974. The average value per short ton increased 35.6%, or \$7.70, from \$21.65 in 1974 to \$29.35 in 1975.

More than 10 million short tons each was produced in Monongalia and McDowell Counties, with the former being the leading producing county. Monongalia also led in production in 1974; however, McDowell County traditionally had been the leading producing county in previous years. These two counties were followed in descending order of production by Boone, Wyoming, Logan, and Kanawha. McDowell County again led in production of underground-mined coal, followed by Monongalia, Wyoming, Boone, and Logan Counties. Barbour County led in production of surface-mined coal, followed by Kanawha, Boone, Preston, and Nicholas Counties.

During 1975, 10 mines individually produced more than 1 million short tons, compared with 9 mines in 1974. Of the mines that produced more than 1 million short tons during 1975, four produced more than 2 million short tons. According to the West Virginia Department of Mines, Consolidation Coal Co. was the top producing company in 1975, followed by Eastern Associated Coal Corp., Pittston Co., Island Creek Coal Co., and United States Steel Corp.

Counties that produced coal in amounts valued at more than \$100 million during 1975 numbered 10, compared with 8 counties during 1974. The five leading counties

in order of descending value of coal production were McDowell, Wyoming, Boone, Raleigh, and Logan.

Production of open-market coal totaled 95.4 million short tons during 1975, a 6.2% increase when compared with the 89.8-million-short-ton level of such production in 1974. The total value of open-market production increased by \$808 million, or 43.3%, in comparison with the 1974 total value of \$1,866 million. Open-market coal increased 35.0% in average value per short ton, from \$20.77 in 1974 to \$28.04 in 1975. During the same period, the average value of captive coal increased from \$27.94 per short ton to \$38.31 per short ton. The total value of captive coal production increased 51.0% from \$353 million in 1974 to \$533 million in 1975. Production of captive coal increased 10.3% from 12.6 million short tons in 1974 to 13.9 million short tons in 1975.

The number of active mines that produced at least 1,000 short tons during 1975 was 1,072, a 20.3% increase from the 891-mine count in 1974. Of the total number of active mines in 1975, 703, or 65.6%, were underground mines and 369, or 33.4%, were surface mines. The number of underground mines increased by 119, or 20.4%, above the 1974 level of 584, and the number of surface mines increased by 62, or 20.2%, above the 1974 level of 307.

Of the total coal produced in the State, 80.9% was produced by underground methods and 19.1% was produced by surface mining methods. Production of both underground-mined coal and surface-mined coal increased above the 1974 levels of output. Underground mine production increased 7.5% from 82.2 million short tons to 88.4 million short tons. Surface mine production increased 3.5% from 20.2 million short tons to 20.9 million short tons. The total value of underground coal production increased 51.1% to \$2,704 million in comparison with the 1974 value of slightly more than \$1,789 million. The total value of surface-mined coal increased 17.2% from the 1974 level of \$429 million to \$503 million in 1975. Of the total value of coal produced during 1975, 84.3% was contributed by underground mines and 15.7% was contributed by surface mines.

Comparable contributions by type of mine in 1974 were 80.2% for underground mines and 19.8% for surface mines.

The average values per short ton of coal by method of production did not change as markedly during 1975 as they did during 1974. Whereas the average value per short ton of underground-mined coal increased 77.8% above the 1973 level to reach \$21.76 per short ton in 1974, the average value per short ton increased only 40.6% to reach \$30.60 per short ton during 1975. Surface-mined coal, which increased 147.2% during 1974 to reach \$21.21 per short ton, increased only 13.3% to reach \$24.04 per short ton during 1975.

The total amount of coal mechanically loaded during 1975 increased 7.6% from 82.1 million short tons in 1974 to 88.3 million short tons, reflecting the increase in underground production. Of the total coal produced underground, 99.9% was mechanically loaded during 1975. Hand-loaded coal decreased 65.8% to 25,000 short tons. Continuous-mining machines loaded 62.2 million short tons, or 70.4%, of the mechanically loaded coal. This tonnage was 10.5% above the 1974 level of 56.3 million tons. The amount of mechanically loaded coal contributed by mobile loading machines decreased slightly to 21.9 million short tons, 0.9% below the 1974 level of 22.1 million short tons. Mobile loading machines loaded 24.8% of the coal mechanically loaded in 1975, compared with 26.9% during 1974. The percentage of mechanically loaded coal mined by longwall machines decreased slightly from 4.0% in 1974 to 3.9%. Longwall machines loaded 3.4 million short tons for an increase of 3.0% above the 3.3 million tons loaded during 1974. Scoops, a new category of loading added to the Bureau of Mines' analysis of coal statistics in 1974, loaded 0.8 million tons, or 0.9%, of the mechanically loaded coal. This tonnage was a 60.0% increase above the 0.5 million short tons loaded by scoops during 1974.

Other types of equipment used in underground coal mines in 1975 included 533 cutting machines, 52 more than in 1974; 315 hand-held and/or post-mounted coal drills, 49 more than in 1974; 292 mobile coal drills, 23 more than in 1974; 753 rotary rock drills, 293 fewer than in 1974; 101 percussion rock drills, 18 fewer than in 1974; and 94 rotary-percussion

rock drills, 4 more than in 1974. Cutting machines cut 23 million short tons during 1975, a 4.5% increase when compared with the 22 million short tons cut during 1974. The tonnage cut by hand or shot from the solid face amounted to 152,000 short tons, 18.8% more than the 128,000 short tons in 1974. Mobile drills were used in the production of 16 million short tons, a 5.9% decrease from the 17 million short tons drilled by such machines in 1974. During 1975, 7 million short tons was produced using hand-held and/or post-mounted drills, compared with 5 million short tons produced using this method of face drilling in 1974.

Surface mining equipment used during 1975 included 52 augers, 31 fewer than in 1974; 207 power shovels, 29 more than in 1974; 67 drag lines, 21 fewer than in 1974; 58 carryall scrapers, 11 more than in 1974; 916 bulldozers, 113 more than in 1974; 345 power drills, 61 more than in 1974; 721 front-end loaders, 126 more than in 1974; 14 power booms, 9 fewer than in 1974; 167 motor graders, 7 fewer than in 1974; and 31 coal drills, 26 fewer than in 1974.

The number of coal-cleaning plants operated in the State during 1975 totaled 124, 2 fewer than in 1974. These plants cleaned 91.4 million short tons of raw coal to produce 63.1 million short tons of cleaned product and 28.3 million short tons of refuse. Of the total coal production in the State, the cleaned product represented 57.8% compared with 61.3% during 1974. Cleaned coal production increased 0.3 million short tons, or 0.5%, in comparison with the 62.8 million short tons of cleaned coal in 1974. Percentages of the total cleaned coal production cleaned by various methods in 1975 follow: 23.8% by jigwashers, 46.6% by dense-medium processes, 18.8% by concentrating tables, 7.7% by froth flotation, 1.9% by pneumatic methods, and 1.2% by classifiers. A total of 54 thermal dryers were used at 39 coal-cleaning plants to dry 25.5% of the cleaned coal production, compared with 50 dryers at 35 plants in 1974 to dry 26.6% of the cleaned coal production. Crushing and/or screening alone were used to process 37.2% of the total coal production while 5.0% was unprocessed. In 1974, 35.6% of the total coal

production was only crushed and/or screened, and 3.1% was unprocessed.

Of the total coal production in the State during 1975, 79.4 million short tons, or 72.6%, was shipped by railroads, an increase of 1.1% from 1974. Unit trains carried 26.0 million short tons, or 32.7% of the total rail shipments, in comparison with 23.1 million short tons, or 29.4%, in 1974. Coal shipped by waterways totaled 14.9 million short tons, an increase of 4.2% from the 14.3 million short tons shipped by this method in 1974. Waterways carried 13.6% of the total production, compared with 14% in 1974. The balance of the total production was transported either by truck or conveyors for use near or at the mine mouth.

**Table 4.—West Virginia: Bituminous coal production**

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1971	118,258	1,128,282
1972	123,743	1,275,813
1973	115,448	1,340,338
1974	102,462	2,218,418
1975	109,288	3,206,951

**Coke and Coal Chemicals.**—Coke production totaled 2.7 million tons during 1975, a 25.0% decrease from the 3.6 million tons produced in 1974. Coking coal used in this production amounted to 4.0 million tons valued at \$163.8 million versus 5.3 million tons valued at \$160.2 million in 1974. The average value per ton of coking coal used at West Virginia coking plants in 1975 was \$40.59, a 33.3% increase from the \$30.45 per ton average value of coking coal used in 1974. The coke yield averaged 67.1% versus a yield of 67.6% in 1974. A total of 4.5 million tons of coking coal were supplied to the four coke plants in West Virginia. Some 311%, or 1.4 million tons, of this coal was produced in the State; 55.6%, or 2.5 million tons, was from Pennsylvania; and the balance of 13.3%, or 0.6 million tons, was from Kentucky, Virginia, Tennessee, and Arkansas. The four coke plants operated during the year were three oven-coke plants, one each in Brooke, Hancock, and Marion Counties, and one beehive oven plant in Preston County. Production at the beehive oven plant was curtailed during the installation of an air-pollution control system.

Coal-chemical materials produced at the oven-coke plants included tar, gas, ammonium sulfate, and crude light oil. Production of coke-oven tar decreased 8.2% from 42.7 million gallons in 1974 to 39.2 million gallons in 1975. Coke-oven gas production decreased 17.3% from 59.4 billion cubic feet to 49.1 billion cubic feet during the year. Production of ammonium sulfate decreased 50.8% from 61,000 tons to 30,000-tons during the same period. Crude light oils recovered from the oven-coking operations were used to produce benzene, toluene, xylene and naphtha. A total of 177,000 tons of coke breeze also was distributed from the coke plants during 1975.

**Natural Gas Liquids.**—Production of natural gas liquids in West Virginia during 1975 decreased about 1%. The total value of production increased 30.7%. Natural gas liquids were produced in three counties during the year; Wetzel County led in production. At yearend, proven reserves totaled 82.5 million barrels, a 0.9% increase above the reserve estimate for yearend 1974.

**Petroleum and Natural Gas.**—Production of crude oil totaled 2,479,000 barrels during 1975, a 7.0% decrease of 186,000 barrels compared with 1974 production. The total value of this production increased 9.8% to slightly more than \$29.7 million. The average unit value of this crude was \$11.99 per barrel. When compared with the 1974 unit value of \$10.15 per barrel, this is an 18.1% increase.

Natural gas production decreased to 154,484 million cubic feet for a 47,822-million-cubic-foot change from the 1974 production of 202,306 million cubic feet. The total value of this production decreased 14.1% to \$57.0 million from \$66.4 million in 1974. The average wellhead value for natural gas in West Virginia increased 12.5% from the 1974 value of 32.8 cents per thousand cubic feet to a level of 36.9 cents per thousand cubic feet in 1975.

The estimated number of producing wells increased during 1975 in West Virginia to 35,771 at yearend. This number amounted to a 1.9% increase over the estimated 35,100 wells in production at the close of 1974. The estimated number of oil wells increased from 13,650 to 13,750 for a 0.7% increase, and producing gas

wells increased 2.6% from 21,450 to 22,001 wells.

According to the American Petroleum Institute, drilling activities recorded another increase during 1975. Total footage drilled rose 3.49% from 2,319,938 feet to 2,400,866 feet. The total number of wells completed rose 1.5% from 779 in 1974 to 791 in 1975. Completed development wells, or proved field wells, decreased from 677 in 1974 to 676 in 1975, while dry wells rose from 102 to 115. Of the total wells, 120 were oil wells, 556 were gas wells completed, while the largest number of successful gas wells was completed in Clay County.

The three leading counties in descending order of footage drilled in 1975 were Harrison, Gilmer, and Kanawha. Gilmer, Clay, and Harrison Counties led the State in number of completions. Lincoln County again led in the number of successful oil wells was completed in Clay County.

According to the Oil and Gas Division of the West Virginia Department of Mines, 954 permits to drill or deepen old wells were issued in 1975, 94, or 10.9%, more than in 1974. The number of fracturing permits declined from 101 to 84 during 1975, for a 16.8% decrease. A 47.0% decline occurred in the number of plugging permits issued, which dropped from 888 in 1974 to 471 in 1975. Clay, Gilmer, and Barbour Counties, in descending order, were the three leading counties in which drilling or well-deepening permits were issued. The three leading counties in which fracturing permits were issued were Gilmer, Kanawha, and Calhoun. The greatest number of permits to partially plug or abandon wells were issued in Doddridge, Roane, and Ritchie Counties. The total number of new drilling permits issued in the State exceeded the number of permits issued to partially plug or abandon wells by 102.5%.

According to the West Virginia Geological and Economic Survey, the Big Injun Sand was the main target for shallow drilling during 1975 with 286 well completions. The Pocono Sands (Squaw, Weir, and Berea) was the main target for shallow drilling during 1974 but was second in 1975 with 219 well completions. The third- and fourth-ranking targets for shallow drilling were the Catskill Sands with 210 completions and the Upper Devonian Chemung Sands with 149 com-

pletions. The most concentrated shallow drilling occurred in the Lost Creek storage field of Harrison and Lewis Counties, the Big Injun and Fifth Sands of Gilmer County, and the Greenbrier and Pocono units of the tricoounty area of Clay, Fayette, and Nicholas Counties. This latter drilling resulted in developing the new Lizemores field, extending existing shallow fields, and filling in areas between fields. The primary deep-drilling targets were the Onondaga and Oriskany, with 16 completions, followed by the Newburg and Tuscarora. Most deep drilling occurred in Preston County where six wells were drilled to extend Huntersville-Oriskany production in the South Burns Chapel field. Perhaps the most interesting deep drilling resulted in two possible gas discoveries in Harrison and Taylor Counties and a Cambrian gas discovery in Jackson County. Gas flows from two formations, both below 14,300 feet, in this 17,675-foot test by the Exxon Corp.

The four most active fields during 1975, according to the West Virginia Geological and Economic Survey, were the Weston-Jane Lew, Griffithsville, Lizemores, and Gauley Mountain on the basis of total wells drilled. On the basis of total footage drilled, the four most active fields were the Weston-Jane Lew, Lizemores, Griffithsville, and Clendenin. A total of 178 wells with a combined total footage of 130,366 feet were drilled in the Weston-Jane Lew field of Harrison and Lewis Counties, including 31 gas wells, 2 combination wells, 4 dry holes, and 141 miscellaneous wells, primarily storage and observation wells drilled or redrilled by Consolidated Gas Supply. Forty-five wells with a total footage of 108,711 feet, including 44 oil wells and 1 combination well, were drilled in the Griffithsville field of Lincoln County. Forty-five wells were also drilled in the Lizemores field of Clay County for a total of 109,326 feet that included 44 gas wells and 1 dry hole. Thirty-one wells (28 gas wells and 3 dry holes), were drilled in the Gauley Mountain field for a total of 72,632 feet. A total of 99,828 feet was drilled in the Clendenin field of Kanawha County for a total of 21 wells that included 18 gas wells, 2 combination wells, and 1 dry hole.

The Big Injun secondary recovery project of Columbia Gas in the Granny Creek-Stockly field of Clay County remained

the only full-scale waterflood project in the State. The company drilled 11 additional service wells in that field and drilled 2 wells and reworked another in the Tuscarora field in Kanawha County as possible sources for CO<sub>2</sub> for a gas-injection project in the Granny Creek-Stockly field. Research activities and issuance of a contract for a secondary recovery project in the Griffithsville field of Lincoln County by the Energy Research and Development Administration portend increases in secondary recovery activities in the future.

Proved crude oil reserves at yearend were estimated at 31.4 million barrels for a 0.8-million-barrel, or 2.5% decrease from the 1974 yearend estimate. Proved reserves of natural gas increased 2.0%, or 4.5 billion cubic feet, to an estimated level of 2,311 billion cubic feet at yearend.

### NONMETALS

**Cement.**—The Martin Marietta Division of the Martin Marietta Corp. is the only producer of cement in the State. The company operated three coal-fired rotary kilns at its plant at Martinsburg, Berkeley County. According to the West Virginia Department of Commerce, market areas for the product from these kilns include Delaware, the District of Columbia, Florida, Maryland, North Carolina, Pennsylvania, Virginia, and West Virginia.

Shipments of portland cement declined 18.9% during 1975. Production declined 18.8%, and yearend stocks were 8.4% below the 1974 yearend level. The total value of portland cement shipments declined 6.2% even though the average value per ton increased 15.6%. Masonry cement production declined 14.2%, and the total value of this production declined 5.4%. Total shipments of masonry cement declined 14.0%. Stocks of masonry cement on hand at yearend were 33.0% below the 1974 yearend level. Shipments of portland cement consumed by ready-mix concrete producers declined 15.6% even though the percentage of total shipments consumed by these producers increased from 61.0% in 1974 to 63.5% in 1975. The balance of shipments was used in production of concrete products and in construction of buildings and highways. Trucks transported 76.7% of 1975 shipments of portland cement; the balance was shipped by railroad.

**Clays.**—Clays were produced in four counties—Berkeley, Cabell, Hancock, and Lincoln—during 1975. The leading producer of miscellaneous clay was Berkeley County, and the only producer of fire clay was Hancock County. The total production of all clays declined 23.2% below the 1974 level, the total value of production declined 26.3%, and the average unit value declined 4.0%. Miscellaneous clay production declined 17.9%. The total value of this production declined 15.6%, although the unit value increased 2.6%. The unit value of fire clay increased 2.6%, but production of this type of clay declined 29.4% and the total value declined 27.5%. Seven companies mined clays for production of common unprocessed brick, unprocessed face brick, fire brick, cement block, and mine explosives stemming.

**Lime.**—Production of lime during 1975 decreased below the 1974 level. Total value declined also, even though the average unit value per short ton increased. Two companies, one in Berkeley County and one in Pendleton County, produced lime for basic oxygen steel furnaces, open hearth steel furnaces, acid mine water neutralization, agriculture, and other purposes.

**Salt.**—Production of salt declined 228,225 tons below the 1974 level to 972,365 tons, a 19.0% drop. The total value of production declined to \$4.7 million, 25.8% below the 1974 total value. The average unit value declined by 43 cents per short ton. Salt was produced by three companies from brine obtained from deep-well solution-mining operations in Marshall and Tyler Counties. The salt was used to produce soda ash, chlorine, hydrochloric acid, bleaching powder, calcium, magnesium chlorides, and bromine.

**Sand and Gravel.**—Production of sand and gravel amounted to 5,068,000 short tons during 1975 for a decline of 314,000 tons, or 5.8%, from the 1974 level. The total value of this production, however, increased 11.6% from \$16.0 million to \$17.9 million. Average value per ton of sand and gravel production increased 18.5% from \$2.98 in 1974 to \$3.53 in 1975.

Sand and gravel was produced by 11 companies at 14 operations in 11 counties during the year. Hancock, Tyler, and Morgan were the top producing counties



Table 5.—West Virginia: Sand and gravel sold or used by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	3,354	12,340	2,844	12,246
Gravel -----	2,003	3,631	2,176	5,436
Unprocessed: Sand and gravel -----	25	47	48	82
Industrial:				
Sand -----	W	W	W	W
Total -----	5,382	16,018	5,068	17,764

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

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

in descending order of production. Of the 14 operations, 5 were dredges and 9 were stationary or portable plants.

**Stone.**—A total of 44 companies operated 53 mines and quarries that produced stone in 24 counties during 1975. Crushed limestone was produced by 31 companies at 37 mines and quarries; crushed sandstone was produced by 11 companies from 12 quarries; dolomite was produced by 2 companies from 2 quarries; crushed quartzite was produced by 1 company from 1 quarry; and 1 company operated a quarry that produced dimension stone. Two of the limestone-producing companies also produced sandstone.

Limestone and dolomite were produced in 18 counties. The four leading producing counties in order of descending production were Jefferson, Monongalia, Greenbrier, and Berkeley. Jefferson County was the only producer of dolomite. Major uses of this limestone and dolomite were construction aggregate, cement, chemicals, lime, metallurgical flux, railroad ballast, mine dust, septic fields, and agriculture.

Sandstone was produced in nine counties. The four leading counties in descending order of production were Raleigh, Fayette, Harrison, and Kanawha. Quartzite was produced in Lewis County. Major uses of sandstone were construction aggregate, glass, and dimension stone.

Production of crushed stone (limestone, dolomite, quartzite, and sandstone) totaled 10.6 million tons in 1975, a decline of 3.4% below the 1974 level. The value of this production amounted to \$24.3 million, an increase of 9.1% above the 1974 total. The average value per ton rose \$0.26, for a 12.8% increase above the 1974 value. Output of crushed limestone and dolomite declined 1.5%, while that of crushed sandstone and quartzite declined 29.3%.

Trucks were used for shipping 58.8% of the total crushed stone production, railroads carried 24.3%, and barges carried 4.9%. Other means of transportation were used for balance of the total production, or the method of transportation was not reported.

Table 6.—West Virginia: Crushed stone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Bituminous aggregate -----	451	772	258	821
Concrete aggregate -----	1,525	2,814	1,806	3,232
Dense-graded roadbase stone -----	2,163	4,990	1,303	3,739
Macadam aggregate -----	167	438	81	278
Other construction aggregate and roadstone -----	2,237	4,950	3,088	7,536
Surface treatment aggregate -----	499	802	538	1,140
Agricultural purposes <sup>1</sup> -----	148	320	113	352
Cement and lime manufacture -----	1,802	3,066	1,386	2,332
Mine dusting -----	151	771	166	1,127
Railroad ballast -----	582	823	646	1,062
Riprap and jetty stone -----	W	W	31	94
Other uses <sup>2</sup> -----	1,230	2,563	1,167	2,619
Total <sup>3</sup> -----	10,954	22,308	10,583	24,332

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

<sup>1</sup> Includes agricultural limestone and other soil conditioners.

<sup>2</sup> Includes chemical stone (1974), fill (1975), flux stone, manufactured fine aggregate, refractory stone, and roofing aggregates (1974).

<sup>3</sup> Data may not add to totals shown because of independent rounding.

## METALS

**Aluminum.**—Production of primary aluminum during 1975 declined 32.3% below the 1974 level. The total value of production in 1975 declined 11.5%, although the average value per pound increased 30.0%. The Kaiser Aluminum & Chemical Corp. operated a completely integrated aluminum plant at Ravenswood in Jackson County. Imported alumina is electrolytically converted to aluminum ingots, which are rolled into sheet, plate, and commercial foil. The rolled products are then transported by rail and truck for distribution and production of aluminum products.

**Ferroalloys.**—Production of ferroalloys decreased 26.1% during 1975. The value of this production decreased 4.5%, although the average value per ton increased 29.4%. Diamond Shamrock Chemical Co.'s Chemetals Division produced ferromanganese at its Kingwood plant in Preston County. The Foote Mineral Co. produced ferroalloys at its Graham Station plant in Mason County. The Ferroalloy Division of Union Carbide Corp. produced low-carbon ferrochrome, medium-carbon ferromanganese, and ferrosilicon at its Alloy plant in Fayette County.

**Iron and Steel.**—Production of pig iron during 1975 declined 17.6%, and shipments declined 17.8%. Stocks on hand at yearend were 79.0% above the 1974 yearend level. The total value of shipments

increased 38.8%, and the average value per short ton increased 68.4%. Weirton Steel Co. produced and sold iron oxide pigments from the pickling liquor treatment plant installed to control water polluting effluents.

**Magnesium Compounds.**—The AMAX Specialty Metals Corp., a subsidiary of AMAX, Inc., produced anhydrous magnesium chloride as a byproduct during the production of zirconium sponge metal at its plant near Parkersburg in Wood County.

**Nickel.**—Wrought nickel and high-nickel base alloys were produced by the International Nickel Co.'s Huntington Alloy Products Division plant at Huntington in Cabell County. Principal products consisted of mill forms, such as strip, sheet, plate, pipe, tube, wire, rod, and bar, and welding products, such as nickel and high-nickel bare welding filler wire, coated electrodes, and welding fluxes. According to the West Virginia Department of Commerce, this is the largest rolling mill in the world devoted exclusively to the production of high-nickel base alloys.

**Zinc.**—Although not a primary zinc producer, the zinc plant operated by Meadowbrook Corp. at Spelter in Harrison County produced zinc dust, zinc oxides, and other zinc products. Raw materials used were zinc drosses, zinc ashes, and other zinc residues.

**Zirconium.**—AMAX Specialty Metals Corp. produced zirconium sponge at its Parkersburg plant in Wood County. Imported Australian zircon sand was converted to zirconium carbonitride in a 5,000-kilovolt-ampere arc-type electric

furnace. Corhart Refractories Co. produced slip-cast and isostatically pressed high-density zircon and chromic oxide refractory bricks for the metallurgical industry at its Buckhannon plant in Upshur County.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement: Martin-Marietta Corp. <sup>1</sup>	277 Park Ave. New York, N.Y. 10017	Plant -----	Berkeley.
Clays:			
Crescent Brick Co., Inc --	Box 368 New Cumberland, W. Va. 26047	Underground mine-	Hancock.
Globe Refractories, Inc ---	Box D Newell, W. Va. 26060	----do -----	Do.
Coal:			
Amherst Coal Co -----	Port Amherst Charleston, W. Va. 25306	Underground and strip mines.	Logan and Wyoming.
Armco Steel Co -----	703 Curtis St. Middletown, Ohio 45042	Underground mines.	Boone and Raleigh.
Bethlehem Mines Corp ----	Martin Tower Bethlehem, Pa. 18016	Underground and strip mines.	Barbour, Boone, Kanawha, Marion, Nicholas, Raleigh, Upshur.
Consolidation Coal Co ----	1 Oliver Plaza Pittsburgh, Pa. 15222	Underground, strip, and auger mines.	Harrison, Marion, Marshall, Mercer, Monongalia, McDowell, Raleigh, Wyoming.
Eastern Associated Coal Corp.	Koppers Bldg. Pittsburgh, Pa. 15219	Underground and strip mines.	Boone, Marion, McDowell, Monongalia, Raleigh, Wyoming.
United States Steel Corp. <sup>2</sup> -	600 Grant St. Pittsburgh, Pa. 15230	----do -----	McDowell, Mingo, Wyoming.
Westmoreland Coal Co ----	123 South Broad St. Philadelphia, Pa. 19109	----do -----	Boone, Fayette, Nicholas, Raleigh, Upshur, Wyoming.
Lime:			
Greer Limestone Co. <sup>3</sup> ----	Greer Bldg. Morgantown, W. Va. 26505	Plant -----	Monongalia.
Jones & Laughlin Steel Corp. <sup>2</sup>	3 Gateway Center Pittsburgh, Pa. 15230	----do -----	Berkeley.
Petroleum refineries:			
Pennzoil Co -----	Oil City, Pa. 16301	----do -----	Kanawha.
Quaker State Oil Refining Corp.	Farmers Valley, Pa. 16749--	Plants -----	Hancock and Pleasants.
Salt:			
Allied Chemical Corp ----	Box 1219R Morristown, N.J. 07960	Plant -----	Marshall.
FMC Corp -----	Box 8127 South Charleston, W. Va. 25303	Plants -----	Pleasants and Tyler.
PPG Industries, Inc ----	1 Gateway Center Pittsburgh, Pa. 15222	Plant -----	Marshall.
Sand and gravel:			
Dravo Corp -----	1 Oliver Plaza Pittsburgh, Pa. 15222	Dredge -----	Brooke and Hancock.
Duquesne Sand Co -----	144 East Beaver St. Sewickley, Pa. 15143	----do -----	Brooke.
McDonough Co -----	Box 538 Parkersburg, W. Va. 26100	----do -----	Berkeley, Tyler, Wetzel, Wood.

See footnotes on next page.

Table 7.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Sand and gravel—Continued</b>			
Shippingport Sand and Gravel Co.	1200 Stambough Bldg. Youngstown, Ohio 44501	Plant -----	Hancock.
Smelters: Kaiser Aluminum & Chemical Corp.	300 Lakeside Dr. Oakland, Calif. 94626	----do -----	Jackson.
<b>Stone:</b>			
Acme Limestone Co -----	Box 27 Fort Spring, W. Va. 24936	Mine and quarry --	Greenbrier.
Black Rock Contracting, Inc.	Box 1913 Charleston, W. Va. 25327	Quarry -----	Randolph.
Elkins Limestone Co -----	Box 1228 Elkins, W. Va. 26241	Mine and quarry --	Do.
The H. Frazier Co., Inc --	Box 1377 Richmond, Va. 23211	Quarry -----	Greenbrier.
Shenandoah Quarry, Inc --	Box C Millville, W. Va. 25432	----do -----	Jefferson.

<sup>1</sup> Also clays.<sup>2</sup> Also stone.



# The Mineral Industry of Wisconsin

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Wisconsin Geological and Natural History Survey, under a memorandum of understanding for collecting information on all minerals except coal and liquid fuels.

By Ronald C. Briggs<sup>1</sup> and Dr. Meredith E. Ostrom<sup>2</sup>

The overall quantitative output from mines and quarries in Wisconsin during 1975 was slightly lower than that of the previous year. However, the total value of mineral production in the State increased more than 15%, to a record high of \$132.3 million. This situation reflected a period of increasing prices and costs coupled with some erosion of markets.

Nonmetals—chiefly sand and gravel and crushed stone—continued to be the principal mineral commodities in both quantity and value produced in the State. Production of sand and gravel and crushed stone for use primarily in construction re-

mained stable, but the value increased by about 11%. The value of these construction materials accounted for 58% of the total value for all minerals in the State. Other nonmetallic minerals produced included abrasive stone, cement, clays, and lime. Expanded perlite and exfoliated vermiculite were produced from crude materials mined outside the State. Elemental sulfur was recovered at the Murphy Oil Corp. refinery in Superior.

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<sup>2</sup> Director and State Geologist, Wisconsin Geological and Natural History Survey, Madison, Wis.

Table 1.—Mineral production in Wisconsin<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays -----thousand short tons--	2	\$4	2	\$4
Gem stones -----	NA	1	NA	1
Iron ore (usable) -thousand long tons, gross weight--	899	W	791	W
Lead (recoverable content of ores, etc.) -short tons--	1,285	578	W	W
Lime -----thousand short tons--	311	6,764	296	8,604
Peat -----do-----	W	W	11	502
Sand and gravel -----do-----	28,850	34,577	30,057	40,580
Stone -----do-----	22,443	40,912	20,566	40,156
Zinc (recoverable content of ores, etc.) -short tons--	8,737	6,273	W	W
Value of items that cannot be disclosed:				
Abrasive stone, cement, copper, silver, and values indicated by symbol W -----	XX	25,654	XX	42,413
Total -----	XX	114,763	XX	132,260
Total 1967 constant dollars -----	XX	54,260	XX	52,375

<sup>1</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>2</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of mineral production in Wisconsin, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Adams	\$401	\$2	Sand and gravel.
Ashland	W	W	Do.
Barron	409	384	Do.
Bayfield	41	35	Do.
Brown	W	W	Lime, stone, sand and gravel.
Buffalo	W	628	Stone, sand and gravel.
Burnett	W	117	Sand and gravel, stone.
Calumet	W	W	Do.
Chippewa	305	405	Sand and gravel.
Clark	213	1,287	Sand and gravel, stone.
Columbia	4,131	4,323	Do.
Crawford	799	W	Stone, sand and gravel.
Dane	3,450	W	Sand and gravel, stone.
Dodge	W	W	Stone, lime, sand and gravel.
Door	580	751	Sand and gravel, stone.
Douglas	W	12,168	Cement, lime, sand and gravel, stone.
Dunn	142	432	Sand and gravel, stone.
Eau Claire	1,401	805	Sand and gravel.
Florence	39	24	Do.
Fond du Lac	W	W	Stone, sand and gravel, lime, clays.
Forest	W	77	Sand and gravel.
Grant	W	W	Stone, sand and gravel.
Green	502	949	Do.
Green Lake	1,644	1,586	Sand and gravel, stone.
Iowa	W	W	Stone, zinc, lead, silver, copper.
Iron	( <sup>1</sup> )	69	Sand and gravel.
Jackson	W	W	Iron ore, sand and gravel.
Jefferson	W	598	Sand and gravel, stone.
Juneau	W	W	Stone, sand and gravel.
Kenosha	808	764	Sand and gravel.
Kewaunee	439	398	Do.
La Crosse	W	1,205	Stone, sand and gravel.
Lafayette	W	W	Zinc, stone, lead, silver, copper.
Langlade	W	W	Sand and gravel.
Lincoln	541	606	Sand and gravel, peat.
Manitowoc	4,788	3,800	Lime, cement, stone, sand and gravel.
Marathon	5,666	5,478	Stone, sand and gravel.
Marinette	W	2,177	Do.
Marquette	W	W	Do.
Menominee	W	W	Do.
Milwaukee	8,425	W	Cement, stone.
Monroe	W	603	Stone.
Oconto	W	W	Sand and gravel, stone.
Oneida	517	574	Sand and gravel.
Outagamie	W	W	Stone, sand and gravel.
Ozaukee	W	W	Sand and gravel, stone.
Pepin	W	W	Stone, sand and gravel.
Pierce	W	W	Do.
Polk	W	W	Do.
Portage	927	770	Sand and gravel.
Price	35	W	Do.
Racine	W	3,445	Stone, sand and gravel.
Richland	W	W	Do.
Rock	2,814	2,858	Sand and gravel, stone.
Rusk	498	607	Sand and gravel.
St. Croix	W	627	Stone, sand and gravel.
Sauk	W	W	Stone, sand and gravel, abrasive stone.
Sawyer	W	573	Sand and gravel.
Shawano	W	642	Sand and gravel, stone.
Sheboygan	512	670	Do.
Taylor	553	555	Sand and gravel.
Trempealeau	W	W	Stone.
Vernon	W	W	Stone, sand and gravel.
Vilas	242	277	Sand and gravel.
Walworth	646	1,337	Sand and gravel, stone.
Washburn	W	71	Sand and gravel.
Washington	1,909	W	Sand and gravel, stone.
Waukesha	W	9,662	Sand and gravel, stone, peat.
Waupaca	350	599	Sand and gravel, stone.
Wausara	W	524	Sand and gravel.
Winnebago	3,258	3,452	Stone, sand and gravel.
Wood	148	W	Do.
Undistributed <sup>2</sup>	67,626	65,343	
Total <sup>3</sup>	114,763	132,260	

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

<sup>1</sup> Less than 1/2 unit.

<sup>2</sup> Includes gem stones, some stone (1974) that cannot be assigned to specific counties, and values indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

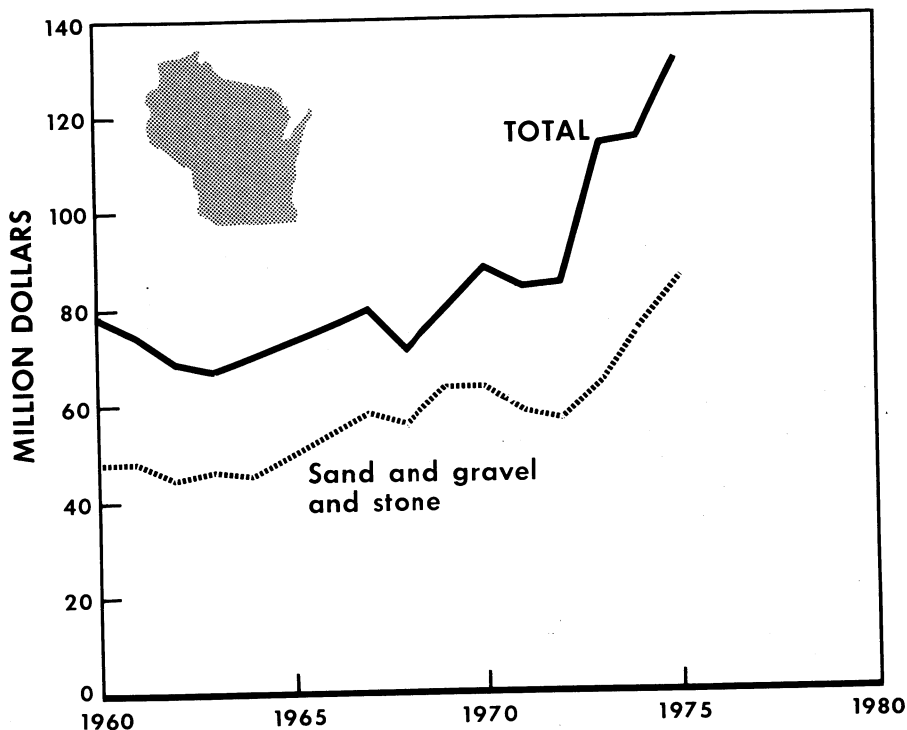


Figure 1.—Value of sand and gravel, stone, and total value of mineral production in Wisconsin.

Output of taconite pellets from the single iron ore mine in Wisconsin declined for the second consecutive year. Shipments dropped from 899,000 long tons in 1974 to 791,000 long tons in 1975. Buoyed by an improved market price, output of zinc concentrate increased slightly over that of the previous year; however, the production of lead as a byproduct of the zinc operations declined during 1975.

The intensity of exploration activities for base metals in Wisconsin remained at a high level during 1975. Mining prospects brightened as Flambeau Mining Corp. furthered its plans to develop a copper mine south of Ladysmith. In late 1974, the company submitted an 828-page environmental impact report, which the Wisconsin Department of Natural Resources (DNR) used as the basis for preparing an Environmental Impact Statement (EIS). The EIS must be subjected to public hearings before it is approved and the necessary per-

mits for mining issued. Noranda Exploration, Inc., also notified the Wisconsin DNR of the possible development of a copper-zinc mine near Rhinelander. Exploration drilling by Noranda intersected copper-zinc mineralization on lands owned by Consolidated Papers, Inc. Although a zinc-copper deposit has been delineated, it could be 5 to 7 years before mining begins.

The heightened exploration activity by several companies—notably Exxon-USA, Duval, Inc., and NL Industries Inc.—in northern Wisconsin brought with it an increase in land negotiations for purposes of mineral prospecting and mining. Mining companies and brokers in increasing numbers were approaching landowners in northern counties with offers to lease land for mineral exploration. Some landowners were receiving multiple offers for the same property.

The massive railroad and excellent harbor facilities available in Superior influenced the decision to invest about \$85



Table 3.—Indicators of Wisconsin business activity

	1974	1975 <sup>p</sup>	Change, percent
Employment and labor force, annual average:			
Total labor force -----thousands--	2,082.0	2,128.0	+2.2
Unemployment -----do-----	94.0	148.0	+57.4
Employment (nonagricultural):			
Mining -----do-----	2.8	2.4	-14.3
Manufacturing -----do-----	545.6	503.1	-7.8
Contract construction -----do-----	65.4	56.4	-13.8
Transportation and public utilities -----do-----	85.1	81.3	-4.5
Wholesale and retail trade -----do-----	374.3	375.0	+2
Finance, insurance, and real estate -----do-----	71.7	73.3	+2.2
Services -----do-----	281.1	293.0	+4.2
Government -----do-----	276.9	285.4	+3.1
Total nonagricultural employment -----do-----	1,702.9	1,669.9	-1.9
Personal income:			
Total -----millions--	\$24,106	\$26,109	+8.3
Per capita -----do-----	\$5,281	\$5,669	+7.3
Construction activity:			
Number of private and public residential units authorized -----do-----	26,023	26,002	-.1
Value of nonresidential construction -----millions--	\$276.8	\$284.4	+2.7
Value of State road contract awards -----do-----	\$104.0	\$130.0	+25.0
Shipments of portland and masonry cement to and within Wisconsin -----thousand short tons--	1,685	1,605	-4.7
Mineral production value:			
Total crude mineral value -----millions--	\$114.8	\$132.3	+15.2
Value per capita, resident population -----do-----	\$25.13	\$28.82	+14.7
Value per square mile -----do-----	\$2,043.72	\$2,355.31	+15.2

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

million for the construction of two transshipment terminals—one for taconite pellets and one for coal—in the area.

After receiving the required State and Federal dredging and structural permits for various phases of constructing and operating the terminal, Burlington Northern, Inc., awarded contracts totaling \$50 million for construction of a taconite (iron ore) pellet-shiploading facility and an accompanying pellet storage area at the Port of Superior. After reviewing a lengthy environmental impact report on the terminal prepared by the company, both Federal and State agencies determined that a formal EIS would not be required. The terminal will handle increased output from taconite operations on the Mesabi Iron Range in Minnesota. The storage facility was scheduled to begin receiving pellets at the end of 1976. The shiploading structure, 130 feet high and 900 feet long, will have 2 sets of 18 elevated pellet bins, each set having a pellet storage capacity of 36,000 long tons. The dock, situated on Allouez Bay, was expected to be completed at the opening of the 1977 navigation season on the Great Lakes and will be capable of loading vessels of up to 1,000

feet in length. Despite a month-long strike at the beginning of the project, general construction was on, or ahead of, schedule with more than 25% of the construction work completed at the end of December. Major considerations for environmental control are being designed into the entire terminal system.

Construction of a new \$35 million transshipment facility for coal began in December 1974 and accelerated into full swing during 1975. Being constructed for ORTRAN, Inc., on a site fronting on St. Louis Bay in Superior, the terminal will be the focal point for coal shipments down the Great Lakes. The owner of the terminal is Midwest Energy Resources, Inc., a wholly owned subsidiary of Detroit-Edison Co. Burlington Northern, Inc., unit trains of 110 cars each will haul coal from Becker, Mont., for transshipment aboard Great Lakes vessels to the St. Clair Shores, Mich., generating plant of the Detroit-Edison Co., prime customer for the fuel. The Becker Mining Co. in Montana will supply an estimated 180 million tons of coal over a 25½-year period to the Superior terminal. Construction by yearend was about 90% completed, and the first

shipment of coal was scheduled to arrive in early 1976.

In addition to the substantial economic impact on the local area, there was a statewide ripple effect of these terminal projects. Construction underway and on order for new vessels and alterations to some of the post-World War II vessels of the Great Lakes fleet had the Wisconsin shipyards operating at peak levels. A new addition to the Lakes fleet, the *Sam Laud*, was placed in service at Sturgeon Bay, Wis., in May. The 635-foot vessel was constructed by Bay Shipbuilding Corp. for the American Steamship Co. It is similar in length to several other recently constructed self-unloaders built to navigate the tight bends to steel mills along Cleveland's Cuyahoga River. The 770-foot hull of the *St. Clair* was launched at Sturgeon Bay in July. The *St. Clair*, a \$24 million vessel that will weigh 7,000 tons, also is being built by Bay Shipbuilding Corp. for the American Steamship Co. The vessel was expected to be completed in 1976 and is to be used to carry low-sulfur coal from Superior to the electric generating plant of Detroit-Edison Co. in Michigan.

Groundbreaking ceremonies were held on April 17 at Bay Shipbuilding's yard to initiate construction of a new 1,150- by 140-foot drydock needed for building a number of 1,000-foot ships now on order; the first was to be completed in 1977 for the American Steamship Co.

In June, a major conversion of the *Wilfred Sykes*, owned by Inland Steel Co., to a self-unloader was completed at the Fraser Shipyards in Superior. The multimillion-dollar conversion project took several months to complete. The conversion to self-unloading will reduce the time in port for unloading from about 14 hours to approximately 4 hours. The *Sykes* was the largest U.S. flagship on the Great Lakes to undergo the self-unloader conversion. At the Fraser Shipyards, other vessels were being lengthened to take advantage of enlarged facilities at the Soo Locks. Lengthening of United States Steel Corp.'s *Arthur M. Anderson* by 120 feet was completed in the spring and increased that vessel's capacity by about 6,000 gross tons. Work on adding a 96-foot midsection to the *Arthur B. Homer* of the Bethlehem Steel Corp. fleet and lengthening the *Str. Reserve* (operated by the Columbia Transportation Div., Oglebay-Norton Co.) by 120 feet was

also completed at the Fraser Shipyards during 1975. The expansion of the *Homer* was the first for a 730-foot laker, that overall length being the maximum for passage of lake boats through any of the locks in the lake-Seaway system until the 1,200-foot Poe Lock was opened at Sault Ste. Marie in 1969. Two more lakers were scheduled for lengthening during the 1975-76 winter at the Fraser Shipyards.

Wisconsin's manufacturing community, centered principally around Milwaukee, also benefited from the port terminal projects. The manufacturers will benefit not only by the equipment they supply directly to the projects, but also through supplying equipment to powerplant and mining companies at the other end of the transportation lines.

Environmental considerations delayed the plans of Lakehead Pipeline Co. to construct a major petroleum products transshipment terminal in Superior. In February, the U.S. Army Corps of Engineers reversed its earlier position on requiring an EIS for the project. An EIS being prepared by the Corps was scheduled for completion in January 1976. Under the current timetable, Lakehead would not be able to gain the necessary State and Federal permits for the terminal project until mid-1976, meaning construction would not be finished until well into 1977. Lakehead had hoped to begin construction in 1974 and to be operating the terminal at the start of the 1975 shipping season. Increasing construction and shipping costs were forcing Lakehead to reconsider plans for the project, which was estimated to cost \$11.2 million in 1974.

A mild winter, as well as bubbler systems that prevent ice forming near docks, permitted the shipping of taconite pellets on the Great Lakes all during the 1974-75 shipping season.

The 729-foot ore carrier *Edmund Fitzgerald* departed from the Burlington Northern docks in Superior on November 9 with a cargo of 26,216 tons of taconite pellets bound for Detroit, Mich. In the early evening of the following day, the ship sank in eastern Lake Superior with 29 persons aboard. It had encountered a violent winter storm that kicked up 25-foot waves, driven by hurricane force winds. The *Edmund Fitzgerald*, built in 1958, was one of the prize ships of the Great Lakes

fleet. It was operated by the Columbia Transportation Div., Oglebay-Norton Co., of Cleveland, Ohio, and frequently loaded taconite pellets from the Burlington Northern ore docks in Superior.

#### Legislation and Government Programs.

—Administrative codes to implement the prospecting (chapter NR 130) and mining (chapter NR 131) provisions of the Metallic Mining Reclamation Act of 1973 (chapter 318) were developed by the Department of Natural Resources and the Mine Reclamation Council. The new codes must be subjected to public hearings and receive final approval by the Natural Resources Board and the appropriate legislative committee before being placed in force. A Mine Reclamation Unit was established in the Department of Natural Resources to develop and enforce regulations and rules promulgated under the Metallic Mining Reclamation Act.

In December, a special nine-member study committee of the Legislative Council, created under the Copper Ore Tax Law of 1973 (chapter 283), recommended a comprehensive metal mining tax structure. The special committee recommended a progressive net-proceeds tax on metal mining operations in the State with tax rates ranging from 5% to 20%, depending on corporate profits. The specific tax rate schedule adopted by the committee exempts mining companies with less than \$100,000 in net proceeds per year. Firms with \$100,000 to \$500,000 in net proceeds would be taxed at 5%; \$500,000 to \$2 million at 10%; \$2 million to \$6 million at 15%; and over \$6 million at 20%. Several amendments were also included in the proposed tax package. The amendments included the following: Allowing postponement of tax payments for up to 1 year for firms that have been stockpiling ore and have been unable to sell it at profitable prices; allowing deductions for royalties paid by mining companies to the owners of the mineral rights; allowing a cooling-off period of 10 days for individual landowners and 90 days for government agencies to cancel any contract for exploration rights by a mining company; and limiting mining exploration leases to a maximum of 10 years, with one renewal of no more than 10 years permitted at the end of the first period. The committee also voted to propose a gradual phasing out over a 5-

year period of the percentage depletion now allowed mining companies in the State. The proposed tax changes were expected to be presented to the legislature during the 1976 session.

Wisconsin joined California as the only States following a procedure of billing private industry for a State-prepared EIS. The Bureau of Environmental Impact, Wisconsin Department of Natural Resources, drafted and began hearings on proposed rules to clarify and interpret regulations that have been put into effect since enactment of the Wisconsin Environmental Policy Act of 1972. Included in the proposed rules was a provision, already in effect, for assessment of fees for an EIS. The billing rate as established by the recent law was 0.05% of the total dollar cost of a project. Prior to this change in the law, a State-prepared EIS was paid for with tax dollars.

A bill requiring utilities to file construction plans with the Public Service Commission (PSC) 10 years in advance with an update every 2 years was signed into law. The legislation for powerplant sites also regulates location of transmission lines. The State government action culminated 5 years of efforts to safeguard the public interest and to provide for orderly powerplant and utility line development.

A proposed constitutional amendment that would have permitted the State to expend funds and issue bonds to finance a system of railroads and urban mass transit systems was rejected by voters in an April 1 referendum ballot. If the amendment had been adopted, the State would have been able to offer financial assistance for repairing railroad beds and possibly prevent the proposed abandonment of rail service in several areas of the State. Railroads were seeking to abandon an estimated 400 miles of rail service in Wisconsin during 1975.

As directed in the Metallic Mining Reclamation Act, the Department of Natural Resources and the Wisconsin Geological and Natural History Survey initiated a study to prepare a program of mineral resources zoning and financial incentives for the purpose of discouraging those uses of land which tend to preclude the mining of minerals lying beneath. The study will consider mineral resource potential, mineral rights, zoning and financial incentives,

as well as community impacts and public acceptance. The study was scheduled to be completed by June 30, 1976.

The Geological and Natural History Survey announced intentions to expand its activities in Precambrian geology and geophysics. The shift in emphasis will include greater focus on mapping of Precambrian rocks and assessment of their mineral potential and closer coordination of geophysical studies. Work began on a special report on the mineral and water resources of Wisconsin by the Survey at the request of Senator William Proxmire. The report, which would summarize min-

eral resources by commodity, was scheduled to be published in 1976. Data from an aeromagnetic survey of approximately 18,000 square miles in northern Wisconsin continued to be collected and interpreted during 1975. The aeromagnetic survey was flown along north-south flight lines from an elevation of 500 feet above the ground surface. The published maps will have a contour interval of 20 milligals and be at a scale of 1:62,500. The Survey work was accomplished with funds provided primarily through grants of the Upper Great Lakes Regional Commission.

## REVIEW BY MINERAL COMMODITIES

### NONMETALS

**Abrasive Materials.**—Deburring and burnishing media were produced by Baraboo Quartzite Co., Inc., from a quartzite deposit near Baraboo in Sauk County. Primary customers were metal-stamping plants. Depressed economic conditions within the manufacturing industries using abrasive materials contributed to the company's large decrease in sales during 1975 as compared with those of 1974. During the 13 years that the company has operated the quarry, 1974 and 1975 were the first years that the firm had to close down for short periods due to buildup of inventories at the quarry site. The company produces 15 sizes of abrasives, and the material is usually sold in 100-pound bags.

**Cement.**—Shipments of portland and masonry cement from two cement manufacturing plants and two grinding facilities in the State decreased from those of the previous year with the closing of one plant. The Medusa Cement Co., Manitowoc County, continued as the only producer of white portland cement in Wisconsin. Facilities for grinding partially manufactured cement materials from outside the State were operated by Universal Atlas Cement Div. of United States Steel Corp. and Huron Cement Div. of National Gypsum Co. at Milwaukee and Superior, respectively.

Most of the cement shipments from the plants were to points within the State. More than 90% of the cement was shipped by truck in bulk form. Ready-mix com-

panies were the principal customers, receiving more than 70% of the shipments. The remaining quantity was destined for concrete product manufacturers, highway and other contractors, and building material dealers. Total cement consumed in Wisconsin was more than three times greater than the quantity produced in the State.

The Marquette Co. permanently closed its 230,000-ton-per-year cement plant in Milwaukee in early April. After production ceased, shipments of cement from inventory and cement received from other plants continued. Increasing costs of bringing raw materials to Milwaukee, rising labor costs, and a Wisconsin Department of Natural Resources requirement for the installation of \$2 million in pollution control equipment were the deciding factors in closing the plant, which was converted to a distribution center. Cement for distribution in the Milwaukee area will be brought in from other company-owned plants in Pennsylvania, Illinois, and Ohio.

**Clays.**—The only producer of clays in the State during 1975 was Oakfield Shale Brick & Tile Co. The company used all the clay and shale produced from its operation near Oakfield in Fond du Lac County in the manufacture of brick. Output from the operation during 1975 was essentially the same as that for 1974.

**Lime.**—Three companies produced lime at five plants during 1975. The CLM Corp. operated a plant in Douglas County, the Rockwell Lime Co. operated a plant in Manitowoc County, and The Western Lime

& Cement Co. operated plants in Brown, Dodge, and Fond du Lac Counties. Each of the plants produced quicklime and hydrated lime. While the total quantity produced declined nearly 5% from that of the previous year, the value of output rose to a record high for the State of more than \$8.6 million.

Construction continued throughout the

year on a two-phase expansion project at the CLM Corp. plant at Superior. The capacity of the plant will be increased by about 75% with the installation of a third lime kiln. The expansion program also includes the construction of two oil storage tanks and the installation of additional dust control equipment and other pollution control devices.

Table 4.—Wisconsin: Lime sold or used by producers, by use

Use	1974		1975	
	Quantity (short tons)	Value (thou- sands)	Quantity (short tons)	Value (thou- sands)
Paper and pulp -----	107,336	\$2,284	W	W
Mason's lime -----	71,192	1,672	54,445	\$1,835
Water purification -----	44,837	955	53,011	1,467
Sewage treatment -----	W	W	39,056	1,081
Soil stabilization -----	W	W	10,541	355
Basic oxygen furnaces -----	W	W	6,702	185
Food and food byproducts -----	4,133	88	W	W
Agriculture -----	1,833	46	W	W
Paint -----	1,711	36	697	19
Other uses <sup>1</sup> -----	80,048	1,683	131,274	3,661
Total -----	311,090	6,764	295,726	<sup>2</sup> 8,604

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."  
<sup>1</sup> Includes electric steel furnaces, tanning, finishing lime, copper ore concentration, other chemical uses, insecticides, oil well drilling, sugar refining, other metallurgy, petroleum refining, sulfur removal (1974), wire drawing, sand-lime brick (1975), and items indicated by symbol W.

<sup>2</sup> Data do not add to total shown because of independent rounding.

**Perlite.**—W. R. Grace & Co. and Midwest Perlite Co. operated plants in Milwaukee and Outagamie Counties, respectively, to expand crude perlite mined outside of the State. Most of the expanded perlite produced in Wisconsin was used for horticultural purposes and as insulation. Sales of the expanded material showed significant increases in both quantity and value over those of 1974.

**Sand and Gravel.**—The sand and gravel industry continued to rank as the largest mineral industry in Wisconsin. Production topped 30 million tons, a slight gain over the level of the previous year, but value of output increased more than 17% to \$40.6 million, owing to prevailing higher prices. Sand and gravel accounted for nearly 31% of the State total value in 1975. Production of sand and gravel was reported from 66 of the 72 counties in the State by 297 companies operating at 408

sites. The greatest activity was in and near the large urban centers of southeastern Wisconsin (Columbia, Dane, Ozaukee, Rock, Walworth, Washington, and Waukesha Counties). Production in excess of 1 million tons was reported for each of these counties, and collectively they accounted for 44% of the State's total output in 1975. Most of the sand and gravel produced was used for construction aggregates, although more than 1 million tons of high-purity sand was produced for industrial uses.

**Stone.**—The stone quarrying and processing industry in Wisconsin ranked second to sand and gravel in terms of both quantity and value of output. Production of stone (mostly crushed limestone and dolomite) decreased more than 8% in quantity from that of the previous year, but the value remained essentially the same. Stone

Table 5.—Wisconsin: Sand and gravel sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Adams	3	235	401	1	8	2
Barron	9	318	391	8	343	384
Bayfield	1	45	41	3	31	35
Brown	5	604	682	6	408	521
Buffalo	1	76	21	1	26	10
Burnett	1	171	135	2	W	104
Calumet	1	W	W	3	360	657
Chippewa	4	394	305	9	377	405
Clark	3	219	211	5	919	1,286
Columbia	6	1,112	3,709	12	1,046	3,964
Crawford	3	161	335	2	W	W
Dane	19	1,094	1,431	19	1,081	1,547
Dodge	10	590	440	9	350	346
Door	4	366	460	12	500	633
Douglas	11	320	257	9	W	W
Dunn	1	76	67	3	150	275
Eau Claire	3	912	1,401	4	256	805
Florence	1	22	39	1	16	24
Fond du Lac	4	W	187	7	194	206
Forest	2	217	W	1	60	77
Green	2	W	W	5	190	191
Green Lake	7	572	1,445	7	530	1,454
Iron	1	W	( <sup>1</sup> )	3	229	69
Jackson	3	226	381	3	143	264
Jefferson	9	435	334	10	301	401
Juneau	1	W	W	1	46	41
Kenosha	5	674	808	4	649	764
Kewaunee	4	540	439	3	312	398
La Crosse	2	W	W	2	68	92
Lafayette	1	1	1	--	--	--
Lincoln	5	464	541	7	583	606
Manitowoc	11	884	922	10	585	577
Marathon	8	721	833	7	609	585
Marquette	3	300	416	5	115	162
Oconto	4	320	257	10	697	868
Oneida	8	542	517	8	531	574
Ozaukee	9	482	579	11	1,077	1,420
Pepin	2	W	W	1	11	6
Pierce	4	100	163	7	135	203
Polk	6	474	459	6	513	512
Portage	3	895	927	4	682	770
Price	1	63	35	2	W	W
Racine	4	430	291	7	617	1,413
Richland	2	67	73	2	52	70
Rock	10	1,605	2,386	13	1,733	2,486
Rusk	3	449	498	6	482	607
St. Croix	4	536	617	4	233	173
Sauk	7	459	558	8	W	W
Sawyer	1	W	W	7	205	573
Shawano	6	362	375	8	394	488
Sheboygan	5	521	482	5	617	630
Taylor	4	347	553	8	454	555
Vilas	5	161	242	4	123	277
Walworth	11	W	W	23	2,551	1,238
Washburn	2	97	W	2	48	71
Washington	8	1,873	1,728	10	1,627	1,626
Waukesha	27	3,948	3,687	32	3,970	4,802
Waupaca	5	427	350	6	348	562
Waushara	2	W	W	6	368	524
Winnebago	8	539	851	11	484	1,039
Wood	1	222	57	1	W	W
Undistributed <sup>2</sup>	13	2,185	2,258	12	1,621	2,207
Total <sup>3</sup>	319	28,850	34,577	408	30,057	40,580

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

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Includes Ashland, Grant, Langlade, Marquette, Outagamie, and Vernon Counties.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

Table 6.—Wisconsin: Sand and gravel sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	4,177	6,280	5,256	8,369
Highway and bridge construction -----	2,448	2,941	2,132	2,953
Other construction (dams, waterworks, airports, etc.) -----	647	763	251	376
Concrete products (cement blocks, bricks, pipe, etc.) -----	2,392	3,631	1,808	2,436
Bituminous paving (asphalt and tar paving) -----	4,665	4,674	4,122	5,958
Roadbase and subbase -----	7,318	7,086	7,509	9,148
Fill -----	1,229	861	1,397	1,503
Other uses -----	578	636	110	146
<b>Unprocessed:</b>				
Roadbase and subbase -----	1,215	492	3,969	1,907
Fill -----	2,304	1,400	2,088	1,553
Other uses -----	--	--	110	67
Industrial sand -----	1,376	5,813	1,304	6,165
<b>Total</b> <sup>1</sup> -----	<b>28,850</b>	<b>34,577</b>	<b>30,057</b>	<b>40,580</b>

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 7.—Wisconsin: Stone sold or used by producers, by kind  
(Thousand short tons and thousand dollars)

Kind of stone	1974			1975		
	Number of quarries <sup>1</sup>	Quantity	Value	Number of quarries <sup>1</sup>	Quantity	Value
<b>Granite:</b>						
Dimension -----	7	8	2,452	6	7	2,593
Crushed and broken ---	13	1,347	1,179	11	776	1,028
<b>Total</b> <sup>2</sup> -----	<b>20</b>	<b>1,354</b>	<b>3,632</b>	<b>17</b>	<b>783</b>	<b>3,622</b>
<b>Limestone and dolomite:</b>						
Dimension -----	25	155	3,973	26	62	1,503
Crushed and broken ---	351	18,566	27,789	350	17,452	28,990
<b>Total</b> -----	<b>369</b>	<b>18,721</b>	<b>31,762</b>	<b>368</b>	<b>17,514</b>	<b>30,493</b>
<b>Other stone:</b>						
Dimension -----	6	1	35	5	1	23
Crushed and broken ---	10	2,367	5,482	8	2,269	6,019
<b>Total</b> <sup>2</sup> -----	<b>16</b>	<b>2,368</b>	<b>5,517</b>	<b>13</b>	<b>2,269</b>	<b>6,042</b>
<b>Total stone:</b> <sup>2</sup>						
Dimension -----	38	164	6,461	37	69	4,119
Crushed and broken ---	374	22,279	34,451	369	20,497	36,037
<b>Total</b> -----	<b>405</b>	<b>22,443</b>	<b>40,912</b>	<b>398</b>	<b>20,566</b>	<b>40,156</b>

<sup>1</sup> Detail may not add to total because some quarries produce more than one class of material.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

was quarried in 48 of the State's 72 counties. Production of crushed stone, primarily for use as construction aggregate, showed a decrease in most of the more densely populated counties in the southern part of the State. More than 1 million tons of crushed stone was produced in Marathon, Waukesha, and Winnebago Counties. Dimension stone, while less than one-half of 1% of the total quantity produced, accounted for more than 10% of the total value of stone. About 90% of the dimension stone produced in Wisconsin was limestone, coming principally from Waukesha and Fond du Lac Counties.

**Sulfur (Recovered Elemental).**—The only producer of sulfur in the State was Murphy Oil Corp. The company operated a sulfur extraction plant at its Superior refinery in Douglas County and recovered 643 tons of sulfur during 1975.

**Vermiculite.**—Exfoliated vermiculite was produced by the Construction Products Division of W. R. Grace & Co. at Milwaukee, and by Koos, Inc., at Kenosha, from crude material shipped from outside the State. The exfoliated material was used primarily for insulation, agricultural and horticultural uses, and lightweight aggregate.

Table 8.—Wisconsin: Crushed limestone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Barron	1	8	18	--	--	--
Brown	9	944	1,276	14	921	1,525
Buffalo	9	186	W	8	307	618
Calumet	3	W	W	8	398	511
Columbia	8	279	422	5	210	358
Crawford	15	360	464	13	249	338
Dane	26	1,214	2,019	24	828	1,382
Dodge	9	774	1,059	12	758	1,056
Door	5	106	120	5	101	118
Dunn	3	57	75	5	85	158
Fond du Lac	11	540	825	12	604	912
Grant	33	727	1,153	33	751	1,141
Green	21	W	W	19	385	758
Green Lake	4	187	199	4	96	132
Iowa	20	590	678	18	576	727
Jefferson	1	35	W	3	108	197
La Crosse	3	W	W	8	806	1,114
Lafayette	21	419	450	19	431	567
Manitowoc	2	W	W	3	425	852
Marquette	1	44	W	1	29	W
Menominee	1	19	W	--	--	--
Monroe	6	W	W	--	460	603
Outagamie	7	740	1,080	6	685	1,030
Pepin	4	46	W	2	80	W
Pierce	8	271	W	8	269	W
Polk	1	49	133	1	32	84
Racine	5	W	W	3	851	2,032
Richland	10	230	W	7	205	W
Rock	14	288	428	15	234	372
St. Croix	6	W	W	6	259	454
Sauk	7	W	W	8	207	W
Shawano	4	W	W	2	W	154
Sheboygan	1	W	30	1	W	40
Trempealeau	8	282	W	12	370	W
Vernon	26	419	W	14	347	598
Walworth	3	W	W	1	54	99
Waukesha	11	2,508	3,906	14	2,146	3,676
Waupaca	--	--	--	1	19	37
Winnebago	14	1,497	2,407	14	1,438	2,413
Undistributed <sup>1</sup>	11	5,746	11,047	15	1,777	4,933
Total <sup>2</sup>	351	18,566	27,789	350	17,452	28,990

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

<sup>1</sup> Includes Douglas (1975), Juneau, Marinette (1975), Milwaukee, Oconto, Ozaukee, and Washington Counties and some crushed limestone that cannot be assigned to specific counties (1974).

<sup>2</sup> Data may not add to totals shown because of independent rounding.



Table 9.—Wisconsin: Dimension limestone sold or used by producers, by use

Use	1974			1975		
	Short tons	Cubic feet	Value (thou- sands)	Short tons	Cubic feet	Value (thou- sands)
Irregular shaped stone ----	12,152	150,997	\$189	10,223	127,332	\$169
Rubble -----	27,423	339,972	384	6,864	84,396	102
Cut stone -----	W	W	W	341	4,005	18
House stone -----	19,123	236,628	1,032	12,951	160,602	615
Sawed stone -----	7,089	88,400	W	2,913	34,788	156
Construction -----	5,834	72,021	134	5,481	68,057	113
Flagging -----	8,945	110,903	173	5,850	72,649	128
Other uses <sup>1</sup> -----	74,762	934,118	2,062	17,321	216,416	201
Total <sup>2</sup> -----	155,328	1,933,039	3,973	61,944	768,245	1,508

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

<sup>1</sup> Includes rough blocks and other unspecified rough stone (1974).

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Table 10.—Wisconsin: Crushed limestone sold or used by producers, by use  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quan- tity	Value	Quan- tity	Value
Bituminous aggregate -----	1,190	1,655	1,068	1,759
Concrete aggregate -----	1,669	2,487	1,015	1,653
Dense-graded roadbase stone -----	8,009	10,876	7,971	11,812
Macadam aggregate -----	W	W	479	854
Surface treatment aggregate -----	1,362	2,115	1,315	2,149
Other construction aggregate and roadstone -----	3,535	5,428	3,055	5,302
Agricultural limestone <sup>1</sup> -----	907	1,982	1,065	2,571
Fill -----	29	58	67	67
Filter stone -----	23	52	16	36
Railroad ballast -----	149	204	95	170
Riprap and jetty stone -----	182	391	377	895
Other uses <sup>2</sup> -----	1,509	2,582	929	1,722
Total <sup>3</sup> -----	18,566	27,789	17,452	28,990

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

<sup>1</sup> 1974 data include other soil conditioners.

<sup>2</sup> Includes stone sand, lime, flux stone, bedding material (1975), disinfectant and animal sanitation, fillers, and uses indicated by symbol W.

<sup>3</sup> Data may not add to totals shown because of independent rounding.

## METALS

**Copper.**—Although no copper mines were developed or operated in Wisconsin during 1975, base-metal exploration activity continued in the State at a high level. The Flambeau Mining Corp., a wholly owned subsidiary of Kennecott Copper Corp., moved one step closer in its plans to start development and construction at a proposed minesite near Ladysmith, in Rusk County. The company advanced its 6-year effort, which it hopes will lead to a viable open pit copper mine, by submitting an 828-page, four-volume environmental impact report to the Wisconsin

DNR in late 1974. After identifying several items of concern from the report and receiving responses from the Flambeau Mining Corp., the State agency began preparing an EIS. The draft EIS was completed and submitted to the public hearing process in 1975. If the EIS gains approval, the company will still have to make application for about 14 permits relating to environmental issues before mine development work can begin.

Noranda Exploration Co. also notified the Wisconsin DNR of its intent to develop an open pit copper-zinc mine near Rhinelander. The firm, a wholly owned subsidiary of Noranda Mines Ltd., of

Toronto, Canada, discovered the deposit while drilling on lands owned by Consolidated Papers, Inc., in Oneida County. The start of mining operations will depend upon issuance of necessary permits after an environmental review and could take as long as 5 to 7 years. The company estimated that the deposit could produce 1,000 tons of ore per day for 10 to 14 years.

Landowners in several counties were benefiting from the increased exploration activity as they began to receive checks representing rental fees payable under the terms of prospecting leases. Many companies were actively acquiring landholdings and conducting extensive aerial and land surveys as well as drilling programs.

**Iron Ore.**—Jackson County Iron Co.'s mine and mill near Black River Falls continued to be the only iron mining operation in Wisconsin during 1975. Production from the firm's taconite operation declined for the second straight year, to 784,000 tons. Several increases in pellet prices resulted in an increased value for the output even though the tonnage declined. The price of taconite pellets increased from 44.55 cents per unit of iron at the beginning of the year to 47.2 cents per unit of iron by the end of the year. The Jackson County Iron Co. is a subsidiary of Inland Steel Co., and all pellets produced at the Black River Falls operation were shipped by rail to the parent company's Indiana Harbor Works at East Chicago, Ind.

**Zinc and Lead.**—Eagle-Picher Industries, Inc., continued to operate its Shullsburg mill with ore supplied from the Shullsburg and Bear Hole mines in Lafayette County. The company closed the Jewell mine and Linden mill, both in Iowa County, in May. The Jewell mine and Linden mill were brought into production in late 1974 but were closed after only a few months of operation as a backlog of concentrates at the smelter forced the company to reduce concentrate shipments. Output of zinc concentrate increased slightly over that of the previous year, and the production of lead as a byproduct of the zinc operations declined during 1975.

Eagle-Picher Industries, Inc., filed application with the Wisconsin DNR to reopen two zinc mines in southwestern Wisconsin. It was questionable as to

whether or not the necessary permits could be issued because of regulations promulgated in November by the U.S. Environmental Protection Agency and adopted by the State agency covering point-source discharges for the mining and milling industry. Of particular concern was the limitation placed upon the content of the effluent discharges from the mine. The standards established for the zinc content of mine discharge waters were one-tenth of that allowed for safe drinking water in the area. The company appealed this regulation and requested a variance.

#### MINERAL FUELS

**Coke.**—Milwaukee Solvay Coke Co., a division of Pickands Mather & Co., continued to be the only coke producer in Wisconsin. Foundries were the principal consumers of coke in the State.

**Peat.**—Moss and humus peat were produced from bogs and processing plants in Waukesha County by Bogda's Top Soil & Excavating Co., Certified Peat & Sod, Inc., and Demilco, Inc., a division of Nitragin Sales Corp. Also, Superior Brand Peats produced a small quantity of moss and humus peat from a bog near Tomahawk in Lincoln County. The total output (11,330 tons, valued at \$502,000) was sold for horticultural purposes.

**Petroleum Refining.**—The decision by the Canadian Government to gradually cut back all crude oil exports to the United States and to completely eliminate such shipments by 1981 had its effect on the refinery operated by the Murphy Oil Corp. in Superior during 1975. The supply of Canadian crude was cut by about 20% in 1975, and an additional cut of 30% was announced for 1976. The refinery is entirely dependent upon Canadian crude oil, and as a result of the cutback, was operating at less than capacity throughout the year. The major construction project at the refinery during 1975 was the rebuilding of a truckloading rack that was destroyed by fire on July 2. The new truckloading facility incorporated the latest design in safety features. Additional monies were spent at the refinery for equipment replacements, energy and water conservation, and environmental considerations.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
<b>Abrasive stone:</b>			
Baraboo Quartzite Co., Inc.	Box 123 Baraboo, Wis. 53913	Quarry, stationary plant.	Sauk.
<b>Cement:</b>			
Marquette Co	20 North Wacker Dr. Chicago, Ill. 60606	Dry process plant.	Milwaukee.
Medusa Cement Co., a division of Medusa Corp.	Box 5668 Cleveland, Ohio 44101	----do	Manitowoc.
National Gypsum Co., Huron Cement Div.	17515 West 9 Mile Rd. Honeywell Center Southfield, Mich. 48075	Grinding plant only.	Douglas.
Universal Atlas Cement Div., United States Steel Corp.	U.S. Steel Building 600 Grant St. Pittsburgh, Pa. 15230	----do	Milwaukee.
<b>Clays:</b>			
Oakfield Shale Brick & Tile Co.	Oakfield, Wis. 53065	Pit and plant	Fond du Lac.
<b>Coke:</b>			
Milwaukee Solvay Coke Co., a division of Pickands Mather & Co.	311 East Greenfield Ave. Milwaukee, Wis. 53204	Coke ovens	Milwaukee.
<b>Iron ore:</b>			
Jackson County Iron Co., a subsidiary of Inland Steel Co. Black River Falls	30 West Monroe St. Chicago, Ill. 60603	Mine, concentrator, agglomerator.	Jackson.
<b>Iron-oxide pigments, finished:</b>			
Delta Color & Supply Co	1050 East Bay St. Milwaukee, Wis. 53217	Plant	Milwaukee.
<b>Lime:</b>			
CLM Corp	12th Ave. & Waterfront Duluth, Minn. 55802	Rotary kilns, con- tinuous hydrator.	Douglas.
Rockwell Lime Co	Route 2, Box 124 Manitowoc, Wis. 54220	Rotary kiln, con- tinuous hydrator.	Manitowoc.
The Western Lime & Cement Co. Eden plant	Box 2076 Milwaukee, Wis. 53201	Shaft kilns, batch hydrator.	Fond du Lac.
Green Bay plant			Brown.
Knowles plant		Shaft kilns, con- tinuous hydrator.	Dodge.
<b>Peat:</b>			
Bogda's Top Soil & Excavating Co.	12600 West Cleveland Ave. New Berlin, Wis. 53151	Bog, processing plant.	Waukesha.
Certified Peat & Sod, Inc.	19000 West Lincoln Ave. New Berlin, Wis. 53151	----do	Do.
Demilco, Inc., a division of Nitragin Sales Corp.	3101 West Custer Ave. Milwaukee, Wis. 53209	----do	Do.
<b>Perlite, expanded:</b>			
Construction Products Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Processing plant	Milwaukee.
Midwest Perlite Co	Westfield Ave. Appleton, Wis. 54911	----do	Outagamie.
<b>Petroleum refinery:</b>			
Murphy Oil Corp	200 Jefferson Ave. El Dorado, Ark. 71730	Refinery	Douglas.
<b>Sand and gravel:</b>			
B. R. Amon & Sons Co	Route 3 Elkhorn, Wis. 53121	Pits, portable plants.	Jefferson, Kenosha, Racine, Rock, Walworth.
C. A. Chier Sand Co	P.O. Box 97 Fairwater, Wis. 53931	Pit, stationary plant.	Green Lake.
Courtney & Plummer, Inc.	Box 767 Neenah, Wis. 54956	Pits, portable plants.	Calumet and Winnebago.
Janesville Sand & Gravel Co.	P.O. Box 427 Janesville, Wis. 53545	Pit, stationary plant, portable plant.	Rock.
Johnson Sand & Gravel, Inc.	22750 West Bluemound Rd. Waukesha, Wis. 53186	Pit, stationary plant.	Waukesha.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577	Pits, portable plants.	Chippewa, Columbia, Dunn, Lincoln, Oconto, Ozaukee, Price, Shawano, Waukesha, Waushara.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
<b>Sand and gravel—Continued</b>			
Manley Bros. of Indiana, Inc., Hanover Div.	P.O. Box 67 Chesterton, Ind. 46375	Pit, stationary plant.	Rock.
Manley Sand Div., Martin Marietta Corp.	110 East Main St. Rockton, Ill. 61072	-----do-----	Columbia.
Mann Brothers, Inc -----	P.O. Box 48 Elkhorn, Wis. 53121	Pits, portable plants.	Jefferson, Rock, Walworth, Waukesha.
Plautz Brothers, Inc -----	Route 1, Box 47 Willard, Wis. 54493	Pits, stationary plant, portable plant.	Chippewa, Clark, Jackson, Taylor, Wood.
State Sand & Gravel Co --	10833 West Watertown Plank Rd. Milwaukee, Wis. 53226	-----do-----	Waukesha.
Wissota Sand & Gravel Co.	P.O. Box 1268 Eau Claire, Wis. 54701	-----do-----	Barron, Rusk, Washington.
<b>Stone:</b>			
<b>Granite:</b>			
Anderson Bros. & Johnson Co.	Box 26 Wausau, Wis. 54401	Quarries, stationary plant.	Marathon.
Ben Gottschalk, Inc --	Route 2 Edgar, Wis. 54426	Quarries, portable plant.	Do.
Lake Wausau Granite Co.	Box 397 Wausau, Wis. 54401	Quarry, stationary plant.	Do.
Carl Wimmer -----	2807 Dove Ave. Wausau, Wis. 54401	Quarry, portable plant.	Do.
<b>Limestone and dolomite:</b>			
Courtney & Plummer, Inc.	Box 767 Neenah, Wis. 54956	Quarries, stationary plant, portable plant.	Calumet, Outagamie, Winnebago.
Daanen & Janssen ----	Box 127 De Pere, Wis. 54115	Quarries, portable plants.	Brown.
Franklin Stone Products, Inc.	7220 South 68th St. Hales Corners, Wis. 53132	Quarry, stationary plant.	Milwaukee.
Halquist Stone Co., Inc.	N52 W23564 Lisbon Rd. Sussex, Wis. 53089	Quarries, stationary plant.	Waukesha.
Edward Kraemer & Sons, Inc.	Plain, Wis. 53577 -----	Quarries, portable plants.	Buffalo Columbia, Crawford, Dunn, Green, La Crosse, Manitowoc, Marquette, Pepin, Pierce, Richland, Sauk, Trempealeau, Vernon.
Landwehr Materials, Inc.	Route 2 Appleton, Wis. 54911	Quarry, stationary plant.	Outagamie.
C. C. Linck, Inc -----	1226 North Center St. Beaver Dam, Wis. 53916	Quarries, portable plants.	Dodge, Fond du Lac, Green Lake.
Arthur Overgaard, Inc.	Box 87 Elroy, Wis. 53929	Quarries, stationary plant, portable plant.	Juneau, La Crosse, Monroe.
Valders Lime & Stone Co., Inc.	Valders, Wis. 54245 -----	Quarry, stationary plant.	Manitowoc.
Vulcan Materials Co., Midwest Division.	Box 6 Countryside, Ill. 60525	Quarries, stationary plants.	Milwaukee, Racine, Waukesha, Winnebago.
G. A. Watson -----	Barneveld, Wis. 53507 ----	Quarries, portable plants.	Dane, Iowa, Lafayette.
Waukesha Lime & Stone Co.	Box 708 Waukesha, Wis. 53186	Quarry, stationary plant, portable plant.	Waukesha.
<b>Quartzite:</b>			
Foley Bros., Inc -----	Rock Springs, Wis. 53961 --	Quarry, stationary plant.	Sauk.
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, Minn. 55101	Quarries, stationary plant.	Marathon.
<b>Sandstone:</b>			
Nemke's Stone Quarry.	Route 1 Hatley, Wis. 54440	Quarry -----	Do.

Table 11.—Principal producers—Continued

Commodity and company	Address	Type of activity	County
Stone—Continued			
Traprock (basalt):			
Bryan Dresser Trap Rock, Inc.	Box 215 Chaska, Minn. 55318	Quarry, stationary plant, portable plant.	Polk.
GAF Corp -----	Box 630 Pembine, Wis. 54156	Quarry, stationary plant.	Marinette.
Sulfur, recovered elemental:			
Murphy Oil Corp -----	200 Jefferson Ave. El Dorado, Ark. 71730	Byproduct sulfur recovery plant.	Douglas.
Vermiculite, exfoliated:			
Construction Products Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, Mass. 02140	Processing plant --	Milwaukee.
Koos, Inc -----	4500 13th Court Kenosha, Wis. 51340	-----do -----	Kenosha.
Zinc and lead:			
Eagle-Picher Industries, Inc.:	Box 406 Galena, Ill. 61036		
Bear Hole -----	-----	Mine -----	Lafayette.
Jewell -----	-----	Mine and mill ----	Iowa.
Shullsburg -----	-----	----do -----	Lafayette.

# The Mineral Industry of Wyoming

By Charles A. Koch<sup>1</sup>

The value of raw minerals continued to increase from \$1.4 billion in 1974 to \$1.6 billion in 1975. This is the second year that mineral value has exceeded \$1 billion, which has resulted in a per capita value of \$4,374 in mineral production. The principal mineral commodities, in order of value, were petroleum, sodium carbonate, coal, natural gas, and uranium. Combined value of these commodities was about \$1.5 billion. Energy minerals were valued at about \$1.3 billion, or about 80% of the total value. The 14% increase in value

was primarily the result of a per-unit cost increase in commodities, rather than a production increase.

Wyoming held on to its ranking of fifth in the Nation and first in the Rocky Mountain Region in crude oil production. Production for the year declined at the rate of 2.9% compared to 4.6% for the Nation. The marketed quantity of natural gas decreased but the total value increased by 33% over the 1974 value.

<sup>1</sup> State Liaison Officer, Bureau of Mines, Cheyenne, Wyo.

Table 1.—Mineral production in Wyoming<sup>1</sup>

Mineral	1974		1975	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays -----thousand short tons--	2,511	\$29,339	2,582	\$36,046
Coal (bituminous) -----do-----	20,703	103,915	23,804	160,447
Gem stones -----do-----	NA	140	NA	140
Gypsum -----thousand short tons--	315	960	271	902
Iron ore (usable) gross weight, thousand long tons--	2,105	W	2,039	26,792
Lime -----thousand short tons--	29	464	W	W
Natural gas -----million cubic feet--	326,657	80,031	316,123	106,533
Natural gas liquids:				
Natural gasoline and cycle products thousand 42-gallon barrels--	2,933	18,577	2,909	17,694
LP gases -----do-----	6,804	31,707	6,061	29,578
Petroleum (crude) -----do-----	139,997	914,360	135,943	983,785
Sand and gravel -----thousand short tons--	5,532	9,508	4,323	10,746
Stone -----do-----	2,384	5,989	2,882	7,618
Uranium (recoverable) -----thousand pounds--	7,449	78,213	6,862	84,406
Value of items that cannot be disclosed:				
Cement, feldspar, phosphate rock, sodium carbonates, stone (dimension) (1974), and values indicated by symbol W	XX	163,997	XX	179,751
Total -----do-----	XX	1,437,200	XX	1,644,438
Total 1967 constant dollars -----do-----	XX	679,508	XX	851,197

<sup>p</sup> Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

<sup>1</sup> Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

<sup>2</sup> Excludes value of dimension stone; included with "Value of items that cannot be disclosed."

Table 2.—Value of mineral production in Wyoming, by county  
(Thousands)

County	1974	1975	Minerals produced in 1975 in order of value
Albany -----	W	\$9,153	Cement, petroleum, stone, sand and gravel, clays, gypsum.
Big Horn -----	\$34,434	41,231	Petroleum, clays, natural gas, gypsum, sand and gravel, lime.
Campbell -----	261,624	252,112	Petroleum, natural gas liquids, natural gas, coal, sand and gravel.
Carbon -----	84,540	127,770	Coal, uranium, natural gas liquids, natural gas, petroleum, sand and gravel, stone.
Converse -----	84,844	122,004	Petroleum, uranium, coal, natural gas liquids, natural gas, sand and gravel.
Crook -----	33,239	37,437	Petroleum, clays, stone, sand and gravel, natural gas.
Fremont -----	126,231	131,606	Petroleum, uranium, iron ore, natural gas, natural gas liquids, sand and gravel, stone, feldspar.
Goshen -----	W	343	Lime, petroleum, sand and gravel.
Hot Springs -----	67,694	W	Petroleum, natural gas, coal, sand and gravel.
Johnson -----	28,350	33,252	Petroleum, clays, sand and gravel, natural gas, natural gas liquids.
Laramie -----	W	W	Stone, petroleum, sand and gravel, natural gas.
Lincoln -----	31,012	32,286	Coal, natural gas liquids, phosphate rock, natural gas, petroleum, sand and gravel, stone.
Natrona -----	119,630	106,183	Petroleum, uranium, natural gas, sand and gravel, natural gas liquids, clays.
Niobrara -----	3,088	4,015	Petroleum, natural gas.
Park -----	179,548	W	Petroleum, natural gas, natural gas liquids, gypsum, sand and gravel.
Platte -----	W	12,514	Iron ore, petroleum, stone, sand and gravel, natural gas.
Sheridan -----	7,238	W	Coal, petroleum, sand and gravel.
Sublette -----	33,008	36,386	Petroleum, natural gas, sand and gravel, natural gas liquids, stone.
Sweetwater -----	198,292	263,920	Sodium carbonate, petroleum, natural gas, coal, natural gas liquids, sand and gravel.
Teton -----	W	W	Stone, sand and gravel.
Uinta -----	W	722	Natural gas liquids, clays, sand and gravel, petroleum, natural gas.
Washakie -----	17,401	19,714	Petroleum, natural gas, natural gas liquids, clays, sand and gravel, lime.
Weston -----	21,191	14,641	Petroleum, clays, natural gas, sand and gravel, stone.
Undistributed <sup>1</sup> -----	105,845	399,146	
Total <sup>2</sup> -----	1,437,200	1,644,438	

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

<sup>1</sup> Includes value of mineral production that cannot be assigned to specific counties and values indicated by symbol W.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

Coal production increased 3.1 million tons from 1974 to 1975, compared with a 5.3-million-ton increase from 1973 to 1974; however, coal is the primary energy source in the State. Coal development in the State was hampered by union contract disputes and the lawsuit between the Sierra Club and the U.S. Department of the Interior which stopped planned development in the Powder River Basin. During the year, one new coal mine came onstream, and a new underground mine was added at an existing mining operation.

Uranium production decreased and value increased in 1975. This is the second year that production has decreased; however, development work in the State should reverse this trend. The State's reserves continue to be second highest in the United States.

Production and reserves of sodium carbonate continued to rank first in the Nation. All producers in the State had an increase in output over that of 1974.

Reclamation has become associated with surface mining. During the year, about 3,810 acres was disturbed by surface mining, about 1,437 acres of which was attributed to coal surface mining. The coal mining industry accounted for 38% of the acreage surface mined and about 48% of the land reclaimed. In 1975 the coal industry was reclaiming land at the rate of about three-quarters of an acre for every acre mined compared with slightly less than one-half acre to an acre mined in 1973.

Wyoming's estimated consumption of fossil fuels and energy in 1975 consisted of 7.4 million tons of coal, 23 million barrels of petroleum products, 100.4 billion cubic feet of natural gas, and 4.2 million megawatt-hours of electricity. The State continued to be a net exporter of energy. This would put the per capita energy consumption for 1975 at 1,121 million Btu compared with the national per capita consumption of 412 million Btu's.

Table 3.—Indicators of Wyoming business activity

	1974	1975 <sup>p</sup>	Change, percent
<b>Employment and labor force, annual average:</b>			
Total labor force -----thousands--	167.4	175.5	+4.8
Unemployment -----do-----	5.9	7.2	+22.0
<b>Employment (nonagricultural):</b>			
Mining -----do-----	15.5	18.0	+16.1
Manufacturing -----do-----	8.2	8.2	--
Contract construction -----do-----	14.9	14.4	-3.4
Transportation and public utilities -----do-----	12.1	12.4	+2.5
Wholesale and retail trade -----do-----	28.0	30.1	+7.5
Finance, insurance, real estate -----do-----	4.3	4.6	+7.0
Services -----do-----	20.5	20.5	--
Government -----do-----	32.0	34.5	+7.8
Total nonagricultural employment -----do-----	135.5	142.7	+5.3
<b>Personal income:</b>			
Total -----millions--	\$2,042	\$2,294	+12.3
Per capita -----do-----	\$5,644	\$6,131	+8.6
<b>Construction activity:</b>			
Number of private and public residential units			
authorized -----do-----	2,084	2,637	+26.5
Value of nonresidential construction -----millions--	\$25.3	\$28.1	+11.1
Value of State road contract awards -----do-----	\$58.0	\$83.0	+43.1
Shipments of portland and masonry cement to and within Wyoming -----thousand short tons--	248	320	+29.0
<b>Mineral production value:</b>			
Total crude mineral value -----millions--	\$1,437.2	\$1,644.4	+14.4
Value per capita, resident population -----do-----	\$3,970.17	\$4,373.51	+10.2
Value per square mile -----do-----	\$14,678.19	\$16,794.72	+14.4

<sup>p</sup> Preliminary.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.



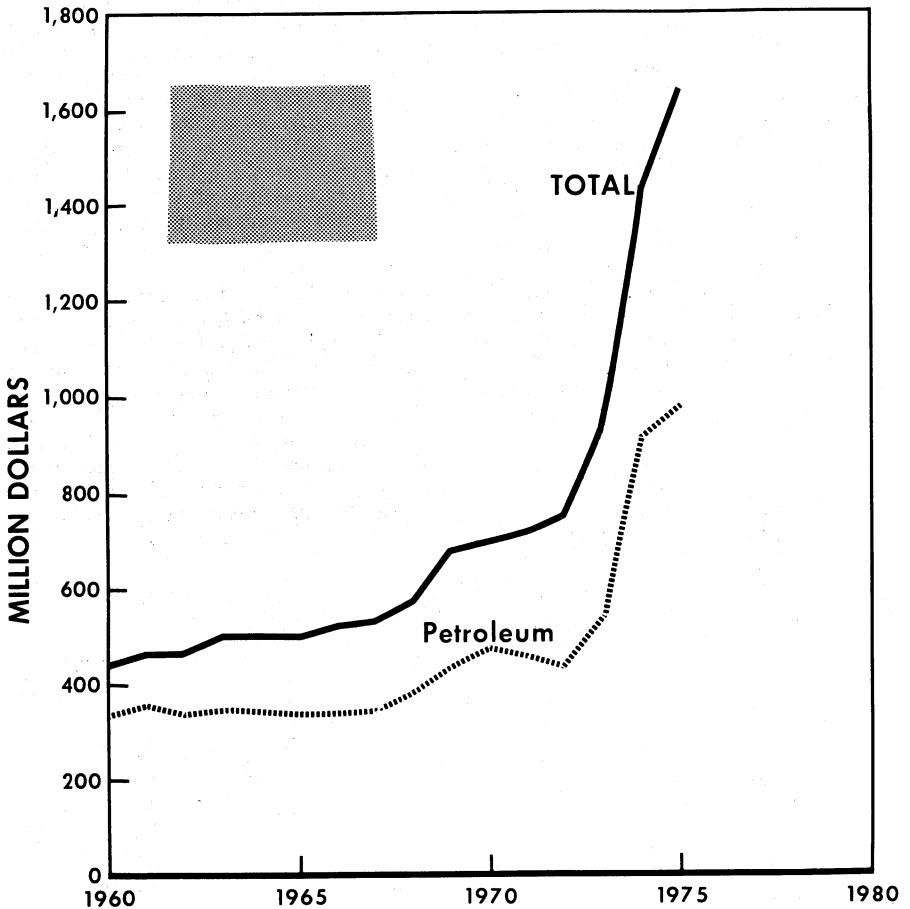


Figure 1.—Value of petroleum and total value of mineral production in Wyoming.

#### Legislation and Government Programs.

—The Governor's request that consideration be given at the 1975 regular session to matters of mineral taxation, amendments to the Environmental Quality Act, and land use planning were acted on by the session.

The 1975 legislative session passed and had signed by the Governor a number of bills related to the mineral industry. A summary of these bills follows:

Act 108 (Industrial Development Information and Siting Act)—Covered by the law are plants costing \$50 million or more, but the figure can be adjusted by the

seven-member council. This act was reported as being the most important piece of legislation acted on.

Act 118 (Coal Tax for Impact Assistance)—The bill provides for a special impact tax on the value of coal produced in 1974 of 0.4%; that produced in 1975, 0.8%; that produced in 1976, 1.2%; that for 1977, 1.6%; and coal produced in 1978, 2%. The tax will expire completely on January 1 following the year in which taxes collected total \$120 million. The revenue from the tax will be deposited in the "Wyoming Coal Tax Revenue Fund," and may be invested and loaned by the

Wyoming Farm Loan Board to defray unusual expenses incurred by counties, cities, and towns because of mining impact.

Act 115 (Severance Tax Clarification)—The bill increases the severance tax on gold, silver, or other precious metals, soda, salines, uranium, bentonite, or other valuable deposits, from 1% to 2%. It increases the severance tax on trona, coal, petroleum, natural gas, oil shale, or any other fossil fuel from 3% to 4%. The bill also increases the severance tax on stripper wells from 1% to 2%.

Act 49 (Wyoming Community Development Act)—In effect, it creates the "Wyoming Community Development Authority" and empowers that board to issue revenue bonds up to \$100 million to offset the mining impact on towns and counties.

Act 72 (Environmental Quality Act Amendment)—What began as a bill to amend Wyoming's Department of Environmental Quality Act grew to a major attempt to restrict industrial expansion in the State. Amendments to provide landowner consent before strip mining, to require licenses and permits before plant construction, and even to require a 2-year moratorium on the application of Wyoming's new SO<sub>2</sub> regulations.

Act 112 (Land Use Planning)—This act provides the mechanism for statewide land use planning under a State level advisory commission, which has some rule-making authority but which generally is expected to set guidelines for county and city planning.

A bill was introduced to repeal the slurry pipeline bill but it was defeated. The slurry pipeline bill approved during the 1974 special budget session gave permission to Energy Transportation System, Inc., to build a pipeline from Wyoming to Arkansas. However, Governor Herschler has stated he still intends to seek a constitutional test of the 1974 legislation.

The Governor expressed great disappointment when he disclosed receipt of a letter from Interior Secretary Kleppe that rejected any cooperation at this time to bring an out-of-court settlement of the Sierra Club lawsuit that has halted most

coal development in the northeast part of the State. At a Western Governors Conference, the Governor had suggested a proposal that would have allowed coal development to continue in certain areas while a State-Federal study also continued on the environmental impact in the region. The proposal was endorsed by the conference and supported by the Sierra Club.

On October 28, the Governor and the State Director of the U.S. Bureau of Land Management (BLM) signed a memorandum of understanding concerning land use planning. The agreement states that the State and BLM should work together to develop coordinated action programs of land and natural resource use and management, pending completion of long-range land use plans, and reduce duplication of efforts. It also provides for annual meetings between the Governor and the State Director of BLM and their representatives to evaluate current conditions and trends on the function of the memorandum.

The new regulations for mining became effective May 26, and all operations were required to have licenses or permits at that time. The new Environmental Quality Act, which was revised during the 1975 legislature, covers the small miner and soft- and hard-rock mining and includes time tables for mining and reclamation.

The State Farm Loan Board agreed to award the first grant under the new Coal Tax for Impact Assistance to the town of Douglas. The board voted to give the town \$40,000 for a sewer water study and for general planning purposes.

Wyoming's Representative reported that Federal funds for energy research in Wyoming have nearly doubled. He said that the Energy Research and Development Administration plans to spend nearly \$7 million for research in Wyoming. The budget includes \$2.3 million for coal, \$1.25 million for petroleum and natural gas, \$2.6 million for oil shale, \$265,000 for nuclear material, and \$120,000 for solar, geothermal, and advanced energy system research.

The Bureau of Mines awarded a \$15,000 grant to the State Geological Survey for updating information on the Hanna Basin coalfields.

## REVIEW BY MINERAL COMMODITIES

### MINERAL FUELS

**Coal.**—Wyoming's coal production has continued to increase for the eighth consecutive year and set a new record of 23.8 million tons in 1975 compared with 20.7 million tons in 1974. The value of the production increased from \$103.9 million to \$160.4 million, a 54% increase over that of 1974. Wyoming remained eighth nationally in production, but it is pushing Indiana for seventh. Strip mining accounted for 98% of the production in 1975. The increased production was primarily the result of a new strip mine, bringing the total number of strip mines to 15; the number of underground mines remained at 5. Six of Wyoming's mines are among the top 31 producers nationally according to the 1976 Keystone Coal Industry Manual. Carbon County led the State in production, followed by Campbell, Converse, and Lincoln Counties.

During the year, about 7.4 million tons of coal, about 31% of the State's production, was used in the State. The majority, 95%, was for mine-mouth-type electrical generation operations. The primary receiving States were Indiana, Iowa, and Colorado.

According to the Annual Report of the State Inspector of Mines, the five major companies, including subsidiaries, produced about 21.9 million tons or 92% of the State's production. The companies and their production are as follows: Arch Minerals Corp. (Arch), 8.2 million tons from three mines; Pacific Power and Light Co. (PP&L), 5.1 million tons from two mines; Amax Coal Co. (AMAX), 3.3 million tons; Kemmerer Coal Co., 2.7 million tons from two mines; and Peter Kiewit & Sons Co., 2.6 million tons from two mines. The only new coal mine to open in the State was the Medicine Bow mine, which had its dedication ceremony on April 15, 1975.

The Medicine Bow mine is a joint venture of Arch Minerals Corp. and Rocky Mountain Energy Co., a subsidiary of Union Pacific Corp. The mine will supply 3 million tons of coal per year over the next 10 years to utilities in Indiana, Iowa, and Kansas. The mining of coal began on a limited basis in January, and full production began in April. The mine, located

on the west flank of the Hanna Basin, will strip and mine five seams with a total thickness of about 60 feet and an average heat value of 10,000 Btu per pound.

A 22-year plan for development of AMAX's Belle Ayr south strip mine, southeast of Gillette, Campbell County, has been blocked by the U.S. District Court in Washington, D.C. Early in November 1975, Secretary of the Interior Thomas Kleppe approved a modified plan for long-term expansion at the mine. The plan included seven Federal stipulations dealing with waste materials and reclamation. The District Court issued an injunction November 14 limiting AMAX, which has mined about 50 acres at the site, to expanding the mine by not over 126 acres annually for the next 2 years. After that time, a proposed expansion to include about another 3,500 acres will be subject to the outcome of the pending lawsuit filed by the Sierra Club against the U.S. Department of the Interior.

Carter Oil Co. announced the suspension of development effective September 30, 1975, at its Rawhide coal mine north of Gillette, Campbell County, because of the lawsuit filed by the Sierra Club. The mine had been scheduled to open in 1976, and original estimates called for a production level of 12 million tons of coal annually by 1980.

The Public Service Co. of Oklahoma initiated development on a 500,000-ton-per-year open pit coal mine in the northern corner of Sheridan County. The company asked for permission to widen a 3-mile stretch of county road, which will be the key to a daily truck shuttle from the mine site to a rail spur near Acme. The company had planned to start mining late this year, but this has been delayed by negotiations for gravel and coal mining permits. Mining rescheduled to start during 1976.

The Panhandle Eastern Pipe Line Co. has selected the site for its coal gasification plant. A tract of land about 15 miles northeast of Douglas on Converse County road No. 55 was chosen by company officials after months of debate as to where in eastern Wyoming the proposed plant would be built. After much dispute in and out of court about diverting North Platte

River water for the plant, the company formulated a three-part plan for 4,750 acre-feet per year of water it estimates will be needed for the project. The plan calls for rehabilitation of the LaPrele Reservoir; construction of a new diversion facility from the North Platte together with a new 26,00-acre-foot, off channel reservoir near Douglas; and deep wells for reserve supply. Coal will be produced from reserves dedicated to the project by Peabody Coal Co. An estimated 11 million tons per year will be needed for the project.

Kerr-McGee Coal Corp. was issued a permit by the Department of Environmental Quality (DEQ) to go ahead with construction of its Jacob's Ranch coal mine south of Gillette. The mine was scheduled to open in 1977 with a projected production of 9 to 16 million tons per year by 1980. The opening of the mine is dependent on the completion of Burlington Northern Railroad's 126-mile line from Gillette to Douglas. Kerr-McGee plans to mine about 4,000 acres of federally leased coal deposits and 353 acres of privately owned land.

Sunoco Energy Development Co., a subsidiary of Sun Oil Co., received a State mining permit and has posted the required bonds for a coal mining operation. The mine (Cordero) will be located 18 miles southeast of Gillette. Sunoco's original contract was to supply coal to San Antonio City Public Service Board's Sommers plant, San Antonio, Tex. The company signed another contract with Western Fuels Association, Inc., to provide coal for a power-plant proposed by the Missouri Basin Power Project near Wheatland, Platte County. The Sunoco contract with Western Fuels, a nonprofit fuels procurement corporation formed by Basin Electric to find supplies of fuel for the plant, is to supply the coal over a 20-year period.

Mining operations were scheduled to begin in 1976.

Northwestern Resources, a subsidiary of Western Energy Co., Billings, Mont., has applied for a mining permit with Land Quality Div. of DEQ to open a strip mine northwest of Thermopolis, Hot Springs County. The operation, formerly owned by Dusky Diamond Coal Co., was a small underground mine. Northwestern did some exploratory strip mining in 1974, estimated at 8,000 tons. The Grass Creek mine will have a yearly production of 700,000 to 1 million tons. Contracts were reported to be with miscellaneous domestic users in Montana and Wyoming.

The second phase of the Laramie Energy Research Center's underground coal gasification project at Hanna has been started with the drilling of new wells. It is anticipated that this phase of the project will triple the volume of gas produced by the first-phase burning operation. In phase 1, two producing wells and one air well generated about 2,000 cubic feet of gas per minute.

Morrison-Knudsen Co., Inc., of Boise, Idaho, received a fee contract from FMC Corp. covering long-term mining services at FMC coal deposits to be opened near Kemmerer, Lincoln County. The contract calls for initially mining 600,000 tons of coal per year, with provisions for future increases up to 1 million tons per year. Production was to have started late in 1976.

Mobil Oil Corp. finalized its right to acquire the interests of Tipperary Corp. in about 20,000 acres of Wyoming coal leases. A year ago, Mobil made an initial advance royalty payment of \$2.66 million under the contract and will be paying a balance of \$9.8 million in installments over the next 5 years. Tipperary retains a 2.5% gross royalty on the approximate 500-million-ton reserves acquired by Mobil.

Table 4.—Wyoming: Bituminous coal production in 1975, by type of mine and county

(Excludes mines producing less than 1,000 short tons annually)

County	Number of mines			Production (thousand short tons)			Value (thousands)
	Under-ground	Strip	Total	Under-ground	Strip	Total	
Campbell	--	2	2	--	W	W	W
Carbon	3	6	9	310	10,668	10,978	\$90,888
Converse	--	1	1	--	W	W	W
Hot Springs	1	1	2	W	W	W	W
Lincoln	--	2	2	W	W	W	W
Sheridan	--	2	2	W	W	W	W
Sweetwater	1	1	2	W	W	W	W
Undistributed	--	--	--	126	12,701	12,827	69,563
Total <sup>1</sup>	5	15	20	436	23,369	23,804	160,447

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

<sup>1</sup>Data may not add to totals shown because of independent rounding.

**Natural Gas.**—Marketed natural gas totaled 316 billion cubic feet in 1975 compared with 327 billion cubic feet in 1974. The production showed a 3% decline compared with a 9% decline between 1973 and 1974. Despite this decline in marketed production, the value increased 33% to \$106 million, compared with \$80 million in 1974. This is the fourth year that production has declined. Wyoming's decline is far below the national average of 6.9% for the 1974-75 period. Wyoming remained seventh in national production, but it is only 2 billion cubic feet behind California, which is in sixth place. Production from public lands increased slightly to 50.7% from 50.5% the previous year. The major gas-producing counties and their production percentages, according to the State Ad Valorem Tax Div., were as follows: Sweetwater 29%, Sublette 18%, Fremont 16%, and Campbell 11%.

Production in the Hilight field continued its rapid decline with a production of 11.7 billion cubic feet in 1975. The production was down from the 29.3 billion cubic feet in 1974 and from the 45.1 billion cubic feet in 1972. The Beaver Creek field with a production of 19.9 billion cubic feet replaced the Hilight field, which dropped to fourth. According to the Wyoming Oil and Gas Conservation Commission, the 25 largest gasfields produced 66% of the State's production in 1975. Two new fields, Spearhead Ranch and Well Draw, replaced Riverton Dome and Birch Creek among the 25 largest pro-

ducers. Production from the Brady field more than doubled, from 3.5 billion cubic feet in 1974 to 7.8 billion cubic feet in 1975.

The American Gas Association reported that Wyoming's natural gas reserves totaled 3.7 trillion cubic feet at yearend 1975 compared with 3.9 trillion cubic feet in 1974. This 5% decline in reserves compares with a 4% decline nationwide.

Wyoming's natural gas production exceeded consumption in the State. The total State consumption was 100.4 billion cubic feet, of which 67% was for consumer use and the remainder was for extraction loss, lease and plant fuel, and pipeline fuel. The major consumers were industrial users, followed by residential and commercial users. The recipients of exported gas, in order of quantities received, were Colorado, Utah, Idaho, Nebraska, and Montana.

Although not listed as a new field discovery, Texaco Inc.'s 19 Table Rock Unit in Sweetwater County was a major find for the Green River Basin of southwestern Wyoming. The discovery was the first gas from the Madison formation of Mississippian age in the Green River Basin and a new pay zone in the Table Rock field. The initial flow rate was about 10 million cubic feet per day at the 18,020- to 18,368-foot interval. The gas will be sold to Colorado Interstate Gas Co. for interstate consumption.

Northern Utilities, Inc., will be allowed to construct and operate a 16-inch pipeline 10½ miles long in Fremont County.

In approving the application, the Wyoming Public Service Commission said it would waive its environment protection rule, which requires filing 6 months prior to construction. The pipeline will extend from the Sand Draw Field to the firm's Sand-Draw Casper Transmission lines and replace two intrastate natural gas pipelines being used between these points to transport natural gas to Casper. The line is to be constructed on and parallel to the adjacent right-of-way to the existing line. The pipeline is expected to cost about \$820,000.

Deep drilling in Sweetwater County has stirred exploration in this southwest area. Besides the Texaco discovery in the Table Rock Field, Champlin Petroleum Co. completed a well in the southwest Table Rock Field that had daily flow rates of 5.5 million cubic feet from the Nugget Formation of Jurassic age and 2.4 million cubic feet from the Weber Formation of Pennsylvanian age. The Nugget zone was at depths

of 15,625 to 15,888 feet, and the Weber zone was at depths of 17,640 to 17,778 feet. The field discovery well is producing from the Mesaverde Formation. The area has always been active, and the hope is that the deep drilling will produce some substantial gas finds.

According to the Wyoming Oil and Gas Conservation Commission, there were nine gasfields discovered in 1975. The more significant field discoveries were as follows: Shute Creek in Lincoln County (by AMOCO Production Co.), Pinegrove in Sublette County (by Dyco Petroleum), and Storm Shelter in Sweetwater County (by Davis Oil Co.). The field names and operators of the other discoveries were Bald Mountain—Pacific Transmission Supply, Crooked Canyon—Kenneth Luff, Siberia Ridge—Equity Oil Co., Verne—AMOCO Production Co., Wiskey Butte—AMOCO Production Co., and Wild Rose—Ladd Petroleum.

Table 5.—Wyoming: Field production of natural gas, by major field  
(Million cubic feet)

Field	County	1974	1975
Beaver Creek	Fremont	21,974	19,902
Desert Springs	Sweetwater	13,841	14,158
Hogsback	Sublette	14,065	13,254
Hilight	Campbell	29,276	11,739
Tip Top	Sublette	10,911	11,068
Elk Basin	Park	15,770	11,068
Worland	Washakie	10,317	10,039
Canyon Creek	Sweetwater	10,478	9,829
Table Rock	do	9,236	9,529
Madden	Fremont	8,769	8,704
Other fields		193,153	200,543
Total		337,790	319,833

Source: Wyoming Oil and Gas Conservation Commission.

**Natural Gas Liquids.**—Production of natural gas liquids decreased from 9.7 million barrels in 1974 to 9 million barrels in 1975. The decrease in production was a direct result of the declining natural gas production. Although the unit value of the products increased, there was a \$3 million decline in total value from that in 1974.

The sales of liquefied petroleum gases (LPG) and ethane to users excluding the use in gasoline production was 6.1 million barrels. The major use of these products was by residential and commercial users. These uses accounted for 70% of the prod-

uction. Other uses were for internal combustion engines (18%), and industrial purposes (12%). Wyoming was a net exporter of LP gases.

American Quaser Petroleum reached agreement with Mountain Fuel Supply for a \$2.5 million gas-processing plant and gathering system in the Spearhead Ranch field. The plant will be a refrigerated lean oil plant capable of recovering propane and heavier hydrocarbons.

A \$10 million major expansion is planned for the Phillips Petroleum Co.'s gas-processing plant north of Douglas. The

expansion will result in more gas for the Kansas-Nebraska system, which serves eastern Wyoming and western Nebraska. The plant will also be able to deliver more liquid hydrocarbons into the 6-inch products line that runs from Douglas to the Phillips fractionating plant at Borger, Tex.

At yearend, there were 35 gas-processing plants operating. A total of four new plants came onstream during the year. The plants and the operators, were as follows: Brady—Champlin Petroleum Co.; In-exco—Ginther plant No. 1—Ginther Gas Processing Co.; Spearhead—Quasar Energy, Inc.; and Spearhead Ranch—Continental Oil Co. The Lost Soldier—Wertz plant, formerly operated by Pasco, Inc., was taken over by AMOCO, and the plant name was changed to Bairoil.

According to the American Gas Association, Wyoming's yearend reserves of natural gas liquids totaled 67.1 million barrels. This was an 11-million-barrel decrease in reserves from that of 1974.

**Oil Shale.**—The U.S. Energy Research and Development Administration (ERDA) continued to conduct experiments on the extraction of oil from Wyoming's oil shale deposits. The research was being done at two sites: at Laramie and west of Rock Springs. At the Laramie site, ERDA was experimenting with batch retorting; that is cooking the oil shale in a container to determine the recovery potential and examining the spent shale. In situ (or in-place) retorting is taking place at the Rock Springs site. Little is known about in situ retorting of oil shale, and ERDA hopes to develop the technology to make the process feasible in the future.

The U.S. Bureau of Land Management announced that for the second time in 2 years industrial firms seeking Government permission for prototype oil developments have bypassed Wyoming in favor of Colorado and Utah. BLM land offered for lease lies about 6 miles north of the Colorado State line in an area known as Kinney Rim in Sweetwater County. Tests of the area indicate a recoverable potential of 20 gallons of oil per ton of oil shale, compared with estimates of 30 gallons of oil per ton in Colorado.

**Petroleum.**—Total crude oil production decreased to 136 million barrels from 140 million in 1974. This is a continuation of a

general decline in production that started in 1970, but the decline has flattened out in recent years. The major oil-producing counties and their approximate share of production, as reported by the State Ad Valorem Tax Div. were as follows: Campbell, 25%; Park, 19%; Converse, 12%; Natrona, 8%; Hot Springs, 7%; and Sweetwater, 7%. Converse County, which was not in the top six in 1974, replaced Fremont County. About 58% of the production was from public lands, an increase of 2% over that of 1974, according to the Wyoming Oil and Gas Conservation Commission. A breakdown of mineral ownership is as follows: All Federal lands, 62% State lands, 6%, and fee lands, 32%. Although the production declined, the value of the crude petroleum increased 8% over that of 1974. The State's annual production continued its rank of fifth in the Nation and first among the Rocky Mountain States.

According to Bureau data, about 151 million barrels of oil was shipped to refineries: 54 million barrels was refined in State, and the remaining 97 million barrels was shipped out-of-State. The State has a refining capacity of about 68 million barrels annually, and during the year it operated at 79% of capacity. Shipments east of the Mississippi were as follows, in million barrels: Illinois, 16.8; Indiana, 9.8; Michigan, 7.9; Ohio, 4.2; and Kentucky, Tennessee, and Pennsylvania, 1.9. Other destinations were as follows, in million barrels: Montana, 19.8; Kansas, 19.2; Colorado, 8.5; Utah, 6.9; Missouri—Nebraska, 1.1; Minnesota—Wisconsin, 0.6; and Oklahoma, 0.6. Crude oil shipped into the State was from Colorado (1.8 million barrels), Utah (0.8 million barrels), and Montana (0.5 million barrels).

The State's 10 leading fields (table 7) contributed about 43% of the production in 1975. Except for Salt Creek and Hilight, the fields are located in the Big Horn Basin in the northwest section of the State. The primary producing formation of the Big Horn Basin fields are the Embar-Tensleep and the Tensleep.

At yearend, the reserves of the major fields were estimated as follows: Oregon Basin, 88.3 million barrels; Hilight, 77.8 million barrels; Salt Creek, 67.2 million

barrels; and Elk Basin (including Montana portion of field), 60.6 million barrels.<sup>2</sup>

Wyoming's crude oil reserves at yearend 1975, as estimated by the American Petroleum Institute (API), totaled 877,385,000 barrels, down from 903,360,000 barrels in 1974. This is about a 3% decline in reserves but retains the State's ranking of sixth in the Nation.

According to American Petroleum Institute reports, 1,263 exploratory and development wells were drilled in 1975, 28% more than the 988 drilled in 1974. The total drilling depth reached 8.9 million feet compared with 6.7 million feet in 1974. A total of 461 exploratory wells were drilled of which 63 (or 14%) were successful oil wells and 29 were successful gas wells. The 802 development wells resulted in 557 producing oil wells and 49 producing gas wells, a success ratio of 76%. A rotary rig count for 1975 showed that the active drilling rigs ranged from a high of 133 rigs to a low of 83 rigs and a yearly average of 107 rigs operating.<sup>3</sup> Converse County, which replaced Campbell County as the primary site of drilling

activity, has 314 wells and a total of 2.4 million feet of drilling. The total wells drilled in Converse County was 40% more than the 225 wells drilled in Campbell County in 1974.

The Powder River Basin was the site of much drilling activity, as evidenced by the number of wells drilled in Converse and Campbell Counties. The prime target in Converse County was the Teapot sand of the Mesaverde Formation of upper Cretaceous age. Other important areas were in the Green River Basin of Sweetwater County, where the emphasis has been on deep drilling, and the overthrust belt of Lincoln County on the Wyoming-Utah border.

Platte County was added to the production roles with a discovery east of Wheatland. The No. 1 Johnson discovery well had an initial production of 20 barrels per day of oil from the Codell sandstone of upper Cretaceous age. This leaves only Teton County as a nonproducing county.

<sup>2</sup> Oil and Gas Journal. V. 74, No. 4, Jan. 26, 1976, p. 120.

<sup>3</sup> Page 107 of work cited in footnote 2.

Table 6.—Wyoming: Oil and gas well drilling completions in 1975, by county

County	Proved field wells <sup>1</sup>			Exploratory wells			Total	
	Oil	Gas	Dry	Oil	Gas	Dry	Number of wells	Footage
Albany	--	--	--	--	--	2	2	10,855
Big Horn	8	--	3	--	--	7	18	100,641
Campbell	117	6	64	21	2	92	302	2,575,179
Carbon	--	2	4	2	1	18	27	177,715
Converse	235	3	22	22	2	30	314	2,395,089
Crook	7	--	7	1	--	29	44	254,911
Fremont	16	1	4	1	1	29	52	310,685
Goshen	--	--	--	--	--	3	3	20,501
Hot Springs	24	--	--	1	--	1	26	100,051
Johnson	22	--	5	5	--	31	63	569,308
Laramie	--	--	--	1	--	7	8	53,330
Lincoln	3	11	2	--	5	1	22	157,155
Natrona	25	--	22	3	--	23	73	337,352
Niobrara	5	--	4	--	--	14	23	135,566
Park	38	1	10	3	2	11	65	340,557
Platte	--	--	--	1	--	5	6	21,529
Sheridan	--	--	2	--	--	7	9	62,995
Sublette	8	7	7	--	2	1	25	133,119
Sweetwater	18	17	14	--	13	34	96	702,831
Teton	--	--	--	--	--	1	1	3,171
Uinta	--	--	--	--	1	2	3	38,578
Washakie	3	--	3	--	--	5	11	91,992
Weston	28	1	23	2	--	16	70	343,344
Total	557	49	196	63	29	369	1,263	8,936,454

<sup>1</sup> Development wells as defined by American Petroleum Institute.

Source: American Petroleum Institute.



Table 7.—Wyoming: Production of crude petroleum, by major field  
(Thousand 42-gallon barrels)

Field	County	1974	1975
Oregon Basin	Park	11,346	12,554
Salt Creek	Natrona	13,343	9,838
Elk Basin	Park	7,898	6,825
Hilight	Campbell	7,217	5,556
Grass Creek	Hot Springs	(1)	4,710
Hamilton Dome	do	4,691	4,623
Little Buffalo Basin	do	(1)	3,971
Garland	Big Horn	4,722	3,523
Frannie	Park	3,372	3,236
Byron	Big Horn	(1)	3,010
Other fields <sup>2</sup>		87,408	78,097
Total		139,997	135,943

<sup>1</sup> Grass Creek, Little Buffalo Basin, and Byron fields have replaced Raven Creek, Lost Soldier, and Winkleman Dome fields in top 10, in 1975.

<sup>2</sup> Includes production from Raven Creek, Lost Soldier, and Winkleman Dome fields.

Source: Wyoming Oil and Gas Conservation Commission.

Table 8.—Wyoming: Principal oil and gas discoveries in 1975

County and field	Operator	Production formation	Total depth (feet)
CRUDE OIL			
Campbell:			
Thunder Creek	Cities Service Oil Co	Muddy	9,130
Hartzog	Southland Royalty	Shannon	12,025
Gold Mine Draw	Kissinger Petroleum	Minnelusa	10,000
Bone Pile	Jerry Chambers	do	10,993
Winter Draw	Farmers Union Central Exchange.	do	9,302
Sharp	Anderson Oil Co	do	10,414
Gas Draw, East	Marmik Oil Co	Muddy	6,855
Carbon: Rim	Tesoro Petroleum	Phosphoria	6,305
Converse:			
Fly Draw	Diamond Shamrock	Muddy	14,126
Ross	Woods Petroleum	Frontier	13,300
Mikes Draw	Brinkerhoff Drilling	Teapot	7,226
Johnson: Bonnidree	Mountain Fuel Supply	Frontier	12,950
Natrona: Emerald	Beren Corp	Tensleep	5,151
NATURAL GAS			
Campbell: L-X Bar	Anschutz Corp	Muddy	7,985
Carbon: Deep Gulch	Exeter Drilling & Exploration.	Deep Creek	12,840
Converse: Powell	Woods Petroleum	Frontier	13,036
Fremont: Lost Creek	Mav Petroleum	Fort Union	11,008
Lincoln: Shute Creek	AMOCO Production	Frontier	11,000
Sublette: Pinegrove	Dyco Petroleum	do	8,010
Sweetwater:			
Wild Rose	Ladd Petroleum	Almond	10,471
Siberia Ridge	Equity Oil	do	10,509
Whiskey Butte	Amoco Production	Frontier	17,236

Source: Petroleum Information Corp. 1975 Resume Oil and Gas Operations in the Rocky Mountain Region.

Burlington Northern (BN) installed three small hydroskimming refining units at a 25-acre site north of Osage. Each unit has a capacity of 1,000 barrels per day. The company will refine its own Montana crude from the Cedar Creek anticline. The crude petroleum will be drawn from the nearby Butte pipeline, in which BN holds an interest. The yield from the three units will be about 900 barrels per day of

diesel fuel. The company expects to supply about 10% to 15% of its diesel needs through product tradeouts and crude-processing agreements. Primary products will be naphtha, diesel fuel, and fuel oil. The site and tankage were designed for additional refining capacity.

Pasco, Inc., accepted an offer of \$225 million from Standard Oil Co. of Indiana for seven oil and gas properties in Wyo-

ming and two related gas-processing plants. The sale does not include Pasco's refinery at Sinclair or pipelines and marketing facilities. Fields covered in the agreement are Bailey Dome, Crooks Gap, Happy Springs, Lost Soldier, Mahoney Dome, Big Sand Draw, and Wertz, all in Carbon and Fremont Counties and the northwest corner of Sweetwater County.

The Federal Trade Commission announced that Standard Oil Co. of Indiana agreed to sell 100 million barrels of Wyoming crude oil to independent refiners over the next 20 years. The commission said the consent agreement would decrease the threats of an oil monopoly in Colorado, Idaho, Montana, Utah, and Wyoming. The crude oil sale became available because of the recent purchase of seven oilfields from Pasco, Inc.

#### NONMETALS

**Cement.**—According to the State Inspector of Mines Annual Report of 1975, Monolith Portland Midwest Co. in Laramie continued to be the only cement producer in Wyoming. The plant processed about 191,000 tons during the year, which was a decrease from the 206,000 tons in 1974. The types shipped were I, II, and V, but the larger share shipped were types I and II. The major recipients of the products were ready-mix companies, highway contractors, concrete products manufacturers, and building material dealers.

**Clays.**—The production of clays rose to 2,582,142 tons in 1975 compared with 2,511,151 tons in 1974. The output in 1975 consisted of 2,404,169 tons of bentonite and 177,973 tons of common clay and shale. The bentonite production increased by 109,000 tons in 1975 over that of 1974. There were eight companies that mined bentonite and four companies that mined other clay and shale. Bentonite production was from Big Horn, Crook, Johnson, Natrona, Washakie, and Weston Counties; clay and shale production came from Albany, Big Horn, and Uinta Counties. Crook County again led the State in bentonite production with about 40% of the State's production, followed by Big Horn and Johnson Counties. The majority of the clay and shale came from Albany County.

The major uses of bentonite in 1975 was in the pelletizing of iron, in drilling mud,

and in foundry molds. Other uses of bentonite are in animal feed, chemical manufacturing, in paints, and as a waterproof sealant.

The State's oldest bentonite-processing plant, the Baroid plant at Clay Spur, was shut down. The equipment is being moved to Colony where Baroid is building an extension to its quick-gel plant. Reasons given for the shutdown were obsolete machinery and the unavailability of high-grade bentonite. The plant was put in operation near Osage in 1926.

**Feldspar.**—The only mining operation in the State was Modern Mining and Milling Co., Inc.'s Quien Sabe mine; however, the company operated two mines in 1974. Production decreased 38% from that of 1974, but the unit-ton price increased 16%.

After the mined product is separated, the feldspar is ground to plus 325 mesh and shipped by rail to the Faultless Starch Co. in Kansas City, Mo.

**Gem Stones.**—The value of gem stones produced in Wyoming in 1975 was estimated at \$140,000, same as in 1974.

The discovery of several minute diamond crystals in a rare rock south of Laramie was announced by the U.S. Geological Survey. The diamonds, which are about one twenty-fifth of an inch in size, were found while examining diatremes (small volcanic vents). The diatremes are composed primarily of kimberlite, a basic igneous rock and the source of most diamonds found around the world. It is too early to determine the economic significance of the find.

The State Geologist received authority to make a 6-month evaluation of the first documented diamond discovery in Wyoming. The State Land Board also approved his request to withdraw from leasing about seven sections of State land south of the discovery at Tie Siding in Albany County. The Geological Survey will submit leasing recommendations to the board after the investigation is complete.

Majestic Jade Co. of Riverton completed installing a unique piece of equipment in its shop which will turn out finished jade for use in jade-top furniture. The machine, a polishing mill, was specifically designed for the Riverton firm. The polishing mill was built by Granite City Iron Works of St. Cloud, Minn. A

company official stated that its claim near Jeffery City has a 25-year supply of jade.

**Gypsum.**—The Celotex Corp., Georgia-Pacific Corp., and Wyoming Construction Co. mined 271,000 tons of gypsum in Park, Big Horn, and Albany Counties. Output declined 14% from that of 1974. The Celotex Corp. and Georgia-Pacific Corp. calcined gypsum in Park and Big Horn Counties; output decreased 8%.

The Big Horn gypsum plant at Cody, manufacturer of gypsum wallboard, was expanding its facilities. The new expansion, a 10,000-square-foot addition, was scheduled to be for completed in June 1976. With the new expansion, an increase of 60 million square feet of gypsum board is expected annually. The primary expansion at the plant will be the addition of a new eight-level drying rack.

**Lime.**—Holly Sugar Corp. and Great Western Sugar Co. produced quicklime in Big Horn, Goshen, and Washakie Counties during 1975. Output continued to decline.

**Phosphate Rock.**—The marketable production of phosphate rock decreased 24% from that of 1974 but the unit value in-

creased 13%. The Leefe mine of Stauffer Chemical Co. of Wyoming in Lincoln County remained the State's only producer. Dravo-Soda Springs was developing a phosphate rock deposit near the Idaho-Wyoming border that will be mined by surface methods.

**Sand and Gravel.**—The number of sand and gravel operations increased but total output decreased in 1975. The total value of the sand and gravel produced increased to \$10.7 million from \$9.5 million in 1974. Processed sand production decreased to 0.7 million tons compared with 1.5 million tons in 1974. The average price of sand was \$2.59 per ton, an increase of 64% compared with that of 1974. Processed gravel production dropped to 3.4 million tons from 3.9 million tons in 1974. The average price per ton increased to \$2.23 from \$1.79 per ton in 1974. Publicly funded projects accounted for 36% of the tonnage and 33% of the value. The leading use of the sand and gravel was for road construction, followed by nonresidential construction.

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

County	Number of mines	1974		1975		
		Quantity	Value	Number of mines	Quantity	Value
Albany	6	131	152	6	329	569
Big Horn	2	W	W	4	50	174
Campbell	—	—	—	1	W	W
Carbon	6	304	716	4	105	376
Converse	—	—	—	1	W	W
Crook	1	W	W	2	132	W
Fremont	10	1,071	1,668	11	728	1,376
Goshen	2	W	W	1	W	W
Hot Springs	1	15	32	1	6	18
Johnson	2	W	W	3	266	690
Laramie	5	445	1,203	6	370	1,045
Lincoln	1	13	27	1	15	40
Natrona	4	685	1,677	4	647	2,606
Park	3	92	168	2	W	W
Platte	1	W	W	5	547	1,040
Sheridan	2	W	W	2	W	W
Sublette	3	1,194	953	1	W	W
Sweetwater	7	911	1,820	4	272	684
Teton	4	W	W	3	W	W
Uinta	1	54	102	2	W	W
Washakie	2	W	W	5	W	W
Weston	3	142	180	2	W	W
Undistributed	2	474	811	1	861	2,127
Total <sup>1</sup>	68	5,532	9,508	72	4,328	10,746

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

Table 10.—Wyoming: Construction and industrial sand and gravel sold or used by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value <sup>1</sup>	Quantity	Value <sup>1</sup>
Construction:				
Processed:				
Sand -----	1,461	2,305	662	1,714
Gravel -----	3,895	6,962	3,404	7,603
Unprocessed: Sand and gravel -----	175	215	261	288
Industrial:				
Sand -----	1	6	--	--
Total -----	5,532	9,488	<sup>2</sup> 4,328	9,605

<sup>1</sup> Value f.o.b. plant per ton of processed sand and per ton of processed gravel. Values in all other tables are f.o.b. plant of blended processed sand and gravel used as construction aggregate. Unit value of construction aggregate is generally higher than the unit value of unblended processed sand or gravel.

<sup>2</sup> Data do not add to total shown because of independent rounding.

Table 11.—Wyoming: Construction aggregate (blended sand and gravel) and industrial sand and gravel sold or used commercially by producers

(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
Processed:				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction -----	960	2,351	1,205	3,564
Highway and bridge construction -----	47	70	349	645
Other construction (dams, waterworks, airports, etc.) -----	310	704	66	182
Concrete products (cement blocks, brick, pipe, etc.) -----	147	277	13	55
Bituminous paving (asphalt and tar paving) -----	1,412	1,637	463	1,460
Roadbase and subbase -----	253	565	399	738
Fill -----	293	283	148	360
Other -----	1	1	W	W
Unprocessed:				
Roadbase and subbase -----	75	92	44	62
Fill -----	100	123	60	86
Other -----	--	--	16	W
Industrial sand and gravel -----	1	6	--	--
Total -----	3,599	6,109	2,763	<sup>1</sup> 7,201

W Withheld to avoid disclosing individual company confidential data; included with "Nonresidential and residential construction."

<sup>1</sup> Data do not add to total shown because of independent rounding.

Table 12.—Wyoming: Construction aggregate (blended sand and gravel) sold or used for publicly funded projects by producers  
(Thousand short tons and thousand dollars)

Use	1974		1975	
	Quantity	Value	Quantity	Value
<b>Processed:</b>				
Concrete aggregate (including use in ready-mixed concrete):				
Nonresidential and residential construction ----	13	33	199	472
Highway and bridge construction -----	357	668	102	419
Other construction (dams, waterworks, airports, etc.) -----	30	84	9	37
Concrete products (cement blocks, brick, pipe, etc.) -----	--	--	W	W
Bituminous paving -----	992	1,796	484	1,312
Roadbase and subbase -----	540	815	559	994
Fill -----	W	W	64	W
Other -----	1	3	--	83
<b>Unprocessed:</b>				
Roadbase and subbase -----	--	--	136	211
Fill -----	--	--	(1)	(1)
Other -----	--	--	5	16
Total <sup>2</sup> -----	1,933	3,398	1,565	3,544

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

<sup>1</sup> Less than ½ unit.

<sup>2</sup> Data may not add to totals shown because of independent rounding.

**Sodium Carbonate.**—Wyoming continued its role as the Nation's principal producer of natural sodium carbonate. According to the State Inspector of Mines report, the three trona mining companies had a total output of 8.1 million tons of trona from which the sodium carbonate was produced. Production in 1975 was 0.5 million tons higher than in 1974. The producers, in order of output, were FMC Corp., Stauffer Chemical Co. of Wyoming, and Allied Chemical Corp. The total sodium carbonate processed from the trona in 1975 rose about 6.5%.

A multimillion-dollar expansion of Stauffer Chemical Co. of Wyoming's soda ash processing plant near Green River was started during the last quarter of 1975. Production capacity of the plant will be increased by about 200,000 tons per year. The new addition was scheduled to go onstream in early 1977.

The second mine shaft for production of trona from Texasgulf, Inc.'s project in southwestern Wyoming reached the two flat-lying beds at 1,370 feet and 1,420 feet below the surface. More than 6 miles of development entries have been driven, making the mine ready for full production. Surface processing facilities are proceeding on schedule with completion expected in late 1976 at a production rate of 1 mil-

lion tons per year. The company has already announced plans to build another large processing plant at the site. The second stage of construction will bring the plant capacity to 2 million tons per year. The plant has been designed to use coal as a fuel.

According to the State Inspector of Mines report, the FMC Corp. plant expansion, expected to be completed in 1976, would add 750,000 tons per year of refining capacity and bring the total capacity to 2.5 million tons per year. Dravo Corp. completed the first of two 22 foot-diameter shafts to a depth of 1,600 feet and started work on the second shaft. The two additional shafts will bring the total number of shafts to seven at the Westvaco operation.

The No. 3 shaft at Allied Chemical Corp.'s Alchem mine was completed by Centennial Development Co. during the year. The 1,600-foot-deep and 20-foot-diameter shaft will primarily be used as a production shaft. The plant expansion completed in 1975 brought the annual production capacity to 2.2 million tons of refined soda ash.

**Stone.**—Production of stone was 2.9 million tons, up 21% from the 1974 production. Unit value continued to increase, from \$2.51 per ton in 1974 to \$2.64 per

Table 13.—Wyoming: Stone sold or used by producers, by county  
(Thousand short tons and thousand dollars)

County	1974			1975			Kind of stone produced in 1975
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	
Albany -----	5	283	270	6	461	696	Limestone, granite, sandstone.
Carbon -----	1	80	166	2	49	101	Limestone.
Crook -----	2	W	W	4	441	645	Do.
Fremont -----	4	53	104	1	40	86	Sandstone.
Laramie -----	2	W	W	3	W	W	Limestone, granite.
Lincoln -----		--	--	1	20	36	Various.
Natrona -----	1	21	67	--	--	--	
Platte -----	2	W	W	2	914	W	Dolomite, marble.
Sublette -----		--	--	2	29	51	Various.
Teton -----	1	W	W	2	W	W	Limestone.
Washakie -----	1	1	4	--	--	--	
Weston -----		--	--	3	104	210	Limestone.
Undistributed -----	2	1,946	5,379	--	824	5,792	
Total <sup>1</sup> -----	21	2,384	5,989	26	2,882	7,618	

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

<sup>1</sup> Data may not add to totals shown because of independent rounding.

<sup>2</sup> Data represent crushed and broken stone only.

ton in 1975. Limestone, which was produced from 16 quarries, surpassed granite as the single largest type of stone produced. The other types of stone produced in decreasing order of output, and number of quarries were as follows: granite, 3; dolomite, 1; marble, 1; other stone, 3; and sandstone, 2. Twenty-five quarries produced crushed and broken stone, and one quarry produced dimension stone. The major use of the stone was as railroad ballast. Other primary uses of stone were as bituminous aggregate, concrete aggregate, and as rip-rap.

**Sulfur.**—Sulfur sold or used in 1975 decreased 25% to 39,218 tons. Production of sulfur as a byproduct of sour natural gas decreased slightly from 55,000 tons in 1974 to 52,000 tons in 1975. Park and Fremont Counties accounted for most of the produced sulfur. Four plants continued operations during 1975.

#### METALS

**Copper.**—A proposed large-scale, low-grade copper mining project is being considered by AMAX Incorporated in northwest Wyoming. The mining project is proposed for the once-abandoned mining town of Kirwin, about 35 miles from Meeteetse in the high, narrow, Wood River Valley.

AMAX officials plan to extract molybdenum, lead, silver, and gold from the ore

during the mining process. Plans call for the removal of one peak, Bald Mountain, in the open pit operation. The ore will be reduced at a mill near the operation and the concentrate trucked to Cody, Worland, or Thermopolis. Water for the project was purchased by AMAX from the Greybull Valley Irrigation District when Upper Sunshine Dam was built.

AMAX anticipates that 12,000 tons of concentrate ore will be handled daily. Permanent employment will be about 350.

**Iron Ore.**—Iron ore shipments declined to 2.3 million short tons in 1975, compared with 2.4 million short tons in 1974, according to published reports in Skillings' Mining Review. United States Steel Corp. reported shipments of 1,808,000 short tons of pellets, down from the peak shipment of 1,867,000 short tons in 1974.<sup>4</sup> The company employed 525 persons at its open pit mine and beneficiation plant.

The State had two mines in operation. The operators and locations according to size were United States Steel Corp., Fremont County, open pit; and CF&I Steel Corp., Platte County, underground, and starting on open pit.

**Uranium.**—Wyoming's production of U<sub>3</sub>O<sub>8</sub> declined for the second year. Production in 1975 was 6,862,000, 8% less

<sup>4</sup> Skillings' Mining Review. U.S. Steel's Shipments at Western Operation. V. 65, No. 12, Mar. 20, 1976, p. 22.

than in 1974. Wyoming's production was 30% of the Nation's total, and remained second to New Mexico in production.

The Tennessee Valley Authority (TVA) drafted an environmental impact statement on the Morton Ranch uranium site in Converse County. Mining activities were scheduled to begin in 1976. Surface, underground, and in situ leaching mining methods are proposed to extract the uranium ore. Mining is expected to continue at least until 1987, when presently known ore reserves are expected to be exhausted. TVA purchased a 50% undivided interest in the Morton Ranch properties from United Nuclear Corp. and Teton Exploration Drilling Co. of Casper, a subsidiary of United Nuclear. TVA proposed to participate with United Nuclear in mining uranium from the properties; United Nuclear will operate the facility.

Western Nuclear, Inc., announced the largest contract in its history, a \$121 million uranium fuel contract with the Washington Public Power Supply System. The contract calls for the sale of 5.5 million pounds at \$22 per pound, part of which will come from Western's mine near Jeffrey City in Fremont County. Western has a \$22 million expansion program underway at the mine. The Jeffrey City mine could supply the entire 5.5 million pounds if problems develop in construction of a mine in Washington. Delivery is scheduled to begin in 1979 and continue through 1983.

Officials for the Union Pacific Corp. announced plans for a \$20 million uranium mine and processing mill at a site about 40 miles northwest of Douglas and 65 miles northeast of Casper. The firm planned to start mining operations at the Bear Creek site in 1976.

The Petrotomics Co. uranium mill in the Shirley Basin area was purchased by Getty Oil Co. and Skelly Oil Co. Petrotomics, which owned one-half interest, closed the mine in May 1973. A Getty official stated that no date for resumption of the milling has been decided, but because of the rapidly rising prices for yellow cake, it is possible that milling would start early in 1976. Kerr-McGee Nuclear Corp. has mined out most of the high-grade uranium ore, but the Getty interests have reserves that could keep the operation running for another 25 years.

Westinghouse Electric Corp. plans to invest another \$500,000 into the search for uranium reserves in Wyoming. Its subsidiary, Wyoming Minerals Corp., will proceed with the third phase of a joint Powerco-Wyoming Mineral uranium exploration program, bringing the total investment to \$750,000. The exploration involves a 900-square-mile area in eastern Wyoming in which Powerco holds leases on about 51,000 acres of State and 53,000 acres of private lands. Exploration targets are potential roll-front uranium deposits at depths ranging from just below the surface to 900 feet.

Western Standard Corp. of Riverton announced that it would begin stage 3 of its uranium exploration project in the Powder River Basin. Chevron Oil Co., in partnership with Western Standard, began the Kaycee Uranium Project on the 80,000-acre property in the summer of 1974. Chevron had spent \$650,000 on the project and planned to spend \$600,000 more in 1975.

Cleveland-Cliffs Iron Co. announced that it and Power Reactor and Nuclear Fuel Development Corp. had agreed to jointly explore for uranium in Wyoming. Power Reactor, a Japanese Government concern based in Tokyo, is developing advanced nuclear reactors, nuclear fuels, and exploring for uranium. Cleveland Cliffs, which will manage the project, had a modest exploration budget planned for the venture in 1975.

The Wyoming Geological Survey will investigate the uranium potential of Precambrian rocks of the Medicine Bow Mountains and Sierra Madre of southern Wyoming. These rocks are thought to be similar to certain uranium-bearing rocks of Canada.

Another study to help in uranium exploration is being done by the University of Wyoming. The university is making geophysical studies in the southern Powder River Basin of east-central Wyoming. The research is designed to develop geophysical techniques to be used in uranium exploration.

Rocky Mountain Energy Co., a joint venture of Union Pacific Corp., and Mono Power Co. agreed to double their joint uranium exploration program to \$24 million. Under the agreement, the two firms are committed to \$24 million in an-

nual increments of \$4 million over the next 6 years. Mono Power will pay 75% of projected costs and Rocky Mountain will pay 25%. Mono Power will earn a 60% interest in all lands committed to the

agreement and also will be granted a lease on surface minable coal in Sweetwater County. The lease provides for advance royalty payments in addition to customary lease provisions.

Table 14.—Principal Producers

Commodity and company	Address	Type of activity	County
Cement: Monolith Portland Midwest Co. <sup>1</sup>	3326 San Fernando Rd. Los Angeles, Calif. 90065	Plant -----	Albany.
Clays:			
American Colloid Co -----	5100 Suffield Ct. Skokie, Ill. 60076	Pits and plants ---	Big Horn, Crook, Weston.
Dresser Industries, Inc ---	Box 6504 Houston, Tex. 77005	---do -----	Big Horn.
Federal Bentonite Co -----	4614 Prospect Ave. Cleveland, Ohio 44103	---do -----	Crook and Weston.
International Minerals & Chemical Corp.	5401 Old Orchard Rd. Skokie, Ill. 60076	---do -----	Crook.
NL Industries, Inc -----	Box 1675 Houston, Tex. 77001	---do -----	Crook and Weston.
Wyo-Ben Products, Inc ---	Box 1979 Billings, Mont. 59103	---do -----	Big Horn.
Coal, bituminous:			
Arch Minerals Corp -----	Box 459 Hanna, Wyo. 82327	Strip mines -----	Carbon.
Kemmerer Coal Co -----	Frontier, Wyo. 83121	2 strip mines and plant.	Lincoln.
Pacific Power & Light Co.	920 SW. Sixth Ave. Portland, Oreg. 97204	Strip mine -----	Converse.
Rosebud Coal Sales Co ---	Box 398 Hanna, Wyo. 82327	---do -----	Carbon.
Gypsum:			
The Celotex Corp -----	1500 North Dale Mabry Tampa, Fla. 33607	Surface mine and plant.	Park.
Georgia-Pacific Corp -----	900 SW. Fifth Ave. Portland, Oreg. 97204	---do -----	Big Horn.
Wyoming Construction Co. <sup>2</sup>	Box 907 Laramie, Wyo. 82070	Surface mine ---	Albany.
Iron ore:			
CF&I Steel Corp -----	Box 316 Pueblo, Colo. 81002	Underground mine and plant.	Platte.
United States Steel Corp --	Lander, Wyo. 82520	Open pit mine and plant.	Fremont.
Lime:			
The Great Western Sugar Co. <sup>3</sup>	Box 5308 Denver, Colo. 80217	Plant -----	Big Horn.
Holly Sugar Corp -----	Holly Sugar Bldg. Colorado Springs, Colo. 80902	---do -----	Washakie.
Natural gas and petroleum: <sup>3</sup>			
Phosphate rock: Stauffer Chemical Co. of Wyoming. <sup>4</sup>	636 California St. San Francisco, Calif. 94108	Open pit mine and plant.	Lincoln.
Sand and gravel:			
Gilpatrick Construction Co., Inc.	Box 973 Riverton, Wyo. 82501	Pit -----	Sublette.
Peter Kiewit & Sons Co --	Box 1009 Sheridan, Wyo. 82801	Pits -----	Natrona and Sweetwater.
Rissler-McMurry Co., Inc -	Box 2499 Casper, Wyo. 82602	---do -----	Carbon, Fremont, Natrona.
Teton Construction Co ---	Box 3243 Cheyenne, Wyo. 82001	Pit -----	Laramie.
Sodium carbonate:			
Allied Chemical Corp -----	Box 70 Morristown, N.J. 07960	Underground mine and plant.	Sweetwater.
FMC Corp -----	Box 872 Green River, Wyo. 82935	---do -----	Do.
Stone:			
Guernsey Stone Co -----	Box 337 Guernsey, Wyo. 82214	Quarry -----	Platte.
Union Pacific Railroad Co.	1416 Dodge St. Omaha, Nebr. 68102	---do -----	Laramie.
Uranium: Utah International Inc.	Box 831 Riverton, Wyo. 82501	Open pit and underground mines, and plants.	Carbon and Fremont.

<sup>1</sup> Also clays.<sup>2</sup> Also stone.<sup>3</sup> Most of the major oil and gas companies and many smaller companies operate in Wyoming, and several commercial directories contain complete lists.<sup>4</sup> Also sodium carbonate.



